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De Leuw, Cather & Company
Engineering Management Services Division • Gaithersburg, Maryland

Final Report

Engineering Study for the Evaluation of Public Road Administration and Maintenance Alternatives

Iowa Department of Transportation
Iowa Highway Research Board
Project HR-265

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The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Project Advisory Panel or personnel from the public and private agencies that provided assistance to this study.

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The project Advisory Panel met regularly with the project staff to review the project progress and provide input and guidance throughout the project. This participation and guidance contributed significantly to the successful completion of the project objectives. Panel members were:

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made in accordance with current guidelines actually reduce total highway transport costs. This is true because the savings occur in highway user costs which typically represent more than 80 percent of the total highway transport costs.

In fact, the timely implementation of improvements, particularly those designed to protect and restore existing roads and streets, can significantly reduce user costs and consequently total highway transport costs in Iowa. HR-265 elaborates the various improvement types and their cost savings potential under varying traffic and other conditions.

Consolidation of Operations

Since 1919, Iowa's public roads and streets have been administered by the state, counties and cities. The responsibility for construction and maintenance of the 112,000 miles of public roads and streets has remained relatively stable except for an increase in the state primary system from 6,500 miles to 10,105 miles. HR-265 staff investigated several major consolidation alternatives and found that the consolidation of construction and maintenance operations does not offer substantial cost savings or improved operations. The staff found that:

1. there is little or no duplication of services among jurisdictions;

2. there would be increased costs related to the transition itself, as well as, inefficient resource utilization during the transition to consolidation; and

3. apparent cost savings to one jurisdiction appear as increased costs to the jurisdiction receiving the additional responsibilities -- a cost transfer not a savings.

The legal mechanisms already exist to accommodate the performance of services by entities outside the responsible jurisdictional agency. This can be accomplished as required on a case-by-case basis through either 28-E agreements between government agencies or private contracting.

Extensive general consolidation of operations does not offer a potential for cost savings. However, there is room for improvement in the delivery of maintenance services at the operational levels of all jurisdictions. This can result in some cost savings, and most likely will result in improved productivity or output.

The adoption and use by the local jurisdictions of formalized maintenance guidelines to develop annual maintenance budgets and execute work programs will result in more effective maintenance operations through increased uniformity in the levels of maintenance service and more efficient utilization of personnel, equipment and materials.

ABSTRACT

Iowa's public road system of 112,000 miles is one of the largest and the best in the nation. It represents a considerable financial investment of taxpayer revenues over the years. And, it requires a sustained investment to preserve an economical level of transport service into the future.

In 1982, a Governor's Blue Ribbon Transportation Task Force evaluated the effectiveness of Iowa's entire transportation system. Four important Task Force recommendations dealt with public road administrative issues in Iowa. These issues were related to:

1. design criteria and levels of maintenance;

2. consistency in the use of standards among jurisdictions;

3. consolidation of maintenance operations at one jurisdictional level; and

4. jurisdictional authority for roads.

The issues formed the background for Research Project HR-265.

Objectives

Research Project, HR-265, an "Engineering Study for the Evaluation of Public Road Administration and Maintenance Alternatives," was undertaken to provide the jurisdictional agencies with an independent, quantitative assessment of the issues. Specific objectives for HR-265 were to evaluate the economic and other impacts associated with:

1. the development of consistent and uniform design, maintenance and construction standards for use by public road agencies;

2. the consolidation of public road construction and maintenance operations, and

3. the transfer of public roads between various jurisdictions.

Uniform Standards

The Iowa Department of Transportation, the counties and the larger cities have adopted uniform design guidelines that generally conform to those of the American Association of State Highway and Transportation Officials. The findings of HR-265 indicate that there is not a great cost savings potential in simply lowering these design guidelines. The issue is more complex and involves the inclusion of all highway transport costs, not only the governments' investment costs. When all costs are considered, the findings indicate that most road and street improvements

Jurisdictional Authority

Closely linked to the consolidation issue is the issue of the jurisdictional authority for roads. As with consolidation, the transfer of the jurisdictional authority for roads should be the result of the adoption of a plan for delivering public services that demonstates:

1. cost savings,

2. improved service levels, and/or

3. more equitable and practical public road financing.

In accordance with these three measures, changes in the current jurisdictional authority for roads are not warranted.

Specifically, the proposal to transfer county farm-to-market roads to the state would be the first step in establishing a centralized consolidated authority for all public roads in Iowa. As this occurred, the citizens would be one level of government further from the governmental agency responsible for performing the work. County maintenance organizations would be left with unacceptably low paved road mileages and the resulting inefficient use of paved road maintenance resources.

Experience in other states, demonstrates that it is the local road systems and programs that ultimately suffer the most when available revenues are inadequate and the rural road mileage is entirely under State control. Furthermore, it is recognized that legislative bodies are not receptive to the substitution of motor vehicle user funding for losses of non-user (local) funding. The net effect is a decline in total highway revenue. Revenues from local sources would not be available under the current Iowa Code to fund a state administered road program that included former local road mileage. Revenues from motor vehicle users probably could not be increased sufficiently to fund a road program that included these additional local secondary miles.

In summary, the premise that costs savings in Iowa's government road and street investment programs will compensate for a shortfall in existing and future program investment is unfounded. A policy of freezing the governments' investment in roads, based on this premise, risks increasing highway transport costs. Programs and projects designed to restore and protect the current road and street infrastructure offer the greatest potential for reduced highway transport costs in Iowa.

CHAPTER ONE

RESEARCH APPROACH AND DEVELOPMENT

INTRODUCTION

The 1982 Report of the Governor's Blue Ribbon Transportation Task Force identified 26 recommendations related to Iowa's highways, roads and streets. Although all of the recommendations were important, four represented major impacts on the various jurisdictional agencies responsible for the public road systems in Iowa. These related to:

- Design Criteria and Levels of Maintenance;
- Consistency in Standards;
- Consolidation of Maintenance Activities; and
- Jurisdictional Responsibilities.

Due to time limitations for the 1982 study, the Governor's Task Force was unable to perform an in-depth, quantitative evaluation of the issues and impacts addressed in the discussions accompanying the recommendations. Furthermore, substantial information and data are required to develop implementation programs related to the subject issues. As a result, the purpose of this study was to provide the jurisdictional agencies with an independent in-depth, quantitative assessment of the key issues as a foundation for recommendations to the Legislature.

Specific objectives for the project were to evaluate the economic and other impacts associated with:

1. the development of consistent and uniform design, maintenance and construction standards for use by public road agencies,
2. the consolidation of public road construction and maintenance operations, and
3. the transfer of public roads between various jurisdictions.

Project analyses and evaluations are based on technical, economic and financial data particular to Iowa. Data were obtained from the local jurisdictions through questionnaires and on-site interviews with officials in 12 counties and 20 cities. Transportation agencies in four states were also visited to assess alternative approaches to public road administration.

The results of this study provide the state and local jurisdictions supportable bases for legislative actions that may be warranted and operational improvements in the areas of public road administration and maintenance in Iowa.

The research approach for Research Project HR-265, "Evaluate Public Road Administration and Maintenance Alternatives," for Iowa's public road systems consisted of three major tasks. These were:

Task 1 -- Initial Review and Analysis
Task 2 -- Impact Identification
Task 3 -- Impact Measurement and Evaluation

An Advisory Panel of state, county and city public road and street officials provided overall guidance and direction during the project through periodic meetings to review signficant project activities and preliminary findings. Monthly progress reports and quarterly status reports were also submitted.

The thrust of the three tasks was twofold:

1. to elicit the perceptions and opinions of all levels of government within Iowa with respect to the issues, and

2. to collect and subsequently analyze information as part of an independent assessment of the issues.

The three tasks are briefly summarized in the following sections.

INITIAL REVIEW AND ANALYSIS

The availability of existing data, relevant reports and published information related to the project objectives was determined through a series of orientation interviews and meetings with state, county and municipal officials.

Existing reports and other published data were reviewed and analyzed to delineate the overall scope and background of the study, as well as the areas of public road performance and impact. Data sources were assessed relative to their content, reliability and overall adequacy for the analyses that were to be performed.

The Iowa Department of Transportation (DOT) maintains a comprehensive data system for the public road systems. Data for the state primary systems are very complete and updated annually. Data for the county road systems and municipal street systems primarily include only basic geometric and traffic items. The local road and street data systems are also updated on a regular basis, but not annually unless the local jurisdiction submits the data changes that have occurred.

The Iowa DOT conducts a 20-year needs study of all public roads and bridges every four years as specified by Chapter 307A of the Code of Iowa. The needs study presents the dollars required to construct, maintain and administer an adequate public road and street system in Iowa for a 20-year period. The current needs study is for the period 1982-2001. Needs are presented for the state, county and municipal

jurisdictions by functional classifications and 5-year time periods. County needs are also presented for each county, whereas municipal needs are presented for selected major cities, as well as total needs for the remaining cities.

Revenue and expenditure data for construction and maintenance operations by the counties and cities were available from the Iowa DOT, Office of Local Systems and Office of Transportation Inventory respectively. Construction and maintenance cost data available for the counties were identified for specific types of construction and maintenance work. However, only total costs were available; data on material quantities or magnitude or work accomplished were not provided in the county reports. City street costs for construction and maintenance operations were reported by broad categories, for example, roadway maintenance, snow and ice removal, storm sewers, traffic services and street cleaning are the only categories identified for city street maintenance costs.

The Iowa DOT, Office of Maintenance, maintains detailed data for the state primary system on maintenance costs, work accomplishment and resources utilized through a maintenance management system which has been in use since 1975. The system provides for budgeting based on roadway features to be maintained, planning and scheduling work and evaluation of work performed.

Discussion outlines were prepared for the three policy analysis areas: (1) uniform standards; (2) consolidation of construction and maintenance operations; and (3) modification of jurisdictional responsibilities. These outlines identified key issues and impacts. The Project Kick-Off Meeting with the Advisory Panel reviewed the detailed work plan and schedule, as well as the discussion outlines for the policy analysis areas. Based on guidance from the Advisory Panel, a sample of 20 cities and 12 counties was selected for on-site interviews and data collections. Table 1-1 lists the sample jurisdictions.

IMPACT IDENTIFICATION

This phase addressed the identification of the economic and other impacts related to the three policy analysis areas, as well as the data required to perform the analyses and to measure and predict the impacts.

Two analytical models were selected to determine the measurable relationships between the impacts and policy issues: (1) the Highway Design and Maintenance Model (HDM) and (2) Road Maintenance Planning, Programming and Budgetary Model (MMS). Based on an assessment of the availability of existing data from state and local sources, as well as the reliability of these data, additional data needs were identified that were required to perform the analyses. Procedures were prepared for obtaining these data from on-site interviews with the sample jurisdictions and questionnaires from the counties and cities.

TABLE 1-1

LOCAL JURISDICTION SAMPLE

Sample Cities

Over 50,000	1980 Population	0-5,000	1980 Population
Des Moines	191,003	Humbolt	4,794
Davenport	103,264	Waukon	3,983
Sioux City	82,003	Osceola	3,750
Waterloo	75,985	Monticello	3,641
Council Bluffs	56,449	Toledo	2,445
		Mediapolis	1,685
5,001 - 50,000		Glidden	1,076
		Colo	808
Mason City	30,144	Oxford	676
Ottumwa	27,381	Earling	520
Spencer	11,726		
Webster City	8,572		
Shenandoah	6,274		

Sample Counties

Name	Population	Name	Population
Benton	23,649	Floyd	19,597
Calhoun	13,542	Jefferson	16,316
Dallas	29,513	Polk	303,170
Dickinson	15,629	Pottawattamie	86,561
Dubuque	93,745	Ringgold	6,112
Fayette	25,488	Shelby	15,043

A comprehensive questionnaire was developed, pilot-tested and reviewed with the Advisory Panel. The basic questionnaire was sent to the 99 counties and 956 municipalities in Iowa. Minor modifications in selected questions were made to reflect procedural differences between the counties and cities of varying population groups. The Appendix contains the three different versions of the questionnaire, as well as samples of the transmittal letters. The questionnaire design was directed toward obtaining factual data on local road and street operations and available maintenance resources, as well as local agency opinions on the adequacy of the total public road system operations and financing. Respondents were also encouraged to provide additional information and comments on impacts and issues relevant to the analysis areas.

Of the 1,055 questionnaires mailed, 243 were returned completed. The number of responses by jurisdictional group are shown in Table 1-2. The response rates for the counties and cities over 5,000 population was very good -- counties 80 percent; cities over 50,000 population 75 percent; and cities between 5,000-50,000 population 61 percent. The response rate of 14 percent from cities of less than 5,000 population was good for the type of questions asked, as many were not applicable to the smaller cities, plus many of the administrative staffs are part-time. The geographic distribution of all responses can be judged representative of the entire state, as shown in Figures 1-1 and 1-2.

Summaries of the responses to all questions are contained in the Appendix. The responses followed similar trends for the respective jurisdictional groups, for example, the responses to the following question are shown in Table 1-3.

> Are you satisfied with the current percentage apportionments of road user tax funds between the state and other levels of government presuming jurisdictional responsibilities do not change?

Current percentage apportionments of road user tax funds between the state and local jurisdictions are generally acceptable to the counties, 94 percent are satisfied; however only 71 percent of the urban counties, those with cities over 50,000 population, are satisfied with the current percent distributions. The majority of cities with populations 5,000 and greater are not satisfied with the current percent distributions. A follow-up question on the priority importance of factors for allocating the local share of road user tax funds between the counties and cities resulted in "Highway Needs Including Local Facilities" receiving the highest priority factor ranking from all jurisdictional groups. "Vehicle Miles of Travel" received the next highest ranking from all groups, except for urban counties, for revenue allocations between the two jurisdictions.

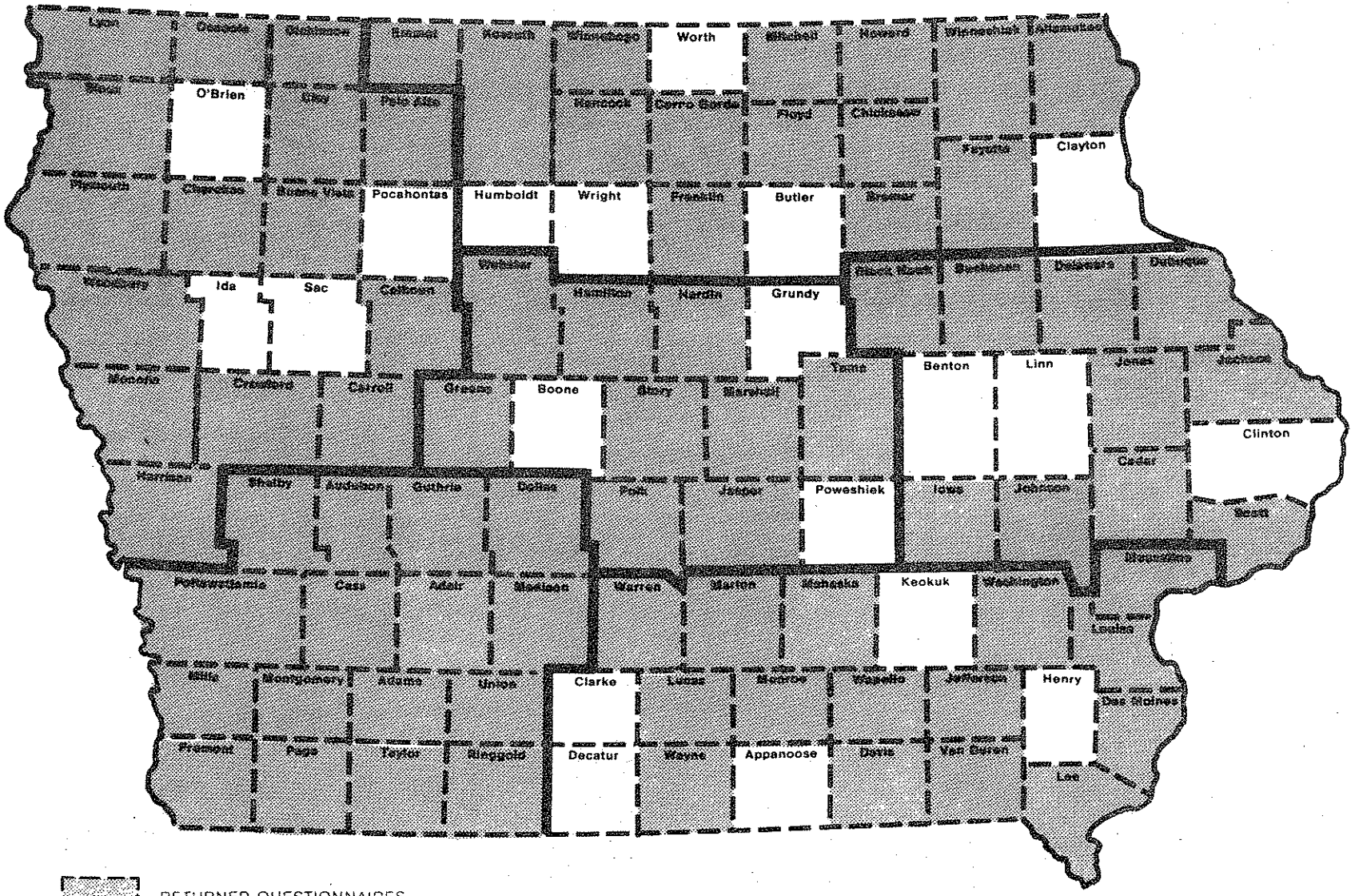
TABLE 1-2

NUMBER OF RESPONSES TO QUESTIONNAIRE

GROUP		TOTAL SENT	RESPONSES RECEIVED	PERCENT RESPONSES
ALL	COUNTIES	99	79	80
RURAL		91	72	79
URBAN (with Cities over 50,000)		8	7	88
OVER 50,000	CITIES	8	6	75
BETWEEN 5-50,000		59	36	61
BELOW 5,000		889	122	14

FICURE 1-1

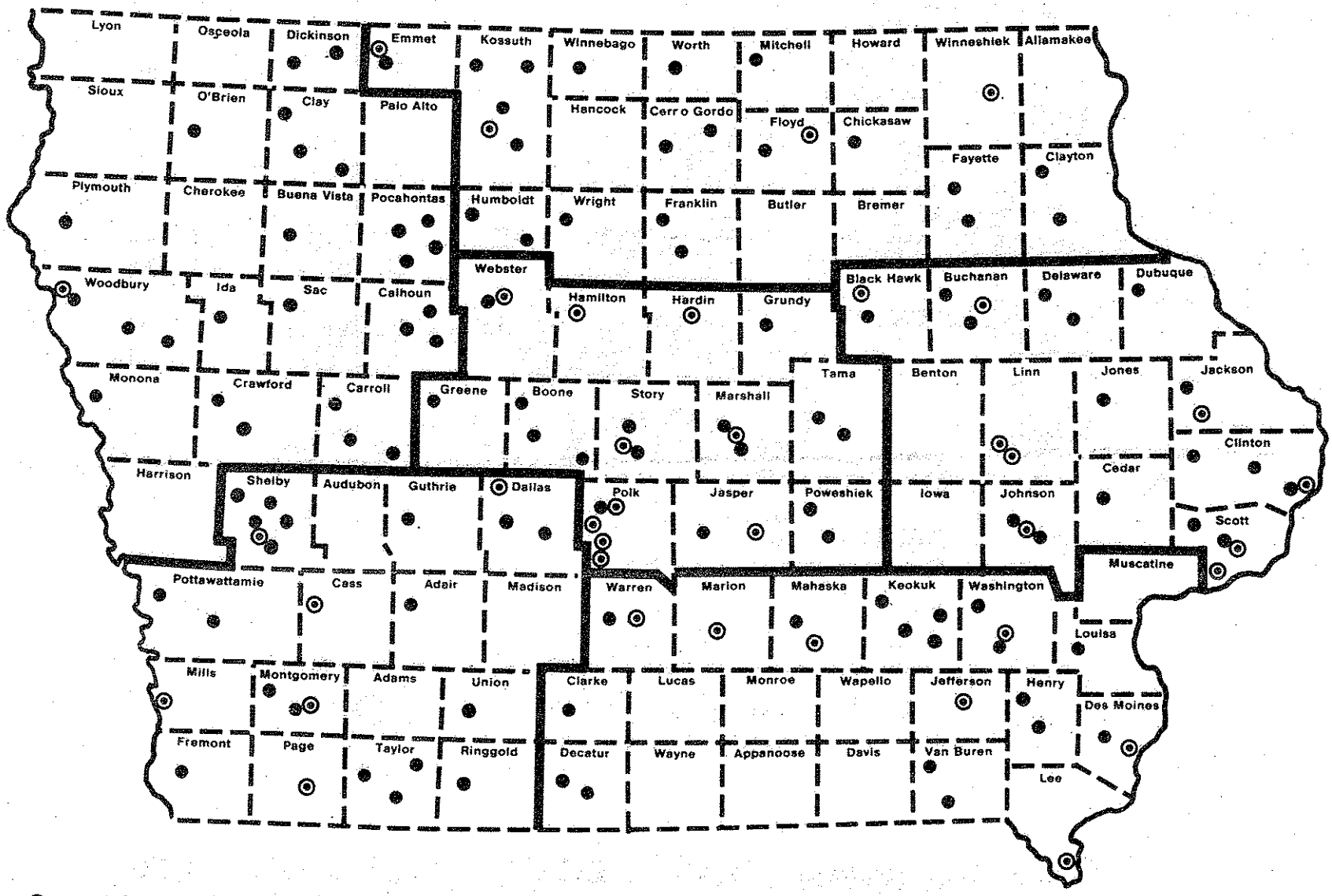
Counties Returning Questionnaire



RETURNED QUESTIONNAIRES

FIGURE 1-2

Cities Returning Questionnaire



◎ CITIES OF 5,000 POPULATION AND OVER

● CITIES LESS THAN 5,000 POPULATION

TABLE 1-3

SATISFIED WITH CURRENT PERCENT DISTRIBUTION OF ROAD USER TAX FUNDS BETWEEN THE STATE AND OTHER LEVELS OF GOVERNMENT

JURISDICTIONAL GROUP		PERCENT OF TOTAL RESPONSES			NUMBER OF RESPONSES
		YES	NO	NO RESPONSE	
ALL COUNTIES	COUNTIES	94	6	0	79
RURAL COUNTIES	COUNTIES	96	4	0	72
URBAN COUNTIES (with Cities over 50,000)	COUNTIES	71	29	0	7
CITIES OVER 50,000	CITIES	20	80	0	6
CITIES BETWEEN 5-50,000	CITIES	44	53	3	36
CITIES BELOW 5,000	CITIES	69	18	13	122

A question on changing the current public road mileage administered and maintained by the Iowa Department of Transportation indicated that the majority of jurisdictions favored no major changes as shown in Table 1-4.

TABLE 1-4
QUESTIONNAIRE RESPONSES ON MILEAGE CHANGE
FOR STATE PRIMARY SYSTEM

JURISDICTIONAL GROUP		PERCENT FOR NO CHANGE
All Counties	COUNTIES	82
Rural Counties	COUNTIES	82
Urban Counties (with Cities over 50,000)	COUNTIES	86
Cities over 50,000	CITIES	100
Cities between 5-50,000	CITIES	86
Cities below 5,000	CITIES	71

The response to this question was further supported by the on-site interviews with the sample county engineers, city engineers, public works directors and other city personnel having responsibility for street maintenance and operations. These interviews also confirmed the differences in maintenance and construction requirements between the rural counties and urban counties, those with cities over 50,000 population and experiencing continued developments. Cities over 5,000 population, and cities with less than 5,000 population also exhibit similar differences in street requirements and available financing.

IMPACT MEASUREMENT AND EVALUATION

Data and other information generated from Tasks 1 and 2 provided the data bases for performing the analyses to measure the impacts related to the three policy analysis areas.

The Highway Design and Maintenance Model and the Road Maintenance Planning, Programming and Budgeting Model provided quantitative measurements for alternative design, construction and maintenance policies

related to uniform standards and consolidation of services. These analyses and an assessment of the related impacts are presented in detail in subsequent chapters. Impacts have been expressed in quantitative terms, when applicable, so as to provide the affected jurisdictions supportable bases to assess the conclusions and recommendations.

The key issues and subsequent impacts were identified for the three policy analysis areas corresponding to the research objectives. These issues and impacts provide the focus for the analyses and interpretation of the findings. The issues are discussed in the following sections.

Uniform Design and Construction Standards

The Iowa Department of Transportation uses design guides in accordance with the 1984 Policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO). Farm to Market Design Guides are utilized by the counties for these facilities and are acceptable guides for other rural secondary roads. Based on interviews and questionnaire responses, the majority of the cities over 5,000 population have formalized design guides that meet or exceed the AASHTO design guides. Cities of less than 5,000 population generally do not have formalized design guides but utilize engineering consultants as required on a project by project basis.

The following are the key issues and areas of impact associated with requiring uniform design guides to be used on all public roads in the same functional classification and traffic volume groups.

1. Should different jurisdictions necessarily use the same design guides for roads in the same functional class grouping and traffic class?

   (a) uniformity between state and local units?
   (b) uniformity among counties?
   (c) uniformity among municipalities?

2. Do the present functional system groupings and traffic clasifications provide a sufficient basis for design guide distinctions, recognizing those design elements that are affected by vehicle use and vehicle size and weight?

3. Is there maintenance and user cost justification for the employment of lower surface type designs and/or lower surface thickness on low volume roads and streets?

4. If uniform design guides are required for all jurisdictions, how are the relative needs among the various jurisdictions affected?

5. Would additional highway user revenues be made available to the jurisdictions to offset any additional costs associated with the application of uniform design guides?

6. What effect would uniform design guides have on the issue of tort liability?

Impact areas identified for this policy analysis are listed below.

1. Optimum service levels.
2. Construction and maintenance costs.
3. Road user costs.
4. Condition and surface deterioration of system.
5. Highway safety.
6. Magnitude of needs.
7. Road Use Tax Fund distributions.
8. Total revenue requirements.
9. Tort libability.

Uniform Maintenance Standards

Maintenance standards relate to two distinct and different areas. One refers to maintenance performance standards, which defines for each unique maintenance work activity, the most effective crew size, equipment and materials required, work methods and procedures to be used, and the average daily accomplishment of work completed by a standard crew. These standards represent typical conditions and are modified to reflect specific requirements for traffic conditions and haul distances for materials.

The other maintenance standard area concerns maintenance level of service standards. Different maintenance service levels may be applied to different classes of roads and streets according to predefined criteria, for example, snow removal and roadside mowing. Frequently, these maintenance standards vary among the jurisdictions, and even within the same jurisdiction. This occurs when maintenance service levels are not established by management and each maintenance supervisor applies his interpretation of what service level is required.

The Iowa DOT utilizes both types of maintenance standards for the maintenance program of the state primary system. Since 1975, the Office of Maintenance, Highway Division, has been planning, scheduling and evaluating maintenance work through a maintenance management system. Performance standards have been formulated and are reviewed and updated periodically. The primary system has been classified into four different service levels for maintenance purposes.

Local agency responses to a question on the questionnaire indicated the majority of the counties and cities do not utilize maintenance service level criteria to develop their annual maintenance budgets. However, the majority of cities over 50,000 population and counties with cities over 50,000 population responded affirmatively to this question. Iowa Statutes (309.57) authorizes the counties to designate a Level B service classification of county roads for maintenance purposes. These roads may receive a lower level of maintenance than the other public roads,

however Level B service roads must be adequately signed at all access points from other public roads. Relatively few counties have adopted a Level B maintenance classification at this time, although it is becoming increasing popular because of the reduced maintenance effort required and limited liability for damages as long as the road is properly classified, signed and maintained at the designated Level B maintenance level.

All jurisdictions have limited immunity from liability for damages caused by snow and ice conditions, as long as the jurisdiction has complied with its formal policy or level of service for snow and ice conditions.

Key issues and impact areas associated with uniform maintenance standards are similar to those for uniform design guides. They are listed below.

1. Should uniform maintenance standards be required for all jurisdictions?

   (a) between state and local agencies?
   (b) among counties?
   (c) among municipalities?

2. Should uniform maintenance standards include both maintenance service level and maintenance performance standard?

3. What authority would be responsible for establishing uniform maintenance standards and ensuring their adoption and use?

4. Would local jurisdictions be required to submit annual maintenance budgets based on uniform maintenance standards?

5. How would uniform maintenance standards affect improvement needs?

6. Would road user tax fund allocations be adjusted to reflect costs associated with the adoption of uniform maintenance standards?

7. What effect would uniform maintenance standards have on the issue of tort liability?

Impact areas related to the above issues are listed below.

1. Optimum service levels.
2. Maintenance and construction costs.
3. Road user costs.
4. Condition and surface deterioration of system.
5. Highway safety.
6. Magnitude of needs.
7. Road Use Tax Fund distributions.
8. Total revenue requirements.
9. Tort liability.

Consolidation of Construction and Maintenance Operations

In each county three separate jurisdictions have responsibility for maintenance and construction of the public roads and streets within the county -- Iowa DOT, county and city. The number of individual agencies providing these services increases considerably when the number of independent cities in the county is added to the state and county maintenance organizations. With 956 cities and 99 counties, there are over 1,000 separate agencies that have construction and maintenance responsibilities in Iowa. Staffing for these responsibilities range from approximatelly 150 for the largest local agency to part-time services of one person for the smaller agencies.

Rural secondary miles per county ranges from 556 to 1,674 miles for a rural secondary density of 1.22 and 1.71 miles per square mile of area respectively for the two counties. The statewide average is 1.61 miles per square mile.

Some of the smaller cities contract with the counties to provide routine maintenance services, as provided in Chapter 28E of the Code of Iowa. Other small cities rely on part-time services of a city employee for routine maintenance and private contractors for major maintenance work. The majority of the local agencies interviewed, even the smaller cities, indicated the current structure for maintenance in their agency provided an adequate level of service to their community. The consensus of local agencies interviewed did not favor changes in the existing maintenance operations because of the potential for a loss of responsiveness to their maintenance needs.

The issues and impacts related to uniform design, construction and maintenance standards are also applicable to the consolidation of construction and maintenance operations, however there are additional issues and impacts to consider. They are listed below.

1. Should one jurisdiction be responsible for the maintenance of all public roads and streets -- state, county, municipal?

2. Are there duplications in maintenance operations under the existing jurisdictional responsibilities for maintenance.

3. Can consolidated maintenance services improve efficiency and/or eliminate duplication without unwanted reductions in the levels of maintenance service or other adverse impacts?

4. Can intergovernmental arrangements, such as intergovernmental contracts, coordinated maintenance programs and agreement on the application of maintenance standards, improve efficiency?

5. Are there inefficiencies in the current system of construction adminstration?

6. Should all public road construction projects be administered by one level of government -- contract award, construction supervision, quality control and inspection, project acceptance?

Impact areas related to the above issues were identified for maintenance and construction and are given below.

- Maintenance:

  1. Levels of maintenance service.
  2. Capital facilities.
  3. Personnel and equipment requirements.
  4. Transitional costs and implementation efforts.
  5. Total public road maintenance costs.
  6. Snow removal and maintenance priorities.
  7. Reduced local revenues for maintenance.
  8. Planning, scheduling and evaluating maintenance work.
  9. Liability for maintenance defects.

- Construction:

  1. Organizational structure for construction.
  2. Personnel
     + Additional staffing/reductions.
     + Construction inspection training.
  3. Capital facilities.
  4. Total public road construction and administration costs.
  5. Construction/preservation priorities.
  6. Liability of construction defects.
  7. Construction technology.
  8. Contract for construction inspection.
  9. Quality control standards and procedures.

Jurisdictional Transfers

Since 1919 and the establishment of the state primary system at a maximum 6,500 miles, Iowa's public roads and streets have been administered by the state, county and city jurisdictions. The responsibility for the more than 112,000 miles of public roads has remained relatively stable during this 65 year period, except for the increase of the state primary system to the current 10,105 mile system.

The most recent efforts to achieve jurisdictional transfers in accordance with the functional classification of the road or street was initiated in 1979. These transfers ceased in 1981, when the Iowa Legislature passed legislation restricting such transfers to those where the transfer was mutually agreeable between the affected jurisdictions. Prior to 1981, disputed classification and jurisdictional transfers were reviewed and ruled on by a state review board. Disputes leading to the

1981 legislation stopping functional classification transfers primarily involved mileage transfers without commensurate transfers of revenues. While provision was made for adjustment in the allocation of the road use tax funds among the jurisdictions, as well as surface improvements for the transferred mileages, the affected jurisdictions did not concur in their equity or adequacy.

The dearth of revenues available from the Road Use Tax Fund was the key issue. Whereas the state primary system is funded primarily from the Road Use Tax Fund and federal aid revenues, the counties and cities must provide local revenues from local sources in order to fund minimal road and street programs. The increase in the federal tax on motor vehicle fuel in 1984 will provide additional federal aid revenues to Iowa, but federal allocations have earmarked these revenues for federal aid facilities that are primarily on the state primary system. The issue of insufficient Road Use Tax Fund revenues has not been altered.

The key issues and impacts identified for the areas of uniform standards and consolidated operations are also applicable to potential jurisdictional transfers. Differences in concepts of highway service responsibility, mentioned under other impact headings above, have a significant bearing on jurisdictional transfers. A road which may be perceived as having relatively low service importance on the state system may be a relatively important route from the county network standpoint. If the road is on the state system, therefore, it may not receive the attention it deserves.

Although differences may occur currently in the way programs are administered, standards that are utilized both in maintenance and construction, efficiency of performance, and ability to meet needs, it does not necessarily follow that changes in basic jurisdictional responsibilities are needed. There are distinct possibilities of arrangements among units of government, to carry out jurisdictional responsibilities, which would not necessarily change these responsibilities. This is not to say, however, that changes in responsibilities may not be the best way of achieving objectives.

CHAPTER TWO

FINDINGS OF THE CURRENT SITUATION

Responsibility for the 112,000 plus miles of public roads and streets in Iowa is divided among the state, counties and cities. As of January 1, 1983, the respective jurisdictional responsibilities are shown in Table 2-1. Annual vehicle miles of travel for 1983 are also shown for the jurisdictions in Table 2-2. A comparison of 1983 system miles and vehicle miles of travel is shown in the following.

Jurisdiction	Percent of Total	
	1983 System Miles	1983 Vehicle Miles
State Primary[1/]	9.3	56.5
Counties	79.8	19.4
Cities	10.9	24.1
Total	100.0	100.0

Source: Iowa Department of Transportation

1/ Includes State Parks & Institution Miles

Information collection on the current administration and operations for the existing jurisdictions represented a significant effort of this study. The importance and significance of the policy analysis areas required obtaining factual information of existing operations from the jurisdictions, as well as familiarization with the problems confronting the respective agencies. This was accomplished through structural interviews with state, county and city officials, together with a comprehensive questionnaire transmitted to the local agencies.

An overview of current operations in the three jurisdictions is presented in the following sections, as directly related to the analysis areas.

TABLE 2-1

IOWA PUBLIC ROAD MILEAGE
January 1, 1983

	Rural	Municipal	Total	Percent of Total
State Primary	8,754.24	1,350.65	10,104.89	9.0
County Secondary				
Federal and Secondary[1/]	12,635.85			
Other Secondary	77,051.21			
	89,687.06		89,687.06	79.8
City System[1/]				
Federal Aid Secondary		529.39		
Other City		11,730.51		
		12,259.90	12,259.90	10.9
Parks & Institutions			309.81	0.3
TOTAL	98,441.30	13,610.55	112,361.66	100.0

1/ Includes FAUS

SOURCE: IOWA Department of Transportation

TABLE 2-2

1983 VEHICLE MILES OF TRAVEL

Iowa Public Road System
(Millions)

	Rural	Municipal	Total	Percent of Total
State Primary[1/]	7,890	3,069	10,959	56.5
County Secondary	3,762		3,762	19.4
City Streets		4,670	4,670	24.1
TOTALS	11,652	7,739	19,391	100.0

1/ Includes State Parks and Institutions

SOURCE: Iowa Department of Transportation

IOWA DEPARTMENT OF TRANSPORTATION

The Iowa DOT, Highway Division and Planning and Research Division, is responsible for the planning, construction and maintenance of the state primary system of 10,105 miles. The Interstate represents 734 miles with an average daily traffic of approximately 11,650 vehicles. Traffic volumes for the other primary miles average 1,910 and 5,285 for the rural and urban systems respectively. The state primary system is entirely paved except for 14.8 gravel surface miles and 79.1 miles of low bituminous surface.

Organization

The State is divided into six geographic districts as shown in Figure 2-1. The districts are further divided into residency areas for construction and maintenance with an engineer responsible for each area. Each district has four maintenance residency areas, with one area in each of three districts having responsibility for both maintenance and construction. The number of construction residencies areas varies with the construction workload. As of March 1984 there were 18 construction residencies, plus the three responsible for maintenance as well as construction.

Maintenance

Primary extensions through cities are the joint responsibility of the state and cities. The state is responsible for the construction and right of way costs of the primary extension to the minimum design criteria established by the Iowa DOT. Additional costs beyond these criteria are the responsibility of the city. The state maintenance responsibility is limited to the surface, curb to curb features (excluding parking lanes and parking signs), traffic signs, pavement markings, bridges and snow removal from the traffic lanes. Other street maintenance, including the removal of windrowed snow, sidewalks and all areas between the curb and the right of way line are the responsibility of the city. The Iowa DOT does enter into maintenance agreements with some cities for the maintenance of the state's responsibility on all, or a portion of the primary extensions (Chapter 28E, Code of Iowa). Reimbursement to the city is on a lane mile basis, which is $695 per lane mile for fiscal 1986.1/ These agreements are limited to specified routine maintenance work; special maintenance such as major full-depth patching or resurfacing is contracted through a separate contract if the city performs the work. In fiscal year 1984, the state entered into primary extension routine maintenance agreements with 34 cities at a total cost of $258,984, an equivalent 2-lane mileage of approximately 218 miles, or less than 20 percent of the total primary extensions.

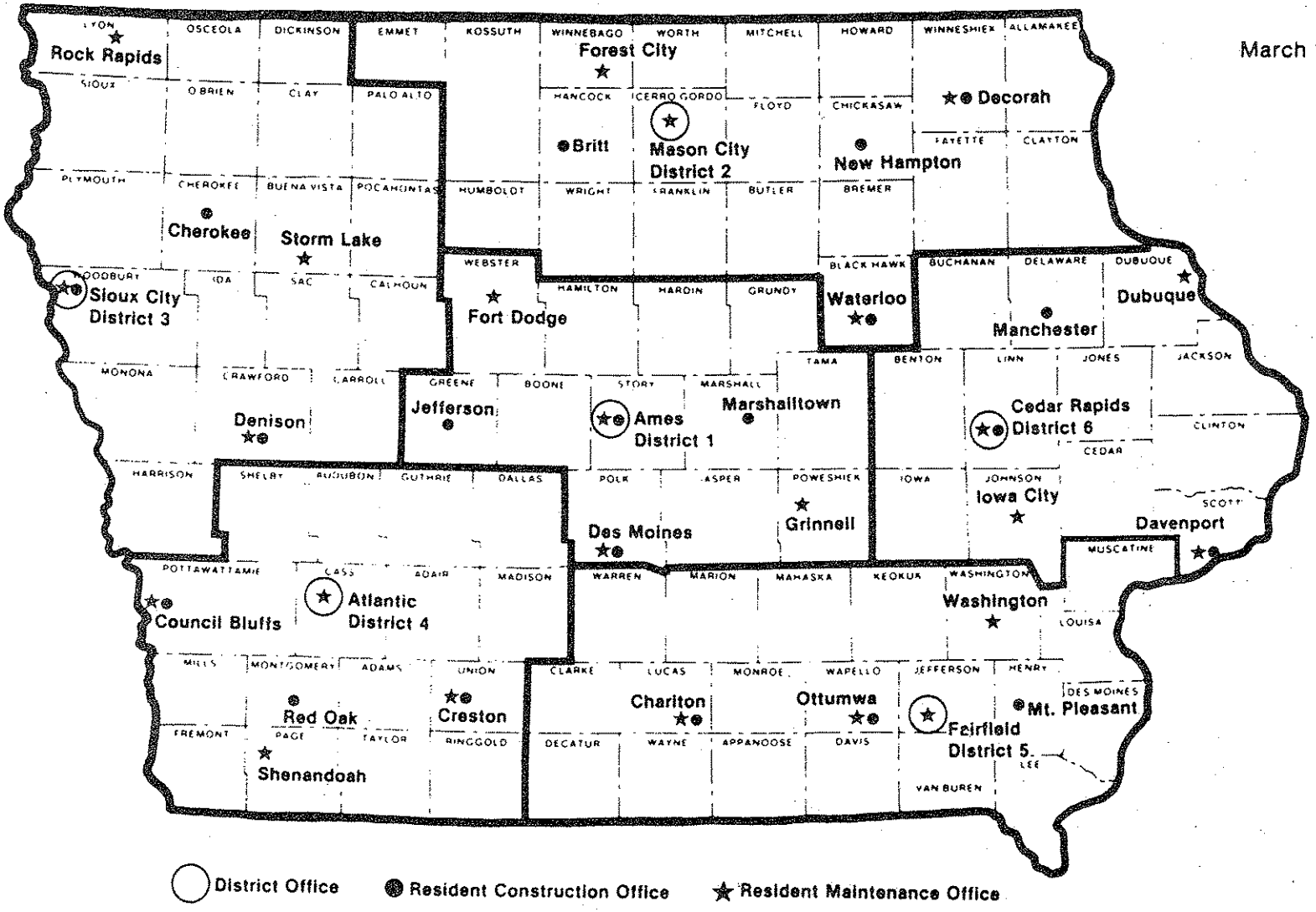
Private contract maintenance, for specific work functions, such as pavement patching, seal coats, slurry seals, resurfacing/leveling, bridge painting/repair and mowing on the Interstate system, with private contractors is utilized by the Iowa DOT and has proven very successful.

1/ Iowa DOT Commission Order No. H-85-588, May 7, 1985.

FIGURE 2-1

Highway Division Districts

March 1984



A research project was conducted in 1982 and 1983 by the Iowa DOT on contracting the complete maintenance on specific primary routes in four districts. These contracts included a variety of work functions and variable workloads that involved responses to emergencies and isolated situations. The findings of this private contracting research concluded that private contracting for maintenance of this type over extended time periods was not cost-effective and should not be pursued further.[1/] In addition to the higher costs for most work functions, other problems cited included:

- lack of necessary equipment when needed;
- the work descriptions and functions were not always clear to the contractor;
- lack of experienced/qualified personnel to perform some of the functions;
- poor quality of work;
- contractors behind schedule on work;
- bases of operation were far away from maintenance areas;
- poor communication between the contractors and their workers;
- workers not using safety equipment and proper traffic control;
- loss of contact with property owners; and
- inadequate response time to emergencies and isolated conditions.

Therefore, the Iowa DOT has limited contract maintenance in recent years primarily to city agreements for maintenance of primary extensions and specific functional maintenance work that has proven cost-effective. For fiscal years 1982 and 1983 these contract efforts amounted to $10.3 and $10.5 million respectively.

State primary system maintenance is planned and controlled through the Office of Maintenance and district maintenance field personnel. Iowa's maintenance management system provides maintenance standards for approximately 95 work functions used for planning, budgeting and reporting work accomplishment. These maintenance standards specify for each function the following items:

- Work program category
- Description and purpose
- Level of maintenance (quality standard)
- Scheduling guide
- Recommended work procedures

1/ Iowa's Experience with General Contract Maintenance, Iowa Department of Transportation, Highway Division, Office of Maintenance, 1983.

- Materials to use
- Recommended crew size
- Recommended equipment
- Accomplishment (unit of measure, hourly production, daily production)

These are typical maintenance standards required for all effective maintenance management systems. The individual work functions are classified into eleven function categories as shown in Table 2-3. Actual and planned maintenance costs by category are shown for fiscal years 1983, 1984 and 1985. Not included in these costs are the contract functional maintenance costs and city maintenance contracts.

Construction

Annually, a state primary improvement program is prepared in accordance with State Statutes (307A.2(12)). In recent years, Iowa has shifted highway improvement emphasis from new construction to re-construction and/or preservation. Priorities for state highway funds are as follows:

1. maintenance;
2. preservation of existing highways and bridges; and
3. reconstruction/construction.

Based on the current 10,105 mile state primary system and design life of 20 years, approximately 500 miles should be improved each year. Of this "500 mile target", 160 miles should be reconstructed and 340 miles are resurfacing/preservation work. Current funds available for highway improvements, after maintenance requirements, reduce the number of miles that can be reconstructed -- in 1984 this amount was approximately 50 miles. Without additional revenues for the state primary system, the number of miles that can be resurfaced and improved will continue to decrease. Note: The 160/340 ratio is based on a "maximum life of 60 years" with appropriate resurfacings and other preservations.

Current 1985-1990 program allocations are shown in Table 2-4. For 1985, maintenance and system preservations amount to $94 million, or 29 percent of the total state primary program costs for 1985.

IOWA COUNTIES

The County Board of Supervisors in each of the 99 Iowa counties is responsible for the construction and maintenance of the rural secondary road system in the county. The Board of Supervisors is required by State Law (Chapter 309.17) to employ one or more registered civil engineers to direct and supervise all construction and maintenance work on the secondary system. Iowa Code (309.19) further authorizes the Boards of two, or more adjacent counties, to enter into agreements to jointly employ the same registered engineer to provide these services to the respective counties. To date, there have been no joint agreement of this type between any counties. However, one county and a major city in the county have entered into an agreement of this type, whereby one registered engineer provides engineering services to both jurisdictions.

TABLE 2-3

ANNUAL MAINTENANCE COSTS (THOUSANDS)
FISCAL YEARS 1983 - 1985

ACTIVITY	ACTUAL		PLANNED	
	1983	1984	1985	Percent of Total
Supervision/Support	$ 16,829	$ 17,201	$ 17,091	25.7
Roadway Surface	6,409	5,913	6,950	10.4
Shoulders	5,915	5,506	6,563	9.9
Roadside	3,106	3,170	3,841	5.8
Drainage	1,453	1,349	1,497	2.2
Traffic Services	9,084	9,118	9,936	14.9
Snow & Ice	8,793	11,587	11,540	17.3
Bridges	1,592	1,530	1,924	2.9
Service Contracts	1,336	317	2,356	3.5
General	4,517	5,009	4,383	6.6
Work for Others	611	614	523	0.8
TOTAL	$ 59,645	$ 61,314	$ 66,604	100.0

NOTE: Does not include contract functional maintenance.

SOURCE: Iowa DOT, Office of Maintenance.

TABLE 2-4

STATE PRIMARY SYSTEM PROGRAM COSTS
1985 - 1990 Allocations

(Millions of Dollars)

	1985	1986	1987	1988	1989	1990
Maintenance	$ 67	$ 73	$ 77	$ 82	$ 86	$ 91
Support/Administration	23	24	25	27	28	29
Construction Programmed	201	184	164	161	158	167
Preservation	27	65	86	90	92	86
Parks, Institutions	4	4	4	4	4	4
TOTAL	$322	$350	$356	$ 364	$368	$377

SOURCE: Iowa Transportation Improvement Program 1985 - 1990.

The rural secondary system consists of 89,687 miles of public roads. This system is further classified as farm-to-market and local secondary as shown in Table 2-5. The farm-to-market roads are those functionally classified as trunk or trunk collector. The farm-to-market system totals 29,401 miles, of which 12,523 miles are on the federal aid secondary and federal aid urban systems, which qualify for participation of federal aid secondary and FAUS funds received by the Iowa DOT (Table 2-5).

Table 2-6 shows the county secondary system by surface types. On the farm-to-market system all routes are surfaced -- gravel or paved -- except for 221 miles. Over 150 miles of the 221 occur in one county and are primarily dirt surface treated with oil. Approximately 35 percent of the paved miles on the farm-to-market system are portland cement concrete surface, with the remaining being asphaltic concrete. The trend in recent years has been to use portland cement concrete paving on county roads because of the low initial maintenance costs and the long service life before major maintenance or rehabilitation is required. Low type bituminous surfaces have not been used to any extent in Iowa as shown by the low mileage of this type in Table 2-6.

Organization

Each county has a similar organization for maintaining the county secondary roads. In addition to a central garage location where the majority of the personnel are assigned, each county has other locations throughout the county where equipment may be stored, or parked. The number of locations vary with the size of the county and the miles to be maintained, but 6 to 10 locations are typical. These locations may have heated garages or may only be a storage yard where one or more motor graders can be parked. The typical location is a small shed or garage where one to two equipment operators and motor graders are assigned to perform the blading of gravel and earth surfaces. During the winter season, snow removal is also performed from these locations. A typical motor patrol area consists of 45 to 65 miles of unpaved roads.

The Iowa County Engineers Association provides an important service to the county engineers through the various committees and formal and informal exchange of information and technology. As a result of this work and other pioneering efforts throughout the years, the Iowa county road organization is often viewed as a leader in rural road organization and operations.

Maintenance and Construction Operations

Maintenance represents the single largest expenditure of the county road program. The county engineers submit annual reports on revenues and expenditures for the scondary road system. Separate accounting is made for the farm-to-market roads and the local secondary roads as separate allocations of road use tax funds are made to these systems. These annual reports do not include federal aid revenues, as these revenues are administered by the Iowa DOT and credited to the counties as eligible federal aid projects are obligated.

TABLE 2-5

RURAL COUNTY SECONDARY SYSTEM MILEAGE
January 1, 1983

	Farm-to-Market	Local Secondary	Total
Federal aid Secondary[1/]	12,522.99	112.86	12,635.85
Non-Federal aid	16,878.28	60,172.93	77,051.21
TOTAL	29,401.27	60,285.79	89,687.06

1/ Includes FAUS

NOTE: Excludes Proposed Roads and Legal Roads not Open to Traffic

SOURCE: Iowa Department of Transportation

TABLE 2-6

COUNTY SECONDARY SYSTEM SURFACE TYPES
(January 1, 1983)

Miles by Surface Type

	Earth/ oiled	Gravel	Low Type Bitum.1/	High Type Paved	TOTAL
Farm-to-Market					
Federal aid Secondary2/	68.23	1,972.29	503.82	9,978.65	12,522.99
Non-Federal aid	152.40	13,094.50	558.24	3,073.14	16,878.28
Sub-Total	220.63	15,066.79	1,062.06	13,051.79	29,401.27
Percent of Total	0.8	51.2	3.6	44.4	100.0
Local Secondary					
Federal aid Secondary1/	0.84	60.32	8.61	43.09	112.86
Non-Federal aid	5,276.58	53,692.30	374.48	829.57	60,172.93
Sub-Total	5,277.42	53,752.62	383.09	872.66	60,285.79
Percent of Total	8.8	89.2	0.6	1.4	100.0
TOTAL SECONDARY	5,498.05	68,819.41	1,445.15	13,924.45	89,687.06
Percent of Total	6.1	76.8	1.6	15.5	100.0

1/ Less than 8 inches thickness.
2/ Includes FAUS.

SOURCE: Iowa Department of Transportation.

Table 2-7 shows total revenues and expenditures on the county secondary systems for the five-year period 1978. Maintenance expenditures have increased from 60 percent to 70 percent of total expenditures during this period. Revenue contributions from local sources have also increased during this same period.

The counties are required to submit five-year improvement programs of specific projects for the secondary system to the Iowa DOT for review and approval. Farm-to-market design guides for these improvements have been adopted by the county engineers association and the department. Annual secondary road budgets are also required to be submitted to the Iowa DOT for review and approval. These budgets include all proposed expenditures on the secondary system, although the budget control categories are fairly broad, such as maintenance, construction, new equipment, equipment operations, and others. Typically, these budgets are based on previous years expenditures, plus projected increases. The maintenance portion of the budget submittal is not necessarily based on any uniform level of maintenance service or maintenance standards among the counties. Interviews with the twelve sample counties identified only one county that developed an annual maintenance budget and work program on the basis of planned work quantities and work frequencies for specific types of major routine maintenance functions. This is the planning and development procedure used by the Office of Maintenance, Iowa DOT.

Although the majority of the county secondary roads primarily serve the rural areas, 8 to 10 counties in the State have high concentrations of residential and commercial areas outside of city corporate limits. The roads/streets outside of the corporate limits are the responsibility of the counties. Most of the affected counties have adopted development standards requiring these roads and streets to be built to adequate standards by the developer. However, frequently the existing secondary roads in these areas are not adequate to serve the increased traffic volumes and usage. Improvement of these facilities can represent a significant cost to the county.

IOWA CITIES

The 956 cities in Iowa are responsible for the construction and maintenance of all public streets within the corporate limits, including the extensions into and through the city of county secondary roads. As discussed in a previous section, the extension of state primary highways are the combined responsibility of the cities and state. As of January 1, 1983, the city street mileage was 12,260. Over 50 percent of the total mileage is in the 67 cities of 5,000 population and greater (Table 2-8).

Table 2-9 shows the city street mileage by surface type. Over 85 percent of the mileage is paved, including low type bituminous surfaces, and the remaining 1,763 miles are gravel and earth surfaces.

TABLE 2-7

COUNTY ROAD REVENUES AND EXPENDITURES
All Counties

(Thousands)

	1978	1979	1980	1981	1982
REVENUES					
Federal Funds	$ 14,320	$ 14,262	$ 12,604	$ 9,476	$ 10,142
Road Tax	84,800	91,318	86,073	92,203	97,495
Other State	2,585	2,469	4,617	2,270	2,481
Property Tax/Assessm.	67,807	71,815	82,623	91,302	97,581
Other Local	2,992	4,385	5,340	3,668	3,720
Total	172,504	184,249	191,257	198,919	211,419
EXPENDITURES					
Construction	$ 54,190	$ 51,349	$ 43,238	$ 37,345	$ 39,829
Maintenance	110,170	129,758	126,778	129,134	146,836
Administration	13,934	17,735	17,676	19,105	20,384
Other	3,396	1,762	1,715	1,452	1,178
Total	181,690	200,604	189,407	187,036	208,227

SOURCE: PR535, Local Road and Street Finance Report - 1979,1980,1981.
PR536, Local Highway Finance Report - 1982, 1983.

TABLE 2-8

CITY STREET MILEAGE
January 1, 1983

Population Group	Number of Cities	Miles	Percent of Total
50,000 and greater	8	3,778	30.8
5,000 to 50,000	59	3,053	24.9
Less than 5,000	889	5,429	44.3
Total	956	12,260	100.0

SOURCE: IOWA Department of Transportation.

TABLE 2-9

CITY STREET SURFACE TYPES
January 1, 1983

Surface Type	Miles	Percent of Total
Gravel/Earth	1,763	14.4
Low Type Bituminous	944	7.7
Asphaltic Concrete	6,076	49.5
Portland Cement Concrete	3,477	28.4
Total	12,260	100.0

SOURCE: IOWA Department of Transportation.

Organization

Cities over 10,000 population usually have a city engineer or public works director who is responsible for the construction and maintenance of the city streets. Cities less than 10,000 population typically have a street superintendent, when justified by the magnitude of their street program.

Cities less than 1,000 population may have one to two full-time city employees who perform all related city work, including streets. City street maintenance is usually performed from one facility, except for an outlying area for storage of materials.

Maintenance and Construction Operations

All cities in the state which receive road use tax fund revenues are required to submit annual reports on city street revenues and expenditures. Table 2-10 summarizes these reports for the 5-year period 1979-1983. As with the counties, maintenance represents the largest single expenditure of the city street program; debt service payments amounted for approximately 25 percent of street related expenditures in 1983. Bond financing for streets has been an integral part of the street program throughout the years.

The annual reports on city street maintenance are not as detailed as the county submittals and include several work functions not applicable to rural roads, such as street lighting, street cleaning and storm sewers. City street maintenance presents different problems than rural facilities. Table 2-11 shows the breakdown of maintenance items reported in the annual reports. With the exception of roadway/surface maintenance, there is considerable inconsistency in the reporting of individual maintenance items, particularly the cities less than 5,000 population. A review of selected individual city reports from this group revealed that several cities used only two or three categories for reporting the maintenance costs. The primary objective appeared to be an accounting that the road use tax funds were expended for street purposes.

Cities of 5,000 population and greater are required to submit annually a five-year program of street construction and reconstruction projects and to report on the progress made on the completion of each project in the approved program. Cities less than 5,000 and greater than 1,000 population are required to submit proposed annual street improvement programs.

The majority of the cities over 5,000 population have formalized design guides for street construction and reconstruction, while the others rely on design consultants for specific projects. All cities over 5,000 population require developers to build streets to specified standards within new developments before the streets will be accepted for city maintenance. The developer adds these street costs to the purchase price which is paid by the home buyer.

TABLE 2-10

CITY STREET REVENUES AND EXPENDITURES
All Cities

(Thousands)

	1979	1980	1981	1982[1/]	1983[1/]
REVENUES					
Federal Funds	$ 14,745	$ 18,020	$ 16,003	$ 13,304	$ 14,674
Road Tax	52,261	52,861	50,682	60,704	64,641
Other State	1,760	4,904	3,892	4,611	4,806
Property Tax/Assessm.	46,962	44,950	53,395	83,469	93,051
Bonds	25,362	40,821	41,151	51,901	42,332
Other Local	7,511	9,046	10,316	13,531	17,994
Total	148,601	170,602	175,439	227,520	237,498
EXPENDITURES					
Construction	$ 57,976	$ 81,811	$ 80,964	$ 82,490	$ 70,397
Maintenance	53,125	56,290	54,422	85,669	91,612
Administration	4,788	5,287	6,204	7,137	7,724
Debt Service	27,675	26,823	33,686	43,783	55,283
Other	9	1	18	1	7
Total	143,573	170,212	175,294	219,080	225,023

1/ Includes Parking and Indirect Street Functions

SOURCE: PR535, Local Road and Street Finance Report - 1979, 1980, 1981.
PR536, Local Highway Finance Report - 1982, 1983.

TABLE 2-11

CITY STREET MAINTENANCE COSTS
All Cities

(Thousands)

	1982		1983	
	Dollars	Percent of Total	Dollars	Percent of Total
Roadway/Surface	$ 43,863	51.2	$ 48,510	52.9
Snow & Ice	8,354	9.7	6,902	7.5
Storm Sewers	2,338	2.7	2,660	2.9
Traffic Services	5,399	6.3	5,728	6.3
Street Cleaning	4,334	5.1	4,827	5.3
Street Lighting	16,119	18.8	16,884	18.4
Trees	1,186	1.4	1,422	1.6
Equipment Purchases	3,909	4.6	4,419	4.8
Other Maintenance	167	0.2	260	0.3
TOTAL	$ 85,669	100.0	$ 91,612	100.0

SOURCE: PR536, Local Highway Finance Report - 1982, 1983.

ROAD AND STREET RESPONSIBILITIES IN OTHER STATES

Public road and street responsibilities and operations in other states were reviewed to identify specific features or items that warranted consideration for Iowa. Specific applications identified included the following:

1. All rural roads maintained by the state.

   Delaware - 5,250 miles
   North Carolina - 76,000 miles
   Virginia - 53,000 miles
   West Virginia - 35,000 miles

2. County farm-to-market system maintained by the state.

   Missouri - 24,274 miles

3. Counties maintain the state highway system.

   Michigan - 62 of 83 counties maintain the entire state system in their counties
   Wisconsin - 72 counties maintain the entire state system.

The four states selected for on-site interviews and data collections represented states that offered a different approach or philosophy to highway, road and street operations and responsibilities that warranted consideration for the current Iowa study on public road administration and maintenance alternatives. The states selected were Kansas, Michigan, Missouri and North Carolina.

Initial contact was made with the state maintenance engineer in each state and a series of meetings scheduled with headquarters and field maintenance personnel. County engineers were also contacted in Kansas, Michigan and Missouri. The following sections present highlights from each state.

Kansas

The Kansas Department of Transportation organization for maintenance is similar to Iowa's and also provides the option to municipalities for maintenance of municipal extensions on a fixed rate per lane mile, which currently is $1,250 per lane mile. Snow and ice control policy provides a lower level of service than Iowa's.

The county organization for public roads specifies county engineers, but the State Statute has been modified to permit non-engineer road supervisors, as long as work requiring the services of a professional engineer is not performed. Only 38 of the 105 counties currently have registered professional county engineers. State Statutes permit the formation of Engineering Districts whereby one engineer provides county engineering services to two counties. Currently, there are three Engineering Districts in Kansas.

The counties share of state highway user funds are allocated to the counties on the basis of motor vehicle registrations and vehicle miles of travel. The thirteen counties that have significant urban populations are required to share the county's allocation of state user revenues with the cities in proportion to the urban population.

Michigan

The Michigan Department of Transportation (DOT) organization for maintenance is similar to Iowa, except for the function whereby the DOT contracts with the counties and municipalities for maintenance of the entire state trunk line system in their jurisdictions, including the Interstate. Currently, 62 counties and 152 municipalities have contracts with the DOT for maintenance of the state highway system. State roads in the other 21 counties are maintained by DOT personnel.

A budget for work to be performed is developed for the county or municipality and the local agency is reimbursed on a monthly basis for work performed. Reimbursement is based on unit costs, including overhead items, for labor, equipment and materials as specified in the contract. Provision is made for a ten percent overrun and the agencies may receive an advance against the annual budget. Supervision and inspection by DOT personnel is minimal and ten full-time auditors are assigned to verify compliance with the financial contract provisions.

The city and county portion of the state highway user revenues is allocated to the respective jurisdictions through a formula that involves several factors. These include:

Cities -- excess snowfall, population, equivalent major street mileage, local street mileage.

Counties -- $10,000 for registered engineer, excess snowfall, urban road mileage, weight tax collection fees (vehicle registrations), equal share (1/83), primary road miles, rural population, local road miles.

Missouri

The Missouri state highway system is 28.0 percent of the total public road mileage and includes the basic county farm-to-market system of 24,274 miles. The entire state system is maintained as a paved bituminous system, although the majority of the routes are low type bituminous surfaces. The Missouri Department of Transportation (DOT) maintains all municipal extensions of the state highway system -- there are no municipal maintenance contracts. The DOT has a Bare Pavement Policy for snow removal on state routes with an average daily traffic volume of 1,000 vehicles or more.

The counties (114) are classified according to population and property evaluation as either first, second or third class counties. The first class counties (7) usually have county engineers, while only a few of the other counties have engineers. In addition to the county road organization, there are 304 Special Road Districts that levy taxes and maintain the public roads within the district (maximum of 8 square miles). The counties must return 25 percent of the county road tax revenues collected in the cities back to the cities within the county.

The county portion of the state road user tax is distributed to the counties on the basis of: 50 percent on road miles and 50 percent on rural land evaluation. The city portion is allocated on the basis of population to cities having a population of 100 or more.

North Carolina

The North Carolina Department of Transportation (DOT) is responsible for the maintenance of all rural public roads (76,300 miles), which is 85 percent of the total public road mileage.

Municipal primary and secondary extensions are maintained under contract by seven cities. A budget is established and reimbursement is for actual costs within the budget limits. Traffic services on state extensions are performed under contract by approximately 100 cities.

The DOT uses 2,000 convict laborers per day under contract with the Department of Corrections. Over 50 percent of this labor source is integrated with regular DOT maintenance crews.

Separate maintenance allocations are made to the field divisions for the primary, secondary and urban systems. Maintenance needs, lane mileage, paved mileage, unpaved mileage and population are factors used for allocations. Within the divisions, secondary system allocations are made to the counties on the basis of maintenance needs, paved road mileage and population.

Comparisons with Iowa

Direct comparisons of highway, road and street operations in the four state transportation departments contacted presented a unique challenge due to the distinct differences in public road jurisdictional responsibilities and management policies to accomplish the state's transportation objectives. The following related items are compared directly with Iowa data:

- Miles of public roads
- Land area
- Jurisdictional responsibilities
- Paved and unpaved road miles
- Vehicle miles of travel

Table 2-12 compares public road mileage by jurisdictional responsibility for Iowa and the four states contacted. Total public road mileages ranges from a high of 131,783 in Kansas to 89,270 in North Carolina (excluding toll roads, state parks, forest roads, institutions).

Tables 2-13 and 2-14 illustrate public road miles and density per square mile of land area and population.

Paved public road mileages for all jurisdictions are shown in Table 2-15. North Carolina has the highest percent of paved public road mileage at 77.3 percent and Kansas is the lowest with 24.9 percent, while Iowa has 32.1 percent.

Annual vehicle miles of travel (VMT) range from 63.6 billion in Michigan to 17.7 billion in Kansas for the year 1982/83 as shown in Table 2-16. Fifty percent or more of the travel accrued on the state highway systems in the respective states. The distributions of travel among the jurisdictional systems is very similar for Iowa and Kansas.

Daily vehicle miles of travel per road mile by jurisdictional system are shown in Table 2-17. As for total vehicle miles of travel, Iowa and Kansas show similar travel characteristics. Kansas has approximately 20,000 more miles of rural roads than Iowa, and less total VMT, which results in the lower daily VMT per road mile for the state and county systems.

TABLE 2-12

PUBLIC ROAD MILEAGE

STATE	State Highway System		County Roads		City Streets		TOTAL1/
	Miles	Percent	Miles	Percent	Miles	Percent	
Kansas	10,449	7.9	109,686	83.2	11,648	8.9	131,783
Michigan	9,476	8.1	88,835	75.6	19,107	16.3	117,418
Missouri	32,239	28.0	69,947	60.7	13,013	11.3	115,199
N. Carolina	76,307	85.5	NA		12,963	14.5	89,270
Iowa	10,105	9.0	89,687	80.0	12,260	11.0	112,052

1/ Does not include toll roads, state parks, forest roads, institutions.

TABLE 2-13

ROAD MILEAGE AND LAND AREA

STATE	Miles	Square Miles	Miles/Sq.Mile
Kansas	131,783	82,277	1.60
Michigan	117,418	58,527	2.01
Missouri	115,199	69,697	1.65
North Carolina	89,270	52,669	1.69
Iowa	112,052	56,669	1.98

TABLE 2-14

ROAD MILEAGE AND POPULATION

STATE	Miles	1980 Population (1,000)	Persons per Road Mile
Kansas	131,783	2,364	17.9
Michigan	117,418	9,262	78.9
Missouri	115,199	4,917	42.7
North Carolina	89,270	5,882	65.9
Iowa	112,052	2,914	26.0

TABLE 2-15

PAVED ROAD MILEAGE

State	Paved		Unpaved		Total	
	Miles	Percent	Miles	Percent	Miles	Percent
Kansas	32,777	24.9	99,006	75.1	131,783	100.0
Michigan	67,083	57.1	50,335	42.9	117,418	100.0
Missouri	51,810	45.0	63,389	55.0	115,199	100.0
North Carolina	68,986	77.3	20,284	22.7	89,270	100.0
Iowa	35,957	32.1	76,095	67.9	112,052	100.0

TABLE 2-16

1982/83 ANNUAL VEHICLE MILES OF TRAVEL (Billions)

State	State System		County		City		Total	
	VMT	Percent	VMT	Percent	VMT	Percent	VMT	Percent
Kansas	9.3	52.5	3.5	19.8	4.9	27.7	17.7	100.0
Michigan	31.8	50.0	19.7	31.0	12.1	19.0	63.6	100.0
Missouri	26.6	72.9	2.6	7.1	7.3	19.9	36.5	100.0
North Carolina	43.2	96.6	NA		1.5	3.4	44.7	100.0
Iowa	11.0	56.5	3.8	19.4	4.7	24.1	19.5	100.0

TABLE 2-17

DAILY VEHICLE MILES OF TRAVEL PER ROAD MILE

State	State System	County	City	Total
Kansas	2,438	87	1,153	368
Michigan	9,194	608	1,735	1,484
Missouri	2,261	102	1,537	868
North Carolina	1,551	NA	323	1,381
Iowa	2,982	115	1,044	474

CHAPTER THREE

ECONOMIC IMPACTS OF STANDARDS AND PRACTICES

INTRODUCTION

The first objective of the Request for Proposal for the study is:

- To evaluate the economic and other impacts associated with development of consistent and uniform design, maintenance and construction standards for use by public road agencies.

Standards and practices are fundamental to highway policy. The benefits to Iowa from following sound engineering and economical standards and guidelines in the highway sector can be very substantial.

In this Chapter, the findings and recommendations resulting from six engineering-economic analyses of key highway standards, guidelines and practices in Iowa are presented.

The Issues

In each of the analyses two basic questions are implicit:

1. What are the cost impacts of applying or not applying a uniform economical standard?

2. What is a uniform economical standard?

The search for more definitive answers to these two questions has been a continuing objective of highway policy makers for more than a half-century. Our approach to contributing to the achievement of this objective is to measure the direct economic costs related to alternative highway improvement and maintenance decisions taken under various circumstances.

Each of the analyses within our approach covers a decision-making topic. The topics are as follows:

1. Upgrading Gravel Roads

2. Resurfacing Paved Roads

3. Resurfacing Paved Roads with Improvements to Shoulders and Lane Widths

4. Rehabilitating Pavements with Improvements to Curvature and Grade

5. Maintaining Paved Road Surfaces

6. Maintaining Unpaved Road Surfaces

Background

The six analyses were performed using a computerized highway economic model called the Highway Design and Maintenance Standards Model, referred to as the HDM. The model was developed by the World Bank.

The economic results of the model are very straightforward. For any alternative specified by the user of the model, the model calculates the following direct economic costs for each year in the analysis period[1/]:

1. Capital/Construction Costs,
2. Road Maintenance Costs,
3. Vehicle Operating Costs,
4. Travel Time Costs,
5. Safety Costs (included as Exogenous Costs), and
6. Total Costs.

The above costs include most of the direct economic costs in the highway sector -- vehicle operating costs by far representing the greatest part. It is possible to include in the HDM other costs and benefits calculated outside the HDM such as those related to economic development, etc. Typically, these other costs and benefits are specific to an area or particular project. This specificity makes these other costs difficult to fairly and adequately include in a general policy analysis of standards and practices. Furthermore, many other less quantifiable service objectives such as distances to a paved road are not considered in the analysis. The foregoing and other factors should be considered in the specific application of standards to projects.

While standards and guidelines can be generally applied to help form policy, set highway needs and assess system alternatives, there is no place for their general and mechanistic application in engineering practice during design and construction. In these phases of highway development, standards and guidelines must guide actions which are taken under varying and specific circumstances and constraints. And, highway design and construction decisions must be tailored to meet specific project circumstances and a miriad of other technical, social and political factors and values.

Making policy as well as design and construction decisions with an understanding of the economics involved, can be valuable to decision makers at all levels. The following paragraphs illustrate our approach to this policy analysis and use of the HDM model.

The model can compare any two alternatives requested by the user. This comparison establishes the cost advantages or disadvantages of one alternative over another. For example:

1/ We chose 20 years for the analysis period.

- Figure 3.1 contains the economic results of doing nothing (except stop gap maintenance) to a highly deteriorated, 100-kilometer (62.14 mile) 2-lane road with 300 vehicles per day, substandard curves and grades and a 2 percent annual traffic increase. This would represent a very low investment cost by the government.

- Figure 3.2 contains the economic results of reconstructing the above road to current standards -- design guides employed by the Iowa DOT in their needs study.

- Figure 3.3 contains a comparison of the two above alternatives.

In the above example, the benefits (savings in costs) of the road reconstruction are substantial, even when future costs are discounted[2/] as much as 20 percent per year.

The example illustrates two important points:

1. There is a relationship between the investment in roads by Iowa's governments (construction and maintenance costs) and user costs (vehicle operating, travel time, and safety costs).

2. User costs, particularly vehicle operating costs, make up a substantial part of the total direct economic costs in the highway transport sector for the State of Iowa.

At a time when harsh economic and political realities are causing distress in other sectors of Iowa's econony, obviously it would be unwise to further burden the overall economy with inefficient highway transport. Focusing policy only on government investment costs and only on apparent efficiencies in this area, runs the risk of broader inefficiencies in the overall highway transport sector.

Presentation of the Results

The challenge of this analysis was to broaden the economic perspective and keep the results manageable. For all six analyses, 578 alternatives were developed similar to those described in Figures 3.1 and 3.2 and 480 economic comparisons were made similar to the comparison shown in Figure 3.3. These data are contained in the documentation presented to the Iowa Highway Research Board for this part of the study. The documentation includes:

1. Details of the modeling assumptions and the description of the model contained in the users manual;

2/ In making economic comparisons, it makes sense to discount costs. In discounting we are simply saying that a dollar spent now has more value than a dollar spent next year, the year after and so on.

FIGURE 3-1

ECONOMIC COSTS OF DOING NOTHING TO A HIGHLY DETERIORATED TWO-LANE ROAD
(300 Vehicles Per Day with Substandard Curves and Grades and 2 Percent Traffic Growth)

ECONOMIC COSTS OF ALTERNATIVE REPORT

IN MILLION DOLLARS

GROUP-ALT. GR04-AL02

COMPARISON 04 - ORIGINAL LENGTH 100.0 KM

YEAR	CAPITAL/ CONSTR. COSTS	ROAD MAINT. COSTS	EXISTING VEHICLE OPERATING COSTS	GENERATED VEHICLE OPERATING COSTS	EXISTING VEHICLE TRAVEL TIME COSTS	GENERATED VEHICLE TRAVEL TIME COSTS	NET EXOGENOUS COSTS	TOTAL ECONOMIC COSTS	TOTAL FOREIGN EXCHANGE COSTS
1985	0.0	0.084	6.587	0.0	0.413	0.0	0.0	7.084	0.0
1986	0.0	0.084	6.593	0.0	0.421	0.0	0.0	7.097	0.0
1987	0.0	0.071	6.591	0.0	0.428	0.0	0.0	7.090	0.0
1988	0.0	0.057	6.618	0.0	0.436	0.0	0.0	7.110	0.0
1989	0.0	0.050	6.687	0.0	0.444	0.0	0.0	7.181	0.0
1990	0.0	0.046	6.783	0.0	0.452	0.0	0.0	7.282	0.0
1991	0.0	0.045	6.896	0.0	0.461	0.0	0.0	7.402	0.0
1992	0.0	0.044	7.021	0.0	0.470	0.0	0.0	7.535	0.0
1993	0.0	0.044	7.153	0.0	0.480	0.0	0.0	7.677	0.0
1994	0.0	0.044	7.292	0.0	0.489	0.0	0.0	7.825	0.0
1995	0.0	0.044	7.435	0.0	0.499	0.0	0.0	7.978	0.0
1996	0.0	0.044	7.582	0.0	0.509	0.0	0.0	8.135	0.0
1997	0.0	0.044	7.733	0.0	0.519	0.0	0.0	8.297	0.0
1998	0.0	0.044	7.887	0.0	0.530	0.0	0.0	8.461	0.0
1999	0.0	0.045	8.045	0.0	0.540	0.0	0.0	8.630	0.0
2000	0.0	0.045	8.206	0.0	0.551	0.0	0.0	8.802	0.0
2001	0.0	0.045	8.370	0.0	0.562	0.0	0.0	8.978	0.0
2002	0.0	0.045	8.538	0.0	0.573	0.0	0.0	9.157	0.0
2003	0.0	0.045	8.709	0.0	0.585	0.0	0.0	9.339	0.0
2004	0.0	0.046	8.884	0.0	0.597	0.0	0.0	9.526	0.0
TOTAL COSTS/BENEFITS - UNDISCOUNTED:									
ECONOMIC:	0.0	1.015	149.610	0.0	9.961	0.0	0.0	160.586	
FOREIGN:	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
DISCOUNTED ECONOMIC COSTS AT :									
0.0 %	0.0	1.015	149.610	0.0	9.961	0.0	0.0	160.586	0.0
5.0 %	0.0	0.699	95.246	0.0	6.316	0.0	0.0	102.261	0.0
10.0 %	0.0	0.527	66.589	0.0	4.396	0.0	0.0	71.513	0.0
15.0 %	0.0	0.425	50.239	0.0	3.303	0.0	0.0	53.967	0.0
20.0 %	0.0	0.361	40.212	0.0	2.633	0.0	0.0	43.205	0.0

FIGURE 3-2

ECONOMIC COSTS OF RECONSTRUCTING THE TWO-LANE ROAD
(DESCRIBED IN FIGURE 3.1) TO CURRENT GUIDELINES

02/14/85 ANALYSIS 1 RUN 1 REPORT TYPE 6 : PAGE 76

ECONOMIC COSTS OF ALTERNATIVE REPORT

IN MILLION DOLLARS

GROUP-ALT. GR04-0802

COMPARISON 04 - ORIGINAL LENGTH 100.0 KM

YEAR	CAPITAL/ CONSTR. COSTS	ROAD MAINT. COSTS	EXISTING VEHICLE OPERATING COSTS	GENERATED VEHICLE OPERATING COSTS	EXISTING VEHICLE TRAVEL TIME COSTS	GENERATED VEHICLE TRAVEL TIME COSTS	NET EXOGENOUS COSTS	TOTAL ECONOMIC COSTS	TOTAL FOREIGN EXCHANGE COSTS
1985	8.861	0.084	6.587	0.0	0.413	0.0	-0.088	15.857	0.0
1986	0.0	0.037	4.374	0.0	0.380	0.0	-0.090	4.702	0.0
1987	0.0	0.039	4.462	0.0	0.388	0.0	-0.092	4.797	0.0
1988	0.0	0.040	4.551	0.0	0.395	0.0	-0.094	4.893	0.0
1989	0.0	0.040	4.642	0.0	0.403	0.0	-0.095	4.991	0.0
1990	0.0	0.041	4.735	0.0	0.411	0.0	-0.097	5.090	0.0
1991	0.0	0.041	4.830	0.0	0.420	0.0	-0.099	5.191	0.0
1992	0.0	0.041	4.927	0.0	0.428	0.0	-0.101	5.295	0.0
1993	0.0	0.704	5.025	0.0	0.437	0.0	-0.103	6.063	0.0
1994	0.0	0.037	5.126	0.0	0.445	0.0	-0.105	5.503	0.0
1995	0.0	0.039	5.228	0.0	0.454	0.0	-0.107	5.614	0.0
1996	0.0	0.040	5.333	0.0	0.464	0.0	-0.110	5.727	0.0
1997	0.0	3.582	5.440	0.0	0.473	0.0	-0.112	9.383	0.0
1998	0.0	0.035	5.548	0.0	0.482	0.0	-0.114	5.950	0.0
1999	0.0	0.035	5.659	0.0	0.492	0.0	-0.116	6.069	0.0
2000	0.0	0.035	5.772	0.0	0.501	0.0	-0.119	6.190	0.0
2001	0.0	0.035	5.888	0.0	0.511	0.0	-0.121	6.313	0.0
2002	0.0	0.036	6.005	0.0	0.522	0.0	-0.123	6.439	0.0
2003	0.0	0.036	6.125	0.0	0.532	0.0	-0.126	6.567	0.0
2004	0.0	0.036	6.248	0.0	0.543	0.0	-0.128	6.698	0.0
TOTAL COSTS/BENEFITS - UNDISCOUNTED:									
ECONOMIC:	8.861	5.012	106.506	0.0	9.094	0.0	-2.142	127.333	
FOREIGN:	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
DISCOUNTED ECONOMIC COSTS AT :									
0.0 %	8.861	5.012	106.506	0.0	9.094	0.0	-2.142	127.333	0.0
5.0 %	8.861	2.970	68.342	0.0	5.779	0.0	-1.357	84.594	0.0
10.0 %	8.861	1.846	48.245	0.0	4.032	0.0	-0.944	62.040	0.0
15.0 %	8.861	1.204	36.794	0.0	3.038	0.0	-0.709	49.188	0.0
20.0 %	8.861	0.824	29.783	0.0	2.428	0.0	-0.565	41.332	0.0

FIGURE 3-3

ECONOMIC COST DIFFERENCES BETWEEN THE RECONSTRUCTION ALTERNATIVE OF FIGURE 3.2 AND THE DO NOTHING OR BASE ALTERNATIVE OF FIGURE 3.1

02/14/85 ANALYSIS 3 RUN 1 REPORT TYPE 7 : PAGE 0

COMPARISON OF ALTERNATIVES REPORT : BJG1

IN MILLION DOLLARS

COMPARISON : GR04-GH02 VS GR04-AL02

GROUP GR04 : COMPARISON 04 - ORIGINAL LENGTH 100.0 KM

ECONOMIC BENEFIT/COST STREAMS OF ALTERNATIVE GH02 RELATIVE TO ALTERNATIVE AL02

YEAR	INCREASE IN CAPITAL/ CONSTRUCTION COSTS (1)	INCREASE IN ROAD MAINTENANCE COSTS (2)	SAVINGS IN EXISTING VEHICLE OPERATING COSTS (3)	GENERATED VEHICLE OPERATING BENEFITS (4)	SAVINGS IN EXISTING VEHICLE TRAVEL TIME COSTS (5)	GENERATED VEHICLE TRAVEL TIME BENEFITS (6)	NET EXOGENOUS BENEFITS (7)	TOTAL ECONOMIC BENEFITS (8=-1-2+3+4+5+6+7)	TOTAL FOREIGN EXCHANGE BENEFITS (9)
1985	8.861	0.0	0.0	0.0	0.0	0.0	0.088	-8.773	0.0
1986	0.0	-0.046	2.218	0.0	0.041	0.0	0.090	2.395	0.0
1987	0.0	-0.032	2.129	0.0	0.040	0.0	0.092	2.293	0.0
1988	0.0	-0.017	2.066	0.0	0.040	0.0	0.094	2.217	0.0
1989	0.0	-0.010	2.045	0.0	0.041	0.0	0.095	2.190	0.0
1990	0.0	-0.006	2.048	0.0	0.041	0.0	0.097	2.192	0.0
1991	0.0	-0.004	2.066	0.0	0.042	0.0	0.099	2.211	0.0
1992	0.0	-0.003	2.094	0.0	0.042	0.0	0.101	2.241	0.0
1993	0.0	0.660	2.126	0.0	0.043	0.0	0.103	1.614	0.0
1994	0.0	-0.007	2.166	0.0	0.044	0.0	0.105	2.322	0.0
1995	0.0	-0.005	2.206	0.0	0.045	0.0	0.107	2.364	0.0
1996	0.0	-0.004	2.249	0.0	0.046	0.0	0.110	2.409	0.0
1997	0.0	3.538	2.293	0.0	0.046	0.0	0.112	-1.087	0.0
1998	0.0	-0.009	2.340	0.0	0.048	0.0	0.114	2.511	0.0
1999	0.0	-0.009	2.386	0.0	0.049	0.0	0.116	2.561	0.0
2000	0.0	-0.009	2.434	0.0	0.050	0.0	0.119	2.612	0.0
2001	0.0	-0.009	2.483	0.0	0.051	0.0	0.121	2.664	0.0
2002	0.0	-0.010	2.533	0.0	0.052	0.0	0.123	2.718	0.0
2003	0.0	-0.010	2.584	0.0	0.053	0.0	0.126	2.772	0.0
2004	0.0	-0.010	2.636	0.0	0.054	0.0	0.128	2.828	0.0
TOTAL COSTS/BENEFITS - UNDISCOUNTED:									
ECONOMIC:	8.861	3.998	43.104	0.0	0.866	0.0	2.142	33.253	
FOREIGN:	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0
ECONOMIC BENEFITS DISCOUNTED AT:									
0.0 %	8.861	3.998	43.104	0.0	0.866	0.0	2.142	33.253	0.0
5.0 %	8.861	2.271	26.904	0.0	0.537	0.0	1.357	17.667	0.0
10.0 %	8.861	1.319	18.344	0.0	0.364	0.0	0.944	9.472	0.0
15.0 %	8.861	0.779	13.445	0.0	0.265	0.0	0.709	4.779	0.0
20.0 %	8.861	0.464	10.429	0.0	0.204	0.0	0.565	1.874	0.0

2. Detailed organized inputs and outputs for each analysis contained in separate bound volumes;

3. Tapes of the computer programs utilized for the analysis; and

4. Tapes of the input data.

The above deliverables will permit more in-depth analysis, new analyses and continued more refined and updated study in this area by Iowa's governments.

In the following sections we have grouped the end results of our 480 economic comparisons. For each economic comparison we have focused on two economic performance measures -- rate of return and net present value of benefits:

1. The rate of return (if calculated by the model) of an investment alternative compared to a base alternative within the same traffic group is presented. The base alternative is often referred to as the "null" or "do nothing" alternative. In our analyses the base or "do nothing" alternative represents the minimum practical investment -- typically stopgap maintenance. The rate of return indicates the annual percentage earned on the government investment alternative over the base or "do nothing" alternative. In principle, the concept of rate of return is similar for any investment be it in roads, savings, real estate, etc.; it is an annual percentage return on investment.

2. The net present values of the benefits resulting from the comparisons discounted at 0, 10 and 20 percent are also presented. This would respectively correspond to the 33.253, 9.472 and 1.874 million dollars shown in column 8 at the bottom of Figure 3.3. This represents the net benefit (+) or disbenefit (-) from pursuing an investment alternative over the base ("do nothing") alternative. The net present value can be compared to the bottom line in a financial report. It indicates how much money over a specified period of time will be gained or lost from pursuing a particular course of action or alternative.

The above data are arrayed in several figures in the following sections, permitting a manageable interpretation of the results and facilitating the recognition of patterns and the extension of results to Iowa's whole road network from the 100 kilometer sections.

The input data for the analyses are representative of typical values for road conditions and traffic volumes in Iowa. Sample data for improvement costs were derived from the "Quadrennial Need Study Report on Highways, Roads and Streets for Study years 1982-2001". Traffic volumes are first-year or existing traffic volumes. Vehicle operating costs were derived from Iowa vehicle characteristics and costs of motor vehicles, fuel, tires and related items from Iowa suppliers. Safety benefits were based on findings of NCHRP Report 197, "Cost and Safety Benefits of Highway Design Elements".

Each of the analyses is performed on a typical 100-kilometer (62.14 mile) section of two-lane road under free flow traffic conditions. For each comparison a figure is given which describes in the title: (1) the name of the analysis, (2) the conditions under which the analysis was performed, and (3) the base alternative used in the comparison. All data shown are unchanged -- they are exactly as generated by the model.

Furthermore, the results are economically conservative -- that is the calculated benefits and rates of return may be on the low side. This occurs because: (1) the estimate of existing structural integrity of Iowa's pavements is optimistic; most of Iowa's pavements have lower structural numbers as opposed to medium or higher ones used in the analysis and (2) as previously mentioned, only direct economic benefits are included in the analysis; economic development benefits and other indirect benefits outside of the road transport sector are not included. Nevertheless, in general the findings indicate that the right government investment in roads yields substantial direct benefits and are economically justified.

Summary of Findings and Conclusions

The results of the six analyses point to the following general findings and conclusions:

1. In general, preventive maintenance and capital replacement/reconstruction improvements, geared to protecting and restoring the existing highway infrastructure in accordance with current design standards and guidelines, are highly economically feasible. The deferment of the implementation of this type of improvement for whatever reasons can significantly increase costs in the highway transport sector in Iowa. Conversely, their timely implementation can produce significant benefits.

2. Timing in the upgrading of lower volume roads is critical. Premature paving of lower volume roads can result in significant economic loss. Conversely, upgrading roads with the appropriate levels of traffic can provide significant benefits.

3. Sound engineering standards and practices established and uniformly applied by public agencies within economic guidelines can produce significant benefits for Iowa -- greater benefits than the potential for improved efficiencies in government administration and operations.

The results summarized in the following sections of this chapter quantify a significant part of the benefits derived from the applications of uniform economical standards, guidelines and practices.

UPGRADING GRAVEL ROADS

This analysis is structured around the following two questions:

1. When is it economical to pave a gravel road?

2. What are the cost impacts of applying or not applying a uniform economical standard for paving?

In the analysis, two upgrading alternatives were tested against a base alternative -- keep the road gravel. The analysis was performed for a range of traffic volumes and growths, under flat and rolling terrain conditions.

Findings and Conclusions

The results are contained in Figure 3.4 and 3.5. Findings and conclusions are listed below.

1. Paving gravel roads between 300 and 400 vehicles per day results in rates of return near 15 percent, which is a reasonably good rate of return.

2. There is very little difference between the economic performance of asphalt concrete and portland cement concrete.

3. The design guides, and more economically conservative alternate design guides (see Figures 3.6 to 3.9), used by the State DOT in their needs studies correspond closely to the results of this analysis. They appear to be economically sound and not unreasonable for use by all jurisdictions.

4. Deviating from the application of uniform economical guidelines for upgrading gravel roads can have significant economic implications for Iowa. For example, prematurely paving 1000 miles of gravel roads having 100 vehicles per day traffic, would result in over a 100 million dollar economic loss to the state during a 20-year period (at a 10 percent discount rate). Similarly, not upgrading more highly traveled gravel roads would also result in substantial losses to the state of the same or greater order of magnitude.

Recommendations

Iowa has more than 70 thousand miles (112 thousand kilometers) of gravel roads. About ten percent of these have more than 100 vehicles per day traffic. Improvement decisions for needs on these roads should be closely monitored.

FIGURE 3-4

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Upgrading Gravel Roads to Paved Roads
CONDITIONS: Flat Terrain
BASE ALTERNATIVE: Maintain Gravel Road

TRAFFIC		DESCRIPTION OF ALTERNATIVE							
		CONSTRUCT ASPHALT CONCRETE SURFACE				CONSTRUCT PORTLAND CEMENT CONCRETE SURFACE			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	-4.4	-4.922	-8.879	-10.018	-5.2	-6.670	-10.778	-11.917
1	100	0.4	0.509	-6.560	-8.704	-0.8	-1.236	-8.458	-10.603
1	200	7.5	11.287	-1.939	-6.078	5.6	9.548	-3.835	-7.976
1	300	13.1	21.846	2.578	-1.197	10.7	20.114	0.685	-3.098
1	400	18.3	32.647	7.169	2.158	15.4	30.924	5.279	0.260
1	500	23.4	44.208	12.087	5.754	19.9	42.495	10.201	3.857
3	50	-3.0	-3.627	-8.483	-9.856	-3.9	-5.374	-10.383	-11.756
3	100	2.2	3.058	-5.774	-8.381	0.8	1.314	-7.672	-10.280
3	200	9.5	16.140	-0.452	-5.470	7.6	14.404	-2.348	-7.367
3	300	15.3	29.336	4.852	0.205	12.9	27.610	2.960	-1.695
3	400	20.7	43.384	10.430	4.168	17.7	41.670	8.543	2.271
3	500	26.0	58.211	16.343	8.378	22.5	56.511	14.461	6.484

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-5

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Upgrading Gravel Roads to Paved Roads
CONDITIONS: Rolling Terrain
BASE ALTERNATIVE: Maintain Gravel Road

TRAFFIC		DESCRIPTION OF ALTERNATIVE							
		CONSTRUCT ASPHALT CONCRETE SURFACE				CONSTRUCT PORTLAND CEMENT CONCRETE SURFACE			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	-3.3	-3.812	-8.410	-9.754	-4.2	-5.559	-10.310	-11.654
1	100	1.5	1.889	-5.975	-8.374	0.1	0.145	-7.873	-10.273
1	200	8.5	13.059	-1.184	-5.652	6.5	11.323	-3.079	-7.549
1	300	14.2	23.970	3.484	-3.002	11.7	22.245	1.593	-4.898
1	400	19.4	35.146	8.234	-0.321	16.4	33.435	6.347	-2.214
1	500	24.7	47.162	13.345	2.567	21.1	45.467	11.464	0.677
3	50	-2.0	-2.444	-7.992	-9.584	-3.0	-4.191	-9.891	-11.483
3	100	3.1	4.538	-5.158	-8.038	1.7	2.796	-7.056	-9.937
3	200	10.4	18.075	0.353	-5.023	8.4	16.343	-1.541	-6.919
3	300	16.3	31.725	5.838	-2.047	13.8	30.008	3.949	-3.942
3	400	21.8	46.315	11.624	1.054	18.7	44.618	9.742	-0.837
3	500	27.3	61.763	17.782	4.368	23.6	60.091	15.907	2.480

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

TABLE 5-C
DESIGN GUIDES
RURAL PRIMARY AND SECONDARY HIGHWAYS
1982-2001 NEEDS STUDY

	Freeway			Expressway/ Arterial			Arterial Connector/Trunk/Trunk Collector									Area Service								
Highway Group	1			2			3			4			5			6			7			8		
ADT (Design Year)	Over 0			Over 0			Over 1,500			400-1,500			Under 400			Over 100			26-100			0-25		
Design Standard #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Terrain[1]	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Design Speed	70	70	70	70	70	70	55	55	50	55	55	50	55	55	50	55	50	50	50	45	40	50	45	40
Max. Degree Curve	3	3	3	3	3	4	7	7	8	7	7	9	7	7	9	7	9	9	9	12	14	9	12	14
Max. Grade (%)	3	3	3	4	4	4	6	6	7	6	6	7	6	6	7	6	6	8	6	8	10	6	8	10
Stopping Sight	600	600	600	600	600	600	425	425	350	425	425	350	425	425	350	425	350	350	350	325	275	350	325	275
Lane Width[2]	12	12	12	12	12	12	12	12	12	12	12	12	11	11	11	11	11	11	11	11	11	11	11	11
Shoulder Width (Rt.)[3]	10	10	10	10	10	10	8	8	8	6	6	6	6	6	6	3	3	3	3	3	3	0	0	0
(Lft.)	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median Width[4]	64	64	64	64	64	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surface Type[5]	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	4	4	4
Pavement Sec.[6]	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	0	0	0	0	0	0
Shoulder Type[7]	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
Access Control[8]	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 - Terrain, 1=Flat, 2=Rolling, 3=Hilly.
2 - Actual number of lanes is computed based on the 1965 Highway Capacity Manual methods.
3 - Left shoulder applies only to divided highways. Left shoulder equals right shoulder width on two-lane highways.
4 - Median applied only when number of lanes required equals or exceeds four and divided highway justified.
5 - 1=Asphalt or portland cement concrete, 2=Surface treatment, 3=Gravel, 4=Earth.
6 - 0=No pavement, 1=Asphaltic or portland cement concrete, 2=Cold mix or road mix, 3=Seal coat, 4=Dust treatment.
7 - 1=Paved, 2=Stabilized, 3=Earth, 4=No shoulder.
8 - 1=Full control, 2=Partial control, 3=No control or local zoning.

FIGURE 3-6

TABLE 5-D
ALTERNATE DESIGN GUIDES
RURAL PRIMARY AND SECONDARY HIGHWAYS
1982-2001 NEEDS STUDY

	Freeway			Expressway/ Arterial			Arterial Connector/Trunk/Trunk Collector									Area Service								
Highway Group	1			2			3			4			5			6			7			8		
ADT (Design Year)	Over 0			Over 0			Over 1,500			400-1,500			Under 400			Over 100			26-100			0-25		
Design Standard #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Terrain[1]	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Design Speed	70	70	70	70	70	70	50	50	40	50	40	40	40	30	30	40	30	30	40	30	30	30	25	25
Max. Degree Curve	3.5	3.5	3.5	4	4	5	7	7	10	7	10	14	10	19	19	10	19	19	10	19	19	19	19	19
Max. Grade (%)	4	4	4	4	4	4	6	8	9	6	7	9	7	10	12	7	10	12	7	10	12	7	11	12
Stopping Sight	600	600	600	600	600	600	375	375	275	275	275	275	275	200	200	275	200	200	275	200	200	200	150	150
Lane Width[2]	12	12	12	12	12	12	12	12	12	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Shoulder Width (Rt.)[3]	10	10	10	10	10	10	8	8	8	6	6	6	3	3	3	2	2	2	2	2	2	0	0	0
(Lft.)	6	6	6	6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Median Width[4]	64	64	64	64	64	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surface Type[5]	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3	3	4	4	4
Pavement Sec.[6]	1	1	1	1	1	1	1	1	1	1	1	1	4	4	4	4	4	4	0	0	0	0	0	0
Shoulder Type[7]	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	4	4	4
Access Control[8]	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

1 - Terrain, 1=Flat, 2=Rolling, 3=Hilly.
2 - Actual number of lanes is computed based on the 1965 Highway Capacity Manual methods.
3 - Left shoulder applies only to divided highways. Left shoulder equals right shoulder width on two-lane highways.
4 - Median applied only when number of lanes required equals or exceeds four and divided highway justified.
5 - 1=Asphaltic or portland cement concrete, 2=Surface treatment, 3=Gravel, 4=Earth.
6 - 0=No pavement, 1=Asphaltic or portland Cement concrete, 2=Cold mix or road mix, 3=Seal coat, 4=Dust treatment.
7 - 1=Paved, 2=Stabilized, 3=Earth, 4=No shoulder.
8 - 1=Full control, 2=Partial control, 3=No control or local zoning.

FIGURE 3-7

TABLE 5-E
DESIGN GUIDES
MUNICIPAL EXTENSIONS, MUNICIPAL ARTERIALS, COLLECTORS AND SERVICE STREETS
1982-2001 NEEDS STUDY

	Freeways				Extensions of Expressways and Arterials				Extensions of Arterial Connectors, Trunks, Trunk Collectors and Municipal Arterials, Municipal Collectors and Municipal Service															
Highway Group	1		2		3		4		5		6		7		8		9		10		11		12	
ADT (Design Year)	Over 50,000		0 - 50,000		Over 25,000		0 - 25,000		Over 25,000		20,000 - 24,999		15,000 - 19,999		10,000 - 14,999		5,000 - 9,999		1,000 - 4,999		100 - 999		0 - 99	
Design Standard #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Type Development[1]	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5
Design Speed	70	70	70	70	70	70	70	70	45	55	45	55	45	55	45	55	40	50	40	50	30	40	30	30
Max. Degree Curve	3	3	3	3	3	3	3	4	4	4	4	5	4	5	4	5	4	5	4	5	6	12	6	19
Max. Grade	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	6	9	6	11
Stopping Sight Dist.	600	600	600	600	600	600	600	600	325	425	325	425	325	425	325	425	275	350	275	350	275	275	275	275
Lane Width (Travel)[2]	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	11	11
(Park)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	8	0	8	0	9	0
Shoulder Width (Rt)[3]	10	10	99	10	99	10	99	10	99	10	99	10	99	10	99	10	99	10	99	8	99	6	0	0
(Lft)	6	6	99	6	99	6	99	6	99	6	99	6	99	6	99	6	99	6	99	0	99	0	0	0
Median Width[4]	16	64	16	64	16	64	16	64	6	64	6	6	6	6	6	6	6	0	0	0	0	0	0	0
Surface Type[5]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2
Pavement Sec.[6]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3
Shoulder Type[7]	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	2	0	2	0	3	0	0
Access Control[8]	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3

1 - 1 = Central Business District, 2 = Fringe, 3 = Outlying Business District, 4 = Residential, 5 = Rural.
2 - Actual number of lanes is computed based on 1965 Highway Capacity Manual methods.
3 - 99 = Curbed section. The left shoulder width equals the right shoulder width on two-lane highways.
4 - Median width applies only when number of lanes required equals or exceeds four and divided highway is justified.
5 - 1 = Asphaltic or portland cement concrete, 2 = Surface treatment, 3 = Gravel, 4 = Earth.
6 - 0 = No pavement, 1 = Asphaltic or portland cement concrete, 2 = Cold mix or roadmix, 3 = Seal coat, 4 = Dust treatment.
7 - 0 = No shoulder, 1 = Paved, 2 = Stabilized, 3 = Earth.
8 - 1 = Full control, 2 = Partial control, 3 = No control or local zoning.

FIGURE 3-8

TABLE 5-F
ALTERNATE DESIGN GUIDES
MUNICIPAL EXTENSIONS, MUNICIPAL ARTERIALS, COLLECTORS AND SERVICE STREETS
1982-2001 NEEDS STUDY

	Freeways				Extensions of Expressways and Arterials				Extensions of Arterial Connectors, Trunks, Trunk Collectors and Municipal Arterials, Municipal Collectors and Municipal Service															
Highway Group	1		2		3		4		5		6		7		8		9		10		11		12	
ADT (Design Year)	Over 50,000		0 - 50,000		Over 25,000		0 - 25,000		Over 25,000		20,000 - 24,999		15,000 - 19,999		10,000 - 14,999		5,000 - 9,999		1,000 - 4,999		100 - 999		0 - 99	
Design Standard #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Type Development[1]	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5
Design Speed	70	70	70	70	60	60	60	60	35	45	35	45	35	45	35	45	35	45	30	40	25	35	25	35
Max. Degree Curve	3.5	3.5	3.5	3.5	4	6	5	6	19	8	19	9	19	10	19	11	19	12	19	12	19	19	19	19
Max. Grade	4	4	4	4	4	4	4	4	4	4	7	7	7	7	7	8	7	8	8	8	8	11	8	11
Stopping Sight Dist.	600	600	600	600	475	475	475	475	250	325	250	325	250	325	250	325	250	325	200	275	150	250	150	250
Lane Width (Travel)[2]	12	12	12	12	12	12	12	12	12	12	11	11	11	11	11	11	11	11	11	11	11	11	11	11
(Park)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	6	0	6	0	6	0
Shoulder Width (Rt)[3]	10	10	99	10	99	10	99	10	99	8	99	8	99	8	99	8	99	6	99	4	99	3	0	0
(Lft)	6	6	99	6	99	6	99	6	99	6	99	6	99	6	99	6	99	0	99	0	99	0	0	0
Median Width[4]	16	16	16	16	16	16	16	16	6	16	6	6	0	0	0	0	0	0	0	0	0	0	0	0
Surface Type[5]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	3
Pavement Sec.[6]	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	4	4
Shoulder Type[7]	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	2	0	2	0	3	0	0
Access Control[8]	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3

1 - 1 = Central Business District, 2 = Fringe, 3 = Outlying Business District, 4 = Residential, 5 = Rural.
2 - Actual number of lanes is computed based on 1965 Highway Capacity Manual methods.
3 - 99 = Curbed section. The left shoulder width equals the right shoulder width on two-lane highways.
4 - Median width applies only when number of lanes required equals or exceeds four and divided highway is justified.
5 - 1 = Asphaltic or portland cement concrete, 2 = Surface treatment, 3 = Gravel, 4 = Earth.
6 - 0 = No pavement, 1 = Asphaltic or portland cement concrete, 2 = Cold mix or roadmix, 3 = Seal coat, 4 = Dust treatment.
7 - 0 = No shoulder, 1 = Paved, 2 = Stabilized, 3 = Earth.
8 - 1 = Full control, 2 = Partial control, 3 = No control or local zoning.

FIGURE 3-10

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Resurfacing Paved Roads
CONDITIONS: Flat Terrain, Structural Number = 3.8, Pavement Requiring Resurfacing
BASE ALTERNATIVE: Maintain Surface Without Resurfacing

TRAFFIC		DESCRIPTION OF ALTERNATIVE															
		1.5 INCHES OVERLAY															
		Each 6 Years				Each 8 Years				Each 10 Years				Each 15 Years			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	-4.5	-1.075	-1.379	-1.135	5.4	1.372	0.402	-0.527	--	0.231	-0.318	-0.314	5.2	0.684	-0.143	-0.114
2	300	23.8	8.984	1.930	0.244	30.0	10.327	2.255	0.448	32.8	8.019	1.769	0.364	33.4	5.247	0.809	0.118
2	500	45.6	22.831	6.337	2.012	51.7	22.940	5.890	1.737	55.8	18.966	4.649	1.274	61.7	11.813	2.151	0.439
2	750	74.8	43.474	12.973	4.726	82.1	41.524	11.311	3.697	88.3	35.310	8.975	2.664	103.1	21.667	4.200	0.939
2	2000	228.6	175.216	54.360	21.311	254.0	161.295	45.699	15.958	281.0	40.155	36.573	11.477	--	87.533	17.871	4.268
2	5500	--	763.360	232.985	90.941	--	686.195	192.897	67.638	--	579.957	152.247	48.526	--	389.205	80.549	19.544

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-10 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Resurfacing Paved Roads
CONDITIONS: Flat Terrain, Structural Number = 3.8, Pavement Requiring Resurfacing
BASE ALTERNATIVE: Maintain Surface Without Resurfacing

TRAFFIC		DESCRIPTION OF ALTERNATIVE														
		3 INCHES OVERLAY														
		Each 6 Years				Each 8 Years				Each 10 Years				Each 15 Years			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	-36.0	-11.681	-5.929	-3.604	-14.9	-5.699	-3.329	-1.987	-88.0	-6.839	-2.603	-1.269	-12.8	-2.850	-1.167	-0.445
2	300	-3.2	-1.624	-2.618	-2.224	6.3	3.262	-0.670	-1.011	--	0.956	0.515	-0.591	6.5	1.718	-0.214	-0.212
2	500	14.9	11.279	1.384	-0.675	21.6	15.250	2.706	0.148	24.1	11.281	2.164	0.235	24.3	7.974	1.037	0.079
2	750	33.4	31.932	8.024	2.041	39.8	33.848	8.131	2.110	43.8	27.641	6.495	1.626	48.3	17.837	3.088	0.580
2	2000	115.4	163.742	49.438	18.637	128.8	153.891	42.595	14.396	142.4	134.371	34.460	10.524	181.0	83.739	16.763	3.909
2	5500	407.3	763.260	232.010	89.870	479.0	698.303	195.486	67.990	--	605.837	157.361	49.504	--	397.185	81.562	19.632

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-11

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Resurfacing Paved Roads
CONDITIONS: Flat Terrain, Structural Number = 3.8, Brand New Excellent Pavements
BASE ALTERNATIVE: Maintain Surface Without Resurfacing

TRAFFIC		DESCRIPTION OF ALTERNATIVE														
		1.5 INCHES OVERLAY														
		Each 6 Years				Each 8 Years				Each 10 Years				Each 15 Years			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	-87.0	-10.534	-4.523	-2.457	-69.6	-7.007	-2.907	-1.452	--	-7.018	-2.271	-0.950	-63.4	-3.502	-1.017	-0.329
2	300	-83.2	-10.451	-4.496	-2.445	-64.3	-6.935	-2.885	-1.444	--	-6.958	-2.254	-0.944	-58.2	-3.464	-1.009	-0.326
2	500	-68.3	-11.156	-4.841	-2.644	-48.3	-7.340	-3.094	-1.558	--	-7.381	-2.412	-1.017	-42.2	-3.605	-1.068	-0.349
2	750	-32.7	-8.947	-4.367	-2.519	-18.3	-5.155	-2.633	-1.440	-82.2	-5.224	-1.963	-0.905	-11.9	-1.606	-0.669	-0.255
2	2000	29.4	37.431	7.741	1.458	44.6	40.210	8.962	2.243	61.5	36.316	8.275	2.167	116.1	29.239	5.634	1.258
2	5500	252.2	440.698	120.911	42.090	389.0	407.619	106.918	34.996	--	345.387	87.814	27.135	--	260.688	53.705	12.967

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-11 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Resurfacing Paved Roads
CONDITIONS: Flat Terrain, Structural Number = 3.8, Brand New Excellent Pavements
BASE ALTERNATIVE: Maintain Surface Without Resurfacing

TRAFFIC		DESCRIPTION OF ALTERNATIVE															
		3 INCHES OVERLAY															
		Each 6 Years				Each 8 Years				Each 10 Years				Each 15 Years			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	-89.5	-21.147	-9.073	-4.926	-73.6	-14.078	-5.835	-2.912	--	-14.089	-4.556	-1.905	-66.8	-7.036	-2.041	-0.659
2	300	-86.8	-21.059	-9.044	-4.913	-69.1	-14.000	-5.811	-2.903	--	-14.021	-4.537	-1.899	-62.1	-6.994	-2.032	-0.657
2	500	-75.2	-22.708	-9.793	-5.331	-55.4	-15.030	-6.279	-3.146	--	-15.067	-4.898	-2.056	-48.6	-7.444	-2.181	-0.708
2	750	-49.6	-20.489	-9.316	-5.204	-30.2	-12.832	-5.813	-3.027	-91.6	-12.893	-4.443	-1.943	-24.2	-5.436	-1.780	-0.614
2	2000	14.9	25.957	2.819	-1.215	24.6	32.806	5.859	0.680	33.9	30.531	6.163	1.213	58.7	25.467	4.534	0.902
2	5500	137.3	440.598	119.936	41.019	202.7	419.727	109.506	35.349	276.1	371.267	92.927	28.113	495.0	268.668	54.719	13.055

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-12

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Resurfacing Paved Roads
CONDITIONS: Flat Terrain, Structural Number = 5.3, Brand New Excellent Pavements
BASE ALTERNATIVE: Maintain Surface Without Resurfacing

TRAFFIC		DESCRIPTION OF ALTERNATIVE														
		1.5 INCHES OVERLAY														
		Each 6 Years				Each 8 Years				Each 10 Years				Each 15 Years			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	--	-10.614	-4.551	-2.469	-84.1	-7.075	-2.929	-1.461	--	-7.076	-2.287	-0.956	-78.8	-3.537	-1.025	-0.331
2	300	-93.0	-10.609	-4.549	-2.469	-80.1	-7.071	-2.928	-1.461	--	-7.072	-2.286	-0.955	-74.2	-3.535	-1.024	-0.331
2	500	-91.0	-11.548	-4.954	-2.689	-76.2	-7.694	-3.187	-1.590	--	-7.697	-2.488	-1.040	-70.0	-3.845	-1.115	-0.360
2	750	-88.1	-11.525	-4.947	-2.686	-71.9	-7.673	-3.182	-1.588	--	-7.679	-2.484	-1.039	-65.4	-3.832	-1.112	-0.359
2	2000	-21.1	-8.098	-4.271	-2.525	-11.7	-4.270	-2.515	-1.432	-62.6	-4.308	-1.827	-0.887	-3.1	-0.503	-0.473	-0.215
2	5500	46.9	101.446	23.647	6.355	77.8	103.596	24.658	7.055	118.0	94.378	22.324	6.303	258.0	74.643	14.862	3.462

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-12 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Resurfacing Paved Roads
CONDITIONS: Flat Terrain, Structural Number = 5.3, Brand New Excellent Pavements
BASE ALTERNATIVE: Maintain Surface Without Resurfacing

TRAFFIC		DESCRIPTION OF ALTERNATIVE															
		3 INCHES OVERLAY															
		Each 6 Years				Each 8 Years				Each 10 Years				Each 15 Years			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	--	-21.231	-9.103	-4.939	-86.1	-14.153	-5.858	-2.921	--	-14.153	-4.574	-1.912	-80.8	-7.076	-2.050	-0.661
2	300	-94.1	-21.225	-9.101	-4.938	-82.4	-14.148	-5.857	-2.921	--	-14.149	-4.573	-1.911	-76.7	-7.073	-2.049	-0.661
2	500	-92.8	-23.114	-9.913	-5.379	-79.1	-15.404	-6.379	-3.181	--	-15.407	-4.980	-2.082	-73.1	-7.700	-2.231	-0.720
2	750	-90.4	-23.090	-9.906	-5.377	-75.4	-15.382	-6.373	-3.179	--	-15.388	-4.975	-2.080	-69.1	-7.686	-2.228	-0.719
2	2000	-38.1	-19.651	-9.226	-5.214	-22.7	-11.965	-5.702	-3.022	-85.0	-12.000	-4.315	-1.927	-16.5	-4.351	-1.588	-0.575
2	5500	30.4	89.988	18.722	3.677	47.4	96.590	21.653	5.521	67.4	91.605	20.790	5.478	134.0	70.844	13.756	3.104

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

2. The six-year resurfacing cycle also yielded the highest net present values for 3-inch overlays, but only for the 2,000 and 5,500 vehicle per day traffic groups.

3. The eight-year cycle of 3-inch overlay yielded the highest net present values for the 500 and 750 vehicles per day traffic groups.

4. The ten-year cycle of 3-inch overlay represented the net present value peak for the 300 vehicles per day traffic group.

5. Resurfacing roads with 150 vehicles per day is not economically viable and according to the upgrading analysis, roads in this traffic range should not be paved.

6. In general, resurfacing improvements result in very high rates of return and net present values of benefits, making them high priority, highly feasible improvements. Deferring resurfacing needs is a higher economic risk than slightly premature resurfacing.

The following findings are made comparing Figures 3.10 and 3.11.

7. A fixed resurfacing cycle for new pavements -- one which is not specifically responsive to actual pavement condition throughout a pavement's life -- is not an economically viable approach to formulating resurfacing policy or identifying resurfacing projects.

8. In general, timely resurfacing (one responsive to the actual physical condition of the pavement, particularly its roughness) can produce extremely significant savings for the state of Iowa.

Recommendations

The following recommendations apply to asphalt paved roads in general, particularly those having greater than 300 vehicles per day.

1. Highway funding schemes and program planning should place high priority on the timely identification and implementation of resurfacing projects. Funding should be adequate to cover resurfacing needs.

2. The identification and effective engineering analysis required for resurfacing projects should be based on adequate up-to-date pavement condition information and documented pavement improvement technical performance. The public agencies should consider establishing a pavement maintenance approach -- popularly referred to as pavement management -- oriented toward making decisions related to the formulation of policy for pavement maintenance, resurfacing and rehabilitation. In light of the significant economic benefits derived from immediately executing and not deferring needed resurfacing projects on roads covering a broad range of traffic flows, the initial system need not be complex. The initial effort can be oriented towards identifying resurfacing projects based on current physical condition. The use of optimization to refine alternatives could be accomplished in a subsequent phase and it is not as critical. The initial thrust should be towards project identification and immediate implementation of needed resurfacing.

RESURFACING PAVED ROADS WITH IMPROVEMENTS TO SHOULDERS AND LANE WIDTHS

This analysis was set up to answer the following two questions:

1. Under what circumstances is it economical to resurface, minor widen pavement lanes[1/] and/or improve the shoulders[2/] of a road?

2. What are the cost impacts of following or not following economic practices regarding the above improvements?

Three resurfacing alternatives with variations of minor pavement widening and shoulder improvements were compared against a base alternative of maintenance without resurfacing for surfaces currently in fair condition.

Findings and Conclusions

The results of this analysis are contained in Figure 3.13. Findings and conclusions follow.

1. Minor pavement widening and shoulder repair to current design guides combined with resurfacing result in an overall highly feasible improvement project for roads having more than 300 vehicles per day traffic.

2. In general, the additions of the minor pavement widening and shoulder improvements, in accordance with current design guides, to resurfacing projects reduce the rate of return. However, the reductions do not make the overall improvement infeasible. This is due primarily to the safety benefits of the minor pavement widening and shoulder improvement additions.

3. Delays in implementing this type of improvement for whatever reasons -- lack of funding, restrictions on funding or non-responsive project identification -- significantly increase costs in the highway transport sector.

Recommendations

There are more than 20 thousand miles of paved roads with greater than 300 vehicles per day traffic. The above mentioned improvements to these roads, when physically required, can have a significant economic benefit.

1. When possible and necessary, minor pavement widening and shoulder improvements in accordance with current design guides (Figures 3.6 to 3.9) should be combined with resurfacing projects on roads with greater than 300 vehicles per day traffic in Iowa's highway programs.

2. Funding for capital improvement and maintenance programs should be responsive to the need for this type of project in light of its high rate of return.

1/ Minor widening means increasing the width of traffic lanes to standards, but not the number of traffic lanes.

2/ Shoulder improvements include widening shoulders to standards widths and/or upgrading shoulders to standard surface types.

FIGURE 3-13

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Resurfacing Paved Roads with Shoulder Improvements and/or Minor Widening
CONDITIONS: Flat Terrain, Structural Number = 3.8 for 150 ADT and 300 ADT, Structural Number = 5.3 for 500 to 5500 ADT
BASE ALTERNATIVE: Maintain Without Resurfacing

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		OVERLAY WITH MINOR WIDENING				OVERLAY WITH SHOULDER IMPROVEMENT				OVERLAY WITH MINOR WIDENING AND SHOULDER IMPROVEMENT			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	7.2	2.454	-0.520	-1.710	6.6	2.697	-0.770	-2.111	1.1	0.617	-2.802	-4.101
2	300	25.8	6.643	2.625	0.757	23.1	7.243	2.532	0.451	10.6	4.868	0.048	-2.031
2	500	42.3	11.900	6.257	3.427	35.0	12.509	5.863	2.729	23.3	10.535	3.848	0.728
2	750	67.2	19.018	11.595	7.612	57.5	20.222	11.463	7.070	41.9	18.356	9.495	5.098
2	2000	184.5	54.954	38.520	28.705	148.0	58.495	39.003	28.241	107.9	56.485	36.526	25.654
2	5500	--	152.327	112.515	87.822	436.7	164.196	116.671	89.555	318.2	163.700	114.861	87.367

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

REHABILITATING PAVEMENTS WITH IMPROVEMENTS TO CURVATURE AND GRADE

The issues addressed within this analysis are as follows:

1. Under what conditions is it economical to improve only the base and surface or reconstruct a highway to improved geometric standards and guidelines?

2. What are the cost impacts of pursuing or not pursuing economical policies in these areas?

To economically quantify these issues, two improvement alternatives were compared to a base alternative of stopgap maintenance only. The two improvement alternatives were:

1. reconstruct the pavement -- base and surface only, and

2. reconstruct the pavement and the alignment to geometric guidelines (See Figures 3.6 to 3.9)

These alternatives were tested over a range of traffic flows on three links with varying alignments, each link requiring pavement rehabilitation.

Findings and Conclusions

The findings based on the results of the analysis contained in Figure 3.14 are as follows:

1. Reconstruction of pavements and alignments to design guidelines are highly feasible improvement projects for existing traffic flows over 300 vehicles per day.

2. As with the addition of minor pavement widening and shoulder improvements in the previous analysis, the addition of alignment reconstruction (in accordance with current guidelines) to pavement reconstruction lowers the rate of return for the overall combined project. However, the reductions do not make the combined project infeasible. The safety benefits derived from the elimination of non-standard curves and grades, although not as cost-effective as pavement reconstruction, do contribute to the high feasibility of the overall improvement.

3. The current design guidelines for alignment are economically sound and make sense from a public safety viewpoint.

4. Deferring required pavement rehabilitation on roads with greater than 300 vehicles per day for whatever reasons, results in significant economic loss to Iowa. Losses get significantly worse proportional to the time of deferment, the volume of traffic and the condition of the road.

FIGURE 3-14

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Rehabilitating Pavements With and Without Improvements to Curvature and Grade
CONDITIONS: Structural Number = 3.8 for 150 and 300 ADT; Structural Number = 4.5 for 500 and 750 ADT; Structural Number = 5.3 for 2000 and 5500 ADT
BASE ALTERNATIVE: Maintain Only

TRAFFIC		DESCRIPTION OF ALTERNATIVE													
		Curvature 8°, Grade 4%								Curvature 10°, Grade 6%					
		Base and Surface Only				B & S Plus Geometry to Standards				Base and Surface Only				B & S Plus Geometry to Standards			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	14.6	10.198	1.588	-1.169	9.5	10.394	-0.268	-3.677	17.7	12.969	2.746	-0.523	11.6	13.165	0.889	-3.031
2	300	34.9	29.670	9.892	3.561	24.8	33.253	9.472	1.874	39.7	35.005	12.120	4.804	27.9	38.587	11.700	3.117
2	500	30.0	50.143	15.737	4.731	19.2	53.526	12.451	-0.669	34.2	59.032	19.450	6.802	21.7	62.415	16.163	1.402
2	750	46.3	83.309	29.862	12.770	30.3	92.583	29.074	8.793	52.3	96.752	35.477	15.902	33.7	106.025	34.688	11.925
2	2000	95.2	247.387	97.833	49.802	53.8	275.744	101.219	45.517	106.9	282.967	112.692	58.090	59.6	311.324	116.077	53.805
2	5500	269.5	635.251	278.530	158.121	156.3	813.869	330.259	176.439	301.3	733.296	319.469	180.954	172.6	911.913	371.197	199.272

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-14 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Rehabilitating Pavements With and Without Improvements to Curvature and Grade
CONDITIONS: Structural Number = 3.8 for 150 and 300 ADT; Structural Number = 4.5 for 500 and 750 ADT; Structural Number = 5.3 for 2000 and 5500 ADT
BASE ALTERNATIVE: Maintain Only

TRAFFIC		DESCRIPTION ALTERNATIVE							
		Curvature 12°, Grade 8%							
		Base and Surface Only				B & S Plus Geometry to Standards			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	21.8	16.977	4.420	0.410	14.3	17.173	2.563	-2.097
2	300	46.5	42.727	15.345	6.604	32.3	46.309	14.926	4.916
2	500	40.0	71.901	24.824	9.801	25.1	75.284	21.538	4.400
2	750	60.9	116.209	43.603	20.435	38.7	125.482	42.814	16.458
2	2000	123.8	334.474	134.202	70.088	68.0	362.831	137.588	65.803
2	5500	347.1	875.234	378.736	214.009	196.1	1053.851	430.465	232.327

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

Recommendations

The timely maintenance and reconstruction of the highway infrastructure undoubtedly pays high returns within the transport sector of Iowa's economy.

1. When possible and necessary, geometric improvements should be combined with pavement reconstruction on roads with greater than 300 vehicles per day traffic in Iowa's highway programs.

2. Funding for capital improvement and maintenance programs should be responsive to the need for reconstruction projects in light of their high rates of return.

MAINTAINING PAVED ROAD SURFACES

The economics of pavement rehabilitation and resurfacing were explored in previous analyses. In this analysis, various asphalt sealing frequencies are compared against a base alternative of minimum patching for surface treated and asphalt paved roads (structural numbers equal to 3.8 and 5.4) over a 20-year period. Seal treatments used for this analysis consist of a single bituminous and chip seal coat on the pavement surface.

Findings and Conclusions

The results of this analysis are presented in Figures 3.15, 3.16 and 3.17 and the findings and conclusions are listed below.

1. Sealing frequencies for surface treated roads with 400 and less vehicles per day traffic flow exhibit no peaks in the net present values (which are relatively small for a 20-year analysis period) over the range of frequencies studied.

2. The 500 vehicles per day traffic group for surface treatment exhibits a net present value peak for a five-year sealing cycle (at 10 percent discount rate).

3. On asphalt paved roads, net present values (at 10 and 20 percent) peak at sealing frequencies between two and four years for traffic flows greater than 750 vehicles per day.

4. On asphalt paved roads, net present values (at 10 percent) peak at sealing frequencies between six and eight years for 300 and 500 vehicles per day traffic flow.

5. In general, sealing is a low-cost, low economic risk maintenance action. However, for higher volume (greater than 750 vehicles per day) asphalt paved roads it yields very high rates of return and reasonably high net present values.

Recommendation

Sealing asphalt paved roads serves a physical need in the maintenance of the pavement -- to seal the pavement from water penetration, help prevent surface deterioration and loss of surface aggregate, and provide a skid resistant surface for motorists. Sealing is a preventive maintenance action which helps prolong the life of asphalt pavements and their corresponding need for resurfacing and reconstruction.

1. The need for sealing should be identified through current pavement information specifically established by public agencies for this purpose -- as part of a pavement management system. The system must be very responsive to decision making from the identification of needs through implementation of works, because beyond a certain level of pavement deterioration sealing is physically not practical or feasible.

FIGURE 3-15

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Paved Road Surfaces
CONDITIONS: Surface Treated with Structural Number = 2.5
BASE ALTERNATIVE: Minimum Asphalt Patching and Routine Maintenance

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		Responsive Asphalt Patching and Routine Maintenance Plus										
		No Seal				Seal Each 2 Years				Seal Each 3 Years		
		Rate of Return	Net Present Value			Rate of Return	Net Present Value			Rate of Return	Net Present Value		
% ANNUAL GROWTH	FIRST YEAR ADT		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%
1	50	--	0	0	0	--	-6.020	-2.731	-1.649	-74.1	-3.512	-1.644	-0.976
1	100	--	-0.299	-0.127	-0.074	--	-5.559	-2.579	-1.584	-64.3	-3.241	-1.571	-0.957
1	200	--	-0.990	-0.464	-0.289	--	-4.594	-2.328	-1.518	-35.1	-2.646	-1.477	-0.979
1	300	--	-0.990	-0.464	-0.289	--	-2.937	-1.803	-1.296	-9.8	-1.289	-1.065	-0.815
1	400	--	-0.990	-0.464	-0.289	--	-0.946	-1.181	-1.039	1.9	0.339	-0.578	-0.624
1	500	--	-0.990	-0.464	-0.289	5.5	1.370	-0.466	-0.747	9.8	2.228	-0.018	-0.407

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-15 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Paved Road Surfaces
CONDITIONS: Surface Treated with Structural Number = 2.5
BASE ALTERNATIVE: Minimum Asphalt Patching and Routine Maintenance

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		Responsive Asphalt Patching and Routine Maintenance Plus											
		Seal Each 4 Years				Seal Each 5 Years				Seal Each 6 Years			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%
1	50	--	-2.928	-1.211	-0.667	--	-2.331	-0.916	-0.479	-77.7	-1.722	-0.694	-0.354
1	100	--	-2.754	-1.182	-0.672	--	-2.240	-0.920	-0.502	-71.6	-1.696	-0.721	-0.388
1	200	--	-2.388	-1.183	-0.746	--	-2.055	-0.988	-0.609	-47.6	-1.640	-0.838	-0.519
1	300	--	-1.275	-0.855	-0.621	--	-1.123	-0.721	-0.511	-11.6	-0.824	-0.613	-0.440
1	400	--	0.058	-0.466	-0.474	--	-0.009	-0.404	-0.396	1.5	0.156	-0.345	-0.347
1	500	--	1.602	-0.019	-0.307	--	1.281	-0.039	-0.263	9.3	1.295	-0.035	-0.239

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-16

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Paved Road Surfaces
CONDITIONS: Asphalt Concrete with Structural Number = 3.8
BASE ALTERNATIVE: Minimum Asphalt Patching and Routine Maintenance

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		Responsive Asphalt Patching and Routine Maintenance Plus										
		No Seal				Seal Each 2 Years				Seal Each 4 Years		
		Rate of Return	Net Present Value			Rate of Return	Net Present Value			Rate of Return	Net Present Value		
% ANNUAL GROWTH	FIRST YEAR ADT		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%
2	150	--	0	0	0	--	-4.584	-2.268	-1.455	--	-1.891	-0.905	-0.551
2	300	--	0	0	0	--	-2.028	-1.429	-1.089	--	-0.129	-0.377	-0.346
2	500	--	0	0	0	6.6	1.635	-0.337	-0.672	--	2.506	0.364	-0.083
2	750	--	0	0	0	23.0	8.331	1.746	0.190	34.1	7.111	1.696	0.417
2	2000	3.8	0.233	-0.115	-0.119	89.1	60.417	17.315	6.342	92.6	42.497	11.632	4.005
2	5500	43.5	22.214	5.172	1.367	296.5	352.365	102.688	39.275	178.7	171.203	51.191	19.662

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-16

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Paved Road Surfaces
CONDITIONS: Asphalt Concrete with Structural Number = 3.8
BASE ALTERNATIVE: Minimum Asphalt Patching and Routine Maintenance

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		Responsive Asphalt Patching and Routine Maintenance Plus										
		No Seal				Seal Each 2 Years				Seal Each 4 Years		
		Rate of Return	Net Present Value			Rate of Return	Net Present Value			Rate of Return	Net Present Value		
% ANNUAL GROWTH	FIRST YEAR ADT		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%
2	150	--	0	0	0	--	-4.584	-2.268	-1.455	--	-1.891	-0.905	-0.551
2	300	--	0	0	0	--	-2.028	-1.429	-1.089	--	-0.129	-0.377	-0.346
2	500	--	0	0	0	6.6	1.635	-0.337	-0.672	--	2.506	0.364	-0.083
2	750	--	0	0	0	23.0	8.331	1.746	0.190	34.1	7.111	1.696	0.417
2	2000	3.8	0.233	-0.115	-0.119	89.1	60.417	17.315	6.342	92.6	42.497	11.632	4.005
2	5500	43.5	22.214	5.172	1.367	296.5	352.365	102.688	39.275	178.7	171.203	51.191	19.662

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-18

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Flat Terrain
BASE ALTERNATIVE: Routine Maintenance Plus Blading Each 180 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		ROUTINE MAINTENANCE PLUS BLADING:											
		Each 120 Days				Each 90 Days				Each 60 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%	Rate of Return	Net Present Value @ 0%	@ 10%	@
1	25	--	0.198	0.088	0.053	--	2.320	1.052	0.642	--	2.390	1.081	0.658
1	50	--	0.738	0.329	0.199	--	5.705	2.586	1.578	--	6.162	2.788	1.698

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-18 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Flat Terrain
BASE ALTERNATIVE: Routine Maintenance Plus Blading Each 180 Days

TRAFFIC		DESCRIPTION ALTERNATIVE							
		ROUTINE MAINTENANCE PLUS BLADING:							
		Each 30 Days				Each 15 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	25	--	2.307	1.039	0.631	--	1.916	0.854	0.515
1	50	--	6.485	2.925	1.779	--	6.303	2.833	1.718
1	100	--	16.650	7.467	4.522	--	17.195	7.697	4.654

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-19

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Rolling Terrain
BASE ALTERNATIVE: Routine Maintenance plus Blading Each 180 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		ROUTINE MAINTENANCE PLUS BLADING:											
		Each 120 Days				Each 90 Days				Each 60 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	25	--	0.208	0.093	0.056	--	2.517	1.141	0.696	--	2.592	1.173	0.714
1	50	--	0.779	0.347	0.209	--	6.213	2.816	1.718	--	6.694	3.029	1.845
1	100	--	3.364	1.466	0.869	--	14.387	6.479	3.935	--	16.208	7.286	4.420

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-18

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Flat Terrain
BASE ALTERNATIVE: Routine Maintenance Plus Blading Each 180 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		ROUTINE MAINTENANCE PLUS BLADING:											
		Each 120 Days				Each 90 Days				Each 60 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%	Rate of Return	Net Present Value @ 0%	@ 10%	@
1	25	--	0.198	0.088	0.053	--	2.320	1.052	0.642	--	2.390	1.081	0.658
1	50	--	0.738	0.329	0.199	--	5.705	2.586	1.578	--	6.162	2.788	1.698

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-18 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Flat Terrain
BASE ALTERNATIVE: Routine Maintenance Plus Blading Each 180 Days

TRAFFIC		DESCRIPTION ALTERNATIVE							
		ROUTINE MAINTENANCE PLUS BLADING:							
		Each 30 Days				Each 15 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	25	--	2.307	1.039	0.631	--	1.916	0.854	0.515
1	50	--	6.485	2.925	1.779	--	6.303	2.833	1.718
1	100	--	16.650	7.467	4.522	--	17.195	7.697	4.654

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-19

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Rolling Terrain
BASE ALTERNATIVE: Routine Maintenance plus Blading Each 180 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		ROUTINE MAINTENANCE PLUS BLADING:											
		Each 120 Days				Each 90 Days				Each 60 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	25	--	0.208	0.093	0.056	--	2.517	1.141	0.696	--	2.592	1.173	0.714
1	50	--	0.779	0.347	0.209	--	6.213	2.816	1.718	--	6.694	3.029	1.845
1	100	--	3.364	1.466	0.869	--	14.387	6.479	3.935	--	16.208	7.286	4.420

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-19 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Rolling Terrain
BASE ALTERNATIVE: Routine Maintenance plus Blading Each 180 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE							
		ROUTINE MAINTENANCE PLUS BLADING:							
		Each 30 Days				Each 15 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	25	--	2.515	1.133	0.688	--	2.127	0.950	0.573
1	50	--	7.041	3.177	1.932	--	6.870	3.090	1.874
1	100	--	17.999	8.075	4.891	--	18.589	8.324	5.035

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-20

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Flat Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		NO REGRAVELLING WITH BLADING:										
		Each 30 Days				Each 15 Days				Each 7 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	68.0	0.344	0.068	0.016	5.3	0.190	-0.057	-0.077	-11.6	-0.706	-0.507	-0.366
1	100	--	3.022	0.772	0.273	--	3.988	0.954	0.298	24.0	3.764	0.686	0.077
1	200	--	17.157	4.782	1.736	--	24.818	6.872	2.467	--	27.595	7.485	2.585
1	400	--	22.055	7.987	3.776	--	63.765	21.021	8.966	--	83.274	27.011	11.289

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-20 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Flat Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		REGRAVELLING EACH 4 YEARS WITH BLADING:										
		Each 30 Days				Each 15 Days				Each 7 Days		
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	-13.3	-0.742	-0.475	-0.313	-18.5	-1.076	-0.634	-0.414	-40.1	-2.074	-1.103	-0.707
1	100	--	3.461	0.505	-0.027	--	3.371	0.455	-0.062	10.6	2.506	0.045	-0.320
1	200	--	28.005	7.185	2.229	--	28.753	7.506	2.418	--	28.349	7.301	2.283
1	400	--	90.058	28.016	10.938	--	93.652	29.602	11.887	--	94.901	30.129	12.191

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-20 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Flat Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		REGRAVELLING EACH 2 YEARS WITH BLADING:										
		Each 30 Days				Each 15 Days				Each 7 Days		
		Rate of Return	Net Present Value			Rate of Return	Net Present Value			Rate of Return	Net Present Value		
% ANNUAL GROWTH	FIRST YEAR ADT		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%
1	50	-11.0	-0.742	-0.526	-0.370	-15.2	-1.076	-0.685	-0.471	-29.8	-2.074	-1.154	-0.764
1	100	16.5	3.461	0.440	-0.099	15.5	3.371	0.390	-0.134	9.8	2.506	-0.020	-0.392
1	200	71.9	28.005	7.100	2.136	--	28.753	7.421	2.324	80.9	28.349	7.216	2.189
1	400	--	90.058	27.895	10.804	--	93.652	29.481	11.754	--	94.901	30.008	12.058

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-16 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Paved Road Surfaces
CONDITIONS: Asphalt Concrete with Structural Number = 3.8
BASE ALTERNATIVE: Minimum Asphalt Patching and Routine Maintenance

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		Responsive Asphalt Patching and Routine Maintenance Plus										
		Seal Each 6 Years				Seal Each 8 Years				Seal Each 10 Years		
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	-33.2	-0.958	-0.485	-0.282	-15.4	-0.557	-0.297	-0.162	--	-0.801	-0.255	-0.108
2	300	4.8	0.331	-0.126	-0.155	7.5	0.417	-0.043	-0.080	--	-0.136	-0.085	-0.056
2	500	21.3	2.322	0.399	0.018	24.5	1.954	0.340	0.038	--	0.869	0.167	0.019
2	750	40.6	5.756	1.329	0.340	46.4	4.599	1.016	0.254	--	2.657	0.623	0.159
2	2000	76.3	32.247	8.307	2.653	61.4	25.069	6.103	1.798	50.3	16.144	3.972	1.119
2	5500	114.9	122.777	34.750	12.428	43.5	22.214	5.172	1.367	43.5	22.214	5.172	1.367

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-17

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Paved Road Surfaces
CONDITIONS: Asphalt Concrete with Structural Number = 5.4
BASE ALTERNATIVE: Minimum Asphalt Patching and Routine Maintenance

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		Responsive Asphalt Patching and Routine Maintenance Plus										
		No Seal				Seal Each 2 Years				Seal Each 4 Years		
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	--	0	0	0	--	-4.838	-2.347	-1.489	--	-2.063	-0.955	-0.571
2	300	--	0	0	0	--	-2.867	-1.679	-1.190	--	-0.703	-0.539	-0.407
2	500	--	0	0	0	--	-0.556	-0.975	-0.920	--	1.006	-0.053	-0.234
2	750	--	0	0	0	13.5	3.527	0.365	-0.338	23.6	3.819	0.788	0.092
2	2000	--	0	0	0	65.4	30.190	8.795	3.200	82.2	22.134	6.136	2.115
2	5500	--	0	0	0	229.2	160.112	47.891	18.783	298.3	110.673	31.210	11.301

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-17 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Paved Road Surfaces
CONDITIONS: Asphalt Concrete with Structural Number = 5.4
BASE ALTERNATIVE: Minimum Asphalt Patching and Routine Maintenance

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		Responsive Asphalt Patching and Routine Maintenance Plus										
		Seal Each 6 Years				Seal Each 8 Years				Seal Each 10 Years			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
2	150	-42.1	-1.090	-0.521	-0.295	-19.8	-0.662	-0.324	-0.171	--	-0.877	-0.275	-0.114
2	300	-1.9	-0.110	-0.244	-0.196	1.4	0.065	-0.133	-0.108	--	-0.382	-0.148	-0.075
2	500	13.1	1.164	0.093	-0.085	15.2	1.031	0.107	-0.036	--	0.235	0.005	-0.031
2	750	27.9	3.215	0.663	0.116	30.8	2.574	0.508	0.094	--	1.280	0.273	0.051
2	2000	94.4	16.745	4.352	1.396	107.1	12.903	3.161	0.943	121.0	8.227	2.048	0.596
2	5500	372.0	83.172	22.070	7.414	453.0	64.457	16.211	5.068	--	42.569	10.828	3.289

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

MAINTAINING UNPAVED ROAD SURFACES

The primary issues facing unpaved road maintenance are expressed below:

1. For earth roads: What is an economical blading frequency?

2. For gravel roads: What are economical regravelling and blading frequencies?

3. What are the cost impacts of following or not following economical unpaved road maintenance practices?

Five alternative blading frequencies varying from 120 days to 15 days were tested against a base alternative blading frequency of 180 days for earth roads. Three blading frequencies 30, 15 and 7 days were tested within four regravelling frequencies, no regravelling and regravelling each 1, 2 and 4 years for a total of twelve alternatives on gravel roads. These twelve alternatives were tested against a base alternative of no regravelling and blading each 60 days.

Findings and Conclusions

The results of the analysis for earth roads are contained in Figure 3.18 for flat terrain and Figure 3.19 for rolling terrain. The findings for earth roads are given below.

1. For 50 vehicles per day traffic, a peak net present value exists near a 30-day blading frequency.

2. For 25 vehicles per day traffic flow a peak net present value exists for a 60-day blading frequency.

3. The risk of not applying an economical blading frequency gets greater as the traffic flow increases. Neglecting the blading of earth roads with greater than 50 vehicles per day can produce significant losses. However, the risks of over blading are not nearly as marked -- they are small.

The results of the analysis for gravel roads are shown in Figure 3.20 for flat terrain and Figure 3.21 for rolling terrain. The findings for gravel roads are given below.

4. The regravelling frequencies to maintain a fixed gravel depth for roads with greater than 200 vehicles per day showed very little economic differences for the frequencies studied. All frequencies for regravelling showed a marked economic benefit over not regravelling for this traffic group.

FIGURE 3-18

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Flat Terrain
BASE ALTERNATIVE: Routine Maintenance Plus Blading Each 180 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		ROUTINE MAINTENANCE PLUS BLADING:											
		Each 120 Days				Each 90 Days				Each 60 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%	Rate of Return	Net Present Value @ 0%	@ 10%	@ 20%	Rate of Return	Net Present Value @ 0%	@ 10%	@
1	25	--	0.198	0.088	0.053	--	2.320	1.052	0.642	--	2.390	1.081	0.658
1	50	--	0.738	0.329	0.199	--	5.705	2.586	1.578	--	6.162	2.788	1.698

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-18 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Flat Terrain
BASE ALTERNATIVE: Routine Maintenance Plus Blading Each 180 Days

TRAFFIC		DESCRIPTION ALTERNATIVE							
		ROUTINE MAINTENANCE PLUS BLADING:							
		Each 30 Days				Each 15 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	25	--	2.307	1.039	0.631	--	1.916	0.854	0.515
1	50	--	6.485	2.925	1.779	--	6.303	2.833	1.718
1	100	--	16.650	7.467	4.522	--	17.195	7.697	4.654

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-19

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Rolling Terrain
BASE ALTERNATIVE: Routine Maintenance plus Blading Each 180 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		ROUTINE MAINTENANCE PLUS BLADING:											
		Each 120 Days				Each 90 Days				Each 60 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	25	--	0.208	0.093	0.056	--	2.517	1.141	0.696	--	2.592	1.173	0.714
1	50	--	0.779	0.347	0.209	--	6.213	2.816	1.718	--	6.694	3.029	1.845
1	100	--	3.364	1.466	0.869	--	14.387	6.479	3.935	--	16.208	7.286	4.420

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-19 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Earth in Rolling Terrain
BASE ALTERNATIVE: Routine Maintenance plus Blading Each 180 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE							
		ROUTINE MAINTENANCE PLUS BLADING:							
		Each 30 Days				Each 15 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	25	--	2.515	1.133	0.688	--	2.127	0.950	0.573
1	50	--	7.041	3.177	1.932	--	6.870	3.090	1.874
1	100	--	17.999	8.075	4.891	--	18.589	8.324	5.035

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-20

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Flat Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		NO REGRAVELLING WITH BLADING:										
		Each 30 Days				Each 15 Days				Each 7 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	68.0	0.344	0.068	0.016	5.3	0.190	-0.057	-0.077	-11.6	-0.706	-0.507	-0.366
1	100	--	3.022	0.772	0.273	--	3.988	0.954	0.298	24.0	3.764	0.686	0.077
1	200	--	17.157	4.782	1.736	--	24.818	6.872	2.467	--	27.595	7.485	2.585
1	400	--	22.055	7.987	3.776	--	63.765	21.021	8.966	--	83.274	27.011	11.289

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-20 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Flat Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		REGRAVELLING EACH 4 YEARS WITH BLADING:										
		Each 30 Days				Each 15 Days				Each 7 Days		
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	-13.3	-0.742	-0.475	-0.313	-18.5	-1.076	-0.634	-0.414	-40.1	-2.074	-1.103	-0.707
1	100	--	3.461	0.505	-0.027	--	3.371	0.455	-0.062	10.6	2.506	0.045	-0.320
1	200	--	28.005	7.185	2.229	--	28.753	7.506	2.418	--	28.349	7.301	2.283
1	400	--	90.058	28.016	10.938	--	93.652	29.602	11.887	--	94.901	30.129	12.191

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-20 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Flat Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		REGRAVELLING EACH 2 YEARS WITH BLADING:										
		Each 30 Days				Each 15 Days				Each 7 Days		
		Rate of Return	Net Present Value			Rate of Return	Net Present Value			Rate of Return	Net Present Value		
% ANNUAL GROWTH	FIRST YEAR ADT		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%		@ 0%	@ 10%	@ 20%
1	50	-11.0	-0.742	-0.526	-0.370	-15.2	-1.076	-0.685	-0.471	-29.8	-2.074	-1.154	-0.764
1	100	16.5	3.461	0.440	-0.099	15.5	3.371	0.390	-0.134	9.8	2.506	-0.020	-0.392
1	200	71.9	28.005	7.100	2.136	--	28.753	7.421	2.324	80.9	28.349	7.216	2.189
1	400	--	90.058	27.895	10.804	--	93.652	29.481	11.754	--	94.901	30.008	12.058

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-20 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Flat Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		REGRAVELLING EACH YEAR WITH BLADING:											
		Each 30 Days				Each 15 Days				Each 7 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	-12.5	-0.813	-0.564	-0.402	-17.1	-1.147	-0.724	-0.502	-36.0	-2.145	-1.192	-0.796
1	100	15.4	3.371	0.392	-0.140	14.5	3.281	0.341	-0.175	9.3	2.416	-0.069	-0.432
1	200	57.4	27.886	7.037	2.083	129.2	28.634	7.358	2.272	60.4	28.230	7.153	2.137
1	400	--	89.885	27.804	10.729	--	93.479	29.390	11.679	--	94.728	29.917	11.983

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-21

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Rolling Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		NO REGRAVELLING WITH BLADING:										
		Each 30 Days				Each 15 Days				Each 7 Days		
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	--	0.888	0.244	0.082	23.6	1.040	0.217	0.026	4.3	0.317	-0.177	-0.243
1	100	--	4.763	1.436	0.557	--	6.492	1.908	0.707	45.8	6.721	1.813	0.560
1	200	--	21.982	6.917	2.788	--	31.789	9.960	3.990	--	35.460	11.032	4.334
1	400	--	26.960	10.504	5.256	--	75.563	27.170	12.597	--	98.282	34.858	15.927

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-21 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Rolling Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		REGRAVELLING EACH 4 YEARS WITH BLADING:											
		Each 30 Days				Each 15 Days				Each 7 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	-9.9	-0.589	-0.519	-0.406	-17.3	-0.916	-0.675	-0.504	-68.2	-1.910	-1.142	-0.796
1	100	--	5.659	1.302	0.253	26.7	5.592	1.262	0.224	19.3	4.739	0.857	-0.030
1	200	--	35.634	10.603	3.880	--	36.466	10.961	4.091	--	36.107	10.776	3.968
1	400	--	105.775	36.461	15.959	--	109.698	38.192	16.994	--	111.119	38.794	17.344

/1 Rates of return are indicated as percents.

/2 Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-21 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Rolling Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE										
		REGRAVELLING EACH 2 YEARS WITH BLADING:										
		Each 30 Days				Each 15 Days				Each 7 Days		
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	-7.1	-0.589	-0.608	-0.504	-11.2	-0.916	-0.764	-0.603	-31.6	-1.910	-1.231	-0.895
1	100	23.3	5.659	1.195	0.135	22.5	5.592	1.155	0.106	17.1	4.739	0.750	-0.148
1	200	74.8	35.634	10.476	3.740	103.9	36.466	10.834	3.951	80.4	36.107	10.649	3.828
1	400	--	105.775	36.028	15.778	--	109.698	38.028	16.814	--	111.119	38.631	17.164

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

FIGURE 3-21 (Continued)

RATES OF RETURN[1] AND NET PRESENT VALUES[2] FOR COMPARISONS AGAINST BASE ALTERNATIVE

ANALYSIS: Maintaining Unpaved Road Surfaces
CONDITIONS: Gravel in Rolling Terrain
BASE ALTERNATIVE: No Regravelling with Blading Each 60 Days

TRAFFIC		DESCRIPTION OF ALTERNATIVE											
		REGRAVELLING EACH YEAR WITH BLADING:											
		Each 30 Days				Each 15 Days				Each 7 Days			
% ANNUAL GROWTH	FIRST YEAR ADT	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%	Rate of Return	Net Present Value @ 0%	Net Present Value @ 10%	Net Present Value @ 20%
1	50	-9.1	-0.711	-0.674	-0.559	-14.2	-1.038	-0.830	-0.658	--	-2.032	-1.297	-0.950
1	100	21.5	5.514	1.117	0.069	20.9	5.447	1.076	0.040	16.0	4.594	0.672	-0.214
1	200	65.1	35.460	10.382	3.661	78.5	36.292	10.740	3.872	68.4	35.933	10.555	3.749
1	400	--	105.547	36.175	15.677	--	109.469	37.906	16.713	--	110.890	38.509	17.063

[1] Rates of return are indicated as percents.

[2] Net present values are in millions of dollars over 20 years for 100 kilometers (62.14 miles) of road.

5. The blading frequencies of 15 and 7 days for gravel roads with greater than 200 vehicles per day showed little economic differences. All of these blading frequencies showed marked economic benefit over blading each 60 days without regravelling.

6. The peak net present value for blading gravel roads with 100 vehicles per day occurs at the 15-day frequency.

7. Blading each 30 days with no regravelling exhibited the highest net present values for gravel roads with 50 vehicles per day.

8. The cost impacts of neglecting the regravelling and/or blading of gravel roads with greater than 200 vehicles per day can be significant. Conversely, the economic risks of over blading and frequently regravelling to a fixed depth are small.

Recommendations

Blading and regravelling needs will vary from road to road and area to area.

However, the economics of unpaved road maintenance do provide guidelines within which standards and practices can be formulated to minimize loss and maximize economic benefit.

1. Uniform guides for the maintenance of Iowa's more than 70,000 miles of gravel and earth roads should be established and applied by its public agencies.

2. The criteria for frequency of work should be combined with production standards to generate programmed budgets for unpaved road maintenance activities.

CHAPTER FOUR

IMPACT ASSESSMENT OF UNIFORM MAINTENANCE STANDARDS

The assessment of the impacts related to uniform maintenance standards concentrated on the two areas typically associated with the term maintenance standard -- performance standards and maintenance service levels, sometimes referred to as maintenance quantity standards.

Performance standards define for each major maintenance work activity the most effective crew size, equipment and materials required, work methods and procedures to be used, and the planned average daily accomplishment of work by a standard crew. These standards represent typical conditions and are modified to reflect specific requirements for traffic conditions and haul distances for materials.

Maintenance level of service standards (quantity standards) define the level of service, or amount of maintenance work, that will be provided to the highways, roads and streets, or to specific classes of these facilities. These are defined for each major maintenance work activity and are usually expressed as work units per roadway feature to be maintained, for example, blade gravel roads two times per month, mow roadsides once per year. Other service levels are related to the amount of material required to maintain the feature to the established service level. For example, an agency has been averaging about 500 tons of bituminous premix each year, for premix patching on 1,000 lane-miles of bituminous surface road. If the level of service is adequate, and engineering judgement says that material has not been wasted, a realistic quantity standard (service level) would be 0.50 ton per lane-mile of inventoried bituminous surface road.

The two maintenance standards described are two of the key elements of a maintenance management system. Therefore, a maintenance planning, programming and budgeting model provided the analytical procedure to assess the impacts of both types of uniform maintenance standards.

IOWA DEPARTMENT OF TRANSPORTATION

The Iowa DOT utilizes both types of maintenance standards for the maintenance program of the state primary system. Since 1975, the Office of Maintenance, Highway Division, has been planning, scheduling and evaluating maintenance work through a maintenance management system. Performance standards have been formulated and are reviewed and updated periodically. The primary system has been classified into four different service levels for maintenance purposes.

Organizational Structure

Each of the six field districts of the Iowa DOT is divided into four resident maintenance areas. Each resident area is divided into maintenance areas/garages with a highway maintenance supervisor in charge of each area. There are a total of 137 maintenance areas statewide with staffing assignments ranging from two to thirty-nine at the maintenance areas. Each district also has a traffic line paint crew and a bridge crew that works throughout the district. The three districts with Interstate rest areas each have a rest area crew. Additionally, there are three specialized statewide maintenance crews.

Resource Allocations

Manpower and equipment allocations are based on total lane miles in an area plus lane mile factors for the four service levels (A, B, C and D) applied to the primary system, miles of ramps, rest areas, weigh stations and factors for travel time and equipment downtime.

Table 4-1 shows 1985 allocations for district maintenance personnel and major equipments units for each district. These allocations are based on the lane mile factors which account for Districts 1, 4 and 6, which have a higher concentration of urban and interstate facilities, having fewer lane miles assigned per person and major equipment unit/trucks.

Maintenance Standards

The Office of Maintenance has developed maintenance performance standards for 82 maintenance work activities, plus 13 for maintenance overhead activities. These standards are used to develop annual maintenance work programs and budgets. Figure 4-1 illustrates the maintenance performance standard for one work function -- spall patching. The other maintenance activities have established performance standards in the same format.

Development of the annual maintenance work program and budget is based on these performance standards and historical trends of daily production rates and levels of service for each district and individual maintenance area.

Maintenance level of service standards (quantity standards) required to maintain each maintenance inventory feature to the desired service level vary from area to area depending on factors unique to the areas. These factors include existing conditions, or extent of deterioration, traffic volumes, vehicle characteristics and climatic conditions.

TABLE 4-1

Iowa Department of Transportation

MAINTENANCE AND EQUIPMENT ALLOCATIONS[1/]

Fiscal Year 1985

DISTRICT	Primary Lane Miles	Number of Personnel	Lane Miles Per Man	Major Equipment Units[2/]	Lane Miles Per Equip. Unit	Number of Trucks	Lane Miles Per Truck
1	4,108.5	295	13.93	429	9.58	180	22.8
2	3,995.4	238	16.79	397	10.06	150	26.6
3	4,148.1	244	17.00	371	11.18	153	27.1
4	4,021.1	278	14.46	417	9.64	167	24.1
5	3,979.3	233	17.08	376	10.58	146	27.3
6	4,156.5	305	13.63	444	9.36	199	20.9
TOTAL	24,408.9	1,593	15.32	2,434	10.03	995	24.5

SOURCE: Iowa DOT, Office of Maintenance

1/ Does not include statewide crews.

2/ Includes dump trucks.

FIGURE 4-1

MAINTENANCE STANDARD

IOWA DEPARTMENT OF TRANSPORTATION
Highway Division
Office of Maintenance

APPROVED BY: [signature] Maint. Engr. Date: Revised 7-2-84

FUNCTION TITLE: Spall Patching FUNCTION CODE: 609

FUNCTION CATEGORY: ROADWAY SURFACE

WORK PROGRAM CATEGORY: Routine Unlimited

DESCRIPTION & PURPOSE:

All operations associated with filling holes in roadway surfaces and bridge decks with bituminous mix to correct spalls, corner breaks, raveling and joint failures.

Incidental spall patching on paved shoulder may be charged to this function. For major shoulder repairs refer to the shoulder maintenance category.

LEVEL OF MAINTENANCE (Quality Std.):

Spalls which are likely to affect traffic safety are to be repaired as soon as practical after the DOT has notification of the condition.

Spalls, corner breaks, raveling, or other surface deterioration which can be repaired with bituminous mix and which may cause further surface damage are to be repaired as soon as the work can be scheduled.

SCHEDULING GUIDE: Normal monthly accomplishment as a percent of total program.

JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
6	9	4	5	6	7	8	11	15	14	8	7

Accounts for 2.6% of total maintenance manhours.

PERFORMANCE STANDARD

FUNCTION: 609

RECOMMENDED PROCEDURES:

Refer to Appendix A to select the proper traffic control plan.

1. Remove loose material and unsound edges to provide near vertical sides.
2. Dry hole if necessary.
3. Apply tack if appropriate.
4. Fill hole with bituminous mix and tamp (Deep holes should be filled in lifts).
5. Final patch should be flush with roadway surface.
6. Clean up all loose material on surface.

Code traffic control to function 673.

The amount of accomplishment reported should balance the amount of bituminous mix used.

Provide safety equipment as required for the operation.

Reference:

MATERIALS:

Bituminous Mix
Emulsion Tack

RECOMMENDED CREW SIZE:

5 - Clean hole, tack, fill and compact

RECOMMENDED EQUIPMENT:

2 - Dump Truck
1 - Premix Heater (if available)
1 - Tack Tank
1 - Air Compressor
1 - Roller or Compactor
Hand tools as necessary

ACCOMPLISHMENT:

Unit: Ton of Material
Standard Rate: 0.13 ton per manhour
Daily Production: 3.9 - 5.2 - 6.5

SOURCE: Iowa DOT, Office of Maintenance

Maintenance standards provide one effective method of uniformly planning, scheduling, performing and evaluating a comprehensive maintenance work program and budget. Specific benefits include:

1. Maintenance objectives are formalized through the development and issuance of formal Maintenance Policy Statements by the Chief Executive Officer.

2. Performance standards are developed for each major maintenance work activity. These standards specify the crew size, equipment and work methods and procedures to utilize for the most effective results.

3. Uniformity of maintenance effort is established through quantity standards which express the desired level of service in a uniform manner and reduce the variations of maintenance effort due to different supervisory judgements.

4. Annual routine maintenance work programs are based on quantity standards, performance standards and maintenance feature inventories which define the total amount of maintenance work to be performed by each management unit.

5. Manpower and equipment allocations can be made to individual maintenance units on the basis of maintenance work to be performed.

6. Maintenance supervisors are able to schedule and control individual maintenance work activities through work orders.

7. Reporting of work performed by the crews provides management at all levels with information required to evaluate work performance and to effectively control the maintenance work program.

Effective application of uniform maintenance standards requires the training of personnel at all management levels in their responsibilities, including the training of maintenance workers in equipment operation and maintenance work methods and procedures, as specified in the maintenance performance standards. As evidenced by the Iowa DOT, the use of uniform maintenance standards results in more effective maintenance operations, increased uniformity in the level of maintenance service provided and more effective resource utilization.

Maintenance Program and Expenditures

Table 4-2 illustrates one page of the 1985 work program and budget prepared by the Iowa DOT, Office of Maintenance. Budget calculations for each of the 82 work activities and overhead functions are prepared in this detail. A summary of manhours and costs by major maintenance categories is shown in Table 4-3 for fiscal years 1984 and 1985. The actual and planned values by work category reflect the accuracy and validity of planning maintenance work through the use of uniform maintenance standards.

TABLE 4-2

EXAMPLE FROM IOWA DOT MAINTENANCE BUDGET

STATE P4150250 FISCAL 85 COMPLETED WORK PROGRAM AND BUDGET 07/09/84 PAGE 11

CODE	ACTIVITY DESCRIPTION	UNIT OF MEASURE	DISTRICT	WORK PROGRAM WORK UNITS	WORK PROGRAM MAN-HOURS	BUDGET AMOUNTS LABOR	BUDGET AMOUNTS EQUIPMENT	BUDGET AMOUNTS MATERIAL	TOTAL
**	FUNCTION CATEGORY SHOULDERS AND APPROACHES								
628	REPR SHOUL W/BIT MIX	TON	5510	1,406	1,335	11,551	8,357	3,495	23,403
			5520	230	921	7,439	3,861	2,885	14,185
			5530	576	1,409	11,828	6,726	1,109	19,663
			5540	710	1,776	14,842	7,763	4,452	27,057
			5550	928	2,072	15,713	8,894	5,209	29,816
			5560	1,692	1,914	15,203	10,583	5,600	31,386
		FUNCTION TOTAL		5,542	9,427	76,576	46,184	22,750	145,510
629	SEAL EDGE RLTS/SHLDR	SQUAREYARD	5510	196,313	2,241	19,079	16,121	60,839	96,039
			5520	191,839	1,264	10,074	5,046	42,258	57,378
			5530	265,387	3,226	27,301	16,032	58,763	102,096
			5540	177,250	2,459	20,177	11,743	72,167	104,087
			5550	255,118	2,753	22,954	12,358	75,992	111,304
			5560	192,162	3,763	31,898	24,299	69,786	125,983
		FUNCTION TOTAL		1,278,069	15,706	131,483	85,599	379,805	596,887
632	FILL SHOULDER JOINTS	GALLON	5510	84,982	3,126	25,699	14,173	81,379	121,251
			5520	9,019	700	5,945	155	19,129	25,229
			5530	14,170	887	7,925	5,287	27,740	40,952
			5540	7,423	430	3,242	2,534	4,441	10,217
			5550	5,232	531	3,977	1,913	17,874	23,764
			5560	27,688	1,421	12,109	7,845	10,818	30,772
		FUNCTION TOTAL		148,514	7,095	58,897	31,907	161,381	252,185
633	PAVED SHLD REPAIR	SQUAREYARD	5510	355	323	2,590	1,718	2,039	6,347
			5520	197	288	2,616	2,220	1,942	6,778
			5530	642	378	3,332	2,544	1,202	7,078
			5540	381	346	2,819	1,569	1,350	5,738
			5550	1,157	500	4,590	2,085	449	7,124
			5560	545	396	2,783	1,018	249	4,050
		FUNCTION TOTAL		3,277	2,231	18,730	11,154	7,231	37,115
636	MOW SHLDS & MEDIANS	ACRE	5510	10,543	6,007	49,840	33,211	415	83,466
			5520	12,564	6,579	53,802	34,899	183	88,884
			5530	17,441	7,841	66,144	42,140	60	108,344
			5540	15,411	9,597	78,110	47,034	238	125,382
			5550	11,213	6,346	52,710	34,065	217	86,992
			5560	7,260	4,449	35,040	28,048	261	63,349
		FUNCTION TOTAL		74,432	40,819	335,646	219,397	1,374	556,417
638	HAND MOWING	MANHOUR	5510	0	1,908	14,910	3,112	149	18,171
			5520	0	2,007	16,125	3,201	163	19,489
			5530	0	2,712	22,639	4,734	58	27,431
			5540	0	4,641	37,107	8,219	729	46,055
			5550	0	1,200	9,728	2,279	20	12,027
			5560	0	1,446	10,972	3,139	3,086	17,197
		FUNCTION TOTAL		0	13,914	111,481	24,684	4,205	140,370
640	PLACE SHOULDERS	MANHOUR	5510	0	7,334	63,608	65,648	35	129,291
			5520	0	4,559	40,416	45,452	0	85,868
			5530	0	6,406	56,005	51,184	42	107,231
			5540	0	4,898	42,826	44,712	1	87,539
			5550	0	6,530	58,811	63,272	1	122,084
			5560	0	6,605	54,538	61,523	251	116,312

TABLE 4-3

STATE PRIMARY MAINTEANCE PROGRAM
Fiscal Years 1984 and 1985

WORK CATEGORY	MAN HOURS (Thousands) 1984 Planned	1984 Actual	1985 Planned	TOTAL COSTS (Thousands) 1984 Planned	1984 Actual	1985 Planned
Supervision & Support	1,216	1,256	1,222	$ 17,138	$ 17,201	$ 17,091
Roadway Surfaces	338	312	352	6,706	5,913	6,950
Shoulders	233	187	243	6,351	5,506	6,563
Roadside	216	227	276	3,102	3,170	3,841
Drainage	94	77	98	1,545	1,349	1,497
Traffic Services	473	488	487	10,032	9,118	9,936
Snow & Ice Control	442	535	512	10,442	11,587	11,540
Bridges	118	108	128	1,891	1,530	1,924
Service Contracts	10	20	19	1,760	317	2,356
General Maintenance	388	405	377	4,247	5,008	4,383
Work for Others	38	55	42	488	615	523
STATE TOTALS	3,566	3,670	3,756	$ 63,702	$ 61,314	$ 66,604

SOURCE: Iowa DOT, Office of Maintenance

The 82 work activities used by the Iowa DOT were grouped into 31 activities for assessing the impacts of uniform maintenance standards by use of the maintenance work programming model. Table 4-4 shows the 1985 work program and budget for the state primary system which was prepared through use of the maintenance model. This was developed by using the Iowa DOT 1985 approved maintenance work program by district. The Iowa DOT performance standards were used to input labor, equipment and materials requirements, as well as average daily production, for each of the 31 work activities. A work program and budget was calculated for each district as shown in Table 4-5. The column "Service Level" provides the planned maintenance service level for each work activity in terms of work units per maintenance feature inventory item. For example, Activity 1010, Surface Patching, has a service level of 0.46 tons mix per lane mile. Based on the statewide lane miles and tons of mix shown in Table 4-4, the average statewide service level is 0.58 tons per lane mile. This reflects that the service level for each district varies according to current surface conditions and the district's previous experience in surface patching requirements. Uniform maintenance performance standards -- crew size, equipment, materials, daily production -- were used in all districts.

Service levels for some maintenance activities should be relatively uniform among all districts. Typically, these activities include non-emergency activities and those based on frequency of work performed, such as Blade Shoulders, Roadside Mowing, Shoulder Mowing, Sign Maintenance and other activities.

Based on the 1985 planned work program for the state primary system, there were deviations of planned service levels among the districts for some of the work activities expected to remain uniform. Table 4-6 shows the variations among the districts for five selected work activities. Typically, these values should be fairly equal for uniform service levels. The impact of not using a uniform service level for these five activities is shown in Table 4-7 for all districts. The "uniform service level" reflects a uniform level of maintenance service for each activity in all districts. The "Actual" values reflect the maintenance service levels used by the individual districts. The last column lists the ratio of the actual to the uniform maintenance service levels. For example, the ratio for shoulder mowing (1120) is 1.39 or 39 percent higher than when a uniform service level is used for all districts. The district totals for all activities show the impact of not using uniform service levels for these five activities only. Additional costs amount to $1,543,321, or 23 percent, of the total costs for these activities. Also, an additional 8,351 mandays, or approximately 35 additional full-time personnel are required. Some of these five work activities are seasonal, so the actual number of personnel for these months would be higher. And finally, additional trucks, motor graders, mowers and other equipment are also required.

Use of Performance Standards

Performance standards represent an agencies' best determination of the most effective crew size, equipment compliment and average daily production. Deviations from these standards, without proper justification,

STATE

WORK PROGRAM AND BUDGET FOR FY 1985

TABLE 4-4

MAINTENANCE MANAGEMENT SYSTEM

DATE: 04/03/85

TIME: 08:32

DeLEUW, CATHER & COMPANY

DEPARTMENT SUMMARY

ACTIVITY	FEATURE INVENTORY	WORK QUANTITY	CREW DAYS	MAN DAYS	COST DISTRIBUTION LABOR	EQUIPMENT	MATERIAL	TOTAL COST
1010 SURFACE PATCHING	24409 LANE MILES	14,053 TONS	2611	14055	991,721	429,071	505,980	1,926,772
1020 MACHINE PATCHING	24409 LANE MILES	20,708 TONS MIX	207	3105	229,356	248,615	351,548	829,519
1030 JOINT/CRACK FILL	24409 LANE MILES	4,221 100 GALL	1689	11823	855,310	266,251	506,700	1,628,261
1040 SEAL COAT	4610 ASPH LANE MI	1,430,675 SQ YDS	272	2720	196,275	268,823	503,200	968,298
1090 OTHER SURFACE	24409 LANE MILES	69,512 MAN HRS	2897	6691	623,434	386,807	579,400	1,589,642
1100 PAVED SHLDR MTCE	3795 PAV SHLDR MI	2,126,895 SQ YDS	328	3280	236,685	324,169	472,320	1,033,174
1110 REPAIR AGGR SHLDR	17770 UNPAV SHLDR M	497,195 TONS MAT	9944	19888	1,543,309	1,517,852	820,380	3,881,541
1120 SHLDR MOWING	26547 MOW SHLDR ACR	85,215 ACRES	4485	4485	308,568	247,572	0	556,140
1130 BLADE SHLDRS	17770 UNPAV SHLDR M	24,026 MAN HRS	3003	3003	233,033	412,012	0	645,044
1190 OTHER SHLDR	21565 TOT SHLDR MI	21,810 MAN HRS	546	2184	163,800	253,300	27,300	444,400
1200 RDSIDE MOWING	19633 DITCH MI	49,621 MAN HRS	6204	6204	426,835	342,461	0	769,296
1210 RDSIDE SPRAYING	19633 DITCH MI	6,732 100 GALL	1683	3366	246,391	128,447	572,220	947,058
1220 REST AREAS	40 IS REST AREAS	80,766 MAN HRS	9761	9761	824,609	269,716	97,610	1,191,935
1290 OTHER RDSIDE	10430 CL MILES	61,797 MAN HRS	2575	7342	527,790	196,524	206,000	930,314
1300 CLEAN/RESTORE DITCHS	19633 DITCH MI	240,549 CU YDS	925	4625	341,140	394,309	0	735,449
1310 CULVERT MTCE	962 CULVERT/100	34,582 MAN HRS	864	4320	318,643	227,543	64,800	610,986
1390 OTHER DRAINAGE	19633 DITCH MI	10,518 MAN HRS	438	1314	94,258	33,428	21,900	149,586
1400 PAVEMENT MARKINGS	24409 LANE MILES	34,826 MILES	829	5803	434,396	311,505	2,113,950	2,859,851
1410 SIGN MTCE	3953 SIGNS/100	171,071 MAN HRS	7128	21384	1,533,946	544,009	1,211,760	3,289,715
1420 RDWY LIGHTING	8592 LIGHTS	11,259 MAN HRS	704	1408	103,066	53,729	774,400	931,195
1430 TRAFFIC CONT MTCE	24409 LANE MILES	201,054 MAN HRS	12566	25132	1,729,082	251,320	125,660	2,106,062
1490 OTHER TRAFFIC	10430 CL MILES	47,941 MAN HRS	1499	5996	425,716	228,807	119,920	774,443
1500 SNOW REMOVAL	24409 LANE MILES	336,381 MAN HRS	13140	39420	3,008,535	2,995,710	657,000	6,661,244
1510 CHEM/ABRASIVES	24409 LANE MILES	33,394 MAN HRS	2087	4174	296,354	393,274	2,087,000	2,776,628
1590 OTHER SNOW	24409 LANE MILES	103,496 MAN HRS	6470	12940	890,272	987,581	194,100	2,071,953
1600 BRIDGE MTCE	3079 SQYD BR/1000	70,933 MAN HRS	1267	9869	652,758	253,218	253,400	1,159,376
1650 BRIDGE INSPECT	3079 SQYD BR/1000	48,103 MAN HRS	1202	6010	576,960	122,027	24,040	723,027
1800 OTHER MTCE	10430 CL MILES	300,980 MAN HRS	3763	37630	2,700,329	1,639,623	564,450	4,904,402
1850 SUPERV/SUPPORT	24409 LANE MILES	840,165 MAN HRS	35006	105018	8,513,460	973,167	3,150,540	12,637,166
1900 AUTHZ/LEAVE	10430 CL MILES	476,642 MAN HRS	5958	59580	4,451,818	0	0	4,451,818
1950 CONTRACT MTCE	6 DISTRICT	18,942 MAN HRS	2367	2367	176,862	47,340	2,130,300	2,354,502

DEPARTMENT GRAND TOTALS

REGULAR TIME COST:	$ 66,538,800	REGULAR TIME MAN DAYS: 445,897	LABOR COST:	$ 33,654,708	(50.6 PERCENT)
OVERTIME COST:	0		EQUIPMENT COST	$ 14,748,211	(22.2 PERCENT)
OVERHEAD - % OF LABOR:	0	AVERAGE NO. MEN NEEDED: 1783.6	MATERIAL COST:	$ 18,135,878	(27.3 PERCENT)
OVERHEAD - % OF TOTAL:	0				
		OVERTIME MAN HOURS: 0			
TOTAL BUDGET:	$ 66,538,800				

TABLE 4-5

STATE

WORK PROGRAM AND BUDGET FOR FY 1985

MAINTENANCE MANAGEMENT SYSTEM

PAGE: 1

DATE: 04/02/85
TIME: 14:02

DeLEUW, LATHER & COMPANY

DISTRICT

ACTIVITY	FEATURE INVENTORY	SERVICE LEVEL	AWQ	AVG PROD	CREW DAYS	CREW SIZE	MAN DAYS	COST DISTRIBUTION LABOR	EQUIPMENT	MATERIAL	TOTAL COST
1010 SURFACE PATCHING	4109 LANE MILES	0.46 TONS	1897	5.0	379	5	1895	133,711	57,851	68,220	259,782
1020 MACHINE PATCHING	4109 LANE MILES	0.25 TONS	1023	100.0	10	15	150	11,080	12,010	16,983	40,073
1030 JOINT/CRACK FILL	4109 LANE MILES	0.15 100 GAL	622	2.5	249	7	1743	126,094	42,987	74,700	243,781
1040 SEAL COAT	709 ASPH LANE MI	265.56 SQ YDS	188364	5280.0	36	10	360	25,978	35,580	66,600	128,157
1090 OTHER SURFACE	4109 LANE MILES	3.99 MAN HRS	16402	24.0	683	3	2049	146,982	91,194	136,600	374,776
1100 PAVED SHLDR MTCE	896 PAV SHLDR MI	568.86 SQ YDS	509696	6500.0	78	10	780	56,285	77,089	112,320	245,694
1110 REPAIR AGGR SHLDR	2625 UNPAV SHLDR M	27.36 TONS MA	71822	50.0	1436	2	2872	222,867	219,191	118,470	560,528
1120 SHLDR MOWING	4202 MOW SHLDR ACR	3.05 ACRES	12794	19.0	673	1	673	46,302	37,150	0	83,452
1130 BLADE SHLDRS	2625 UNPAV SHLDR M	1.83 MAN HRS	4816	8.0	602	1	602	46,715	82,594	0	129,310
1190 OTHER SHLDR	3521 TOT SHLDR MI	0.69 MAN HRS	2423	40.0	61	4	244	18,300	28,299	3,050	49,649
1200 RDSIDE MOWING	3086 DITCH MI	3.17 MAN HRS	9784	8.0	1223	1	1223	84,142	67,510	0	151,652
1210 RDSIDE SPRAYING	3086 DITCH MI	0.47 100 GAL	1459	4.0	365	2	730	53,436	27,857	124,100	205,393
1220 REST AREAS	13 IS REST AREAS	2272.82 MAN HRS	29547	8.8	3358	1	3358	283,684	92,788	33,580	410,052
1290 OTHER RDSIDE	1665 CL MILES	5.18 MAN HRS	8618	24.0	359	3	1077	77,257	27,399	28,720	133,376
1300 CLEAN/RESTORE DITCHS	3086 DITCH MI	12.02 CU YDS	37083	260.0	143	5	715	52,738	60,958	0	113,696
1310 CULVERT MTCE	136 CULVERT/100	52.31 MAN HRS	7093	40.0	177	5	885	65,278	46,615	13,275	125,167
1390 OTHER DRAINAGE	3086 DITCH MI	0.51 MAN HRS	1560	24.0	65	3	195	13,988	4,961	3,250	22,199
1400 PAVEMENT MARKINGS	4109 LANE MILES	1.20 MILES	4950	42.0	118	7	826	61,832	44,340	300,900	407,072
1410 SIGN MTCE	606 SIGNS/100	52.81 MAN HRS	32018	24.0	1334	3	4002	287,077	101,811	226,780	615,668
1420 RDWY LIGHTING	2457 LIGHTS	1.90 MAN HRS	4664	16.0	292	2	584	42,749	22,285	321,200	386,224
1430 TRAFFIC CONT MTCE	4109 LANE MILES	8.18 MAN HRS	33608	16.0	2100	2	4200	288,960	42,000	21,000	351,960
1490 OTHER TRAFFIC	1665 CL MILES	5.47 MAN HRS	9105	32.0	285	4	1140	80,940	43,502	22,800	147,242
1500 SNOW REMOVAL	4109 LANE MILES	13.01 MAN HRS	53433	25.6	2087	3	6261	477,840	475,803	104,350	1,057,992
1510 CHEM/ABRASIVES	4109 LANE MILES	1.43 MAN HRS	5872	16.0	367	2	734	52,114	69,157	367,000	488,272
1590 OTHER SNOW	4109 LANE MILES	4.89 MAN HRS	20110	16.0	1257	2	2514	172,963	191,668	37,710	402,542
1600 BRIDGE MTCE	488 SQYD BR/1000	24.57 MAN HRS	12001	56.0	214	7	1498	110,253	42,769	42,300	195,822
1650 BRIDGE INSPECT	488 SQYD BR/1000	15.55 MAN HRS	7594	40.0	190	5	950	91,200	19,289	3,800	114,289
1800 OTHER MTCE	1665 CL MILES	45.13 MAN HRS	75135	80.0	939	10	9390	673,826	90,444	140,850	905,121
1850 SUPERV/SUPPORT	4109 LANE MILES	36.46 MAN HRS	149791	24.0	6241	3	18723	1,517,811	173,500	561,690	2,253,001
1900 AUTHZ/LEAVE	1665 CL MILES	53.17 MAN HRS	88522	80.0	1107	10	11070	827,150	0	0	827,150
1950 CONTRACT MTCE	1 DISTRICT	4053.00 MAN HRS	4053	8.0	507	1	507	37,683	10,140	456,300	504,323

UNIT TOTALS FOR DISTRICT

REGULAR TIME COST:	$ 11,933,423	REGULAR TIME MAN DAYS:	81,950	LABOR COST:	$ 6,187,435 (51.8 PERCENT)
OVERTIME COST:	0			EQUIPMENT COST	$ 2,338,942 (19.6 PERCENT)
OVERHEAD 0.0% OF LABOR:	0	AVERAGE NO. MEN NEEDED:	327.8	MATERIAL COST:	$ 3,407,048 (28.5 PERCENT)
OVERHEAD 0.0% OF TOTAL:	0				
		OVERTIME MAN HOURS:	0		
TOTAL BUDGET:	$ 11,933,423				

NOTE: AWQ = Annual Work Quantity

TABLE 4-6

VARIATIONS IN MAINTENANCE SERVICE LEVELS
FOR
SELECTED MAINTENANCE ACTIVITIES

State Primary System

Maintenance Activity	DISTRICTS						ALL	Service Level Units
1120 Shoulder Mowing	3.05	3.05	3.27	4.62	3.00	2.31	3.21	Acres/Mowable Acres
1130 Blade Shoulders	1.83	1.00	1.18	1.13	1.45	1.59	1.35	Man Hours/Unpaved Shoulder Miles
1200 Roadside Mowing	3.17	2.83	1.74	2.60	1.70	3.24	3.07	Man Hours/Ditch Mi.
1400 Pavement Marking	1.20	1.42	1.50	1.50	1.55	1.40	1.43	Miles Painted/ Lane Miles
1410 Sign Maintenance	52.81	46.99	40.67	36.42	38.70	44.89	43.3	Man Hours/100 Signs

NOTE: Districts are listed randomly.

TABLE 4-7

IMPACTS OF USING NON-UNIFORM MAINTENANCE SERVICE LEVELS

WORK ACTIVITY	UNIFORM SERVICE LEVEL			ACTUAL SERVICE LEVEL			Actual/ Uniform
	Service Level	Mandays	Costs	Service Level	Mandays	Costs	
1120 Shoulder Mowing							
District A	2.3	511	$ 63,364	3.0	673	$ 83,452	1.32
District B	2.3	544	67,456	3.0	718	89,032	1.32
District C	2.3	615	76,260	3.3	871	108,004	1.42
District D	2.3	504	62,496	4.6	1,008	124,992	2.00
District E	2.3	542	67,208	3.0	704	87,296	1.30
District F	2.3	511	63,364	2.3	511	63,364	1.00
Total		3,227	$400,148		4,485	$556,140	1.39
1130 Blade Shoulders							
District A	1.0	328	70,454	1.8	602	129,310	1.84
District B	1.0	396	85,061	1.0	396	85,061	1.00
District C	1.0	415	89,142	1.2	489	105,037	1.18
District D	1.0	347	74,536	1.2	407	87,424	1.17
District E	1.0	393	84,416	1.4	568	122,006	1.45
District F	1.0	341	73,247	1.6	541	116,207	1.59
Total		2,220	476,856		3,003	645,045	1.35
1200 Roadside Mowing							
District A	1.7	656	81,344	3.2	1,223	151,652	1.86
District B	1.7	714	88,536	2.8	1,190	147,560	1.67
District C	1.7	766	94,984	1.7	766	94,984	1.00
District D	1.7	692	85,808	2.6	1,073	133,052	1.55
District E	1.7	712	88,288	1.7	712	88,288	1.00
District F	1.7	651	80,724	3.2	1,240	153,760	1.90
Total		4,191	519,684		6,204	769,296	1.48
1400 Pavement Marking							
District A	1.2	826	407,072	1.2	826	407,072	1.00
District B	1.2	798	393,273	1.4	945	465,718	1.18
District C	1.2	833	410,521	1.5	1,036	510,565	1.24
District D	1.2	805	396,722	1.5	1,008	496,765	1.25
District E	1.2	798	393,273	1.5	1,022	503,665	1.28
District F	1.2	833	410,521	1.4	966	476,067	1.16
Total		4,893	2,411,382		5,803	2,859,852	1.19
1410 Sign Maintenance							
District A	36.4	2,760	424,598	52.8	4,002	615,668	1.45
District B	36.4	2,442	375,677	47.0	3,153	485,058	1.29
District C	36.4	3,261	501,672	40.7	3,639	559,824	1.12
District D	36.4	2,985	459,212	36.4	2,985	459,212	1.00
District E	36.4	2,751	423,214	38.7	2,925	449,982	1.06
District F	36.4	3,798	584,284	44.9	4,680	719,971	1.23
Total		17,997	2,768,657		21,384	3,289,715	1.19
ALL ACTIVITIES							
District A		5,081	$1,046,832		7,326	$1,387,154	1.33
District B		4,894	1,010,003		6,402	1,272,429	1.26
District C		5,890	1,172,579		6,801	1,378,414	1.18
District D		5,333	1,078,774		6,481	1,301,445	1.21
District E		5,196	1,056,399		5,931	1,251,237	1.18
District F		6,134	1,212,140		7,938	1,529,369	1.26
TOTALS		32,528	$6,576,727		40,879	$8,120,048	1.23
Increases due to non-uniform Service Levels					8,351	$1,543,321	

SERVICE LEVEL MEASUREMENTS

1120 Shoulder Mowing - Number of Mowings per Mowable Shoulder Acre
1130 Blade Shoulders - Manhours of Blading per Unpaved Shoulder Mile
1200 Roadside Mowing - Manhours of Mowing per Roadside Ditch Mile
1400 Pavement Marking - Miles of Pavement Marking per Lane Mile
1410 Sign Maintenance - Manhours of Sign Maintenance per 100 Signs

can have a major impact on the cost effectiveness of the work activity. For example, the standard crew size for surface patching is 5 men and 2 trucks. Figure 4-2 shows the cost impact per unit of work if 2 men and 1 truck are added to the operation. Although more work units are accomplished, the cost per ton of material placed increases from $137 to $156.

Improved work methods and procedures often result in improved performance standards. Uniform maintenance standards should be periodically reviewed and evaluated to identify potential areas for improvements.

Performance standards for surface patching used by some agencies consist of a 3 man crew size and one truck with a daily production of 3-5 tons of material. The effect of this performance standard applied to one district is shown in Figure 4-3. The cost per ton of material placed is reduced from $137 to $109 (average daily production of 4 tons).

IOWA COUNTIES

Maintenance responsibility of the rural secondary road system rests with the 99 county engineers. Each county, through the County Board of Supervisors, establishes the county's maintenance policy and practices by approval of annual maintenance budgets. Typically, a lump sum amount for maintenance is approved on the basis of available revenues. On this basis, the county engineer is faced with the problem of maintaining the secondary road system to the extent funds are available, rather than the maintenance budget being based on a defined maintenance workload.

One of the twelve counties interviewed does develop an annual maintenance work program for specific types of maintenance work activities. This work program is used to support the maintenance budget request to the Board of Supervisors. The board of Supervisors has not formally adopted the maintenance program, therefore examples of the program and maintenance standards used for its development are not available for publication.

Maintenance operations and practices on the secondary road system have been researched by the Iowa Highway Research Board through specific projects. Most of the research has been related to materials and the roadway surfaces, although others were oriented toward maintenance and operations of the secondary road system [1/] [2/].

Organizational Structure

Organization of the county road department for maintenance of the secondary road system is similar in each county. In addition to the central garage location where the majority of personnel are assigned,

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[1/] HR-204, Safer Construction and Maintenance Practices to Minimize Potential Liability by Counties from Accidents.

[2/] HR-242, Economics of Alternative Selections to the Secondary Road Problem.

FIGURE 4-2

CURRENT PERFORMANCE STANDARDS

A C T I V I T Y S U M M A R Y

Activity: 1010 SURFACE PATCHING
Responsible Org: 0510 DISTRICT Type: RT

			Desired	Actual
Feature Inv:	4,108.5 LANE MILES			
Daily Prod:	5.0 TONS MIX			
Hours/Act Day:	8.0	Quantity Standard:	0.63	0.46
Cost/Crew Day:	$ 685	Annual Work Quantity	2,590	1,895
Cost/Unit of Work:	$ 137	Total Cost:	$ 355,058	$ 259,782
Standard Crew Size:	5	Labor:	$ 182,750	$ 133,711
Acceptable Deviation:		Equipment:	$ 79,068	$ 57,851
Print Work Orders:		Material:	$ 93,240	$ 68,220
Control Factor:	N	Total Crew Days:	518	379
Authorization Level:	S	Total Man Days:	2,590	1,895
		Cost/Unit of Inv:	$ 86	$ 63

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CD Total
26	42	54	53	30	28	24	35	16	19	24	28	379

ADD 2 MEN AND 1 TRUCK

A C T I V I T Y S U M M A R Y

Activity: 1010 SURFACE PATCHING
Responsible Org: 0510 DISTRICT Type: RT

			Desired	Actual
Feature Inv:	4,108.5 LANE MILES			
Daily Prod:	6 TONS MIX			
Hours/Act Day:	8.0	Quantity Standard:	0.63	0.46
Cost/Crew Day:	$ 935	Annual Work Quantity	2,592	1,896
Cost/Unit of Work:	$ 156	Total Cost:	$ 404,076	$ 295,574
Standard Crew Size:	7	Labor:	$ 211,853	$ 154,966
Acceptable Deviation:		Equipment:	$ 98,911	$ 72,351
Print Work Orders:		Material:	$ 93,312	$ 68,256
Control Factor:	N	Total Crew Days:	432	316
Authorization Level:	S	Total Man Days:	3,024	2,212
		Cost/Unit of Inv:	$ 98	$ 72

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CD Total
23	35	45	44	25	23	20	29	13	16	20	23	316

FIGURE 4-3

REDUCED CREW SIZE

ACTIVITY SUMMARY

Activity: 1010 SURFACE PATCHING
Responsible Org: 0510 DISTRICT Type: RT

Feature Inv: 4,108.5 LANE MILES
Daily Prod: 4 TONS MIX

		Desired	Actual
Hours/Act Day:	8.0	Quantity Standard:	0.63	0.46
Cost/Crew Day:	$ 436	Annual Work Quantity	2,588	1,896
Cost/Unit of Work:	**$ 109**	Total Cost:	$ 281,781	$ 206,466
Standard Crew Size:	3	Labor:	$ 139,234	$ 102,005
Acceptable Deviation:		Equipment:	$ 49,379	$ 36,176
Print Work Orders:		Material:	$ 93,168	$ 68,256
Control Factor:	A	Total Crew Days:	647	474
Authorization Level:	3	Total Man Days:	1,941	1,422
		Cost/Unit of Inv:	$ 69	$ 50

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CD Total
34	52	67	65	38	35	30	44	20	24	30	35	474

CURRENT PERFORMANCE STANDARD

ACTIVITY SUMMARY

Activity: 1010 SURFACE PATCHING
Responsible Org: 0510 DISTRICT Type: RT

Feature Inv: 4,108.5 LANE MILES
Daily Prod: 5 TONS MIX

		Desired	Actual
Hours/Act Day:	8.0	Quantity Standard:	0.63	0.46
Cost/Crew Day:	$ 685	Annual Work Quantity	2,590	1,895
Cost/Unit of Work:	**$ 137**	Total Cost:	$ 355,059	$ 259,782
Standard Crew Size:	5	Labor:	$ 182,750	$ 136,711
Acceptable Deviation:		Equipment:	$ 79,068	$ 57,851
Print Work Orders:		Material:	$ 93,240	$ 68,220
Control Factor:	A	Total Crew Days:	518	379
Authorization Level:	5	Total Man Days:	2,590	1,895
		Cost/Unit of Inv:	$ 86	$ 63

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	CD Total
27	42	54	52	30	28	24	35	16	19	24	28	379

each county has designated districts throughout the county. These districts are the geographical areas used for assigning road maintenance responsibility, primarily blading unpaved surfaces and snow removal on these same roads. A typical district consists of 45 to 65 miles of unpaved roads. One or more districts has a designated location in the area for equipment storage. These locations may have heated garages or only a covered shed where one or more motor patrols can be parked. Fuel storage facilities are usually available at these locations. The number of locations vary with the county size and the secondary road miles to be maintained, but 6 to 10 locations per county are typical.

The majority of the counties have a designated assistant to the County Engineer, but only 15 counties have registered professional engineers as an Assistant County Engineer.

Resource Allocations

Based on the 80 percent response to the questionnaire from the counties on available personnel and equipment, Table 4-8 shows the personnel and equipment responsibilities for road miles of secondary county roads. There is a distinct difference in scope of responsibilities between the rural and urban counties as shown in the differences of average road miles of responsibilities per equipment unit and personnel.

The numbers presented in Table 4-8 are based on current availability of manpower and equipment which is primarily based on the magnitude of the maintenance budget and dollars available for equipment purchases. Field interviews in the 12 sample counties identified variations among the counties in this respect. Available motor graders in the sample rural counties resulted in a range of unpaved road miles from 30.4 to 92.5 miles per grader. Similar variations in staffing exist -- ranging from 24 to 70 secondary road miles per personnel for sample rural counties. Some county engineers indicated money was not available to replace obsolete equipment or to purchase additional equipment. One of the major factors identifed that directly impacts maintenance costs was the variance in availability and unit cost of materials; gravel and asphalt were the two major items.

Maintenance Standards

One of the twelve counties interviewed does use formalized maintenance performance standards and maintenance service levels (quantity standards) to develop the annual maintenance work program and budget. The responses to the questionnaire item:

> "Do you employ maintenance 'service level criteria' for the different classes of roads under your jurisdiction to develop your annual maintenance budget? ____Yes ____No"

indicated 39 percent of the counties did utilize service level criteria for developing the maintenance budget. However, it was for a limited number of work activities, such as snow removal, gravel replacement and traffic signing and striping.

TABLE 4-8
IOWA COUNTIES
Personnel and Equipment Allocations

COUNTY GROUP	Secondary Road Miles	Number of Personnel	Road Miles Per Man	Unpaved Road Miles	Number of Motor Graders	Unpaved Road Miles Per Motor Grader	Major[1/] Equipment Units	Road Miles Per Equip. Unit
Rural Counties (91)	81,950.99	2,811	29.2	68,356.05	1,158	59.0	3,817	22.0
Urban Counties (8)	7,736.07	488	15.9	5,961.41	127	46.9	513	15.0
Total	89,687.06	3,299	27.2	74,317.46	1,285	57.8	4,330	21.0

SOURCE: County Questionnaire Responses and Iowa DOT (mileage).

[1/] Includes pickups, dump trucks, motor graders, dozers, backhoes and loaders.

Some counties have adopted the Level B service for designated country roads, as authorized in the Code of Iowa, which permits a lower level of maintenance on those designated roads. However, less than 20 percent of the counties have formally adopted it. Interviews in counties that have adopted Level B service indicated the county residents accepted the Level B service, after being informed these roads would not be abandoned for maintenance, but merely receive a minimum level of maintenance.

The Code of Iowa also limits county liability for damages caused by snow and ice conditions, as long as the agency has complied with its formal policy or level of service for snow and ice conditions. This legislation was enacted in 1984 and some counties already have adopted formal snow and ice control policies.

Currently, each county, through the Board of Supervisors, is authorized to establish the levels of maintenance service for the county's roads, which may vary among counties. While there are valid reasons for varying maintenance standards (levels of service) among counties, uniform performance standards provide the potential for the Iowa County Engineers Association to continue a leadership role in promoting effective county road organization and operations. The discussion in the previous section on the benefits of maintenance standards to effectively plan, budget, schedule, perform and evaluate comprehensive maintenance work programs is equally applicable to the 99 Iowa counties. Effective maintenance standards have been adopted and implemented in agencies of less than 15 personnel total work force. The end result of applying uniform maintenance standards is demonstrated through more effective maintenance operations, increased uniformity in the level of maintenance services provided and more effective use of manpower, equipment and materials.

Maintenance Program and Expenditures

County secondary road maintenance expenditures for 1983 totaled $193.7 million as shown in Table 4-9. Over 63 percent of this amount, $123 million, was expended on equipment operation and purchases, blading unpaved surfaces and granular surfacing. Improved efficiencies and economies in any one of these areas represents a real potential for additional revenues being made available for other critical maintenance areas, such as additional bridge maintenance and replacements.

Figure 4-4 shows the range of maintenance costs per mile for the sample counties--from a low of $1,565 per mile to a high of $5,987. The lowest is for a rural county and the highest an urban county. As shown, the three highest costs per mile are urban counties. However, an average maintenance cost per mile can be deceptive, as it does not reflect surface type, number of lanes, number of bridges, or any of the several roadway features that affect the type and amount of maintenance that was performed on the mile of road. A more meaningful accounting of maintenance costs is by using work accomplished, or specific roadway feature maintained.

TABLE 4-9

ALL COUNTY SECONDARY ROAD MAINTENANCE EXPENDITURES

Calendar Year Ending December 31, 1983
(Thousands of Dollarss)

WORK ACTIVITY	Costs	Percent of Total
Roadway and Surface		
Blading Unpaved Surfaces	$ 11,795	6.1
Granular Surfacing	50,589	26.1
Dust Palliatives	2,220	1.1
Seal Coating	4,377	2.3
Asphalt Surfaces	4,183	2.2
PCC Surfaces	1,417	0.7
Other Roadway & Surface	1,586	0.8
Roadside		
Ditch Cleaning	3,452	1.8
Roadside Vegetation	3,948	2.0
Other Roadside	4,001	2.1
Snow and Ice Control		
Snow Removal	6,718	3.5
Apply Chemicals	1,612	0.8
Other Snow & Ice	533	0.3
Traffic Services		
Pavement Markings	1,329	0.7
Signs	2,827	1.5
Other Traffic	293	0.1
Other Maintenance		
Bridges	4,005	2.1
Culverts	3,495	1.8
Equipment	60,716	31.3
Materials & Supplies	5,687	2.9
Administration & Engr.	18,932	9.8
TOTAL	$ 193,715	100.0

SOURCE: Iowa County Engineers Annual Report, 1983.

TABLE 4-10

COUNTY SECONDARY ROAD MAINTENANCE EXPENDITURES
Selected Counties
Calendar Year Ending December 31, 1983

WORK ACTIVITY	Inventory Unit	Dollars per Inventory Unit			
		Rural-1	Rural-2	Urban-1	Urban-2
Roadway and Surface					
Blading Unpaved Surfaces	Unpaved Mile	$ 110	$ 142	$ 254	$ 909
Granular Surfacing	Gravel Mile	402	370	1,065	766
Dust Palliatives	Gravel Mile	---	11	---	15
Seal Coating	BST Mile	7,990	4,619	3,068	8,895
Asphalt Surfaces	Asphalt Mile	63	2,163	4,451	349
PCC Surfaces	PCC Mile	---	6	---	1,222
Other Roadway & Surface	Road Mile	1	10	20	44
Roadside					
Ditch Cleaning	Road Mile	3	19	136	175
Roadside Vegetation	Road Mile	44	206	77	424
Other Roadside	Road Mile	27	59	15	130
Snow and Ice Control					
Snow Removal	Road Mile	123	56	78	136
Apply Chemicals	Paved Mile	74	360	412	113
Other Snow & Ice	Road Mile	---	6	12	62
Traffic Services					
Pavement Markings	Paved Mile	78	92	---	175
Signs	Signs	3	4	14	17
Other Traffic	Road Mile	---	---	41	52
Other Maintenance					
Bridges	1000 Sq Yds	10	31	313	167
Culverts	Road Mile	25	13	50	122
Equipment	Road Mile	638	773	873	767
Materials & Supplies	Road Mile	25	101	60	19
Administration & Engr.	Road Mile	215	210	637	909
TOTAL PER ROAD MILE		$1,565	$2,280	$4,234	$5,987

SOURCE: Summary of Iowa County Engineers Annual Reports and Iowa Department of Transportation.

TABLE 4-11

URBAN COUNTY

WORK PROGRAM AND BUDGET FOR FY 1985 — PAGE: 1

MAINTENANCE MANAGEMENT SYSTEM

DATE: 03/06/85
TIME: 15:03

DeLEUW, CATHER & COMPANY

ACTIVITY	FEATURE INVENTORY	SERVICE LEVEL	1/ AWQ	AVG PROD	CREW DAYS	CREW SIZE	MAN DAYS	COST DISTRIBUTION LABOR	EQUIPMENT	MATERIAL	TOTAL COST
1010 BLADE UNPAV SURF	507 UNPAVED MI	60.00 MI BLAD	30390	5.0	6078	1	6078	471,653	0	0	471,653
1020 GRANULAR SURFACING	504 GRAVEL MILES	1.75 MI GRAV	882	2.0	441	5	2205	180,634	0	214,988	395,621
1030 DUST PALLITATIVES	504 GRAVEL MILES	0.10 MAN HRS	50	16.0	3	2	6	466	0	7,500	7,966
1040 SEAL COATING	38 BST MILES	1.50 MILES	57	0.5	113	8	904	72,591	0	254,250	326,841
1050 ASPHALT SURFACES	247 BITUM MILES	4.00 TONS	986	5.0	197	3	591	45,862	0	35,460	81,322
1060 PCC SURFACES	27 PCC MILES	100.00 MAN HRS	2650	32.0	83	4	332	25,763	0	6,640	32,403
1090 OTHER RDWY/SURFACE	817 TOTAL MILES	1.75 MAN HRS	1430	16.0	89	2	178	27,626	0	8,900	36,526
1110 DITCH CLEANING	817 TOTAL MILES	0.60 DITCH M	490	1.0	490	4	1960	152,096	0	0	152,096
1120 RDSIDE VEGETATION	817 TOTAL MILES	45.00 MAN HRS	36779	32.0	1149	4	4596	356,650	0	0	356,650
1190 OTHER RDSIDE	817 TOTAL MILES	10.00 MAN HRS	8173	16.0	511	2	1022	79,307	0	25,550	104,857
1210 BRIDGE MTCE	548 SQYD BR/1000	12.50 MAN HRS	6850	40.0	171	5	855	70,042	0	23,940	93,982
1220 CULVERT	817 TOTAL MILES	10.00 MAN HRS	8173	24.0	341	3	1023	79,385	0	17,050	96,435
1310 SNOW REMOVAL	817 TOTAL MILES	14.00 MAN HRS	11442	8.0	1430	1	1430	110,968	0	0	110,968
1320 SPREAD CHEMICALS	273 PAVED MILES	2.00 MAN HRS	546	9.6	57	1	57	5,308	0	28,500	33,808
1390 OTHER SNOW & ICE	817 TOTAL MILES	5.00 MAN HRS	4087	16.0	255	2	510	39,576	0	7,650	47,226
1410 PAVEMENT MARKINGS	273 PAVED MILES	0.67 MILES	183	10.0	18	1	18	1,786	0	45,000	46,786
1420 SIGN MTCE	5518 SIGNS	1.20 MAN HRS	6622	16.0	414	2	828	64,253	0	31,050	95,303
1490 OTHER TRAFFIC	817 TOTAL MILES	4.00 MAN HRS	3269	8.0	409	1	409	31,738	0	12,270	44,008
1500 EQUIP OPERATIONS	817 TOTAL MILES	1990.00 DOLLARS	1626427	6255.0	260	0	0	0	1,622,400	0	1,622,400
1520 MATER/SUPPL	817 TOTAL MILES	18.00 DOLLARS	14711	60.0	245	0	0	0	0	15,190	15,190
1530 ADMIN & ENGR	817 TOTAL MILES	40.00 MAN HRS	32692	40.0	817	12	9804	716,346	0	0	716,346

UNIT TOTALS

REGULAR TIME COST:	$ 4,888,385	REGULAR TIME MAN DAYS:	32,806	LABOR COST:	$ 2,532,047 (51.8 PERCENT)
OVERTIME COST:	0			EQUIPMENT COST	$ 1,622,400 (33.2 PERCENT)
OVERHEAD 0.0% OF LABOR:	0	AVERAGE NO. MEN NEEDED:	131.2	MATERIAL COST:	$ 733,938 (15.0 PERCENT)
OVERHEAD 0.0% OF TOTAL:	0				
		OVERTIME MAN HOURS:	0		
TOTAL BUDGET:	$ 4,888,385				

1/ AWQ = Annual Work Quantity

TABLE 4-12

RURAL COUNTY

WORK PROGRAM AND BUDGET FOR FY 1985 — PAGE: 2

MAINTENANCE MANAGEMENT SYSTEM

DATE: 04/17/85
TIME: 08:15

DeLEuw, CATHEx & COMPANY

ACTIVITY	FEATURE INVENTORY	SERVICE LEVEL	AWQ 1/	AVG PROD	CREW DAYS	CREW SIZE	MAN DAYS	COST DISTRIBUTION LABOR	EQUIPMENT	MATERIAL	TOTAL COST
1010 BLADE UNPAV SURF	828 UNPAVED MI	22.42 MI BLAD	18560	7.5	2475	1	2475	192,060	0	0	192,060
1020 GRANULAR SURFACING	823 GRAVEL MILES	1.20 MI GRAV	988	2.0	494	5	2470	202,342	0	240,825	443,167
1030 DUST PALLITATIVES	823 GRAVEL MILES	0.10 MAN HRS	82	16.0	5	2	10	776	0	12,500	13,276
1040 SEAL COATING	3 BST MILES	0.25 MILES	1	0.5	2	8	16	1,285	0	4,500	5,785
1050 ASPHALT SURFACES	21 BITUM MILES	0.50 TONS MI	11	5.0	2	3	6	466	0	360	826
1060 PCC SURFACES	130 PCC MILES	5.00 MAN HRS	651	32.0	20	4	80	6,208	0	1,600	7,808
1090 OTHER RDWY/SURFACE	982 TOTAL MILES	1.00 MAN HRS	982	16.0	61	2	122	9,467	0	6,100	15,567
1110 DITCH CLEANING	982 TOTAL MILES	0.15 DITCH M	147	1.0	147	1	147	11,407	0	0	11,407
1120 RDSIDE VEGETATION	982 TOTAL MILES	6.50 MAN HRS	6384	8.0	798	1	798	61,925	0	0	61,925
1190 OTHER RDSIDE	982 TOTAL MILES	2.00 MAN HRS	1964	16.0	123	2	246	19,090	0	6,150	25,240
1210 BRIDGE MTCE	348 SQYD BR/1000	10.00 MAN HRS	3479	40.0	87	5	435	35,635	0	12,180	47,815
1220 CULVERT	982 TOTAL MILES	1.00 MAN HRS	982	24.0	41	3	123	9,545	0	2,050	11,595
1310 SNOW REMOVAL	982 TOTAL MILES	10.00 MAN HRS	9822	8.0	1228	1	1228	95,293	0	0	95,293
1320 SPREAD CHEMICALS	151 PAVED MILES	2.00 MAN HRS	303	9.6	32	1	32	3,576	0	8,000	11,576
1390 OTHER SNOW & ICE	982 TOTAL MILES	0.50 MAN HRS	491	8.0	61	1	61	4,734	0	1,220	5,954
1410 PAVEMENT MARKINGS	151 PAVED MILES	0.33 MILES	50	10.0	5	1	5	496	0	12,500	12,996
1420 SIGN MTCE	6189 SIGNS	0.15 MAN HRS	928	16.0	58	2	116	9,002	0	4,350	13,352
1490 OTHER TRAFFIC	982 TOTAL MILES	0.20 MAN HRS	196	8.0	25	1	25	1,940	0	500	2,440
1500 EQUIP OPERATIONS	982 TOTAL MILES	831.00 DOLLARS	816208	314.0	2599	0	0	0	805,690	0	805,690
1520 MATER/SUPPL	982 TOTAL MILES	35.00 DOLLARS	34377	133.3	258	0	0	0	0	34,314	34,314
1530 ADMIN & ENGR	982 TOTAL MILES	16.00 MAN HRS	15715	24.0	655	3	1965	143,576	0	0	143,576

UNIT TOTALS

REGULAR TIME COST:	$ 1,961,661	REGULAR TIME MAN DAYS:	10,360	LABOR COST:	$ 808,821 (41.2 PERCENT)
OVERTIME COST:	0			EQUIPMENT COST	$ 805,690 (41.1 PERCENT)
OVERHEAD 0.0% OF LABOR:	0	AVERAGE NO. MEN NEEDED:	41.4	MATERIAL COST:	$ 347,149 (17.7 PERCENT)
OVERHEAD 0.0% OF TOTAL:	0				
TOTAL BUDGET:	$ 1,961,661	OVERTIME MAN HOURS:	0		

1/ AWQ = Annual Work Quantity

TABLE 4-13

COMPARATIVE WORK PROGRAM AND BUDGET
EXAMPLE RURAL COUNTY

COMPARATIIVE BUDGET REPORT FOR FY 1985 — PAGE: 2

M A I N T E N A N C E M A N A G E M E N T S Y S T E M
DeLEUW, CATHER & COMPANY

DATE: 04/17/85
TIME: 08:18

ACTIVITY	FEATURE INVENTORY	DESIRED SERVICE LEVEL	DESIRED BUDGET LEVEL AWQ 1/	DESIRED BUDGET LEVEL MD 2/	DESIRED COST	ACTUAL SERVICE LEVEL	ACTUAL BUDGET LEVEL AWQ 1/	ACTUAL BUDGET LEVEL MD 2/	ACTUAL COST	ACT/ PLAN
1010 BLADE UNPAV SURF	828 UNPAVED MI	26.0 MI BLADE	21523	2870	222,712	22.4 MI BLADE	18560	2475	192,060	0.86
1020 GRANULAR SURFACING	823 GRAVEL MILES	1.3 MI GRAV	1029	2575	462,007	1.2 MI GRAV	988	2470	443,167	0.96
1030 DUST PALLITATIVES	823 GRAVEL MILES	0.1 MAN HRS	82	10	13,276	0.1 MAN HRS	82	10	13,276	1.00
1040 SEAL COATING	3 BST MILES	0.3 MILES	1	16	5,785	0.3 MILES	1	16	5,785	1.00
1050 ASPHALT SURFACES	21 BITUM MILES	0.5 TONS MIX	11	6	826	0.5 TONS MIX	11	6	826	1.00
1060 PCC SURFACES	130 PCC MILES	5.0 MAN HRS	651	80	7,808	5.0 MAN HRS	651	80	7,808	1.00
1090 OTHER RDWY/SURFACE	982 TOTAL MILES	1.0 MAN HRS	982	122	15,567	1.0 MAN HRS	982	122	15,567	1.00
1110 DITCH CLEANING	982 TOTAL MILES	0.2 DITCH MI	147	147	11,407	0.2 DITCH MI	147	147	11,407	1.00
1120 RDSIDE VEGETATION	982 TOTAL MILES	4.5 MAN HRS	4420	552	42,835	6.5 MAN HRS	6384	798	61,925	1.45
1190 OTHER RDSIDE	982 TOTAL MILES	2.0 MAN HRS	1964	246	25,240	2.0 MAN HRS	1964	246	25,240	1.00
1210 BRIDGE MTCE	348 SQYD BR/1000	10.0 MAN HRS	3479	435	47,815	10.0 MAN HRS	3479	435	47,815	1.00
1220 CULVERT	982 TOTAL MILES	10.0 MAN HRS	9822	1227	115,665	1.0 MAN HRS	982	123	11,595	0.10
1310 SNOW REMOVAL	982 TOTAL MILES	10.0 MAN HRS	9822	1228	95,293	10.0 MAN HRS	9822	1228	95,293	1.00
1320 SPREAD CHEMICALS	151 PAVED MILES	2.0 MAN HRS	303	32	11,576	2.0 MAN HRS	303	32	11,576	1.00
1390 OTHER SNOW & ICE	982 TOTAL MILES	0.5 MAN HRS	491	61	5,954	0.5 MAN HRS	491	61	5,954	1.00
1410 PAVEMENT MARKINGS	151 PAVED MILES	0.3 MILES	50	5	12,996	0.3 MILES	50	5	12,996	1.00
1420 SIGN MTCE	6189 SIGNS	0.2 MAN HRS	1238	154	17,725	0.2 MAN HRS	928	116	13,352	0.75
1490 OTHER TRAFFIC	982 TOTAL MILES	1.0 MAN HRS	982	123	12,005	0.2 MAN HRS	196	25	2,440	0.20
1500 EQUIP OPERATIONS	982 TOTAL MILES	831.0 DOLLARS	816208	0	805,690	831.0 DOLLARS	816208	0	805,690	1.00
1520 MATER/SUPPL	982 TOTAL MILES	35.0 DOLLARS	34377	0	34,314	35.0 DOLLARS	34377	0	34,314	1.00
1530 ADMIN & ENGR	982 TOTAL MILES	16.0 MAN HRS	15715	1965	143,576	16.0 MAN HRS	15715	1965	143,576	1.00

TOTALS:	DESIRED	ACTUAL
REGULAR TIME MAN DAYS :	11,654	10,360
AVERAGE NO. MEN NEEDED :	47.4	41.4
OVERTIME MAN HOURS :	0	0
REGULAR TIME COST :	$ 2,110,071	$ 1,961,661
OVERTIME COST :	0	0
OVERHEAD 0.0% OF LABOR:	0	0
OVERHEAD 0.0% OF TOTAL:	0	0
T O T A L B U D G E T :	$ 2,110,071	$ 1,961,661

1/ AWQ = Annual Work Quantity
2/ MD = Man-Days

IOWA CITIES

Maintenance responsibility for public roads and streets within corporate limits is designated by the Code of Iowa to the respective city. The extensions of rural state primary highways are also included, although the responsibility is shared with the Iowa DOT. Roads or streets located on the corporate boundary lines are the joint responsibillty of the city and either the county or Iowa DOT. Specific maintenance responsibilities of the respective jurisdictions are defined through formal agreements.

Cities have the authority to reject for maintenance new subdevelopment streets that are not paved or do not meet the city's standards for subdevelopment streets. All of the cities over 5,000 responding to the questionnaire (41) indicated the use of subdevelopment standards for city streets, while less than 50 percent of the smaller cities reported such standards.

Organization

Organizational structures for city street maintenance varies with the size of the city. Cities over 15,000 to 20,000 populations usually have a city engineer or public works director who is responsible for the maintenance of the city streets. Smaller cities down to a population of approximately 1,000 typically have a street superintendent, who is a working superintendent in cities less than 5,000 population. Cities less than 1,000 population may have one to two full-time city employees who perform all related city work, including streets.

Resource Allocations

Over 60 percent of the cities with 5,000 or more population provided information on available personnel and equipment for street maintenance. Only 14 percent of the cities less than 5,000 population returned the questionnaire and cities less than 1,000 typically have part-time street operations. Table 4-14 shows the personnel and equipment availability based on expanded questionnaire responses. Personnel and equipment allocations per lane mile show variations among the three population groups.

Both the questionnaire results and interviews with the 20 sample cities confirmed these differences in operations among the city population groups. However, one factor common to all cities contacted was the opinion their current street maintenance organization and structure, no matter how small, provided better service levels than could be provided by a different jurisdiction. Currently, some of the smaller cities do contract with the county to perform their street maintenance under provisions of Chapter 28, Code of Iowa. Typically reimbursement for maintenance services is based on actual costs, including labor, materials, equipment rental and related contract costs.

TABLE 4-14

IOWA CITIES
Personnel and Equipment Allocations

Population Group	Number Cities	Street Miles	Lane Miles [1/]	Number of Personnel	Lane Miles per Man	Major Equipment Units [2/]	Lane Miles per Equip.Unit
50,000 and greater	8	3,778	11,315	668	16.9	332	34.1
5,000 to 50,000	59	3,053	9,144	693	13.2	777	11.8
Less than 5,000	889	5,429	10,858	1,361	8.0	2,857	3.8
TOTALS	956	12,260	31,317	2,722	11.5	3,966	7.9

SOURCE: City Questionnaire Responses and Iowa DOT (Mileage)

1/ Estimated based on street miles.

2/ Includes pickups, dump trucks, motor graders, dozers, backhoes and loaders.

Maintenance Standards

Questionnaire responses by cities on the use of maintenance service levels to develop maintenance budgets showed 3 of the 5 cities over 50,000 population responding affirmatively, whereas only 35 percent of the remaining cities responded similarly. However, as with the counties, this use was limited to a few maintenance items, such as snow removal and paved surface maintenance.

According to the responses, all cities over 5,000 population require developers to build streets within the subdevelopments to designated design standards; in some cases the developers are also required to share in the cost of providing a collector street to the subdevelopment.

City interviews in the 20 sample cities support the finding that relatively few cities have adopted maintenance standards for street maintenance operations. One area of exception is for snow removal operations, where several cities have established service levels for designated street systems. The recent addition to the Code of Iowa relative to limiting agency liability for damages caused by snow and ice conditions as long as the agency has complied with its formal policy or level of service for snow and ice conditions should result in an increase of formal policies in this area.

The benefits of maintenance standards to effectively plan, budget, schedule, perform and evaluate comprehensive maintenance work programs also apply to cities.

Maintenance Program and Expenditures

City street maintenance expenditures reported by the cities for 1983 totaled $91.6 million dollars as shown in Table 4-15. The total maintenance cost per street mile ranges from $5,512 for cities less than 5,000 population to $9,677 and $8,508 per mile for the other two population groups.

The annual reports on city street maintenance are not as detailed as the county submittals and include several work functions not applicable to rural roads, such as street lighting, street cleaning and storm sewers. With the exception of roadway/surface maintenance, there is considerable inconsistency in the reporting of individual maintenance items, particularly the cities less than 5,000 population.

Using only the roadway/surface portion of the reported maintenace costs shows the followings costs per street mile:

	Roadway/Surface Cost per Mile
50,000 and greater	$ 3,542
5,000 to 50,000	5,212
Less than 5,000	3,540
ALL CITY STREETS	$ 3,957

TABLE 4-15

CITY STREET MAINTENANCE COSTS

By Population Groups
Fiscal Year 1983 (Thousands)

	POPULATION GROUPS			TOTAL	Percent of Total
	50,000 plus	5,000-50,000	Less Than 5,000		
Roadway/Surface	$ 13,380	$ 15,912	$ 19,218	$ 48,510	52.9
Snow & Ice	3,201	1,821	1,880	6,902	7.5
Storm Sewers	1,385	836	439	2,660	2.9
Traffic Services	3,589	1,868	271	5,728	6.3
Street Cleaning	2,437	1,550	840	4,827	5.3
Street Lighting	6,454	5,602	4,828	16,884	18.4
Trees	812	451	159	1,422	1.6
Equipment Purchases	864	1,473	2,082	4,419	4.8
Other Maintenance	20	30	210	260	0.3
TOTAL	$ 32,142	$ 29,543	$ 29,927	$ 91,612	100.0
Cost per Mile (Dollars)	$ 8,508	$ 9,677	$ 5,512	$ 7,472	

SOURCE: PR536, Local Highway Finance Report, 1983

Within the 20 sample cities the range in roadway/surface maintenance costs shows even broader ranges than the three population groups. The following is the low and high value for the sample cities of each group.

	Roadway/Surface Cost per Mile	
	Low	High
50,000 and greater	$ 3,386	$ 5,430
5,000 to 50,000	2,319	5,272
Less than 5,000	975	7,576

Figure 4-5 illustrates the cost per mile for the individual sample cities. However, an average roadway/surface cost per mile can be deceptive, as it does not reflect surface type, number of lanes, number of bridges, or any of the several roadway features that affect the type and amount of maintenance that was performed on the mile of street. However, this cost data supports the information provided during the interviews with the sample cities that maintain the extensions of the state primary system under Section 28 Agreements, that is, it costs more to maintain the primary extensions than the per mile reimbursements. Routine maintenance of the primary extensions includes surface maintenance (except parking lanes), minor roadbed repairs, culverts, guardrails and snow plowing. The payment to the cities for this routine maintenance is $695 per lane mile for fiscal year 1986.1/

Use of Performance Standards

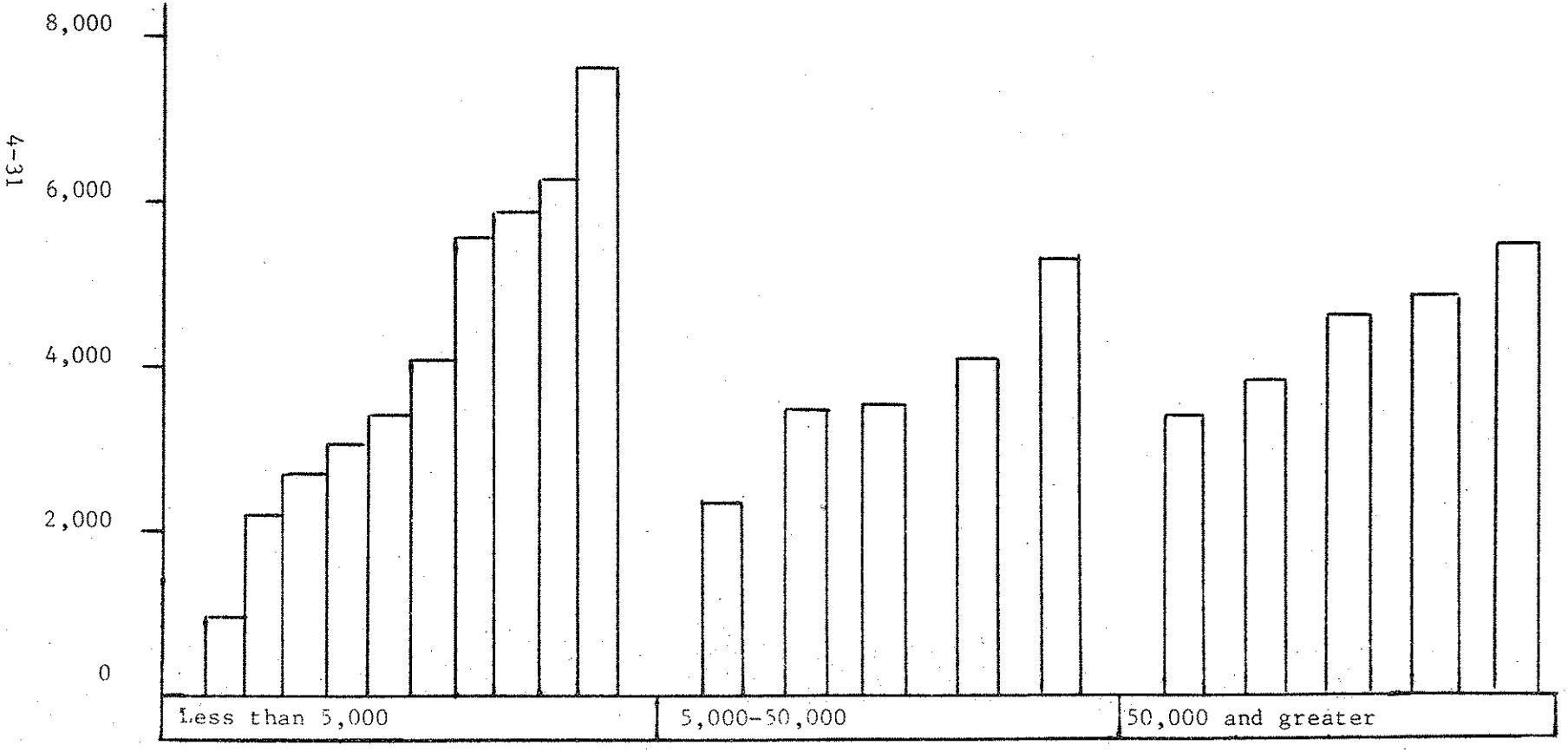
The use of maintenance standards, performance and levels of service, to develop annual maintenance work programs and budgets by the individual cities could provide significant benefits to the cities in their street maintenance operations and programs. Additionally, the cities would have the bases to support requests for additional road user revenues and increases in reimbursement for maintenance of primary extensions. Cities and counties that provide maintenance services to other local jurisdictions typically are reimbursed for actual costs based on a defined level of maintenance service to be provided.

1/ Iowa DOT Commission Order No. H-85-588, May 7, 1985.

FIGURE 4-5

ROADWAY/SURFACE COSTS PER MILE FOR SAMPLE CITIES

Fiscal Year 1983



SOURCE: FR536, Local Highway Finance Report, 1983

CHAPTER FIVE

IMPACT ASSESSMENT OF CONSOLIDATED OPERATIONS AND JURISDICTIONAL CHANGE

The consolidation of government road construction and maintenance operations is closely related to the jurisdictional authority and responsibility for roads. Jurisdictional authority as set forth in Chapter 306 of the Code of Iowa, in essence, gives the designated level of government the authority to set its own course of action (policy) regarding the delivery of construction and maintenance services for the roads under its jurisdiction.

Furthermore, Chapter 28E of the Code of Iowa authorizes public agencies to enter into agreements for construction and maintenance services. To a limited extent, state, county and city jurisdictions utilize this provision of the Code. The Iowa DOT enters into agreements to have some cities perform the state's maintenance for primary road extensions into the cities. The counties and cities enter into agreements for roads and streets on boundary lines and other locations. Some of the smaller cities have agreements with counties to provide the maintenance for all of their streets. To a limited extent, the Iowa DOT and counties utilize Section 28E agreements for maintenance of specific primary or secondary road sections that are the jurisdictional responsibility of the other agency.

Through these agreements, the agencies have determined that it is mutually beneficial and more cost-effective to consolidate the maintenance of certain roads at a level of government not directly responsible for the roads. The Iowa DOT could utilize Chapter 28E and contract with the counties to perform the maintenance and/or construction of the rural state primary system. Likewise, the counties could utilize 28E agreements for the Iowa DOT to maintain the county roads.

Conversely, consolidation of the delivery of government road construction and maintenance services at the state level would most certainly necessitate additional centralization of the authority for roads at that level.

Alternative proposals for the consolidation of operations at any level of government must be analyzed for improvements over the status quo -- for example, better and more responsive service to the public, significant cost savings, and/or more equitable and practical financing. If the improvements of an alternative are significant, it might be adopted as a course of action. Subsequently, relevant authority should be established through jurisdictional change, if necessary, to bring about the most effective alternative.

The assessment presented in this chapter includes seven possible alternatives each presented as a section. The alternatives are:

1. Services for the county farm-to-market/federal-aid secondary system roads under the Iowa DOT.

2. Services for all rural roads under the Iowa DOT.

3. Services for all public roads and streets under the Iowa DOT.

4. County maintenance of the rural state primary system.

5. City maintenance of urban primary system extensions (5,000 population and over).

6. County maintenance of city streets (less than 5,000) population.

7. Maintenance by private contractors.

The first three alternatives relate to degrees of consolidation at the state level and would require additional jurisdictional authority at the state level for their implementation. The remaining four could be implemented under the current Code of Iowa.

FARM-TO-MARKET/FAS TO THE STATE

Under this alternative, approximately 12,523 miles of Federal-aid secondary (FAS) roads currently on the 29,401-mile county farm-to-market system would become the responsibility of the State. This transfer would increase the construction and maintenance responsibility of the Iowa Department of Transportation from 10,105 miles to 22,628 miles, an increase of 124 percent.

Construction

In 1982 and 1983 the counties reported local expenditures of $11.7 million and $12.8 million respectively, for construction on the farm-to-market system. These amounts do not include any Farm-to-Market Funds or Federal-aid secondary construction funds administered by the Iowa DOT and expended on Farm-to-Market/ Federal-aid secondary (FM/FAS) road construction.

Total 20-year road and bridge construction and other improvement needs for the rural trunk and trunk collector systems are reported in the 1982 Needs Report at $3,937 million or $196.9 million annually. Based on these costs and the systems mileage, the average construction cost per mile for these two systems is $128,000. The 20-year construction needs for the FM/FAS system of 12,523 miles would be $1,603 million or an average annual cost of $80.1 million. Comparable construction needs for the existing state primary system are $4,494 million. The additional FM/FAS construction needs represent an approximate increase of 35 percent in current state primary construction needs.

Using the $36.8 million annual maintenance cost for 1985 and the average annual construction need of $80.1 million, provides a total of $116.9 million annual requirements for construction and maintenance of the FM/FAS system. (This amount is conservative as the annual maintenance costs will not remain constant.)

Road Use Tax Fund (RUTF) revenues allocated to the entire 29,401-mile Farm-to-Market Fund were $35.5 million in fiscal year 1984. Average annual RUTF revenue projections to this fund for the period 1985-1990 are $42.3 million. These allocations are for construction and

reconstruction of the farm-to-market system and are far short of the estimated $80.1 million annual construction requirements. The deficit of $37.8 million (80.1 needs - 42.3 revenues) plus annual maintenance requirements of $36.8 million, results in a $74.6 million shortfall for construction and maintenance of the FM/FAS systems. And without adequate construction monies, annual maintenance costs for these roads will most certainly increase at an accelerated rate.

Maintenance Resources

The maintenance planning model was used to develop an estimate of the maintenance work program and budget requirements for the additional 12,523 miles. The 31 work activities used for analyzing the maintenance of the state primary system in Chapter 4 were modified to reflect maintenance work required for this portion of the FAS system. Some work activities were deleted, and others added for the 2,040 miles of gravel and earth roads included in the 12,523 miles.

Maintenance service levels were established by using the average statewide primary system values, with adjustments to reflect lower service levels. Table 5-1 shows the estimated maintenance work program and budget developed for the additional 12,523 miles. Total annual maintenance costs for these roads would be $36.8 million--an average cost of $2,937 per road mile. This maintenance work program would require the following increases in Iowa DOT resources:

- 981 field maintenance personnel,
- 95 pickups,
- 295 dump trucks,
- 117 motor graders, and
- 135 other major equipment units.

Physical Facilities

The Iowa DOT currently has 137 maintenance areas throughout the state for 1,593 field personnel and 2,433 major equipment units, including dump trucks. These facilities would require expansion to accommodate the additional 981 personnel and 642 major equipment units required for maintenance of the FM/FAS by the Iowa DOT. And larger buildings and garages require additional facilities maintenance.

Personnel Recruitment and Training

Employing additional staff in any organization, requires a recruitment and training effort. Although some of the additional staff may be available for transfer from existing county road organizations, some new personnel may be required. All personnel will need to be trained in Iowa DOT procedures.

Other Costs

In addition to the transitional costs for personnel and physical facilities, there are other significant costs associated with the consolidation of services and jurisdictional transfer of this magnitude.

TABLE 5-1

MAINTENANCE REQUIREMENTS FOR FM/FAS ROADS

WORK PROGRAM AND BUDGET FOR FY 1985

MAINTENANCE MANAGEMENT SYSTEM

DATE: 04/02/85 DeLEUW, CATHER & COMPANY FM-FAS IDOT

TIME: 14:15

	ACTIVITY	FEATURE INVENTORY	SERVICE LEVEL	AMT	AVG PROD	CREW DAYS	CREW SIZE	MAN DAYS	COST DISTRIBUTION LABOR	EQUIPMENT	MATERIAL	TOTAL COST
1010	SURFACE PATCHING	19957 PAVED LANE MI	0.50 TONS	9979	5.0	1996	5	9980	704,189	304,669	359,280	1,368,138
1020	MACHINE PATCHING	19957 PAVED LANE MI	0.60 TONS	11974	100.0	120	15	1800	132,960	144,125	203,796	480,881
1030	JOINT/CRACK FILL	19957 PAVED LANE MI	0.16 100 GAL	3193	2.5	1277	7	8939	646,673	220,461	383,100	1,250,234
1040	SEAL COAT	12986 ASPH LANE MI	1.50 SYDS/10	19479	52.8	369	10	3690	266,270	364,690	682,650	1,313,611
1050	BLADE UNPAV SURF	2041 GRAVEL MI	40.00 MI BLAD	81620	5.0	16324	1	16324	1,266,742	2,239,653	0	3,506,395
1060	GRANULAR SURFACING	2041 GRAVEL MI	1.75 MI GRAV	3571	2.0	1785	5	8925	676,872	689,296	870,188	2,236,355
1070	DUST PALLIATIVES	2041 GRAVEL MI	0.10 MAN HRS	204	16.0	13	2	26	2,018	992	32,500	35,510
1090	OTHER SURFACE	19957 PAVED LANE MI	2.00 MAN HRS	39915	24.0	1663	3	4989	357,878	222,044	332,600	912,521
1110	REPAIR AGGR SHLDRS	25046 UNPAV SHLDR M	10.00 TONS MA	250460	100.0	2505	4	10020	777,552	764,726	413,325	1,955,603
1120	SHLDR MOWING	31451 MOW SHLDR ACR	2.00 ACRES	62901	76.0	828	4	3312	227,866	182,822	0	410,688
1130	BLADE SHLDRS	25046 UNPAV SHLDR M	1.25 MAN HRS	31308	8.0	3913	1	3913	303,649	536,864	0	840,512
1190	OTHER SHLDR	25046 TOT SHLDR MI	0.50 MAN HRS	12523	40.0	313	4	1252	93,900	145,207	15,650	254,757
1200	RDSIDE MOWING	23187 DITCH MI	2.00 MAN HRS	46374	32.0	1449	4	5796	398,765	319,939	0	718,704
1210	RDSIDE SPRAYING	23187 DITCH MI	0.20 100 GAL	4637	4.0	1159	2	2318	169,678	88,455	394,060	652,193
1290	OTHER RDSIDE	12523 CL MILES	3.00 MAN HRS	37569	24.0	1565	3	4695	336,788	119,441	125,200	581,429
1300	CLEAN/RESTORE DITH	23187 DITCH MI	10.00 CU YDS	231872	260.0	892	5	4460	328,970	380,242	0	709,211
1310	CULVERT MTCE	1135 CULVERT/100	30.00 MAN HRS	34041	40.0	851	5	4255	313,849	224,119	63,825	601,793
1390	OTHER DRAINAGE	23187 DITCH MI	0.40 MAN HRS	9275	24.0	386	3	1158	83,067	29,460	19,300	131,827
1400	PAVEMENT MARKINGS	9979 PAVED MI	1.00 MILES	9979	42.0	238	7	1666	124,712	89,431	606,900	821,043
1410	SIGN MTCE	236 SIGNS/100	35.00 MAN HRS	8320	24.0	347	3	1041	74,674	26,483	58,990	160,147
1430	TRAFFIC CONT MTCE	19957 PAVED LANE MI	4.00 MAN HRS	79829	32.0	2495	4	9980	686,624	99,800	49,900	836,324
1490	OTHER TRAFFIC	12523 CL MILES	2.50 MAN HRS	31308	32.0	978	4	3912	277,752	149,282	78,240	505,274
1500	SNOW REMOVAL	19957 PAVED LANE MI	9.00 MAN HRS	179616	256.0	702	32	22464	1,607,299	1,600,448	351,000	3,558,747
1510	CHEM/ABRASIVES	19957 PAVED LANE MI	0.25 MAN HRS	4989	16.0	312	2	624	44,304	58,793	312,000	415,097
1520	PLOW SNOW/GRAVEL RDS	2041 GRAVEL MI	5.00 MAN HRS	10203	8.0	1275	1	1275	87,720	174,930	0	262,650
1590	OTHER SNOW	19957 PAVED LANE MI	2.00 MAN HRS	39915	160.0	249	20	4980	342,624	380,074	74,700	797,398
1600	BRIDGE MTCE	4582 SQYD BR/1000	17.70 MAN HRS	81100	56.0	1448	7	10136	746,010	289,392	289,600	1,325,001
1650	BRIDGE INSPECT	4582 SQYD BR/1000	15.70 MAN HRS	71936	40.0	1798	5	8990	863,040	182,533	35,960	1,081,533
1800	OTHER MTCE	12523 CL MILES	10.00 MAN HRS	125230	80.0	1565	10	15650	1,123,044	858,522	234,750	2,216,316
1850	SUPERV/SUPPORT	19957 PAVED LANE MI	15.00 MAN HRS	299360	240.0	1247	30	37410	3,032,704	349,160	1,122,300	4,504,164
1900	AUTHZ LEAVE	12523 CL MILES	20.00 MAN HRS	250460	80.0	3131	10	31310	2,339,483	0	0	2,339,483

UNIT TOTALS FOR FM-FAS IDOT

REGULAR TIME COST:	$ 36,783,544	REGULAR TIME MAN DAYS:	245,290	LABOR COST:	$ 18,437,676 (50.1 PERCENT)
OVERTIME COST:	0			EQUIPMENT COST	$ 11,236,052 (30.5 PERCENT)
OVERHEAD 0.0% OF LABOR:	0	AVERAGE NO. MEN NEEDED:	981.2	MATERIAL COST:	$ 7,109,814 (19.3 PERCENT)
OVERHEAD 0.0% OF TOTAL:	0				
		OVERTIME MAN HOURS:	0		
TOTAL BUDGET:	$ 36,783,544				

Included are up-front costs to acquire and administer the additional major equipment units, parts, supplies, and materials stockpiles, only partially reflected in the maintenance budget estimate.

Maintenance Service Level

Within the priority structure of the state primary system, the FM/FAS roads would have the lowest priority level of the primary system.

Currently, the counties place first priority on the paved roads of the farm-to-market system for snow and ice control. Consequently, these roads are often treated before low priority, state primary roads in the same area. Without judging the appropriateness of the service levels provided by the two jurisdictions, the FM/FAS roads would probably not receive the same level of service for snow and ice control maintenance as currently provided. Reduced maintenance service levels could occur for other maintenance work, as well, because of the new relative priority of the FM/FAS system. Also, the public would be removed one more level of government in establishing accountability for service levels on these roads.

Financial Requirements

Additional financial requirements for construction and maintenance needs on the FM/FAS system, demonstrated that current allocations to the total farm-to-market system were not adequate for the construction and improvement needs associated with only the FM/FAS portion. Therefore, additional revenues would be required from some source to meet the shortfall. Currently, the counties provide revenues from local sources to supplement the RUTF allocations. The existing state primary system, however, is funded from state and federal revenue sources, primarily road user taxes on motor vehicles and motor vehicle fuel. Legislators are not inclined to allocate funds from other sources to state road systems, because of economic needs in other areas. The practicable financial alternatives amount to: (1) a further relative reduction in the state road programs, or (2) an increase in the motor vehicle user taxes.

Impact on County Road Programs

The removal of 12,523 miles from the county secondary system (which totals 98,687 miles) may appear insignificant in that it is only approximately 125 miles per county and will relieve the counties of this construction and maintenance responsibility. However, the counties would still have the same types of maintenance responsibilities, albeit reduced in scope. Paved surface maintenance would be reduced by approximately 70 percent, but 3,945 miles of paved roads would remain on the secondary road system to be maintained by the counties. This would be an average of approximately 40 miles per county, versus the current average of 140 miles per county.

The maintenance impact on a sample rural and urban county was analyzed by using the maintenance planning and budgeting model described in a previous chapter. The two counties used to develop the example maintenance work program and budget in Chapter 4 were also used to illustrate the effect on the maintenance requirements by transferring the FM/FAS miles to the Iowa DOT. The FM/FAS miles and related maintenance features were removed from the two counties' road inventories and the maintenance work program and budget recalculated. The service level for each maintenance activity remained constant. Tables 5-2 and 5-3 show the new work program and budget, respectively, for the urban and rural counties without the FM/FAS miles. Table 5-4 compares annual maintenance costs and requirements for personnel and equipment for the two sample counties.

Removal of the FM/FAS miles from the two counties reduces the total maintenance costs, but increases the average cost per mile for the remaining county secondary miles. Most of the reductions occur on the paved mileage, but each county still would have paved surface to maintain. The reductions in personnel and equipment would also be minimal.

Other impacts related to the efficient utilization of resources are not reflected in the cost comparisons contained in Table 5-4. Typically the routine maintenance workload for less than 100 miles of paved roads can present problems in the scheduling and consequently the utilization of resources and maintenance crew productivity. Clearly an average of 40 miles of paved road per county is less efficient. More importantly, the valuable local engineering knowledge and administrative talent of the county engineers would be under utilized. Maintenance, in general and particularly the efficient maintenance of pavements requires qualified management close to the work.

ALL RURAL ROADS TO THE STATE

Transfer of maintenance and construction responsibility for 89,687 miles of county secondary roads to the Iowa DOT would be a major undertaking, even if it were politically feasible. The first alternative can be considered a step in the direction of this second alternative. And, all of the impacts related to the first alternative would be magnified under this alternative. There is one exception. Road organizations would no longer exist within the county governments. This degree of consolidation must be reached to begin to consider the apparent reorganizational benefits of consolidation. The arguments set forth in the Governor's Blue Ribbon Transportation Task Force Report for the consolidation of operations, particularly maintenance operations,are:

1. There are inefficiencies and duplication of resources in the current government organization for the delivery of road maintenance services; and

2. The consolidation of these services at one level of government can bring about substantial cost savings and improvements in operations.

FIGURE 5-2

MAINTENANCE REQUIREMENTS FOR SAMPLE URBAN COUNTY
WITHOUT FM/FAS MILES

WORK PROGRAM AND BUDGET FOR FY 1985 — PAGE: 1

MAINTENANCE MANAGEMENT SYSTEM

DATE: 04/17/85
TIME: 08:20

DeLEUW, CATHER & COMPANY

ACTIVITY	FEATURE INVENTORY	SERVICE LEVEL	AWD	AVG PROD	CREW DAYS	CREW SIZE	MAN DAYS	COST DISTRIBUTION LABOR	EQUIPMENT	MATERIAL	TOTAL COST
1010 BLADE UNPAV SURF	506 UNPAVED MI	60.00 MI BLAD	30342	5.0	6068	1	6068	470,877	0	0	470,877
1020 GRANULAR SURFACING	503 GRAVEL MILES	1.75 MI GRAV	881	2.0	440	5	2200	180,224	0	214,500	394,724
1030 DUST PALLITATIVES	503 GRAVEL MILES	0.10 MAN HRS	50	16.0	3	2	6	466	0	7,500	7,966
1040 SEAL COATING	37 BST MILES	1.50 MILES	55	0.5	110	8	880	70,664	0	247,500	318,164
1050 ASPHALT SURFACES	135 BITUM MILES	4.00 TONS	538	5.0	108	3	324	25,142	0	19,440	44,582
1060 PCC SURFACES	9 PCC MILES	100.00 MAN HRS	920	32.0	29	4	116	9,002	0	2,320	11,322
1090 OTHER RDWY/SURFACE	688 TOTAL MILES	1.75 MAN HRS	1204	16.0	75	2	150	23,280	0	7,500	30,780
1110 DITCH CLEANING	688 TOTAL MILES	0.60 DITCH M	413	1.0	413	4	1652	128,195	0	0	128,195
1120 RDSIDE VEGETATION	688 TOTAL MILES	45.00 MAN HRS	30964	32.0	968	4	3872	300,467	0	0	300,467
1190 OTHER RDSIDE	688 TOTAL MILES	10.00 MAN HRS	6881	16.0	430	2	860	66,736	0	21,500	88,236
1210 BRIDGE MTCE	461 SQYD BR/1000	12.50 MAN HRS	5768	40.0	144	5	720	58,982	0	20,160	79,142
1220 CULVERT	688 TOTAL MILES	10.00 MAN HRS	6881	24.0	287	3	861	66,814	0	14,350	81,164
1310 SNOW REMOVAL	688 TOTAL MILES	14.00 MAN HRS	9633	8.0	1204	1	1204	93,430	0	0	93,430
1320 SPREAD CHEMICALS	144 PAVED MILES	2.00 MAN HRS	288	9.6	30	1	30	2,794	0	15,000	17,794
1390 OTHER SNOW & ICE	688 TOTAL MILES	5.00 MAN HRS	3441	16.0	215	2	430	33,368	0	6,450	39,818
1410 PAVEMENT MARKINGS	144 PAVED MILES	0.67 MILES	96	10.0	10	1	10	992	0	25,000	25,992
1420 SIGN MTCE	4477 SIGNS	1.20 MAN HRS	5372	16.0	336	2	672	52,147	0	25,200	77,347
1490 OTHER TRAFFIC	688 TOTAL MILES	4.00 MAN HRS	2752	8.0	344	1	344	26,694	0	10,320	37,014
1500 EQUIP OPERATIONS	688 TOTAL MILES	1990.00 DOLLARS	1369319	6255.0	219	0	0	0	1,366,560	0	1,366,560
1520 MATER/SUPPL	688 TOTAL MILES	18.00 DOLLARS	12386	60.0	206	0	0	0	0	12,772	12,772
1530 ADMIN & ENGR	688 TOTAL MILES	40.00 MAN HRS	27524	40.0	688	12	8256	603,238	0	0	603,238

UNIT TOTALS

REGULAR TIME COST:	$ 4,229,585	REGULAR TIME MAN DAYS:	28,455	LABOR COST:	$ 2,213,513 (52.3 PERCENT)
OVERTIME COST:	0			EQUIPMENT COST	$ 1,366,560 (32.3 PERCENT)
OVERHEAD 0.0% OF LABOR:	0	AVERAGE NO. MEN NEEDED:	114.6	MATERIAL COST:	$ 649,512 (15.4 PERCENT)
OVERHEAD 0.0% OF TOTAL:	0				
		OVERTIME MAN HOURS:	0		
TOTAL BUDGET:	$ 4,229,585				

FIGURE 5-3

MAINTENANCE REQUIREMENTS FOR SAMPLE RURAL COUNTY
WITHOUT FM/FAS MILES

WORK PROGRAM AND BUDGET FOR FY 1985 — PAGE: 2

MAINTENANCE MANAGEMENT SYSTEM

DATE: 04/17/85
TIME: 08:21

DeLEUW, CATHER & COMPANY

ACTIVITY	FEATURE INVENTORY	SERVICE LEVEL	AWD	AVG PROD	CREW DAYS	CREW SIZE	MAN DAYS	COST DISTRIBUTION LABOR	EQUIPMENT	MATERIAL	TOTAL COST
1010 BLADE UNPAV SURF	828 UNPAVED MI	22.42 MI BLAD	18560	7.5	2475	1	2475	192,060	0	0	192,060
1020 GRANULAR SURFACING	823 GRAVEL MILES	1.20 MI GRAV	988	2.0	494	5	2470	202,342	0	240,825	443,167
1030 DUST PALLITATIVES	823 GRAVEL MILES	0.10 MAN HRS	82	16.0	5	2	10	776	0	12,500	13,276
1040 SEAL COATING	2 BST MILES	0.25 MILES	1	0.5	1	8	8	642	0	2,250	2,892
1050 ASPHALT SURFACES	6 BITUM MILES	0.50 TONS MI	3	5.0	1	3	3	233	0	180	413
1060 PCC SURFACES	46 PCC MILES	5.00 MAN HRS	229	32.0	7	4	28	2,173	0	560	2,733
1090 OTHER RDWY/SURFACE	883 TOTAL MILES	1.00 MAN HRS	883	16.0	55	2	110	8,536	0	5,500	14,036
1110 DITCH CLEANING	883 TOTAL MILES	0.15 DITCH M	132	1.0	132	1	132	10,243	0	0	10,243
1120 RDSIDE VEGETATION	883 TOTAL MILES	6.50 MAN HRS	5737	8.0	717	1	717	55,639	0	0	55,639
1190 OTHER RDSIDE	883 TOTAL MILES	2.00 MAN HRS	1765	16.0	110	2	220	17,072	0	5,500	22,572
1210 BRIDGE MTCE	313 SQYD BR/1000	10.00 MAN HRS	3126	40.0	78	5	390	31,949	0	10,920	42,869
1220 CULVERT	883 TOTAL MILES	1.00 MAN HRS	883	24.0	37	3	111	8,614	0	1,850	10,464
1310 SNOW REMOVAL	883 TOTAL MILES	10.00 MAN HRS	8826	8.0	1103	1	1103	85,593	0	0	85,593
1320 SPREAD CHEMICALS	52 PAVED MILES	2.00 MAN HRS	104	9.6	11	1	11	1,229	0	2,750	3,979
1390 OTHER SNOW & ICE	883 TOTAL MILES	0.50 MAN HRS	441	8.0	55	1	55	4,268	0	1,100	5,368
1410 PAVEMENT MARKINGS	52 PAVED MILES	0.33 MILES	17	10.0	2	1	2	198	0	5,000	5,198
1420 SIGN MTCE	5401 SIGNS	0.15 MAN HRS	810	16.0	51	2	102	7,915	0	3,825	11,740
1490 OTHER TRAFFIC	883 TOTAL MILES	0.20 MAN HRS	177	8.0	22	1	22	1,707	0	440	2,147
1500 EQUIP OPERATIONS	883 TOTAL MILES	831.00 DOLLARS	733441	314.0	2336	0	0	0	724,160	0	724,160
1520 MATER/SUPPL	883 TOTAL MILES	35.00 DOLLARS	30891	133.3	232	0	0	0	0	30,856	30,856
1530 ADMIN & ENGR	883 TOTAL MILES	16.00 MAN HRS	14122	24.0	588	3	1764	128,890	0	0	128,890

UNIT TOTALS

REGULAR TIME COST:	$ 1,808,296	REGULAR TIME MAN DAYS:	9,733	LABOR COST:	$ 760,080 (42.0 PERCENT)
OVERTIME COST:	0			EQUIPMENT COST	$ 724,160 (40.0 PERCENT)
OVERHEAD 0.0% OF LABOR:	0	AVERAGE NO. MEN NEEDED:	38.9	MATERIAL COST:	$ 324,056 (17.9 PERCENT)
OVERHEAD 0.0% OF TOTAL:	0				
		OVERTIME MAN HOURS:	0		
TOTAL BUDGET:	$ 1,808,296				

Figure 5-4

COMPARISON OF ANNUAL MAINTENANCE REQUIREMENTS
WITH AND WITHOUT FM/FAS MILEAGE

Sample Urban and Rural County

URBAN COUNTY	WITH FM/FAS MILEAGE	WITHOUT FM/FAS MILEAGE
Maintenance Cost	$4,888,385	$4,229,585
Average Cost Per Mile	6,271	6,512
Paved Road Miles	273.0	143.8
Unpaved Road Miles	506.5	505.7
Personnel Required	131	115
Major Equipment Units	99	89
RURAL COUNTY		
Maintenance Cost	$1,961,661	$1,808,296
Average Cost Per Mile	2,003	2,056
Paved Road Miles	151.4	51.8
Unpaved Road Miles	827.8	827.8
Personnel Required	42	39
Major Equipment Units	71	66

Our findings, based on an examination of state and county maintenance organizations indicate:

1. There is very little duplication of either resources or work effort among the maintenance organizations. There is functional duplication--that is, all levels of government purchase and maintain equipment, employ personnel, etc. Functional or administrative consolidation would represent a small savings, if any net savings could be realized. For example, it might be possible to centralize equipment maintenance workshops as a result of consolidation. Centralization alone does not ensure that equipment maintenance would cost less. However, assume that some efficiencies could be realized. Would the cost savings from these efficiencies offset the upfront costs of upgrading workshops and the other transitional costs? The answer to this questions is "no" considering the current efficiency of equipment maintenance operations of the counties and the state. Furthermore, road maintenance intrinsically involves decentralized activities at changing work sites. If the resources (manpower, equipment and materials) are close to the work sites, the maintenance work is generally more responsive and cost-effective.

2. The consolidation of maintenance operations would result primarily in a transfer of costs and not a significant savings in costs related to the elimination of any apparent duplication.

3. There is improvement potential in the current maintenance operations at all levels of government. This potential for improvements is more discernable at the state level, because the state maintenance organization has better records than the county organizations. However, this potential for improvement is minimally related to organizational change. It is related to operational improvements which can be realized within current organizational arrangements.

The broad consolidation represented by this alternative would carry many risks. The minimum real cost savings potential versus the potential for increased costs during the reorganization period as well as the potential for decreased utilization of resources during the transition must be considered. Furthermore, the overall potential for a relative decrease in road revenues could tend to raise the overall transport costs in the highway sector in Iowa.

Revenues from local sources would not be available under the current Iowa Code to fund a state administered road program of this magnitude and revenues from motor vehicle users might not be increased sufficiently to fund a road program of approximately 100,000 miles.

Observation of experience in other states where all rural roads are within the state's jurisdiction, demonstrate it is the local road systems and programs that ultimately suffer the most when available revenues are inadequate. And, it is recognized that legislative bodies are not receptive to the substitution of motor vehicle user funding for losses of non-user (local) funding.

ALL PUBLIC ROADS AND STREETS TO THE STATE

Assigning all public roads and streets to the state would produce all of the impacts identified under the second alternative. These impacts would be extended to all the city construction and maintenance operations. In particular, the issue of having a relevant level of governmental authority for operations and related accountability to the public is important. Additionally, Iowa cities currently provide revenues from local sources, including bond issues, for city street maintenance and construction. The lack of these revenues would be devastating to the city street programs.

COUNTY MAINTENANCE OF STATE PRIMARY SYSTEM

The fourth alternative for consolidated maintenance operations, involves the use of maintenance agreements between the Iowa DOT and individual counties. The counties would maintain the state rural primary roads within their boundaries. The Code of Iowa currently authorizes these types of agreements (Chapter 28E), but to date, there have been no such agreements between the Iowa DOT and the counties, except for limited state primary sections.

The state primary system mileage of 10,105 varies in magnitude from county to county, with a high of 313 miles and a low of 44 miles. Maintenance of the primary system currently is performed by Iowa DOT personnel assigned to 137 maintenance areas plus specialized district-wide crews for each of the six field districts. Extensions of the rural primary system are also maintained by these personnel, except for the segments covered by the 34 city maintenance agreements (fiscal year 1984).

The states of Michigan and Wisconsin make extensive use of the county road organizations to maintain the state highway system. Basically, the counties are maintenance contractors to the state. The maintenance work is defined in the contract and reimbursement is made for actual costs, including overhead items, labor, equipment and materials as specified in the contract.

The application of this approach in Iowa is currently feasible under the Code. However, this approach is basically the same as the Iowa DOT contracting with private sources to provide all routine maintenance. Previous efforts with contract maintenance by the Iowa DOT did not prove to be successful, except for a limited number of maintenance activities where the work could be specifically defined and quantified.

In order for the counties to provide maintenance services for the state primary system within their county, it would be necessary for them to increase manpower and equipment resources, as well as to expand central maintenance garage facilities. The majority of the twelve counties interviewed indicated that they would be able to maintain the state primary routes, provided they had the additional resources. However, none of the twelve counties expressed the desire, or need, to contract for this additional maintenance workload. The consensus of the counties

indicates the existing jurisdictional maintenance responsibilities of the counties and the Iowa DOT are satisfactory. Notwithstanding opinion, other impacts and implications related to county maintenance of the state primary system were assessed. These are addressed in the following sections.

Transitional Costs

The initial costs associated with a county contracting to maintain the state primary roads in the county could be significant. Based on current personnel and equipment usage by the Iowa DOT, every 100 lane miles of state primary maintenance would, on the average, require an additional 6.5 men and 10.0 major equipment units. Equipment storage and maintenance facility modification and/or expansion would represent a major upfront cost.

A majority of the existing county maintenance garages would require expansion to provide adequate storage and repair facilities. The existing Iowa DOT maintenance area facilites in the counties would not be readily adaptable for county use in most counties because of their location. For all, except the largest counties, one major maintenance garage location would be adequate.

Personnel and Training

Additional maintenance personnel would range from 10 to 40 per county, depending on the number of lane miles to be maintained and the total workload to be performed. Qualified maintenance personnel and equipment operators would need to be recruited or new personnel hired and trained. While some of the additional staffing could be available from the existing state maintenance organization, experience shows personnel are reluctant to accept these types of transfers unless salary and other fringe benefits are equivalent.

Equipment Acquisition/Costing

Equipment requirements to maintain the state primary system would range from 10 to 60 additional major equipment units per county which includes 5 to 25 additional dump trucks. Currently, county equipment purchases are included as a separate item in the annual maintenance budget, as are equipment operations and repair costs; few, if any, counties utilize equipment revolving funds and rental rates as the basis for equipment replacement.

Major motorized equipment units used by the Iowa DOT for maintenance are funded through a revolving fund, and equipment rental rates are based on usage. Minor equipment, costing less than $1,000 per unit, is charged directly to the user; whereas other equipment costing $1,000 or more, and not assigned an equipment rental rate, is charged to the user as a monthly cost over a five-year period.

A typical county would require a relatively major investment for new and replacement equipment purchases necessary to maintain the state primary system. Few, if any, counties could finance these purchases with the revenues currently available to them. Additionally, to administer contracts they would be required to develop a costing system and rental rates, or other equipment cost reimbursement system agreed to by the Iowa DOT.

Annual Maintenance Work Program

The annual maintenance work program for the state primary system in the county would require defining the work to be performed in a manner similar to that currently used by the Iowa DOT. This requires the use of maintenance standards--performance and levels of service--as well as maintenance feature inventories. The counties would need to administer the maintenance agreements consistent with the work programs and budgets which would likely become a part of the agreements. This is not meant to imply that the use of maintenance standards and annual work programs is an undesirable element. It would, however, be a procedural change for the counties and there would be associated costs.

Inspection of Accomplished Maintenance

The inspection of contract maintenance work presents unique problems and varies considerably from inspection of construction work. The Iowa DOT is familar with these problems through previous contract maintenance efforts. While some problems encountered with private contractors, such as lack of responsiveness and familiarity with the work might not occur with county maintenance organizations, there is still the difficulty of quantifiable work measurements for a number of maintenance activities. Even the current maintenance work program utilized by the Iowa DOT uses only manhours for reporting the work accomplished for several work activities.

The extent of field inspections for contract maintenance work in progress and accomplished, can be minimal or a major task depending upon the contractor's past performance, the activities underway and other circumstances. In one state where counties contract to maintain the state highway system, the state DOT representative indicated the state performed minimal inspection of the work performed by the county and there was a high degree of "trust" between the State DOT and the counties. Nevertheless, contract administration in addition to inspection would represent some additional cost to the overall process.

Contracting and Reimbursement

Contracting with the counties to maintain the state primary system would require the development of a standard contract that defined the types and amounts of services to be provided, as well as the method of reimbursement. One state that uses counties to maintain the state system provides reimbursement on the basis of specified unit costs for labor, equipment and materials. Allowable overhead items are clearly defined

and specified in the contract. The counties are guaranteed 90 percent of the contract amount, plus there is provision for a 10 percent overrun. Contract counties may request an advance partial payment for routine maintenance to be performed in the amount of 12.5 percent of the current fiscal year budget. This advance is not recovered by the State, but carried forward and adjusted for the next fiscal year--unless the county invoice is not received within 30 days of the ending of the monthly reporting period. Ten full-time state auditors are assigned to audit the counties' (62) financial records to ensure compliance with the state maintenance contract and the accuracy of the maintenance reimbursement request.

Contracting on the basis of a defined maintenance work program provides the parameters of the work to be performed and an equitable basis for reimbursement.

Levels of Service

With the necessary additional resources based on the established maintenance workload for the state primary miles, the counties would be able to provide the same levels of maintenance service currently provided by the Iowa DOT. However, highway and road system priorities could cause problems in the performance of specific work activities, such as snow removal. Although one agency would be performing the maintenance of all highways and roads, there would still be two separate and distinct systems--the state system and the county system. Jurisdictional responsibility of the state primary system would remain with the state and responsiveness and priorities would need to be carefully spelled out in the agreement.

Impact on State Highway Programs

The annual state highway maintenance program performed by the Iowa DOT would be eliminated, or reduced severely, in those counties contracting to maintain the state primary roads. The Iowa DOT would probably need to retain the district-wide crews that perform specialized maintenance work, such as major bridge repairs. While the total maintenance workload performed by the state would be reduced in proportion to the number of counties contracting to maintain the state primary system, it is unlikely that all of the counties would or could accept this additional maintenance responsibility. Therefore, the Iowa DOT would still be required to retain field maintenance capability and adequate resources.

The quality and amount of maintenance work performed directly affects the current and future state primary improvement and rehabilitation program. Experience has demonstrated that inadequate maintenance increases physical deterioration and accelerates the time schedule for major rehabilitation.

Contracting maintenance of the state primary miles to the counties will not reduce total maintenance costs to the state--unless the counties can

perform the same level of maintenance at lower unit costs. In fact, overall maintenance costs, could increase due to additional maintenance inspection and contract administration requirements by the state.

Consolidating maintenance operations, case by case, through mutual investigation and agreement would present less risk than any sweeping consolidation change. Those state primary system maintenance operations with low mileage or very few personnel would be potential candidates for consolidation either through 28E agreements with the county maintenance organization or within the current state organization itself. These would need to be examined on a case by case basis for feasibility.

CITY MAINTENANCE OF URBAN PRIMARY EXTENSIONS

State primary urban extensions total 1,351 miles. The state and cities have joint responsibility for these extensions. State maintenance responsibility is limited to the surface, curb to curb features (excluding parking signs and parking lanes), traffic signs, pavement markings, bridges and snow removal from the traffic lanes. Other street maintenance, including the removal of windrowed snow, sidewalks and all areas between the curb and the right of way line are the responsibility of the city.

Currently, the Iowa DOT has maintenance agreements with 34 cities for maintenance of the state's responsibility on all, or a portion of the primary extensions. Approximately 200 miles, or 15 percent, of the primary extensions are maintained by the cities under maintenance agreements. Of the cities providing maintenance of the primary extensions, 31 have populations of 5,000 or more. Although this is 31 of the total 67 cities over 5,000 population, several cities only maintain a portion of the primary extension mileage. Frequently, the primary extension mileage maintained by the city consists only of segments in the downtown business area where the city would be required to haul the snow from the street in any event.

Although three cities of less than 5,000 population perform contract maintenance of state primary extensions, the majority of the cities of this size do not have the organization or resources to provide additional maintenance services. It would not be feasible or economical for these cities to attempt maintenance of the primary extensions. The majority of the cities have only one or two state primary extensions within the corporate limits. Since most of the primary extensions continue through the city, maintenance by the Iowa DOT provides a continuous primary route segment from the rural portion, through the city and back to a rural section. This route continuity is beneficial for some maintenance operations, such as snow removal, and can be provided by the state maintenance personnel with minimal additional effort. Therefore, assessment of cities maintaining the extensions of the state primary system has been limited to cities over 5,000 population.

Of the 1,351 miles of urban primary extensions, approximately 700 miles are in cities over 5,000 population. Currently, approximately 200 miles are maintained by the cities in this group. Thus, potentially the remaining 500 miles could be maintained by the respective cities. The impacts associated with this additional maintenance responsibility are addressed in the following sections.

Resource Requirements

Currently city personnel and equipment resources are utilized exclusively on current street maintenance functions. Additional resources would be required for cities to contract with the state to maintain the primary municipal extensions. The cities currently have partial maintenance responsibility for these primary extensions and for individual cities the additional maintenance work performed by the Iowa DOT would be minor in relation to the current city street maintenance workload. This is based on the finding that all of the eight cities over 50,000 population currently contract with the state to maintain all or a portion of the primary extensions within their jurisdiction. Without a clearly defined maintenance work program and corresponding resource requirements, it is not possible to determine the overall impact on current personnel and equipment resources.

Since 36 of the cities have opted not to provide, through contract, maintenance on the primary extensions, there appear to be factors other than resource requirements that affected these decisions. In the sample cities contacted, inadequate cost reimbursement was cited frequently as the reason for not participating. Other cities indicated they currently would not contract to maintain the primary extensions under any conditions.

Maintenance Work Programs

The capability to define maintenance work programs for the primary extensions in each city exists within the Iowa DOT. The maintenance standards and feature inventory currently used to develop maintenance work programs for the state primary mileage maintained by the Iowa DOT could be modified and applied equally effectively for the primary municipal extensions in cities over 5,000 population. This would provide the state and the cities a clear definition and understanding of the maintenance work to be performed on these facilities. Additionally, the cities would be able to assess the impact on existing resources and make adjustments as required, or decline to contract for the primary extension maintenance.

Maintenance Service Levels

Maintenance service levels use by the Iowa DOT for the primary extensions, currently not maintained by the cities, could be used to define the amount of work to be provided by the cities, as well as the corresponding maintenance service levels. By incorporating these items

into the maintenance agreement with the city, the state could ensure that an adequate maintenance service level would be provided.

Contracting and Reimbursement

The assessments and findings for county contract maintenance are equally applicable to city maintenance of the municipal primary extensions. Contracting on the basis of maintenance standards and defined maintenance work program provides a mutual agreement as to the work to be performed and an equitable basis for reimbursement.

Current agreements for city maintenance of primary extension do not define service levels or the amount of routine maintenance to be provided. Reimbursement to the cities for this work is $695 per lane mile for fiscal year 1986.1/. Surface/roadway maintenance costs for all city streets reported by cities over 5,000 population in 1983 were approximately $4,300 per street mile and $1,430 per lane mile. Undoubtedly, some of these costs were for maintenance of parking lanes and other features not a part of the state's maintenance responsibility on primary extensions. However, the reported costs are for all streets and typically maintenance costs for major arterial streets, such as the primary extensions, are higher than the average for all streets which include local access residential streets.

Without improved maintenance cost reporting, it is not possible to accurately determine the actual maintenance costs required for the primary extensions.

State Primary Program

Additional use of city contract street maintenance of the primary extensions will not reduce the overall maintenance costs to the state, as long as the same level of service is provided by the cities as is currently provided by the Iowa DOT. And, in fact, the total maintenance costs to the state would increase if all city street maintenance agreements were based on defined workloads and actual maintenance costs reimbursed to the cities performing maintenance of the primary extensions.

COUNTY MAINTENANCE OF CITY STREETS

The maintenance of streets in some small Iowa cities is performed by the counties under 28E agreements as authorized by the Code of Iowa. Whether or not the cities contract with the counties for street maintenance services is a decision made by the individual municipal governing bodies. Frequently, this decision changes when the composition of the council or board changes.

Of the ten sample cities less than 5,000 population contacted, all provide city street maintenance with city personnel, including three

1/ Iowa DOT Commission Order No. H-85-588, May 7, 1985.

cities less than 1,000 population. Discussions with these city representatives supported the questionnaire responses that better responsiveness was the key factor in providing these services with city personnel. Typically, the cities and counties have a good rapport and provide mutual assistance in serving the needs of the residents.

Reimbursement for street maintenance services provided by the counties is based on actual costs to the county at agreed to unit prices for labor, equipment and materials, plus any third party contract costs. On this basis, it does not cost the county to provide these services. There is no subsidy to the city. The counties' role is that of a private contractor.

Unless cities of less than 1,000 population have unique circumstances and other requirements that support the retention of equipment for street maintenance work and sufficient personnel for other reasons, cities of this size should consider contracting these services with the county. However, there must be mutual agreement between the two jurisdictions as to the amount of maintenance to be performed and method of reimbursement. Continuity of city and county maintenance policy supports contractual maintenance of this type and can result in better levels of maintenance service to the residents.

PRIVATE CONTRACT MAINTENANCE

Private contract maintenance offers public agencies the opportunity to provide specialized or additional maintenance work without large investments for equipment and additional staffing. The experience and findings of the Iowa DOT typifies the findings of other agencies on the use of private contractors to perform all road and street maintenance in the jurisdiction.

Specific maintenance work, such as pavement patching, crack sealing, slurry seals, seal coats, resurfacing/leveling and bridge painting, has proven very-cost effective and successful with private contractors, both by the Iowa DOT and the local jurisdictions. However, the contracting of all routine maintenance work for extended periods and work that involved responses to emergencies such as pavement blowups, accidents, traffic control failures and snow storms has not proven successful or cost-effective under current contracting procedures. Other cited contracting problems include inadequate equipment and lack of experienced/qualified personnel to perform some of the maintenance work.

Two of the sample Iowa counties also had experience with contracting the maintenance of all the gravel/earth roads in the county. One county terminated the contract after six months due to lack of responsiveness and poor workmanship. The other county's experience was favorable for 2-3 years. Then the contractor began to increase the prices for providing the maintenance service to the point where this county also terminated the contract.

Advantages

Some of the advantages associated with private contract maintenance by the Iowa DOT, cities, counties and other states are presented in this section.

1. Reduced capital investment for equipment and physical plants.

2. Lower unit maintenance costs for some maintenance functions.

3. Elimination of the need to hire additional personnel and to acquire the equipment necessary to accommodate peak maintenance workloads.

4. Reduced personnel and related overhead costs.

5. Reduction in need for equipment repair facilities and personnel.

Disadvantages

Some of the disadvantages identified with contract maintenance may be contractor specific, but overall are representative of private contracting for maintenance.

1. Lack of responsiveness to emergencies and timely scheduling of maintenance work.

2. Tendancy to treat contract maintenance as fill-in work when resources are not required for other work.

3. Lack of specialized equipment and personnel experienced in performing maintenance.

4. Contractors tend to avoid bidding on specific types of maintenance work, resulting in no bids or lack of competitive bidding.

5. Improper and unsafe traffic control at work sites.

6. Difficulty in defining measurable maintenance work units for contract awards and reimbursement.

7. Maintenance inspection and quality control requirements by public jurisdictions.

8. Impact on current personnel levels and under utilization of existing equipment and physical facilities.

9. Jurisdictional responsibility and resulting tort liability remains with the governmental agency.

10. Increased agency efforts to administer and audit private maintenance contracts.

Management Responsibilities

Private contracting of maintenance relieves the governmental agency of some of the management responsibility associated with the actual performance of the work and mobilization of the necessary resources. However, as noted previously, the agency retains responsibility and subsequent liability, as well as the majority of the management responsibility for planning, budgeting, organizing, scheduling and controlling the maintenance work.

Figure 5-1 shows the respective management responsibilities for maintenance by contract and maintenance by governmental agency forces. Agencies contemplating the use of private contractor maintenance must thoroughly consider the potential long-term impacts as well as any short-term benefits. This is particularly critical when considering the contracting of the total maintenance work program. While initial contract costs may be favorable, the potential exists for major cost increases in the future, particularly after the governmental agency no longer has the resource capability to perform the work. Another major consideration involves the service level and quality of work and the resulting affect on the overall condition of the road system. Inadequate maintenance increases road user costs as well as the costs for resurfacing, rehabilitation and other improvement programs.

FIGURE 5-1

COMPARISON OF MANAGEMENT RESPONSIBILITY
FOR
MAINTENANCE BY CONTRACT AND GOVERNMENT AGENCIES

Management Item	Maintenance by Contract	Maintenance by Government Forces
1. Planning Programming and Budgeting	Government	Government
2. Organizing		
• Contract Documents	Government	Not Applicable
• Equipment	Contractor	Government
• Material	Contractor	Government
• Work Force	Contractor	Government
• Payment	Contractor	Government
3. Scheduling/Directing		
• Maintenance Needs	Government/ Contractor	Government
• Crew Mobilization	Contractor	Government
• Scheduling	Government/ Contractor	Government
• Work Assignment	Contractor	Government
• Supervision	Contractor	Government
4. Controlling		
• Payment	Government	Government
• Quality Control	Government	Government
• Work Accomplishment	Contractor	Government
• Verification of Accomplishment	Government	Government
• Productivity	Contractor	Government
• Updating Planning Values	Government	Government

APPENDIX

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DeLEUW CATHER

Engineering Management Services
A Division of De Leuw, Cather & Company

Suite 300
Six Montgomery Village Avenue
Gaithersburg, Maryland 20879
(301) 921-9008

Our Ref.:

June 15, 1984

Dear

The Iowa Highway Research Board recently approved the award of an engineering study which is being conducted by De Leuw, Cather & Company, Engineering Management Services, for an evaluation of public road administation and maintenance alternatives. This study is a result of specific recommendations made by the Governor's Blue Ribbon Transportation Task Force in 1982. The objective is to provide additional information for all jurisdictions in Iowa on the impacts associated with possible changes in construction and maintenance operations and jurisdictional responsibilities. Any one of several issues could have a severe impact on the financing and administration of public roads and streets in Iowa, as well as the level of maintenance service that is provided by each jurisdiction.

A study of this scope requires complete and accurate information on the current status of public road administration, construction and maintenance operations from all jurisdictions in Iowa. The results of this study must be based on factual data from the various Iowa jurisdictions. In this regard, the enclosed questionnaire has been prepared to collect the necessary information in a uniform format from each county. A Project Advisory Panel of county, city and state representatives was appointed to define the scope of work to review the project progress during the study. Enclosed is a list of the panel members.

The Iowa County Engineers Association and State Association of Counties are aware of this study and have endorsed the need for an independent assessment to determine the impacts associated with the recommendations of the 1982 Transportation Task Force Report.

Your assistance in providing the requested information, or having the information provided by the appropriate individual(s), will ensure that your county is adequately represented in the data bases to be utilized in the study analyses and evaluations. The results of these analyses

DeLEUW CATHER

will provide the jurisdictions a supportable base for possible legislative actions that may be warranted in the areas of public road administration and maintenance.

Please return all questionnaires by July 16, 1984. Only by your completing and returning the enclosed questionnaire will we be able to adequately represent your county in this study. Please contact me (515/292-0548) if you have any questions about the information requested or would like additional information on the study.

Sincerely,

Joseph F. Banks

Joseph F. Banks, P.E.
Principal Investigator

JFB:sbf
enclosure

COUNTY DATA COLLECTION WORKSHEET

IOWA PUBLIC ROAD ADMINISTRATION AND MAINTENANCE ALTERNATIVES

The attached data collection worksheet consists of three separate parts.

Part A -- Primarily yes/no questions with the answers to be recorded on the form.

Part B -- Operational questions that may require supplemental information.

Part C -- Maintenance and resource questions that require supplemental information.

Please provide answers to all questions and provide supplemental information as requested. Any additional information that you feel would be useful to this study would also be appreciated.

If you have questions on specific items, please contact Joe Banks, Ames, Iowa (phone 515/292-0548).

ALL FORMS ARE TO BE RETURNED BY JULY 16, 1984.

Return to:

Joseph F. Banks
De Leuw, Cather & Company
Suite 300
Six Montgomery Village Avenue
Gaithersburg, MD 20879

IOWA PUBLIC ROAD ADMINISTRATION AND MAINTENANCE ALTERNATIVES
DATA COLLECION WORKSHEET

COUNTY _____

COUNTY QUESTIONNAIRE
Part A

A. The following group of questions require answers on this form:

1. Do you have highway design standards/guides for different functional classes of roads?
___ Yes ___ No Specify: _____ 1/

2. For "yes" answers, use Exhibit 1 and compare your design standards/guides for the non-farm-to-market roads as follows:

   (a) For each traffic volume group, check if the design guides used are the same as the State DOT;

   (b) If not the same as the State DOT, enter the basis used and check the appropriate traffic volume group(s);

   (c) For each traffic volume group, check whether construction by the design guides you use is more or less costly than the State DOT criteria.

   NOTE: If different answers apply to federal/state (S) and locally (L) funded projects, please indicate with an "L" and "S" the response for each.

Complete Exhibit 1 for the following categories as indicated:

Geometric Guides
Pavement Surface
Shoulder Surface or Curb and Drain
New Bridges
Reconstructed Bridges

1/ If general AASHTO standards are utilized, answer "AASHTO". Otherwise, specify other generally recognized basis or provide examples.

EXHIBIT 1

COMPARISON OF DESIGN GUIDES
FOR
NON-FARM-TO-MARKET ROADS

	Traffic Volume Groups			
	1,000 & More VPD	400-1000 VPD	100-400 VPD	0-100 VPD
GEOMETRIC GUIDES				
(a) Same as state DOT	___	___	___	___
(b) _____ 1/	___	___	___	___
(c) more/less costly than state	___ more ___ less	___more ___less	___ more ___ less	___ more ___ less
PAVEMENT SURFACE GUIDES				
(a) same as state DOT	___	___	___	___
(b) _____ 1/	___	___	___	___
(c) more/less costly than state	___ more ___ less	___more ___less	___ more ___ less	___ more ___ less
SHOULDER SURFACE OR CURB AND DRAIN				
(a) same as state DOT	___	___	___	___
(b) _____ 1/	___	___	___	___
(c) more/less costly than state	___ more ___ less	___more ___less	___ more ___ less	___ more ___ less
NEW BRIDGES				
(a) same as state DOT	___	___	___	___
(b) more/less costly than state	___more ___less	___more ___less	___more ___less	___more ___less
RECONSTRUCTED BRIDGES				
(a) same as state DOT	___	___	___	___
(b) more/less costly than state	___ more ___less	___more ___less	___more ___less	___more ___less

1/ If general AASHTO standards are utilized, answer "AASHTO". Otherwise specify other generally recognized basis or provide examples.

3. Are State or Federal design standards too high from the standpoint of the amount of funds available to the county for construction of needed facilities? State: _____ Yes _____ No
Federal: _____ Yes _____ No

4. Are you satisfied with the current percentage apportionments of road user tax funds between the state and other levels of government presuming jurisdictional responsibilities do not change?
Yes ___ No ___

If your answer is no, please indicate desirable percentage changes on a separate page, giving reasons why these changes would provide a more equitable or beneficial apportionment.

5. Indicate the priority importance that should be given to the following factors in allocating the local share of road user tax funds among local units of government. Use 10 as the most important factor and zero as no importance and assign priorities from 10-0 without attempting to assign relative weights.

Allocations Between/Among:

COUNTIES & CITIES

___ Highway Needs Including Local Facilities

___ Highway Needs Excluding Local Facilities

___ Vehicle Miles (Volume x Miles) (All Facilities)

___ _____

___ _____

COUNTIES

___ Highway Needs Including Local Roads

___ Highway Needs Excluding Local Roads

___ Population

___ Area

___ Vehicle Miles (Volume x Miles) (All Roads)

___ Miles Including Local Roads

___ Miles Excluding Local Roads

___ Vehicle Registrations

___ Unit Construction Costs

___ _____

6. Do you have a highway program which minimally results in the establishment of a priority listing of road locations for improvements?
___ Yes ___ No

7. a. Do you employ maintenance "service level criteria" for the different classes of roads under your jurisdiction to develop your annual maintenance budget? ___ Yes ___ No

b. If yes, check the following activity categories for which criteria have been established:

	Yes	No
Snow Removal	___	___
Patching	___	___
Sealing	___	___
Maintenance Overlay	___	___
Gravel Replacement	___	___
Shoulder Repair	___	___
Curb and Drain Repair	___	___
Traffic Signing and Striping	___	___
Signal Maintenance	___	___
Other _____	___	___

8. Do you make projections of specific maintenance needs employing objective criteria such as:

	No	Yes	Number of Years
Established Surface Resealing Rates	___	___	___
Crack Inspection/Measurement	___	___	___
Gravel Depletion Inspection	___	___	___
Road Roughness or Deflection Measurements	___	___	___
Other _____	___	___	___
_____	___	___	___

9. Do you use "outside" (non-owned or managed) shops and mechanics for equipment repair/service?

	No	Often	Seldom
Major Repairs	___	___	___
Minor Repairs	___	___	___
Routine Service	___	___	___

10. Do you have a preventive maintenance program for your road equipment?
___ Yes ___ No

11. a. Do you have an analytical procedure for determining equipment sales/replacement/procurement? ___ Yes ___ No

b. If yes, does it include the following:

		Yes	No
(1)	productivity in terms of work requirement?	___	___
(2)	repair costs as compared to average per piece?	___	___
(3)	downtime for repairs?	___	___
(4)	operating costs as compared with alternatives?	___	___
(5)	its preventive maintenance record?	___	___
(6)	standby versus productive work time?	___	___
(7)	possibilities of rental?	___	___
(8)	shared use?	___	___

Do you use state DOT criteria? ___; guidelines? ___; procedures? ___

12. a. Do you require or permit (delete one) developers of large parcels of property to build streets within the new development?
___ Yes ___ No

b. If yes, answer the following:

		Yes	No
(1)	Includes all streets	___	___
(2)	Includes only property access streets	___	___
(3)	Must meet established construction/design standards	___	___
(4)	Are the completed streets purchased and charged to the property owners through special assessments or front-foot benefits.	___	___

13. a. How many liability claims, relating to road maintenance or operations, were filed against your county in 1981 ____; 1982 ____; 1983 ____.

b. What was the total number and dollar value of settlements made in:

1981	No.	_____	$_____
1982	No.	_____	$_____
1983	No.	_____	$_____

14. With and without changes in the current allocations of the RUTF between the state and local units of government, do you think the current mileage of the system administered and maintained by the state DOT should be:

		With Change	Without Change
Check one:	Increased	___	___
	Decreased	___	___
	No Significant Change	___	___

If you wish, you may explain your answer on a separate sheet.

15. Should the State's weight enforcement operations be expanded to provide meaningful weight enforcement on local roads and streets?
___ Yes ___ No

16. Do you favor the continuation of the special provisions for farm and agricultural vehicles?

	Yes	No
No weight limit on unlicensed agricultural vehicle	___	___
Reduced registration fees	___	___

17. In your viewpoint which of the following areas could be changed from the existing situation in order to provide improvements in construction and maintenance operations? Check the appropriate areas below:

	CHANGES NEEDED				
Activities	Better Inter-Gov't. Coordination & Cooperation	Consolidation of Work Forces 1/	Uniform Design Guides	DOT Trng. Materials & Programs	No Change
A. System Planning					
B. Design & Construction					
(1) Res.,Commercial, Farm Access Roads					
(2) Collector:					
0-400 ADT					
400-1000 ADT					
over 1000 ADT					
C. Maintenance & Equip. Use					
(1) Res., Commercial, Farm Access Roads					
(2) Collector:					
0-400 ADT					
400-1000 ADT					
over 1000 ADT					
D. Contract Administration					
E. Equipment Purchase					

1/ It is possible to accomplish this in different ways not necessarily involving any changes in basic jurisdictional responsibilities.

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

COUNTY _____

COUNTY QUESTIONNAIRE
Part B

B. The following group of questions may require, in some cases, and do require, in others, supplemental information. Use separate sheet to provide additional information as necessary. Please note number of question being answered.

18. a. Do you contract any routine maintenance activities?
___ Yes ___ No

b. Do you contract any major maintenance activities?
___ Yes ___ No

c. Do you contract paved resurfacing? ___ Yes ___ No

d. Do you contract granular resurfacing? ___ Yes ___ No

For each yes answer, identify the activities and the amount (percentage) of expenditure for each that is performed by contract for the most recent year.

Activity	Total Expenditure	Percent Contracted
_____	$_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

19. a. Do you rent or borrow equipment?
___ Yes ___ No

b. Do you lend or lease equipment?
___ Yes ___ No

If yes, please provide typical details.

20. Outside of FAS or Farm-to-Market projects, are your procedures and requirements for construction contract advertisement, bidding, bonding, letting, etc., essentially the same as those of the state DOT? ___ Yes ___ No. If no, please describe any fundamental differences.

21. a. Do you require the pre-qualification of construction contractors? Yes ___ No ___.

    b. If yes, are your procedures and requirements basically the same as those employed by the state DOT? ___ Yes ___ No.

    c. If no, please indicate the requirements, if any, that are used?

22. To what extent (if any) do you rely on the state DOT for letting county construction contracts? Show percentage applicability in spaces provided:

    (1) Letting (advertising, obtaining bids, recommending award) Farm-to-Market funded projects _____

    (2) Letting Other Locally Funded Projects _____

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

COUNTY _____

COUNTY QUESTIONNAIRE
Part C

C. Supplemental information, on separate pages, is required for all of the following group of questions. Note number of question being answered.

23. Please provide a listing of your major equipment showing type, numbers of pieces, size or capacity designation, age, current serviceability, and typical (estimated or recorded) hours of actual use per month in winter and summer. Also show projected acquisitions/ disposals during calendar 1984 and 1985.

24. Assume you are going to let a construction contract in the following circumstances using your typical administrative and staffing arrangements, please provide details indicated below: 1/

Description of Work: Construction on completely new grade, including new pavement, or reconstruction of equivalent scope.

Road Service Category: The rural road will possess features typical of the design standards you employ in the environment of your county. When opened to traffic, it is expected to carry over 400 VPD.

		Grading	Paving	
1.	Typical Project Mileage	_____	_____	miles
2.	Typical Project Duration	_____	_____	months
3.	Administrator or Project Manager	_____	_____	man-days
4.	Asst. Engineer or Chief Inspector	_____	_____	man-days
5.	Survey Party Chief or Instrument Man	_____	_____	man-days
6.	Other Survey Crew	_____	_____	man-days
7.	Grading and Drainage Inspection	_____	_____	man-days
8.	Paving or Street Inspection	_____	_____	man-days
9.	Plant Inspection	_____	_____	man-days
10.	Clerical Staff	_____	_____	man-days
11.	_____	_____	_____	man-days

1/ Best judgments are requested in providing these answers. The objective is to determine typical differences of magnitude in the way the same projects may be administered at different jurisdictional levels.

25. On a road map of your county, please show the following:

    a. If the answer to Question 7 (Part A) was yes, show your main road system distinctions for maintenance (color routes and provide code);

    b. location of main maintenance office;

    c. location of major equipment yard and repair shop facilities;

    d. other garages/locations where personnel report and/or equipment is stored.

    NOTE: Identify the main maintenance office and garage location with a unique code number. Unless locations are already numbered (coded) start with '1' for the main maintenance location and continue in sequence until all locations are numbered.

26. Identify the personnel and equipment normally assigned to each location identified in Question 25 according to the breakdown shown in Exhibit 2. As appropriate, show separate for year-round, winter and summer.

27. Please indicate services that are provided for cities or the state pertaining to facilities and activities that are not legally the county's responsibility including reimbursement arrangements -- show how costs and reimbursement relate.

28. Indicate arrangements with cities for maintenance or traffic operations on county interest facilities where reimbursement is paid to the cities, along with the basis of reimbursement.

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

EXHIBIT 2
PERSONNEL AND EQUIPMENT RESOURCES

County _____

☐ Year-round
☐ Winter
☐ Summer

No.	LOCATION 1/	ASSIGNED PERSONNEL				MAJOR EQUIPMENT 2/							REMARKS
		Admin.	Superv.	Equip. Oper.	Lbrs.	Pickups	Dump Trucks	Dozers	Motor Grader	Backhoe	Loader	Other	

1/ Describe the type and extent of garage and repair facilities in Remarks column or on a separate sheet.
2/ Optionally, equipment list provided in Question 23 may be used to report location assignment.

DeLEUW CATHER

Engineering Management Services
A Division of De Leuw, Cather & Company

Suite 300
Six Montgomery Village Avenue
Gaithersburg, Maryland 20879
(301) 921-9008

Our Ref.:

June 15, 1984

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A study of this scope requires complete and accurate information on the current status of public road administration, construction and maintenance operations from all jurisdictions in Iowa. The results of this study must be based on factual data from the various Iowa jurisdictions. In this regard, the enclosed questionnaire has been prepared to collect the necessary information in a uniform format from each city. A Project Advisory Panel of city, county and state representatives was appointed to define the scope of work to review the project progress during the study. Enclosed is a list of the panel members.

The League of Iowa Municipalities and Iowa Chapter, American Public Works Association are aware of this study and have endorsed the need for an independent assessment to determine the impacts associated with the recommendations of the 1982 Transportation Task Force Report.

DeLEUW CATHER

Your assistance in providing the requested information, or having the information provided by the appropriate individual(s), will ensure that your city is adequately represented in the data bases to be utilized in the study analyses and evaluations. The results of these analyses will provide the jurisdictions a supportable base for possible legislative actions that may be warranted in the areas of public road administration and maintenance.

Please return all questionnaires by July 16, 1984. Only by your completing and returning the enclosed questionnaire will we be able to adequately represent your city in this study. Please contact me at (515/292-0548) if you have any questions about the information requested or would like additional information on the study.

Sincerely,

Joseph F. Banks

Joseph F. Banks, P.E.
Principal Investigator

CITY DATA COLLECTION WORKSHEET

IOWA PUBLIC ROAD ADMINISTRATION AND MAINTENANCE ALTERNATIVES

The attached data collection worksheet consists of three separate parts.

Part A -- Primarily yes/no questions with the answers to be recorded on the form.

Part B -- Operational questions that may require supplemental information.

Part C -- Maintenance and resource questions that require supplemental information.

Please provide answers to all questions and provide supplemental information as requested. Any additional information that you feel would be useful to this study would also be appreciated.

If you have questions on specific items, please contact Joe Banks, Ames Iowa (phone 515/292-0548).

ALL FORMS ARE TO BE RETURNED BY JULY 16, 1984.

Return to:

Joseph F. Banks
De Leuw, Cather & Company
Suite 300
Six Montgomery Village Avenue
Gaithersburg, MD 20879

IOWA PUBLIC ROAD ADMINISTRATION AND MAINTENANCE ALTERNATIVES
DATA COLLECTION WORKSHEET
(5,000 and Greater Population)

CITY _____

CITY QUESTIONNAIRE
Part A

A. The following group of questions require answers on this form:

1. Do you have highway design standards/guides for different functional classes of streets?
___ Yes ___ No Specify: _____ 1/

2. For "yes" answers, use Exhibit 1 and compare your design standards/guides for the non-FAUS streets as follows:

(a) For each traffic volume group, check if the design guides used are the same as the State DOT;

(b) If not the same as the State DOT, enter the basis used and check the appropriate traffic volume group(s);

(c) For each traffic volume group, check whether construction by the design guides you use is more or less costly than the State DOT criteria.

NOTE: If different answers apply to federal/state (S) and locally (L) funded projects, please indicate with an "L" and "S" the response for each.

Complete Exhibit 1 for the following categories as indicated:

Geometric Guides
Pavement Surface
Shoulder Surface or Curb and Drain
New Bridges
Reconstructed Bridges

1/ If general AASHTO standards are utilized, answer "AASHTO". Otherwise, specify other generally recognized basis or provide examples.

EXHIBIT 1

COMPARISON OF DESIGN GUIDES
FOR
NON-FAUS STREETS

	Traffic Volume Groups			
	5,000 & More VPD	1,000-5,000 VPD	100-1,000 VPD	0-100 VPD
GEOMETRIC GUIDES				
(a) Same as state DOT	___	___	___	___
(b) _____ 1/	___	___	___	___
(c) more/less costly than state	___ more ___ less	___more ___less	___ more ___ less	___ more ___ less
PAVEMENT SURFACE GUIDES				
(a) same as state DOT	___	___	___	___
(b) _____ 1/	___	___	___	___
(c) more/less costly than state	___ more ___ less	___more ___less	___ more ___ less	___ more ___ less
SHOULDER SURFACE OR CURB AND DRAIN				
(a) same as state DOT	___	___	___	___
(b) _____ 1/	___	___	___	___
(c) more/less costly than state	___ more ___ less	___more ___less	___ more ___ less	___ more ___ less
NEW BRIDGES				
(a) same as state DOT	___	___	___	___
(b) more/less costly than state	___more ___less	___more ___less	___more ___less	___more ___less
RECONSTRUCTED BRIDGES				
(a) same as state DOT	___	___	___	___
(b) more/less costly than state	___ more ___less	___more ___less	___more ___less	___more ___less

1/ If general AASHTO standards are utilized, answer "AASHTO". Otherwise specify other generally recognized basis or provide examples.

3. Are State or Federal design standards too high from the standpoint of the amount of funds available to the city for construction of needed facilities? State: _____ Yes _____ No
Federal: _____ Yes _____ No

4. Are you satisfied with the current percentage apportionments of road user tax funds between the state and other levels of government presuming jurisdictional responsibilities do not change?
Yes ___ No ___

If your answer is no, please indicate desirable percentage changes on a separate page, giving reasons why these changes would provide a more equitable or beneficial apportionment.

5. Indicate the priority importance that should be given to the following factors in allocating the local share of road user tax funds among local units of government. Use 10 as the most important factor and zero as no importance and assign priorities from 10-0 without attempting to assign relative weights.

Allocations Between/Among:

COUNTIES & CITIES

___ Highway Needs Including Local Facilities

___ Highway Needs Excluding Local Facilities

___ Vehicle Miles (Volume x Miles) (All Facilities)

___ _____

___ _____

CITIES

___ Highway Needs Including Local Streets

___ Highway Needs Excluding Local Streets

___ Population

___ Area

___ Traffic Volume (All Streets)

___ Miles Including Local Streets

___ Miles Excluding Local Streets

___ Vehicle Registrations

___ Unit Construction Costs

___ _____

6. Do you have a highway program which minimally results in the establishment of a priority listing of street locations for improvements?
___ Yes ___ No

7. a. Do you employ maintenance "service level criteria" for the different classes of streets under your jurisdiction to develop your annual maintenance budget? ___ Yes ___ No

b. If yes, check the following activity categories for which criteria have been established:

	Yes	No
Snow Removal	___	___
Patching	___	___
Sealing	___	___
Maintenance Overlay	___	___
Gravel Replacement	___	___
Shoulder Repair	___	___
Curb and Drain Repair	___	___
Traffic Signing and Striping	___	___
Signal Maintenance	___	___
Other _____	___	___

8. Do you make projections of specific maintenance needs employing objective criteria such as:

	No	Yes	Number of Years
Established Surface Resealing Rates	___	___	___
Crack Inspection/Measurement	___	___	___
Gravel Depletion Inspection	___	___	___
Road Roughness or Deflection Measurements	___	___	___
Other _____	___	___	___
_____	___	___	___

9. Do you use "outside" (non-owned or managed) shops and mechanics for equipment repair/service?

	No	Often	Seldom
Major Repairs	___	___	___
Minor Repairs	___	___	___
Routine Service	___	___	___

10. Do you have a preventive maintenance program for your street equipment?
___ Yes ___ No

11. a. Do you have an analytical procedure for determining equipment sales/replacement/procurement? ___ Yes ___ No

b. If yes, does it include the following:

		Yes	No
(1)	productivity in terms of work requirement?	___	___
(2)	repair costs as compared to average per piece?	___	___
(3)	downtime for repairs?	___	___
(4)	operating costs as compared with alternatives?	___	___
(5)	its preventive maintenance record?	___	___
(6)	standby versus productive work time?	___	___
(7)	possibilities of rental?	___	___
(8)	shared use?	___	___

Do you use state DOT criteria? ___; guidelines? ___; procedures? ___

12. a. Do you require or permit (delete one) developers of large parcels of property to build streets within the new development? ___ Yes ___ No

b. If yes, answer the following:

		Yes	No
(1)	Includes all streets	___	___
(2)	Includes only property access streets	___	___
(3)	Must meet established construction/design standards	___	___
(4)	Are the completed streets purchased and charged to the property owners through special assessments or front-foot benefits.	___	___

13. a. How many liability claims, relating to street maintenance or operations, were filed against your county in 1981 ____; 1982 ____; 1983 ____.

b. What was the total number and dollar value of settlements made in:

1981	No.	_____	$_____
1982	No.	_____	$_____
1983	No.	_____	$_____

14. With and without changes in the current allocations of the RUTF between the state and local units of government, do you think the current mileage of the system administered and maintained by the state DOT should be:

		With Change	Without Change
Check one:	Increased	___	___
	Decreased	___	___
	No Significant Change	___	___

If you wish, you may explain your answer on a separate sheet.

15. Should the State's weight enforcement operations be expanded to provide meaningful weight enforcement on local roads and streets?
___ Yes ___ No

16. Do you favor the continuation of the special provisions for farm and agricultural vehicles?

	Yes	No
No weight limit on unlicensed agricultural vehicle	___	___
Reduced registration fees	___	___

17. In your viewpoint which of the following areas could be changed from the existing situation in order to provide improvements in construction and maintenance operations? Check the appropriate areas below:

	CHANGES NEEDED				
Activities	Better Inter-Gov't. Coordination & Cooperation	Consolidation of Work Forces 1/	Uniform Design Guides	DOT Trng. Materials & Programs	No Change
A. System Planning					
B. Design & Construction					
(1) Res.,Commercial, Farm Access Roads					
(2) Collector:					
0-100 ADT					
100-1000 ADT					
1000-5000 ADT					
C. Maintenance & Equip. Use					
(1) Res., Commercial, Farm Access Roads					
(2) Collector:					
0-100 ADT					
100-1000 ADT					
1000-5000 ADT					
D. Contract Administration					
E. Equipment Purchase					

1/ It is possible to accomplish this in different ways not necessarily involving any changes in basic jurisdictional responsibilities.

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

CITY _____

CITY QUESTIONNAIRE
Part B

B. The following group of questions may require, in some cases, and do require, in others, supplemental information. Use separate sheet to provide additional information as necessary. Please note number of question being answered.

18. a. Do you contract any routine maintenance activities?
___ Yes ___ No

b. Do you contract any major maintenance activities?
___ Yes ___ No

c. Do you contract paved resurfacing? ___ Yes ___ No

d. Do you contract granular resurfacing? ___ Yes ___ No

For each yes answer, identify the activities and the amount (percentage) of expenditure for each that is performed by contract for the most recent year.

Activity	Total Expenditure	Percent Contracted
_____	$_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

19. a. Do you rent or borrow equipment?
___ Yes ___ No

b. Do you lend or lease equipment?
___ Yes ___ No

If yes, please provide typical details.

20. Outside of FAUS, are your procedures and requirements for construction contract advertisement, bidding, bonding, letting, etc., essentially the same as those of the state DOT? ___ Yes ___ No. If no, please describe any fundamental differences.

21. a. Do you require the pre-qualification of construction contractors? Yes ___ No ___.

    b. If yes, are your procedures and requirements basically the same as those employed by the state DOT? ___ Yes ___ No.

    c. If no, please indicate the requirements, if any, that are used?

22. To what extent (if any) do you rely on the state DOT for letting city street construction contracts? Show percentage applicability in spaces provided:

    (1) Letting (advertising, obtaining bids, recommending award) FAUS Funded Projects _____

    (2) Letting Other State Funded Projects _____

    (3) Letting Other Locally Funded Projects _____

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

CITY _____

CITY QUESTIONNAIRE
Part C

C. Supplemental information, on separate pages, is required for all of the following group of questions. Note number of question being answered.

23. Please provide a listing of your major equipment showing type, numbers of pieces, size or capacity designation, age, current serviceability, and typical (estimated or recorded) hours of actual use per month in winter and summer. Also show projected acquisitions/ disposals during fiscal years 1984 and 1985.

24. Assume you are going to let a construction contract in the following circumstances using your typical administrative and staffing arrangements, please provide details indicated below: 1/

Description of Work: Major construction including paving, curb and gutter and surface drainage provisions.

Street Service Category: The street is in a developing commerical area with a mixture of old residences and shops and will possess features typical of the design standards you employ in your city for a 2-lane facility with parking provided on both sides.

		Grading	Paving	
1.	Typical Project Mileage	_____	_____	thousand ft.
2.	Typical Project Duration	_____	_____	months
3.	Administrator or Project Manager	_____	_____	man-days
4.	Asst. Engineer or Chief Inspector	_____	_____	man-days
5.	Survey Party Chief or Instrument Man	_____	_____	man-days
6.	Other Survey Crew	_____	_____	man-days
7.	Grading and Drainage Inspection	_____	_____	man-days
8.	Paving or Street Inspection	_____	_____	man-days
9.	Plant Inspection	_____	_____	man-days
10.	Clerical Staff	_____	_____	man-days
11.	_____	_____	_____	man-days

1/ Best judgments are requested in providing these answers. The objective is to determine typical differences of magnitude in the way the same projects may be administered at different jurisdictional levels.

25. On a street map of your city, please show the following:

    a. If the answer to Question 7 (Part A) was yes, show your main street system distinctions for maintenance (color routes and provide code);

    b. location of main maintenance office;

    c. location of major equipment yard and repair shop facilities;

    d. other garages/locations where personnel report and/or equipment is stored.

    NOTE: Identify the main maintenance office and garage location with a unique code number. Unless locations are already numbered (coded) start with '1' for the main maintenance location and continue in sequence until all locations are numbered.

26. Identify the personnel and equipment normally assigned to each location identified in Question 25 according to the breakdown shown in Exhibit 2. As appropriate, show separate for year-round, winter and summer.

27. Please indicate services that are provided for the county or the state pertaining to facilities and activities that are not legally your responsibility including reimbursement arrangements -- show how costs and reimbursement relate.

28. Indicate arrangements with the county or the state for maintenance or traffic operations on city interest facilities where reimbursement is paid to the county or state, along with the basis of reimbursement.

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

EXHIBIT 2
PERSONNEL AND EQUIPMENT RESOURCES

City _____

☐ Year-round
☐ Winter
☐ Summer

No.	LOCATION 1/	ASSIGNED PERSONNEL				MAJOR EQUIPMENT 2/							REMARKS
		Admin.	Superv.	Equip. Oper.	Lbrs.	Pickups	Dump Trucks	Dozers	Motor Grader	Backhoe	Loader	Other	

1/ Describe the type and extent of garage and repair facilities in Remarks column or on a separate sheet.
2/ Optionally, equipment list provided in Question 23 may be used to report location assignment.

DeLEUW CATHER

Engineering Management Services
A Division of De Leuw, Cather & Company

Suite 300
Six Montgomery Village Avenue
Gaithersburg, Maryland 20879
(301) 921-9008

Our Ref.:

June 15, 1984

Dear Mayor:

The Iowa Highway Research Board recently approved the award of an engineering study which is being conducted by De Leuw, Cather & Company, Engineering Management Services, for an evaluation of public road administration and maintenance alternatives. This study is a result of specific recommendations made by the Governor's Blue Ribbon Transportation Task Force in 1982. The objective is to provide additional information for all jurisdictions in Iowa on the impacts associated with possible changes in construction and maintenance operations and jurisdictional responsibilities. Any one of several issues could have a severe impact on the financing and administration of public roads and streets in Iowa, as well as the level of maintenance service that is provided by each jurisdiction.

A study of this scope requires complete and accurate information on the current status of public road administration, construction and maintenance operations from all jurisdictions in Iowa. The results of this study must be based on factual data from the various Iowa jurisdictions. In this regard, the enclosed questionnaire has been prepared to collect the necessary information in a uniform format from each city. A Project Advisory Panel of city, county and state representatives was appointed to define the scope of work to review the project progress during the study. Enclosed is a list of the panel members.

The League of Iowa Municipalities and Iowa Chapter, American Public Works Association are aware of this study and have endorsed the need for an independent assessment to determine the impacts associated with the recommendations of the 1982 Transportation Task Force Report.

DeLEUW CATHER

Your assistance in providing the requested information, or having the information provided by the appropriate individual(s), will ensure that your city is adequately represented in the data bases to be utilized in the study analyses and evaluations. The results of these analyses will provide the jurisdictions a supportable base for possible legislative actions that may be warranted in the areas of public road administration and maintenance.

Please return all questionnaires by July 16, 1984. Only by your completing and returning the enclosed questionnaire will we be able to adequately represent your city in this study. Please contact me at (515/292-0548) if you have any questions about the information requested or would like additional information on the study.

Sincerely,

Joseph F. Banks

Joseph F. Banks, P.E.
Principal Investigator

IOWA PUBLIC ROAD ADMINISTRATION AND MAINTENANCE ALTERNATIVES
DATA COLLECTION WORKSHEET
(Less Than 5,000 Population)

CITY _____

CITY QUESTIONNAIRE
Part A

A. The following group of questions require answers on this form:

1. Do you have highway design standards/guides for different functional classes of streets?
___ Yes ___ No Specify: _____ 1/

2. For "yes" answers, provide the following information for the design guides used:

a. Typical street width (back-to-back of curbs) _____ Feet
b. Type of surfacing _____
c. Typical depth of surfacing _____ inches
d. Typical width of bridges
New _____feet
Reconstructed _____feet
e. Use of consultant for design services ____ Yes ____ No
f. If avalable provide examples of typical street design guides.

NOTE: If different answers apply to federal/state (S) and locally (L) funded projects, please indicate with an "L" and "S" the response for each.

1/ If general AASHTO standards are utilized, answer "AASHTO". Otherwise, specify other generally recognized basis or provide examples.

3. Are State or Federal design standards too high from the standpoint of the amount of funds available to the city for construction of needed facilities? State: _____ Yes _____ No
Federal: _____ Yes _____ No

4. Are you satisfied with the current percentage apportionments of road user tax funds between the state and other levels of government presuming jurisdictional responsibilities do not change?
Yes ___ No ___

If your answer is no, please indicate desirable percentage changes on a separate page, giving reasons why these changes would provide a more equitable or beneficial apportionment.

5. Indicate the priority importance that should be given to the following factors in allocating the local share of road user tax funds among local units of government. Use 10 as the most important factor and zero as no importance and assign priorities from 10-0 without attempting to assign relative weights.

Allocations Between/Among:

COUNTIES & CITIES

___ Highway Needs Including Local Facilities

___ Highway Needs Excluding Local Facilities

___ Vehicle Miles (Volume x Miles) (All Facilities)

___ _____

___ _____

CITIES

___ Highway Needs Including Local Streets

___ Highway Needs Excluding Local Streets

___ Population

___ Area

___ Traffic Volume (All Streets)

___ Miles Including Local Streets

___ Miles Excluding Local Streets

___ Vehicle Registrations

___ Unit Construction Costs

___ _____

6. Do you have a highway program which minimally results in the establishment of a priority listing of street locations for improvements?
___ Yes ___ No

7. a. Do you employ maintenance "service level criteria" for the different classes of streets under your jurisdiction to develop your annual maintenance budget? ___ Yes ___ No

b. If yes, check the following activity categories for which criteria have been established:

	Yes	No
Snow Removal	___	___
Patching	___	___
Sealing	___	___
Maintenance Overlay	___	___
Gravel Replacement	___	___
Shoulder Repair	___	___
Curb and Drain Repair	___	___
Traffic Signing and Striping	___	___
Signal Maintenance	___	___
Other _____	___	___

8. Do you make projections of specific maintenance needs employing objective criteria such as:

	No	Yes	Number of Years
Established Surface Resealing Rates	___	___	___
Crack Inspection/Measurement	___	___	___
Gravel Depletion Inspection	___	___	___
Road Roughness or Deflection Measurements	___	___	___
Other _____	___	___	___
_____	___	___	___

9. Do you use "outside" (non-owned or managed) shops and mechanics for equipment repair/service?

	No	Often	Seldom
Major Repairs	___	___	___
Minor Repairs	___	___	___
Routine Service	___	___	___

10. Do you have a preventive maintenance program for your street equipment?
___ Yes ___ No

11. a. Do you have an analytical procedure for determining equipment sales/replacement/procurement? ___ Yes ___ No

b. If yes, does it include the following:

		Yes	No
(1)	productivity in terms of work requirement?	___	___
(2)	repair costs as compared to average per piece?	___	___
(3)	downtime for repairs?	___	___
(4)	operating costs as compared with alternatives?	___	___
(5)	its preventive maintenance record?	___	___
(6)	standby versus productive work time?	___	___
(7)	possibilities of rental?	___	___
(8)	shared use?	___	___

Do you use state DOT criteria? ___; guidelines? ___; procedures? ___

12. a. Do you require or permit (delete one) developers of large parcels of property to build streets within the new development? ___ Yes ___ No

b. If yes, answer the following:

		Yes	No
(1)	Includes all streets	___	___
(2)	Includes only property access streets	___	___
(3)	Must meet established construction/design standards	___	___
(4)	Are the completed streets purchased and charged to the property owners through special assessments or front-foot benefits.	___	___

13. a. How many liability claims, relating to street maintenance or operations, were filed against your county in 1981 ____; 1982 ____; 1983 ____.

b. What was the total number and dollar value of settlements made in:

1981	No.	_____	$_____
1982	No.	_____	$_____
1983	No.	_____	$_____

14. With and without changes in the current allocations of the RUTF between the state and local units of government, do you think the current mileage of the system administered and maintained by the state DOT should be:

		With Change	Without Change
Check one:	Increased	___	___
	Decreased	___	___
	No Significant Change	___	___

If you wish, you may explain your answer on a separate sheet.

15. Should the State's weight enforcement operations be expanded to provide meaningful weight enforcement on local roads and streets?
___ Yes ___ No

16. Do you favor the continuation of the special provisions for farm and agricultural vehicles?

	Yes	No
No weight limit on unlicensed agricultural vehicle	___	___
Reduced registration fees	___	___

17. In your viewpoint which of the following areas could be changed from the existing situation in order to provide improvements in construction and maintenance operations? Check the appropriate areas below:

	CHANGES NEEDED				
Activities	Better Inter-Gov't. Coordination & Cooperation	Consolidation of Work Forces 1/	Uniform Design Guides	DOT Trng. Materials & Programs	No Change
A. System Planning	___	___	___	___	___
B. Design & Construction					
(1) Res.,Commercial, Farm Access Roads	___	___	___	___	___
(2) Collector:					
0-100 ADT	___	___	___	___	___
100-1000 ADT	___	___	___	___	___
1000-5000 ADT	___	___	___	___	___
C. Maintenance & Equip. Use					
(1) Res., Commercial, Farm Access Roads	___	___	___	___	___
(2) Collector:					
0-100 ADT	___	___	___	___	___
100-1000 ADT	___	___	___	___	___
1000-5000 ADT	___	___	___	___	___
D. Contract Administration	___	___	___	___	___
E. Equipment Purchase	___	___	___	___	___

1/ It is possible to accomplish this in different ways not necessarily involving any changes in basic jurisdictional responsibilities.

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

CITY _____

CITY QUESTIONNAIRE
Part B

B. The following group of questions may require, in some cases, and do require, in others, supplemental information. Use separate sheet to provide additional information as necessary. Please note number of question being answered.

18. a. Do you contract any routine maintenance activities?
___ Yes ___ No

b. Do you contract any major maintenance activities?
___ Yes ___ No

c. Do you contract paved resurfacing? ___ Yes ___ No

d. Do you contract granular resurfacing? ___ Yes ___ No

For each yes answer, identify the activities and the amount (percentage) of expenditure for each that is performed by contract for the most recent year.

Activity	Total Expenditure	Percent Contracted
_____	$_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

19. a. Do you rent or borrow equipment?
___ Yes ___ No

b. Do you lend or lease equipment?
___ Yes ___ No

If yes, please provide typical details.

20. Outside of FAUS, are your procedures and requirements for construction contract advertisement, bidding, bonding, letting, etc., essentially the same as those of the state DOT? ___ Yes ___ No. If no, please describe any fundamental differences.

21. a. Do you require the pre-qualification of construction contractors? Yes ___ No ___.

    b. If yes, are your procedures and requirements basically the same as those employed by the state DOT? ___ Yes ___ No.

    c. If no, please indicate the requirements, if any, that are used?

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    (1) Letting (advertising, obtaining bids, recommending award) FAUS Funded Projects _____

    (2) Letting Other State Funded Projects _____

    (3) Letting Other Locally Funded Projects _____

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

CITY _____

CITY QUESTIONNAIRE
Part C

C. Supplemental information, on separate pages, is required for all of the following group of questions. Note number of question being answered.

23. Please provide a listing of your major equipment showing type, numbers of pieces, size or capacity designation, age, current serviceability, and typical (estimated or recorded) hours of actual use per month in winter and summer. Also show projected acquisitions/ disposals during fiscal years 1984 and 1985.

24. Assume you are going to let a construction contract in the following circumstances using your typical administrative and staffing arrangements, please provide details indicated below: 1/

Description of Work: Major construction including paving, curb and gutter and surface drainage provisions.

Street Service Category: The street is in a developing commerical area with a mixture of old residences and shops and will possess features typical of the design standards you employ in your city for a 2-lane facility with parking provided on both sides.

		Grading	Paving	
1.	Typical Project Mileage	_____	_____	thousand ft.
2.	Typical Project Duration	_____	_____	months
3.	Administrator or Project Manager	_____	_____	man-days
4.	Asst. Engineer or Chief Inspector	_____	_____	man-days
5.	Survey Party Chief or Instrument Man	_____	_____	man-days
6.	Other Survey Crew	_____	_____	man-days
7.	Grading and Drainage Inspection	_____	_____	man-days
8.	Paving or Street Inspection	_____	_____	man-days
9.	Plant Inspection	_____	_____	man-days
10.	Clerical Staff	_____	_____	man-days
11.	_____	_____	_____	man-days

1/ Best judgments are requested in providing these answers. The objective is to determine typical differences of magnitude in the way the same projects may be administered at different jurisdictional levels.

25. On a street map of your city, please show the following:

    a. If the answer to Question 7 (Part A) was yes, show your main street system distinctions for maintenance (color routes and provide code);

    b. location of main maintenance office;

    c. location of major equipment yard and repair shop facilities;

    d. other garages/locations where personnel report and/or equipment is stored.

    NOTE: Identify the main maintenance office and garage location with a unique code number. Unless locations are already numbered (coded) start with '1' for the main maintenance location and continue in sequence until all locations are numbered.

26. Identify the personnel and equipment normally assigned to each location identified in Question 25 according to the breakdown shown in Exhibit 2. As appropriate, show separate for year-round, winter and summer.

27. Please indicate services that are provided for the county or the state pertaining to facilities and activities that are not legally your responsibility including reimbursement arrangements -- show how costs and reimbursement relate.

28. Indicate arrangements with the county or the state for maintenance or traffic operations on city interest facilities where reimbursement is paid to the county or state, along with the basis of reimbursement.

Prepared By: (Name) _____

(Title) _____

Phone No.: _____

Date: _____

EXHIBIT 2
PERSONNEL AND EQUIPMENT RESOURCES

City _____

☐ Year-round
☐ Winter
☐ Summer

No.	LOCATION 1/	ASSIGNED PERSONNEL				MAJOR EQUIPMENT 2/							REMARKS
		Admin.	Superv.	Equip. Oper.	Lbrs.	Pickups	Dump Trucks	Dozers	Motor Grader	Backhoe	Loader	Other	

1/ Describe the type and extent of garage and repair facilities in Remarks column or on a separate sheet.
2/ Optionally, equipment list provided in Question 23 may be used to report location assignment.

QUESTIONNAIRE RESULTS

The Questionnaire or Data Collection Worksheets was transmitted to the 99 counties and the 956 cities in Iowa. The following number of completed questionnaires were returned.

JURISDICTION	TOTAL SENT	RESPONSES RECEIVED	PERCENT RESPONSES
ALL COUNTIES	99	79	80
RURAL COUNTIES	91	72	79
URBAN COUNTIES (with Cities over 50,000)	8	7	88
CITIES OVER 50,000	8	6	75
CITIES BETWEEN 5-50,000	59	36	61
CITIES BELOW 5,000	889	122	14

Questionnaires were transmitted in June 1984 and the last response received in January 1985. The responses of all completed questionnaires returned are summarized on the following pages

FORMALIZED DESIGN STANDARDS FOR DIFFERENT FUNCTIONAL CLASSES OF HIGHWAYS, ROADS AND/OR STREETS

	GROUPS					
		COUNTIES		CITIES		
	ALL	RURAL	URBAN (WITH CITIES OVER 50,000)	OVER 50,000	BETWEEN 5 - 50,000	BELOW 5,000
YES	91%	90%	100%	80%	64%	18%
NO	9%	10%	0%	20%	36%	82%
NR	0%	0%	0%	0%	0%	0%
STANDARDS USED	NUMBER OF RESPONSES					
AASHTO	17	17	0	1	14	3
F.M.	45	39	6	0	0	0
OTHERS	10	9	1	3	9	19

1. Do you have formalized highway design standards for different functional classes of highways, roads and/or streets?
   ___ Yes ___ No Specify: _____

ARE DESIGN STANDARDS TOO HIGH?

STATE

GROUP		YES	NO	NR
ALL	COUNTIES	34%	66%	0%
RURAL		31%	69%	0%
URBAN (with Cities Over 50,000)		71%	29%	0%
OVER 50,000	CITIES	60%	40%	0%
BETWEEN 5-50,000		44%	50%	6%
BELOW 5,000		50%	30%	20%

FEDERAL

GROUP		YES	NO	NR
ALL	COUNTIES	52%	48%	0%
RURAL		50%	50%	0%
URBAN (with Cities Over 50,000)		71%	29%	0%
OVER 50,000	CITIES	60%	40%	0%
BETWEEN 5-50,000		58%	36%	6%
BELOW 5,000		47%	29%	24%

3. Are State or Federal design standards too high from the standpoint of the amount of funds available to the county for construction of needed facilities? State: _____ Yes _____ No
Federal: _____ Yes _____ No

SATISFIED WITH CURRENT PERCENT DISTRIBUTION OF ROAD USER TAX FUNDS BETWEEN THE STATE AND OTHER LEVELS OF GOVERNMENT

GROUP		YES	NO	NR
ALL	COUNTIES	94%	6%	0%
RURAL	COUNTIES	96%	4%	0%
URBAN (WITH CITIES OVER 50,000)	COUNTIES	71%	29%	0%
OVER 50,000	CITIES	20%	80%	0%
BETWEEN 5-50,000	CITIES	44%	53%	3%
BELOW 5,000	CITIES	69%	18%	13%

4. Are you satisfied with the current percentage apportionments of road user tax funds between the state and other levels of government presuming jurisdictional responsibilities do not change?
Yes ___ No ___

If your answer is no, please indicate desirable percentage changes on a separate page, giving reasons why these changes would provide a more equitable or beneficial apportionment.

PRIORITY FACTORS FOR ALLOCATIONS OF ROAD USER TAX FUNDS AMONG LOCAL UNITS OF GOVERNMENT

BETWEEN COUNTIES & CITIES

GROUPS	ALL	COUNTIES: RURAL	COUNTIES: URBAN (WITH CITIES OVER 50,000)	CITIES: OVER 50,000	CITIES: BETWEEN 5 - 50,000	CITIES: BELOW 5,000
HIGHWAY NEEDS INCLUDING LOCAL FACILITIES	8.90	9.02	5.75	6.00	6.54	8.10
HIGHWAY NEEDS EXCLUDING LOCAL FACILITIES	3.54	3.16	5.83	1.75	3.25	3.98
VEHICLE MILES (VOLUME X MILES) (ALL FACILITIES)	4.18	3.97	4.75	4.57	6.26	5.66
OTHERS	3.59	3.38	2.13	3.33	3.75	2.38

5. Indicate the priority importance that should be given to the following factors in allocating the local share of road user tax funds among local units of government. Use 10 as the most important factor and zero as no importance and assign priorities from 10-0 without attempting to assign relative weights.

Allocations Between/Among:

COUNTIES & CITIES

___ Highway Needs Including Local Facilities

___ Highway Needs Excluding Local Facilities

___ Vehicle Miles (Volume x Miles) (All Facilities)

___ _____

PRIORITY FACTORS FOR ALLOCATIONS OF ROAD USER TAX FUNDS AMONG LOCAL UNITS OF GOVERNMENT

AMONG COUNTIES OR AMONG CITIES

	GROUPS					
		COUNTIES		CITIES		
	ALL	RURAL	URBAN (WITH CITIES OVER 50,000)	OVER 50,000	BETWEEN 5 - 50,000	BELOW 5,000
HIGHWAY NEEDS INCLUDING LOCAL ROADS	8.95	9.15	5.33	6.29	6.51	8.33
HIGHWAY NEEDS EXCLUDING LOCAL ROADS	2.88	2.75	3.33	1.17	2.84	3.62
POPULATION	3.72	3.41	5.38	5.71	6.71	5.67
AREA	7.01	7.01	5.44	3.22	3.79	4.66
VEHICLE MILES (VOLUME X MILES) (ALL ROADS)	4.30	4.00	5.67	5.29	5.88	6.11
MILES INCLUDING LOCAL ROADS	7.53	7.60	5.00	6.14	6.68	5.98
MILES EXCLUDING LOCAL ROADS	2.47	2.41	2.60	0.86	2.97	2.95
VEHICLE REGISTRATIONS	2.83	2.45	5.25	4.29	3.47	4.05
UNIT CONSTRUCTION COSTS	6.29	6.23	5.33	2.67	2.61	5.41
OTHERS	7.00	6.60	4.50	0	0	2.20

5. Among counties or among cities.

___ Highway Needs Including Local Streets/Roads

___ Highway Needs Excluding Local Streets/Roads

___ Population

___ Area

___ Vehicle Miles (Volume x Miles) (All Roads)

___ Miles Including Local Streets/Roads

___ Miles Excluding Local Streets/Roads

___ Vehicle Registrations

___ Unit Construction Costs

___ _____

HIGHWAY PROGRAM TO ESTABLISH A PRIORITY LISTING OF ROAD LOCATION FOR IMPROVEMENTS

GROUP		YES	NO	NR
ALL	COUNTIES	91%	9%	0%
RURAL		92%	8%	0%
URBAN (WITH CITIES OVER 50,000)		86%	14%	0%
OVER 50,000	CITIES	100%	0%	0%
BETWEEN 5-50,000		97%	3%	0%
BELOW 5,000		36%	62%	2%

6. Do you have a highway program which minimally results in the establishment of a priority listing of road locations for improvements?
___ Yes ___ No

Q.7 EMPLOY MAINTENANCE "SERVICE LEVEL CRITERIA" FOR DIFFERENT CLASSES OF STREETS

		GROUPS					
		COUNTIES			CITIES		
		ALL	RURAL	URBAN	OVER 50,000	BETWEEN 5,000 & 50,000	BELOW 5,000
	YES	39%	36%	71%	60%	36%	35%
	NO	61%	64%	29%	40%	64%	63%
	NR	0%	0%	0%	0%	0%	2%
ACTIVITY CATEGORIES:							
SNOW REMOVAL	YES	39%	35%	86%	60%	25%	34%
	NO	1%	1%	0%	0%	11%	0%
PATCHING	YES	25%	24%	43%	60%	31%	30%
	NO	13%	11%	29%	0%	6%	2%
SEALING	YES	22%	17%	71%	60%	22%	26%
	NO	15%	17%	0%	0%	14%	2%
MAINTENANCE OVERLAY	YES	24%	19%	71%	60%	28%	19%
	NO	11%	13%	0%	0%	8%	3%
GRAVEL REPLACEMENT	YES	34%	32%	57%	0%	19%	24%
	NO	4%	3%	14%	40%	14%	1%
SHOULDER REPAIR	YES	22%	19%	43%	0%	11%	13%
	NO	14%	14%	14%	4%	22%	9%
CURB & DRAIN REPAIR	YES	13%	10%	43%	20%	19%	18%
	NO	22%	22%	14%	20%	17%	7%
TRAFFIC SIGNING & STRIPING	YES	32%	29%	57%	20%	28%	20%
	NO	8%	7%	14%	20%	8%	6%
SIGNAL MAINTENANCE	YES	9%	7%	29%	20%	25%	9%
	NO	23%	24%	14%	20%	11%	9%
OTHER	YES	6%	3%	43%	20%	0%	0%
	NO	1%	1%	0%	0%	0%	1%

NR = NO RESPONSE

7. a. Do you employ maintenance "service level criteria" for the different classes of roads under your jurisdiction to develop your annual maintenance budget? ___ Yes ___ No

   b. <u>If yes</u>, check the following activity categories for which criteria have been established:

Q.8 AVERAGE FREQUENCY (YEARS) TO DETERMINE MAINTENANCE NEEDS.

	GROUPS					
	COUNTIES			CITIES		
	ALL	RURAL	URBAN	OVER 50,000	BETWEEN 5,000 & 50,000	BELOW 5,000
ESTABLISHED SURFACE RESEALING RATES	3.8	3.8	4.2	8	4.0	5.4
(% OF RESPONSES)	47%	44%	71%	20%	11%	20%
CRACK INSPECTION/ MEASUREMENT	2.3	2.2	3.5	2	2.4	2.3
(% OF RESPONSES)	37%	35%	57%	20%	7%	12%
GRAVEL DEPLETION INSPECTION	1.4	1.3	2.6	1	1.8	1.6
(% OF RESPONSES)	77%	76%	86%	20%	5%	15%
ROAD ROUGHNESS/ DEFLECTION MEASUREMENTS	3.0	2.3	5.3	2	1.5	2.8
(% OF RESPONSES)	15%	13%	43%	20%	4%	10%
OTHER	1.1	1.0	1.2	0	0	12.5
(% OF RESPONSES)	8%	3%	57%	0%	0%	2%

8. Do you make projections of specific maintenance needs employing objective criteria such as:

	No	Yes	Number of Years
Established Surface Resealing Rates	___	___	___
Crack Inspection/Measurement	___	___	___
Gravel Depletion Inspection	___	___	___
Road Roughness or Deflection Measurements	___	___	___
Other _____	___	___	___
_____	___	___	___

Q.9 USE OF OUTSIDE SHOPS AND MECHANICS FOR EQUIPMENT REPAIR OR SERVICE.

	GROUPS					
	COUNTIES			CITIES		
	ALL	RURAL	URBAN	OVER 50,000	BETWEEN 5,000 & 50,000	BELOW 5,000
MAJOR REPAIRS:						
NO	6%	7%	0%	20%	0%	18%
OFTEN	37%	36%	43%	20%	58%	47%
SELDOM	56%	56%	57%	60%	42%	25%
NR	1%	1%	0%	0%	0%	11%
MINOR REPAIRS:						
NO	59%	57%	86%	80%	64%	43%
OFTEN	3%	1%	14%	20%	6%	23%
SELDOM	37%	40%	0%	0%	31%	25%
NR	1%	1%	0%	0%	0%	10%
ROUTINE SERVICE:						
NO	89%	89%	86%	80%	86%	61%
OFTEN	0%	0%	0%	20%	6%	11%
SELDOM	10%	10%	14%	0%	8%	15%
NR	1%	1%	0%	0%	0%	12%

NR = NO RESPONSE

9. *Do you use "outside" (non-owned or managed) shops and mechanics for equipment repair/service?*

	No	Often	Seldom
Major Repairs	___	___	___
Minor Repairs	___	___	___
Routine Service	___	___	___

Q.10 PREVENTIVE MAINTENANCE PROGRAM FOR ROAD EQUIPMENT.

	GROUPS					
	COUNTIES			CITIES		
	ALL	RURAL	URBAN	OVER 50,000	BETWEEN 5,000 & 50,000	BELOW 5,000
YES	82%	81%	100%	100%	86%	50%
NO	15%	17%	0%	0%	14%	47%
NO RESPONSE	3%	3%	0%	0%	0%	3%

10. Do you have a preventive maintenance program for your road equipment?
___ Yes ___ No

Q.11 ANALYTICAL PROCEDURES TO DETERMINE EQUIPMENT SALES/REPLACEMENT/ PROCUREMENT AND THE ITEMS INCLUDED.

		GROUPS					
		COUNTIES			CITIES		
		ALL	RURAL	URBAN	OVER 50,000	BETWEEN 5,000 & 50,000	BELOW 5,000
	YES	75%	75%	71%	60%	44%	12%
	NO	24%	24%	29%	40%	56%	83%
	NR	1%	1%	0%	0%	0%	5%
PROCEDURES INCLUDED:							
PRODUCTIVITY IN TERMS OF REQUIREMENTS	YES	57%	57%	57%	60%	22%	9%
	NO	14%	14%	14%	0%	17%	2%
REPAIR COSTS AS COMPARED TO AVE/PIECE	YES	71%	71%	71%	40%	31%	8%
	NO	4%	4%	0%	0%	11%	3%
DOWNTIME FOR REPAIRS	YES	67%	67%	71%	60%	33%	7%
	NO	6%	7%	0%	0%	8%	5%
OPERATING COSTS AS COMPARED W/ALTERNATIVE	YES	65%	64%	71%	40%	39%	7%
	NO	8%	8%	0%	0%	0%	5%
PREVENTIVE MAINT. RECORD	YES	51%	50%	57%	60%	36%	7%
	NO	22%	22%	14%	0%	3%	4%
STANDBY VS PRODUCTIVE WORK TIME	YES	42%	40%	57%	20%	19%	4%
	NO	29%	31%	14%	40%	19%	6%
RENTAL POSSIBILITIES	YES	24%	25%	14%	40%	19%	5%
	NO	46%	46%	43%	0%	22%	7%
SHARED USE	YES	15%	14%	29%	60%	25%	1%
	NO	56%	57%	43%	0%	14%	9%

NR = NO RESPONSE

11. a. Do you have an analytical procedure for determining equipment sales/replacement/procurement? ___ Yes ___ No

b. <u>If yes</u>, does it include the following:

DO YOU REQUIRE DEVELOPERS TO BUILD STREETS WITHIN NEW DEVELOPMENTS

		GROUPS					
			COUNTIES		CITIES		
		ALL	RURAL	URBAN (WITH CITIES OVER 50,000)	OVER 50,000	BETWEEN 5 - 50,000	BELOW 5,000
YES		82%	81%	100%	100%	100%	46%
NO		14%	15%	0%	0%	0%	43%
NR		4%	4%	0%	0%	0%	11%
REQUIREMENTS		NUMBER OF RESPONSES					
ALL STREETS	Y	60	53	7	5	35	46
	N	2	2	0	0	1	5
ONLY PROPERTY ACCESS STREETS	Y	14	12	2	0	2	17
	N	29	27	2	3	31	24
MUST MEET ESTABLISHED CONSTRUCTION/DESIGN STANDARDS	Y	58	52	6	5	35	48
	N	3	2	1	0	1	2
THE COMPLETED STREETS ARE CHARGED TO THE PROPERTY OWNERS	Y	8	7	1	0	1	15
	N	44	39	5	5	34	36

12. a. Do you require or permit (delete one) developers of large parcels of property to build streets within the new development?
___ Yes ___ No

b. If yes, answer the following:

		Yes	No
(1)	Includes all streets	___	___
(2)	Includes only property access streets	___	___
(3)	Must meet established construction/design standards	___	___
(4)	Are the completed streets purchased and charged to the property owners through special assessments or front-foot benefits.	___	___

13. a. How many liability claims, relating to street maintenance or operations, were filed against your county in 1981 ____; 1982 ____; 1983 ____.

b. What was the total number and dollar value of settlements made in:

1981	No.	_____	$_____
1982	No.	_____	$_____
1983	No.	_____	$_____

Insufficient responses to this question were received to tabulate any meaningful results. These data were not readily available to the respondents.

INCREASE OR DECREASE OF STATE ADMINISTERED AND MAINTAINED MILEAGE

	RUTF CHANGE	GROUPS					
			COUNTIES			CITIES	
		ALL	RURAL	URBAN (WITH CITIES OVER 50,000)	OVER 50,000	BETWEEN 5 - 50,000	BELOW 5,000
		NUMBER OF RESPONSES					
INCREASED	WITH CHANGE	2	1	1	0	3	16
	WITHOUT CHANGE	3	3	0	0	0	8
DECREASED	WITH CHANGE	9	9	0	0	2	4
	WITHOUT CHANGE	0	0	0	0	0	0
NO SIGNIFICANT CHANGE	WITH CHANGE	5	4	1	0	4	18
	WITHOUT CHANGE	59	54	5	4	27	52

14. With and without changes in the current allocations of the RUTF between the state and local units of government, do you think the current mileage of the system administered and maintained by the state DOT should be:

		With Change	Without Change
Check one:	Increased	___	___
	Decreased	___	___
	No Significant Change	___	___

If you wish, you may explain your answer on a separate sheet.

EXPANSION OF STATE'S WEIGHT CONTROL ON LOCAL ROADS AND STREETS

		GROUPS					
			COUNTIES			CITIES	
		ALL	RURAL	URBAN (WITH CITIES OVER 50,000)	OVER 50,000	BETWEEN 5 - 50,000	BELOW 5,000
YES		85%	83%	100%	100%	58%	57%
NO		11%	13%	0%	0%	42%	36%
NR		4%	4%	0%	0%	0%	7%
CONTINUATION OF THE SPECIAL PROVISIONS FOR FARM AND AGRICULTURAL VEHICLES							
NO WEIGHT LIMIT ON UNLINCENSED AGRICULTURAL VEHICLE	YES	5%	5%	14%	40%	11%	34%
	NO	94%	94%	86%	60%	86%	57%
	NR	1%	1%	0%	0%	3%	9%
REDUCED REGISTRATION FEES	YES	29%	31%	14%	20%	22%	30%
	NO	70%	68%	86%	80%	75%	55%
	NR	1%	1%	0%	0%	3%	15%

15. Should the State's weight enforcement operations be expanded to provide meaningful weight enforcement on local roads and streets?
___ Yes ___ No

16. Do you favor the continuation of the special provisions for farm and agricultural vehicles?

	Yes	No
No weight limit on unlicensed agricultural vehicle	___	___
Reduced registration fees	___	___

17. In your viewpoint which of the following areas could be changed from the existing situation in order to provide improvements in construction and maintenance operations? Check the appropriate areas below:

Activities	CHANGES NEEDED: Better Inter-Gov't. Coordination & Cooperation	Consolidation of Work Forces [1]	Uniform Design Guides	DOT Trng. Materials & Programs	No Change
A. System Planning					
B. Design & Construction					
(1) Res., Commercial, Farm Access Roads					
(2) Collector:					
0-100 ADT					
100-1000 ADT					
1000-5000 ADT					
C. Maintenance & Equip. Use					
(1) Res., Commercial, Farm Access Roads					
(2) Collector:					
0-100 ADT					
100-1000 ADT					
1000-5000 ADT					
D. Contract Administration					
E. Equipment Purchase					

[1] It is possible to accomplish this in different ways not necessarily involving any changes in basic jurisdictional responsibilities.

The majority of the responses to this item were "No Change" by those jurisdications replying. However, insufficient responses were received for a meaningful tabulation.

CONTRACT MAINTENANCE ACTIVITIES

ACTIVITIES BY CONTRACT

		GROUPS					
			COUNTIES		CITIES		
		ALL	RURAL	URBAN (WITH CITIES OVER 50,000)	OVER 50,000	BETWEEN 5 - 50,000	BELOW 5,000
CONTRACT OF ROUTINE MAINTENANCE ACTIVITIES	Y	42%	39%	71%	20%	17%	31%
	N	57%	60%	29%	80%	80%	65%
	NR	1%	1%	0%	0%	3%	4%
CONTRACT OF MAJOR MAINTENANCE ACTIVITIES	Y	66%	64%	86%	40%	83%	61%
	N	33%	35%	14%	60%	17%	34%
	NR	1%	1%	0%	0%	0%	5%
CONTRACT OF PAVED RESURFACING	Y	92%	92%	100%	60%	94%	49%
	N	7%	7%	0%	40%	6%	46%
	NR	1%	1%	0%	0%	0%	5%
CONTRACT OF GRANULAR RESURFACING	Y	73%	76%	43%	0%	5%	47%
	N	27%	24%	57%	100%	92%	47%
	NR	0%	0%	0%	0%	3%	6%

18. a. Do you contract any routine maintenance activities? ___ Yes ___ No

b. Do you contract any major maintenance activities? ___ Yes ___ No

c. Do you contract paved resurfacing? ___ Yes ___ No

d. Do you contract granular resurfacing? ___ Yes ___ No

Q.19 EQUIPMENT.

	GROUPS					
	COUNTIES			CITIES		
	ALL	RURAL	URBAN	OVER 50,000	BETWEEN 5,000 & 50,000	BELOW 5,000
RENT/BORROW EQUIPMENT:						
YES	48%	46%	71%	80%	36%	19%
NO	52%	54%	29%	20%	56%	77%
NR	0%	0%	0%	0%	8%	4%
LEND/LEASE EQUIPMENT:						
YES	42%	42%	43%	20%	33%	8%
NO	58%	58%	57%	80%	58%	88%
NR	0%	0%	0%	0%	8%	4%

NR = NO RESPONSE

19. a. Do you rent or borrow equipment?
___ Yes ___ No

b. Do you lend or lease equipment?
___ Yes ___ No

If yes, please provide typical details.

REQUIREMENTS FOR CONTRACT AWARDS

REQUIREMENTS		GROUPS: ALL	COUNTIES: RURAL	COUNTIES: URBAN (WITH CITIES OVER 50,000)	CITIES: OVER 50,000	CITIES: BETWEEN 5 - 50,000	CITIES: BELOW 5,000
CONSTRUCTION CONTRACT - ADVERTISEMENT - BIDDING BONDING - LETTING - THE SAME AS IDOT	Y	98%	97%	100%	60%	78%	62%
	N	1%	2%	0%	40%	22%	12%
	NR	1%	1%	0%	0%	0%	25%

20. Outside of FAS or Farm-to-Market projects, are your procedures and requirements for construction contract advertisement, bidding, bonding, letting, etc., essentially the same as those of the state DOT? ___ Yes ___ No. If no, please describe any fundamental differences.

REQUIREMENTS FOR CONTRACT AWARDS

REQUIREMENTS		GROUPS					
			COUNTIES		CITIES		
		ALL	RURAL	URBAN (WITH CITIES OVER 50,000)	OVER 50,000	BETWEEN 5 - 50,000	BELOW 5,000
PRE-QUALIFICATIONS OF CONSTRUCTION CONTRACTORS	Y	92%	92%	100%	0%	17%	52%
	N	8%	8%	0%	100%	78%	42%
	NR	0%	0%	0%	0%	5%	6%
PRE-QUALIFICATION REQUIREMENTS THE SAME AS IDOT	Y	88%	88%	100%	0%	17%	47%
	N	4%	4%	0%	20%	5%	2%
	NR	8%	8%	0%	0%	78%	51%

21. a. Do you require the pre-qualification of construction contractors? Yes ___ No ___.

b. <u>If yes</u>, are your procedures and requirements basically the same as those employed by the state DOT? ___ Yes ___ No.

c. <u>If no</u>, please indicate the requirements, if any, that are used?

AGENCY _____

Part C

C. Supplemental information, on separate pages, is required for all of the following group of questions. Note number of question being answered.

24. Assume you are going to let a construction contract in the following circumstances using your typical administrative and staffing arrangements, please provide details indicated below: 1/

Description of Work: Construction on completely new grade, including new pavement, or reconstruction of equivalent scope.

Road Service Category: The rural road will possess features typical of the design standards you employ in the environment of your county. When opened to traffic, it is expected to carry over 400 VPD.

		Grading	Paving	
1.	Typical Project Mileage	_____	_____	miles
2.	Typical Project Duration	_____	_____	months
3.	Administrator or Project Manager	_____	_____	man-days
4.	Asst. Engineer or Chief Inspector	_____	_____	man-days
5.	Survey Party Chief or Instrument Man	_____	_____	man-days
6.	Other Survey Crew	_____	_____	man-days
7.	Grading and Drainage Inspection	_____	_____	man-days
8.	Paving or Street Inspection	_____	_____	man-days
9.	Plant Inspection	_____	_____	man-days
10.	Clerical Staff	_____	_____	man-days
11.	_____	_____	_____	man-days

1/ Best judgments are requested in providing these answers. The objective is to determine typical differences of magnitude in the way the same projects may be administered at different jurisdictional levels.

Q24 FACTS FROM A TYPICAL CONSTRUCTION CONTRACT OF A RURAL ROAD (TIME PER MILES OR TIME PER 1,000 FEET)

		GROUPS					
		COUNTIES			CITIES		
		ALL	RURAL	URBAN	OVER 50,000	BETWEEN 5,000 & 50,000	BELOW 5,000
TYPICAL PROJECT MILEAGE (COUNTIES: MILES, CITIES: 1,000 FT)	GRADING	4.9	5.0	4.5	1.8	1.8	1.6
	(% RESPONSE)	89%	89%	86%	80%	58%	10%
	PAVING	5.6	5.7	4.0	2.0	1.9	2.3
	(% RESPONSE)	90%	90%	86%	100%	67%	9%
TIME FOR ADMINISTRATOR/ PROJECT MANAGER (MAN-DAYS)	GRADING	16.0	15.3	23.5	15.5	7.9	5.8
	(% RESPONSE)	87%	88%	86%	80%	42%	9%
		3.3	3.1	5.2	8.6	4.4	3.6
	PAVING	9.1	9.1	9.0	14.6	12.0	6.7
	(% RESPONSE)	87%	88%	86%	100%	58%	9%
		1.6	1.6	2.3	7.3	6.3	2.9
TIME FOR ASSISTANT ENGINEER/ CHIEF INSPECTOR (MAN-DAYS)	GRADING	36.8	36.4	41.8	10.0	12.9	5.1
	(% RESPONSE)	87%	88%	86%	80%	42%	10%
		7.5	7.3	9.3	5.6	7.2	3.2
	PAVING	17.6	17.8	15.3	36.6	19.8	5.2
	(% RESPONSE)	89%	89%	86%	100%	58%	9%
		3.1	3.1	3.8	18.3	10.4	2.3
TIME FOR SURVEY PARTY CHIEF/ INSTRUMENT MAN (MAN-DAYS)	GRADING	29.7	29.2	35.3	13.3	7.7	2.2
	(% RESPONSE)	89%	89%	86%	60%	44%	9%
		6.1	5.8	8.0	7.4	4.3	1.4
	PAVING	15.9	16.0	14.2	16.0	9.4	3.7
	(% RESPONSE)	84%	83%	86%	80%	53%	9%
		2.9	2.8	3.6	8.0	4.9	1.6
TIME FOR OTHER SURVEY CREW (MAN-DAYS)	GRADING	47.9	47.4	53.3	16.7	9.1	1.6
	(% RESPONSE)	87%	88%	86%	60%	44%	7%
		9.8	9.5	11.8	9.3	5.1	1.0
	PAVING	21.2	20.9	24.2	24.5	12.1	1.0
	(% RESPONSE)	85%	85%	86%	80%	50%	8%
		3.8	3.7	6.1	12.3	6.4	0.4
TIME FOR GRADING & DRAINAGE INSPECTION (MAN-DAYS)	GRADING	47.9	47.9	48.2	13.5	9.7	6.7
	(% RESPONSE)	82%	82%	86%	80%	39%	8%
		9.8	9.6	10.7	7.5	5.4	4.2
	PAVING	4.9	3.7	13.0	50.0	3.1	3.9
	(% RESPONSE)	41%	39%	57%	20%	31%	7%
		0.9	0.6	3.3	25.0	1.6	1.7
TIME FOR PAVING/STREET INSPECTION (MAN-DAYS)	GRADING	6.2	6.3	4.5	0.0	3.1	3.1
	(% RESPONSE)	35%	36%	29%	0%	17%	7%
		1.3	1.3	1.0	0.0	1.7	1.9
	PAVING	28.0	28.3	25.3	27.0	14.2	7.1
	(% RESPONSE)	82%	82%	86%	100%	56%	9%
		5.0	5.0	6.3	13.5	7.5	3.1
TIME FOR PLANT INSPECTION (MAN-DAYS)	GRADING	3.9	3.1	11.0	0.0	1.8	0.8
	(% RESPONSE)	39%	39%	43%	20%	14%	5%
		0.8	0.6	2.4	0.0	1.0	0.5
	PAVING	17.1	17.8	10.2	4.8	4.7	0.9
	(% RESPONSE)	87%	88%	86%	8%	53%	7%
		3.1	3.1	2.6	2.4	2.5	0.4
TIME FOR CLERICAL STAFF (MAN-DAYS)	GRADING	7.4	7.1	10.5	4.5	2.4	3.3
	(% RESPONSE)	81%	81%	86%	80%	47%	7%
		1.5	1.4	2.3	2.5	1.3	2.1
	PAVING	5.5	5.5	6.0	5.8	4.3	2.1
	(% RESPONSE)	84%	83%	86%	80%	67%	8%
		1.0	1.0	1.5	3.9	2.9	0.9
TIME FOR OTHERS (MAN-DAYS)	GRADING	44.0	50.0	35.0	0.0	0.4	0.0
	(% RESPONSE)	6%	4%	29%	40%	3%	0%
		9.0	10.0	7.8	6.1	0.2	0.0
	PAVING	7.7	8.5	6.0	20.0	0.3	0.0
	(% RESPONSE)	8%	6%	29%	20%	3%	0%
		1.4	1.5	1.5	10.0	0.2	0.0

EXHIBIT 2: PERSONNEL AND EQUIPMENT RESOURCES.

	GROUPS					
	COUNTIES			CITIES		
	ALL	RURAL	URBAN	OVER 50,000	BETWEEN 5,000 & 50,000	BELOW 5,000
ASSIGNED PERSONNEL:						
ADMINISTRATORS	145	102	43	12	22	11
SUPERVISORS	248	218	30	23	50	24
EQUIPMENT OPERATORS	1617	1361	256	141	196	87
LABORS	311	283	28	91	122	25
MAJOR EQUIPMENT:						
PICKUPS	725	596	129	29	119	64
DUMP TRUCKS	1024	890	134	122	223	107
DOZERS	185	163	22	7	6	1
MOTOR CRADERS	964	856	108	28	55	46
BACKHOES	122	113	9	3	23	18
LOADERS	240	207	33	16	56	56
OTHERS	577	468	109	147	205	85

26. Identify the personnel and equipment normally assigned to each location identified in Question 25 according to the breakdown shown in Exhibit 2. As appropriate, show separate for year-round, winter and summer.

IOWA RURAL COUNTIES (RESPONSED TO EXHIBIT 2)

NO. OF COUNTY 1/	MILES	EXHIBIT 2										
		AP				ME						
		A	S	E	L	P	T	D	M	B	L	O
66	60,008.90	102	218	1353	283	583	889	162	848	111	202	401
63	57,032.04											
LANE MILES PER PERSON:		58.3										
LANE MILES PER EQUIPMENT:						206	135	741	142	1081	594	299

IOWA URBAN COUNTIES (7 OUT OF 8 RESPONSES)

NO. OF COUNTY 1/	MILES	EXHIBIT 2										
		AP				ME						
		A	S	E	L	P	T	D	M	B	L	O
7	6,577.97	43	30	256	28	129	134	22	108	9	33	109
6	5,654.56											
AVERAGE:		14.3	6.0	42.7	7.0	18.4	19.1	3.1	15.4	1.5	4.7	15.6
RESPONSES:		3	5	6	4	7	7	7	7	6	7	7
% OF RESPONSES:		43%	71%	86%	57%	100%	100%	100%	100%	86%	100%	100%
LANE MILES PER PERSON:		31.7										
LANE MILES PER EQUIPMENT:						102	98	598	122	1462	399	121

1/ Number of Counties Responding

CITIES, OVER 50,000 POPULATION IN IOWA (4 OUT OF 5 RESPONSES)

NO. OF CITY 1/	POPULAT.	EXHIBIT 2 AP A	AP S	AP E	AP L	ME P	ME T	ME D	ME M	ME B	ME L	ME O
	452,255	15	38	212	147	29	122	7	28	3	16	147
POPULATION PER EMPLOYEE:						1098						
POPUPATION PER EQUIPMENT:						15595	3707	64608	16152	150752	28266	3077

CITIES, POPULATION BETWEEN 5,000 AND 50,000 IN IOWA

NO. OF CITY 1/	POPULAT.	EXHIBIT 2 AP A	AP S	AP E	AP L	ME P	ME T	ME D	ME M	ME B	ME L	ME O
31	461,506	22	50	196	122	119	223	6	55	23	56	205
28	418,630											
POPULATION PER EMPLOYEE:						1073						
POPULATION PER EQUIPMENT:						3878	2069	76917	8391	20065	8241	2251

CITIES, WITH POPULATION UNDER 5,000 IN IOWA (74 OUT OF 122 RESPONSES)

NO. OF CITY 1/	POPULAT	EXHIBIT 2 AP A	AP S	AP E	AP L	ME P	ME T	ME D	ME M	ME B	ME L	ME O
67	69,064	10	21	73	25	60	101	1	43	17	49	77
POPULATION PER EMPLOYEE:						535						
POPULATION PER EQUIPMENT:						1151	683	69064	1606	4062	1409	896

1/ Number of Cities Responding