

South Dakota
Department of Transportation
Office of Research

SD2008-11 Executive Summary 2008 Local Roads Needs Study

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STUDY PURPOSE

The 2008 Session of the South Dakota State Legislature commissioned an Interim Study on Highway Needs and Financing to assess funding needs and sources for state and local roads. The scope of the study was initially described in legislation introduced in the 2008 Session:¹

- projected long term state and local highway needs;
- allocation and distribution of responsibility for all highway segments within the state;
- future state and local highway cost projections compared to projected revenue;
- strategies for creating greater efficiency in financing state and local roads; and
- strategies to promote the development of innovative ideas aimed at reducing highway funding needs.

To support the Interim Study, the Department of Transportation’s Office of Research was directed to evaluate funding needs for roads and bridges owned by local governments in South Dakota.

RESEARCH OBJECTIVES

The objectives of this investigation, entitled *2008 Local Roads Needs Study*, were to:

- assess the current condition of local roads and bridges in South Dakota;
- identify major cost elements and the factors affecting changing needs on local roads and bridges;
- identify objective design, construction, and maintenance standards for use in estimating life-cycle costs of local road and bridges;
- estimate current and future funding needs for local roads and bridges;
- identify opportunities and strategies for reducing funding needs and achieving greater efficiency in financing local roads and bridges.

Key Findings

- Local officials perceive serious challenges in funding local roads and streets
- Significant challenges concern providing and maintaining road and bridge infrastructure
- Funding and expenditures have remained fairly constant since 1998, but purchasing power has declined more than 40%
- Agricultural, residential, and commercial development creates significant demands
- Local officials feel multi-agency collaboration and technical innovation hold the most potential for efficiency improvements
- Local officials view existing funding sources as the most likely sources of increased revenue
- The condition of road surfaces has improved since 1998, but more bridges need treatment
- Road surface condition will deteriorate at current expenditure levels, eroding gains presumably made from 1999 to 2003
- Annual local road surface needs total \$156 million and bridge needs total \$25 million
- A balanced investment strategy is far more effective than a “worst-first” strategy
- Changes to reporting of local financial and roadway information could facilitate future need assessments
- Staff development and use of asset management techniques could help local agencies meet financial challenges

The study considered the road networks belonging to counties, municipalities, and townships. Highways belonging to other entities, such as federal agencies, tribes, and local road districts, were not considered. Because all analysis was performed at the statewide level, it should not be used to evaluate individual agencies or reallocate funding among individual agencies.

¹ HB1315, South Dakota State Legislature 2008 Session.

METHODOLOGY

The methodology employed in this study is based largely upon a similar assessment in 1998. The *1998 Local Roads Need Study*, which was performed by a team of consultants and staff of the Office of Research, relied on information provided by local officials to ascertain the current condition of roads on the county, county secondary, township, and city networks. It used inspection information maintained by SDDOT's Office of Bridge Design to determine the current condition of major bridges and culverts. Based on design, construction, and maintenance standards defined in the South Dakota Secondary Road Plan, knowledge of bridge and road surface deterioration rates, and known costs of construction, rehabilitation, and maintenance treatments, the research team estimated the funding that would be required over a 20-year analysis period. To the extent possible, the *2008 Local Roads Needs Study* uses the same methodology, but with updated cost data, to permit comparison between 1998 and 2008 results.

Some elements were added to the 2008 study to make it more responsive to the defined scope of the Interim Study on Highway Needs and Financing. Its survey of local officials was enhanced to include questions about expenditure distributions, general funding needs and needs driven by residential, commercial, and agricultural development, and opportunities to improve efficiency.

LOCAL AGENCY SURVEY

An important component of this study was a survey of local officials to obtain current information about the condition of local roads and local perspectives on funding. Surveys were performed with support from associations representing local governments—the South Dakota Association of Counties and County Highway Superintendents Association, the South Dakota Municipal League and Street Superintendents Association, and the South Dakota Association of Towns and Townships.

The instrument used for all surveys comprised three distinct sections:

- The first section asked officials to provide information about the condition of road surfaces in their jurisdictions. While only city street information was requested from city officials, county highway superintendents were asked to provide separate responses for the county,

county secondary, and township networks within their counties.

- The second section asked officials to estimate recent expenditures for a variety of road- and street-related cost categories.
- The third section asked officials to respond to questions related to highway funding needs and opportunities for improved efficiency.

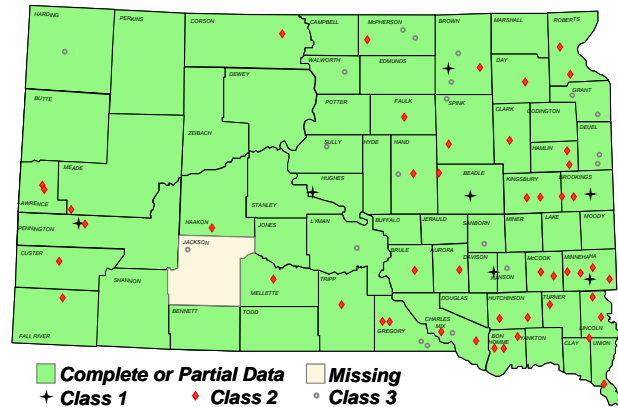


Figure 1: Local Agency Survey Responses

Usable responses were received from 65 of the state's 66 counties (Figure 1). Half (7 of 14) of Class 1 cities (population of 5,000 or more) responded, as did approximately half (49 of 105) of Class 2 cities (population between 500 and 5,000). Staff of the South Dakota Local Transportation Assistance Program (SDLTAP) worked with city staffs to complete surveys for 20 of the state's 192 Class 3 cities (population less than 500).

Responses were also received from 118 of the state's 918 organized townships. Although information received from individual townships did not define road surface conditions on the statewide township system, responses to the second and third sections of the survey provided valuable insights about township funding challenges.

The remainder of this section summarizes findings from the second and third sections of the survey. The application of road surface condition information from the first section is discussed in the Road Surface Need Analysis section on page 9.

Local Expenditures

Local officials provided estimates of recent (1-3 year average) expenditures for major elements of road- and street-related expenses. Figure 2 indicates the average percentage of expenditures reported for county, county secondary, township, and city road systems.

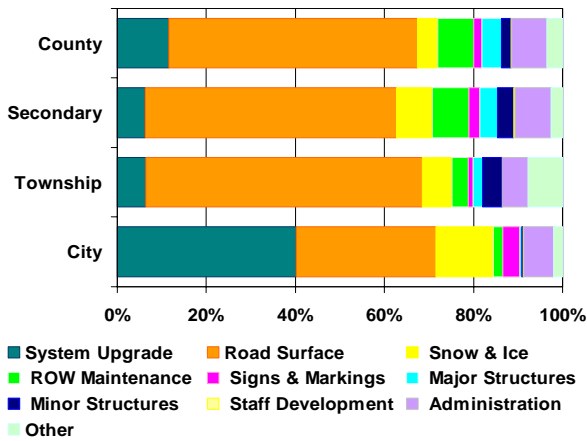


Figure 2: Reported Distribution of Expenditures

Although distinct differences exist between the four types of road systems, strong similarities also exist:

- The majority of expense is for road surface maintenance and for system upgrades and expansion to accommodate growth.
- Cities, especially Class 1 municipalities, devote a large proportion of their expenditures to system upgrades and expansion.
- Smaller but significant cost elements include snow and ice control, roadside maintenance within the right of way, sign maintenance, and maintenance of major and minor structures.
- Administrative costs typically consume less than 10% of total expenses.
- Expenditures for staff development tend to be less than 1% of total expenses.

While the survey responses provided insight into how funding is allocated among major cost elements, reports submitted to the South Dakota Department of Legislative Audit² provided the most reliable information on expenditure amounts.

Figure 3 shows estimates of expenditures by counties, cities, and townships in current dollars. Since 1998, total annual expenditures by counties have ranged from \$83 to \$107 million. During the same period, estimated annual expenditures have ranged from \$60 to \$103 million by cities and from \$13 to \$16 million per year by townships. (City data may be underreported because certain street

² <http://www.state.sd.us/legislativeaudit/home.htm>. County data include expenditure codes 431100—Highways, Roads and Bridges and 431200—Snow Removal; city data include expenditure code 43100 Highways & Streets; township data include line items for Road Maintenance (graveling, grading, etc.), Snow Removal, Weed mowing/spraying, Road Construction (culverts, bridges, regrading, reconstruction). All estimates are adjusted to compensate for missing values.

expenditures are sometimes grouped with other public works improvements or capital asset purchases.)

Other than year-to-year variability, no consistent trend is apparent for total county or township expenditures. City expenditures have experienced similar variability, but also a decline in total expenditure. Cities' annual expenditure averaged \$12 million less during the period of 2003-2007 than during the period of 1998-2002.

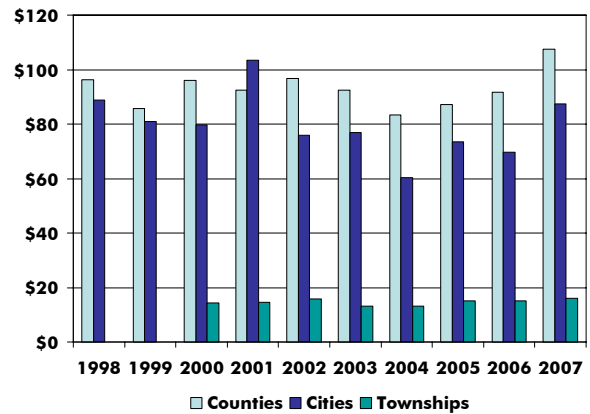


Figure 3: Estimated Local Road & Bridge Expenditures in Current Dollars (\$ million)

The flat or declining levels of local road and bridge expenditures have not sustained local agencies' ability to fund road improvements. Especially during the period from 2003 to 2008, costs of materials and services related to road construction and maintenance escalated sharply (Figure 4). Since 1998, the Highway and Street Construction Production Price Index³ has risen by 70%, reducing the purchase power of \$1.00 to only \$0.58 in 2008.

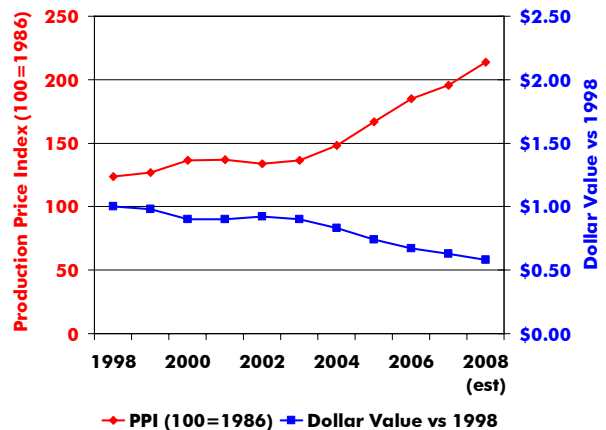


Figure 4: Highway Construction Production Price Index (1998-2008)

³ *Producer Price Index Report*, US Department of Labor, Bureau of Labor Statistics, January 2009, <http://data.bls.gov>

If the reduction in purchasing power is applied to the expenditure levels shown in Figure 3, a steadily declining trend is evident (Figure 5).

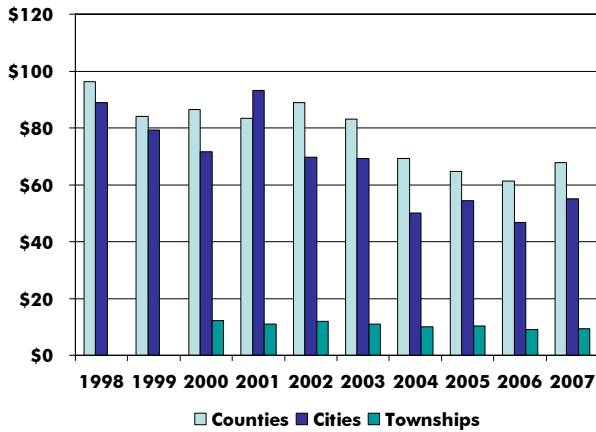


Figure 5: Estimated Local Road & Bridge Purchasing Power in 1998 Dollars (\$ million)

Perceived Adequacy of Revenues

The survey instrument asked local officials to rate the adequacy of current revenues overall and for each of several identified expenditure categories. Figure 6, Figure 7, and Figure 8 show the percentages of respondents rating funding seriously inadequate, inadequate, adequate, or very adequate on county, township, and city systems, respectively.

A very strong majority of county and city respondents rated revenues as either inadequate or seriously inadequate overall and for the expenditure categories of system upgrade and road surface maintenance. A clear majority of city and county respondents reported maintenance of major and minor structures as underfunded. A significant fraction of county respondents felt funding for maintenance of signs and pavement markings and maintenance of roadside (right of way) was also inadequate.

Only 10% of county respondents and 20% of city respondents rated overall funding levels as adequate, but half of township respondents rated them so. Among township officials, funding for system upgrade and maintenance of road surfaces, roadsides, and structures was most often cited as inadequate. In contrast to counties and cities, township officials frequently cited administration as an underfunded activity. Townships are typically administered by township boards with limited staff and budget.

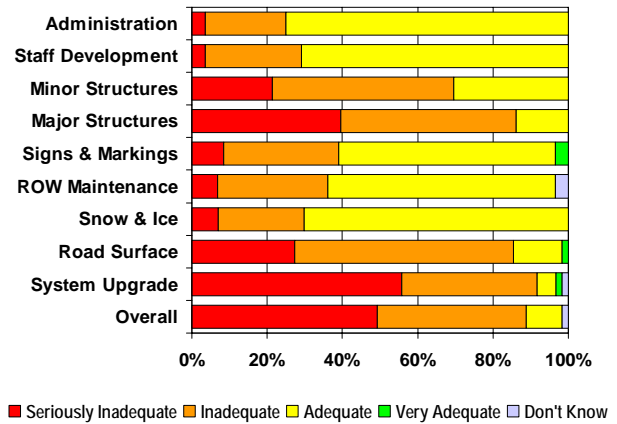


Figure 6: Perceived Adequacy of Funding (Counties)

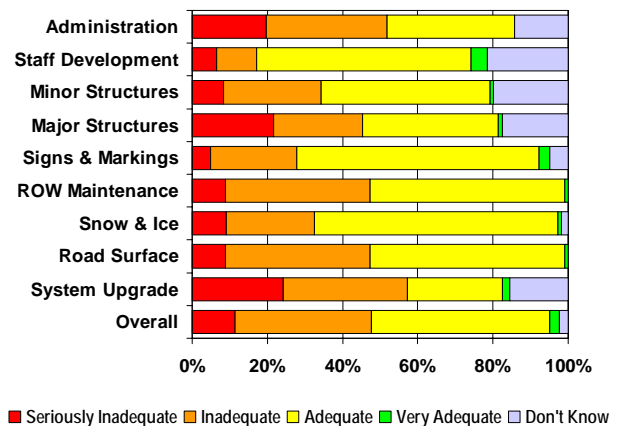


Figure 7: Perceived Adequacy of Funding (Townships)

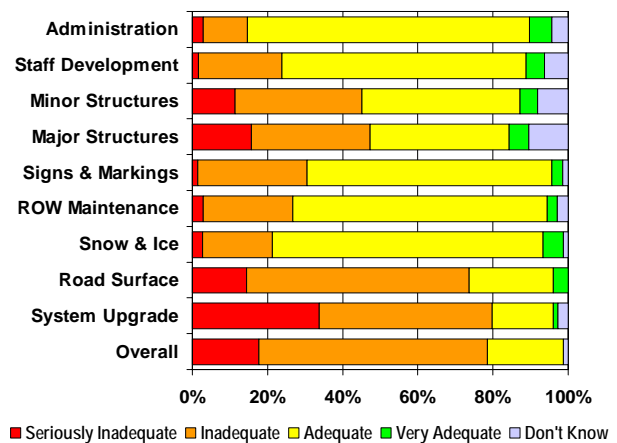


Figure 8: Perceived Adequacy of Funding (Cities)

Effect on Liability Exposure

A potential concern of significantly constrained budgets is liability exposure due to deferred road and bridge maintenance. Postponed surface repair, replacement of signs and pavement markings, or

correction of safety hazards could increase the potential for tort liability.

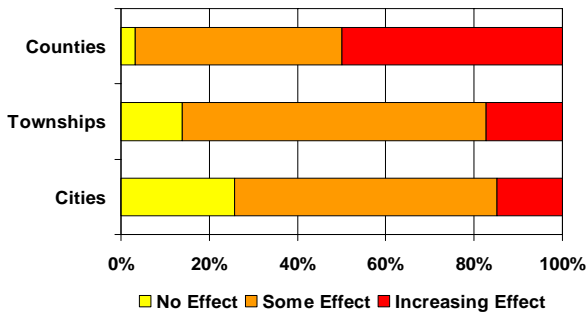


Figure 9: Perceived Effect on Liability Exposure

Very strong majorities of county, township, and city respondents indicated that funding constraints were having some effect, or a significantly increasing effect, on liability exposure. The perception was strongest among county highway superintendents, 97% of whom cited effects of limited funding.

Development Needs

The need to upgrade and expand rural road and city street networks is strongly influenced by residential, industrial, and agricultural development. Local officials estimated the number of miles of upgrade or expansion that would become necessary within two years, two to five years, and five to ten years (Figure 10). On average, Class 1 cities other than Sioux Falls predicted 5 miles of upgrade or expansion to be necessary within the next two years (Sioux Falls indicated 80 miles). The average value reported by townships was 3 miles, while county officials indicated estimated that 14 miles and 5 miles would be needed on the county and county secondary systems, respectively. All agency groups estimated accelerating needs in the future.

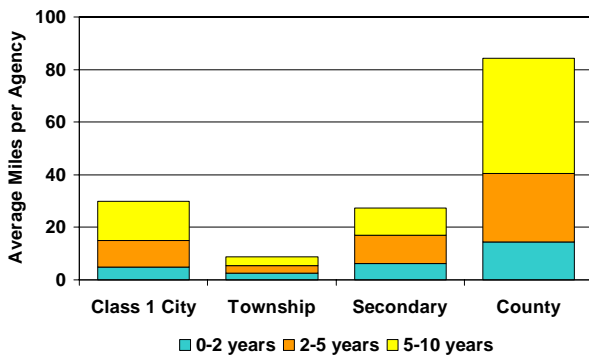


Figure 10: Anticipated Upgrades for Development

The survey also asked how far in advance officials learn of the need for upgrades or expansion. Forty percent of city respondents and more than half of county and township respondents indicated they

receive one year or less of notice. Fewer than 10% of respondents in any jurisdiction category said they receive two years or more. These results suggest that estimates of upgrade and expansion needed 2 to 5 years and 5 to 10 years from now (Figure 11) are highly speculative.

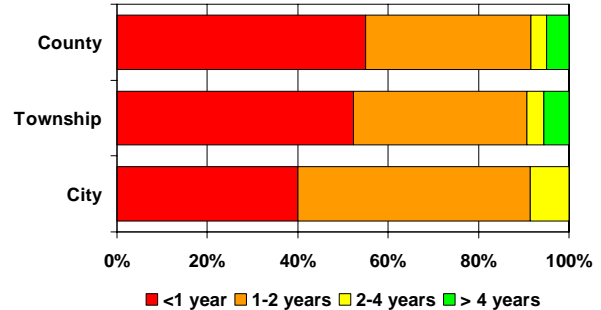


Figure 11: Advance Notice of System Upgrade & Expansion Needs

Unanticipated development can impose strong demands on local highway funding, as illustrated by an example from Blom Township in Deuel County. The primary access to a new dairy constructed west of Brandt, SD was a gravel road (Figure 12) to South Dakota Highway 15. The road had performed well for about 50 years with routine blade maintenance and occasional addition of gravel. After the dairy opened, the road deteriorated to the point that it had to be closed for repair. While it was closed, an alternate route also began to fail under the heavier traffic. Approximately \$40,000 of local funding has been spent for repair and improvements to the primary access road and the alternate route.

Summary of Critical Needs

Local officials were asked to identify the cost elements most critically needing additional funding. System upgrade and road surface maintenance were most frequently named by counties, townships, and cities alike (Table 1). Counties and cities named structures and maintenance of traffic signs and pavement markings as next most critical, while townships named roadside maintenance and administration.

Table 1: Most Critical Needs for Local Agencies

Rank	Counties	Townships	Cities
1	System Upgrade	System Upgrade	System Upgrade
2	Road Surface Maintenance	Road Surface Maintenance	Road Surface Maintenance
3	Structures	ROW Maintenance	Structures
4	Signs & Markings	Administration	Signs & Markings



Figure 12: Duel County Example of Road Deterioration Under Development Traffic (from top: original access road; failed access road; failed alternate route, repaired access road)

Supplemental Funding Sources

In light of funding pressures, local officials were asked to suggest potential sources of additional funding. Responses to the open-ended question focused on expansion or modification of existing funding mechanisms, including vehicle registration fees and county wheel taxes (Table 2).

Several respondents suggested opting out of the property tax freeze, which has limited revenue growth. As funding needs for other governmental functions—such as law enforcement—have increased, less has become available to help fund roads and streets. Counties with high proportions of publicly owned land cited limited ability to apply property tax revenues to highways.

Table 2: Perceived Funding Sources for Local Roads

Source	Change
Vehicle Registration Fees	Increase registration fees
Wheel Tax	Increase maximum charge (currently \$4/wheel)
	Allow more wheels to be taxed (currently limited to 4 per vehicle)
	Adopt a wheel tax in more counties or on a statewide basis
Property Tax	Opt out of tax freeze
Developer Fees	Impose fees to offset costs of additional infrastructure to support residential, commercial, or agricultural development

One idea for addressing financial challenges resulting from development was to impose fees that would require developers to share in the expense for building and maintaining roads and streets that support the development. The City of Sioux Falls amended its ordinances in September 2008 to add a platting fee to help finance expansion of the arterial street system.⁴ The action of the City Council established per-acre fees for various zoning classifications, including residential, commercial, and industrial.

Opportunities for Efficiency

Finally, local officials were asked to rate the potential for increasing efficiency through a variety of technical and administrative techniques. Figure 13 through Figure 15 illustrate the responses of county, township, and city officials, respectively.

One of the most promising areas identified by county, city, and (to a lesser extent) township officials concerned multi-agency collaboration.

⁴ City of Sioux Falls Council Meeting Minutes, Item 14, September 15, 2008.

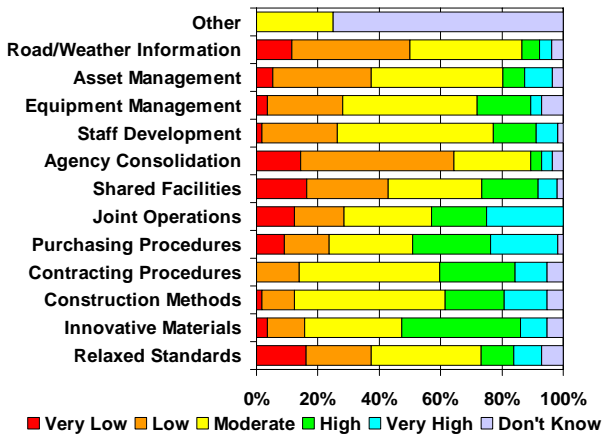


Figure 13: Perceived Opportunities for Efficiency (Counties)

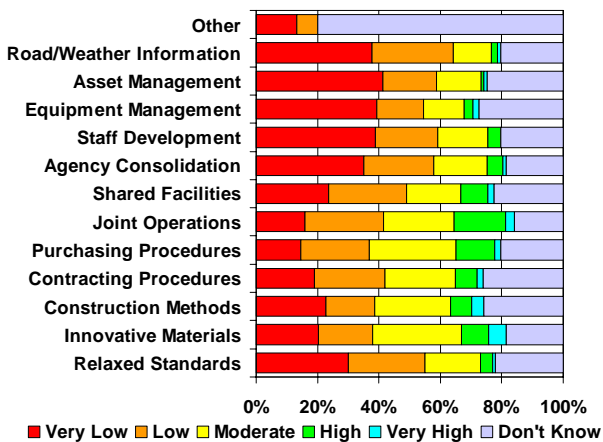


Figure 14: Perceived Opportunities for Efficiency (Townships)

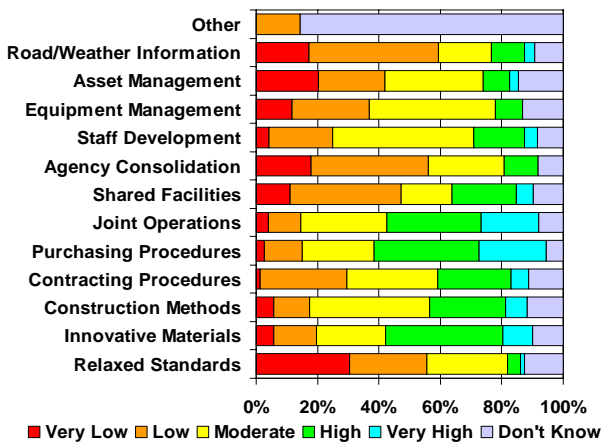


Figure 15: Perceived Opportunities for Efficiency (Cities)

Joint operations (in which staffs of more than one agency work together to perform work), shared equipment and facilities, and shared procurements (which can result in better bid prices) were seen to provide economy of scale. In several counties, the townships jointly contract with private contractors

or the county highway department for more economical road maintenance. Although multi-agency collaboration was rated highly, agency consolidation was not. Officials considered loss of local control counterproductive to efficiency.

Local officials felt innovative construction methods and materials hold potential for efficiency. Examples include the use of reclaimed materials and “warm asphalt”, which requires nearly a third less energy to produce than conventional hot mix asphalt concrete.

Local officials did not feel relaxed specifications and standards held potential for efficiency. Survey respondents commented that savings realized from lower design standards or the use of lower quality materials would be short-term and that long-term costs would actually increase.

A much smaller proportion of township officials saw high or very high potential for increased efficiency than did officials from counties and cities. This difference might be attributable to the basic nature of services provided and the limited funding available at the township level.

BRIDGE NEED ANALYSIS

The first component of need analysis addressed major structures—that is, bridges and culverts extending more than 20 feet in the direction of the highway. The analysis examined current needs and needs that would accrue within the next 20 years.

Local Bridge Inventory

Counties and cities are responsible for the major structures on local roads in South Dakota. More than 3,000 bridges and nearly 650 large culverts exist on the county system, and 100 bridges and 57 large culverts exist on the city system (Figure 16). Roughly half of county bridges and more than 80% of city bridges are longer than 50 feet.

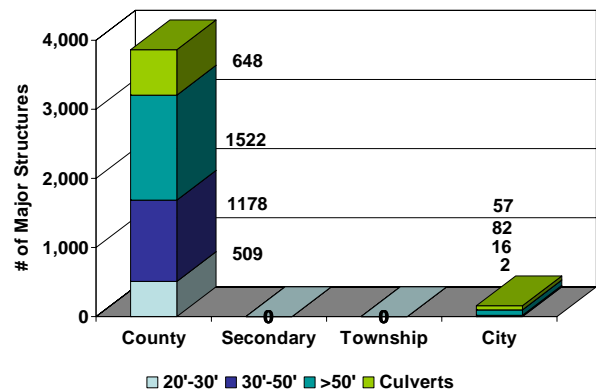


Figure 16: Major Structures on Local Inventories

Figure 17 shows the age distribution of county and city bridges. While most city bridges are less than 50 years old, nearly half of county bridges are older. More than 600 county bridges are 70 to 80 years old, corresponding to the Depression era when many were built in public works programs. The high number of older bridges represents a looming rehabilitation funding need.

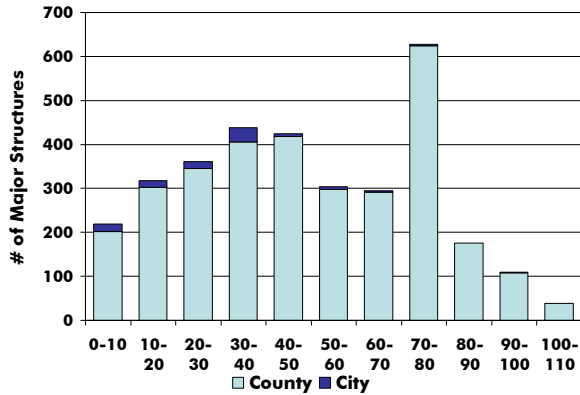


Figure 17: Local Bridge Age Distribution

Condition Assessment

The current condition of structures was determined from structural ratings maintained by the South Dakota Department of Transportation's Office of Bridge Design. Ratings derive from inspections typically conducted at two-year intervals.

For purposes of analysis, bridges were assigned to condition categories corresponding to rehabilitation treatments selected by the criteria listed in Table 3.

Table 3: Bridge Treatment Criteria

Condition	Rehabilitation Category	Structurally Deficient	Federal Sufficiency Rating ¹	Deck Rating ²
Poor	Structure Replacement	yes	<50	any
Fair	Deck Replacement	yes	≥50	3-4
Good	Deck Overlay	yes	≥50	5-6
		no	any	
Very Good	Do Nothing	All other		

¹ rated on a scale of 0-100 ² rated on a scale of 0-10

Depending upon their overall Federal Sufficiency Rating and deck condition, structurally deficient bridges were assigned treatments of structure replacement, deck replacement, or deck overlay. Deck overlay was also assigned to structures not structurally deficient with similar deck condition. All other structures were assigned no rehabilitation treatment (do nothing). The same categories were used in the 1998 Local Road Need Assessment.

Figure 18 shows the distribution of bridges on the county highway and city street systems in 1998 and 2008. The number of county bridges declined, in part because of the replacement of many smaller bridges with culverts.

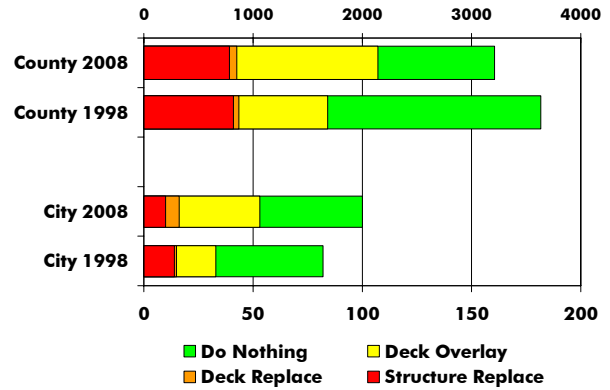


Figure 18: Local Bridge Condition Distribution 1998-2008

On the county system, significantly more bridges need treatment in 2008 than in 1998. While approximately one-half of bridges needed treatment in 1998, nearly two-thirds do in 2008. The situation on the city system is similar. In 1998, 40% of city structures needed treatment, but that fraction rose to more than half in 2008.

Likewise, structurally deficient large culverts with an overall Federal Sufficiency Rating less than 50 were assigned to a structure replacement category (Table 4). All other large culverts were assigned no rehabilitation treatment (do nothing). Figure 19 shows the distribution of large culverts in 1998 and 2008.

Table 4: Large Culvert Rehabilitation Criteria

Category	Structurally Deficient	Federal Sufficiency Rating ¹
Structure Replacement	yes	<50
Do Nothing	All other	

¹ on a scale of 0-100

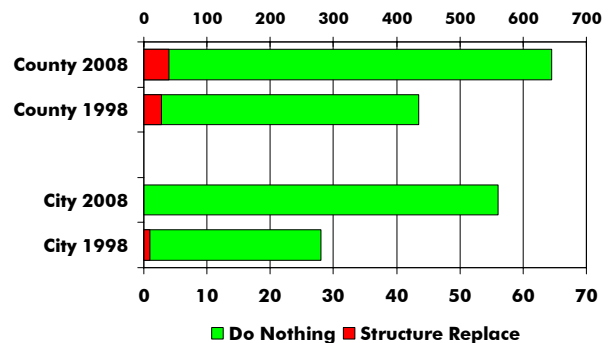


Figure 19: Large Culvert Condition Distribution 1998 & 2008

Bridge Need Estimation

The estimate of need for major structures is based upon the cost of needed rehabilitation anticipated over the 20-year analysis period. The South Dakota Department of Transportation's Office of Bridge Design estimated unit costs of rehabilitation treatments based upon current and recent bid prices for items included in each treatment (Table 5). Unit costs have risen significantly since 1998. Structure replacement costs more than doubled, while costs for less intensive treatments increased even more.

Table 5: Bridge Rehabilitation Unit Costs 1998 & 2008

System	Year	Deck Overlay \$/sq ft	Deck Replacement \$/sq ft	Structure Replacement \$/sq ft
City	1998	\$7	\$20	\$93
	2008	\$18	\$55	\$202
County	1998	\$7	\$20	\$113
	2008	\$33	\$82	\$255

For bridges, the prediction of future need was based upon currently observed relationships between age and condition. Because the statistical relationships are strong, a reliable estimate of the number of bridges needing any of the rehabilitation treatments was possible.

The final factor in the need estimate is the desired condition of the network. The cost to bring and maintain the condition of structures to a sustainable mix of the four condition categories depends upon the mix chosen. The distribution targeted in 2008 was the same as in 1998 (Table 6), which matched the distribution that then existed among bridges on the State Highway System.

Table 6: Current & Target Condition Distributions

System	Year	Replace Bridge	Replace Deck	Overlay Deck	Do Nothing
City	Now	24%	4%	40%	33%
	Target	5%	3%	27%	65%
County	Now	10%	6%	37%	47%
	Target	5%	3%	27%	65%

(Target corresponds to 1998 condition of state bridge system)

Culvert Need Estimation

For large culverts, the relationship between age and condition is weak, as many very old culverts remain in good condition. Because no reliable prediction of future condition is possible, the estimate of need is overly conservative and includes only culverts that already need to be replaced.

The unit cost of large culvert replacement doubled from 1998 to 2008, rising from \$650 per linear foot in 1998 to \$1,300 per linear foot in 2008.

Table 7: Culvert Replacement Unit Costs 1998 & 2008

System	Year	Culvert Replacement \$/ft
City	1998	\$650
	2008	\$1300
County	1998	\$650
	2008	\$1300

Estimated Major Structure Needs

Table 8 summarizes major structure needs for the city and county systems over the next 20 years. Because far more bridges exist on the county road system than in cities, most of the \$25 million per year of total need belongs to counties.

Table 8: Major Structure Needs on Local Systems (\$ million)

Jurisdiction		20-Year Need	Annual Need
County	Bridges	\$475.2	\$ 23.8
	Culverts	\$10.9	\$ 0.5
	All	\$486.1	\$ 24.3
City	Bridges	\$13.8	\$ 0.7
	Culverts	\$0.0	\$ 0.0
	All	\$13.8	\$ 0.7
Total		\$499.9	\$ 25.0

This estimate is conservative, because it considers only needs related to structural condition, not functional needs—such as width, number of lanes, and clearance—related to capacity. Furthermore, a significant number of bridges on the county system have limited load carrying capacity. In 2008, 1098 county bridges were posted for weight restrictions, and another 139 were recommended for posting based upon their most recent inspection. Eight county bridges are currently recommended for closing.

ROAD SURFACE NEED ANALYSIS

The analysis of road surface needs included current rehabilitation and maintenance needs and needs that will accrue during the next 20 years. It considered the factors that significantly affect construction and maintenance costs listed in Table 9.

Table 9: Factors Affecting Road Surface Need

Factor	Information Source
Road Mileage	SDDOT Non-State Trunk Road Inventory
Traffic Levels	
Surface Width	
Surfacing Type	
Surface Condition	Local Highway & Street Departments
Design Standards	SDDOT Secondary Road Plan
Maintenance & Rehabilitation Treatment Costs	SDDOT Office of Project Development SD Local Transportation Assistance Program

Local Road Surface Inventory

The county, county secondary, township, and city roads and street systems in South Dakota comprise approximately 125,000 lane-miles (Figure 20). A majority of rural roadways are unpaved, with over 60% of county roads and nearly all county secondary and township roads consisting of earth or gravel surfaces. Most paved surfaces are asphalt, with concrete pavements primarily limited to larger cities. County secondary and township road networks contain a substantial amount of trails and unimproved roads, which were excluded from the need analysis.

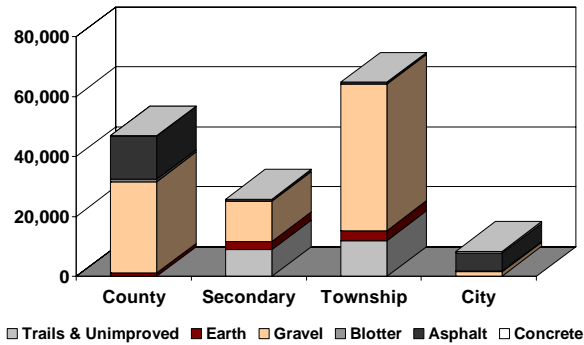


Figure 20: Local Road Network Composition (lane-miles)

Traffic levels vary among the four road systems (Figure 21). Nearly all of the county secondary and township systems and a substantial majority of the county and city systems carry less than 50 vehicles per day on average. Only counties and cities possess substantial lengths of roadway with traffic exceeding 100 vehicles per day.

Condition Assessment

County highway superintendents evaluated the condition of county, county secondary, and township road networks within their counties using a rating guide for rural roads⁵. Officials of Class 1

⁵ Rural Road Condition Survey Guide, SD95-16-G1, South Dakota Department of Transportation, September 1995.

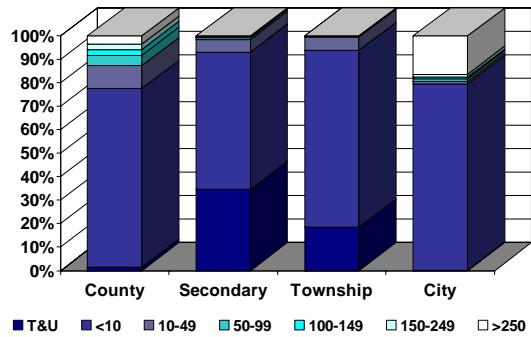


Figure 21: Average Daily Traffic Volumes

and Class 2 cities evaluated their networks using a similar guide for streets⁶. Staff of the South Dakota Local Transportation Assistance Program used the same guide to evaluate the street networks in 20 Class 3 cities. In all cases, evaluators reported the number of lane-miles of roadway in condition categories of poor, fair, good, and very good as defined by text and photographs in the rating guide (Figure 23).

The reported condition of local roads was better in 2008 than in the 1998 assessment (Figure 22). On every system—county, county secondary, township, and city—the combined proportion of roads in good and very good categories increased. More improvement was reported on county roads and city streets than on county secondary and township roads.

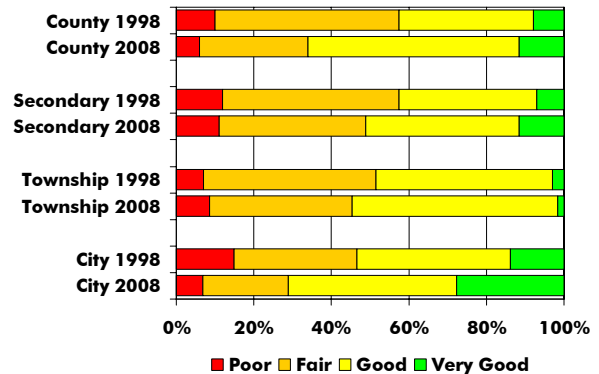


Figure 22: Road Surface Condition Distribution 1998 & 2008

Need Estimation

The estimate of road surface need accumulated the anticipated costs of four types of work over the 20-year analysis period:

- ongoing surface maintenance, such as blading of earth and gravel surfaces and crack sealing of paved surfaces;

⁶ Pavement Condition Survey Guide for City Streets, SD93-07-G1, South Dakota Department of Transportation, June 1994.

Condition	PCI	Description (Please Refer to Rural Road Condition Survey Guide for Descriptive Photographs)	Lane-miles DOT Estimate	Lane-miles Your Estimate
Very Good	61-100	The roadway surface is in excellent to very good condition with very good rideability (50 mph). At the upper end of the category, good gravel thickness and excellent drainage (crown and ditches) exist with the only distress being dusting in dry conditions. At the lower end, moderate loose aggregate, slight washboarding, and slight rutting may exist.	12.8	22.5
Good	41-60	The roadway surface is in good condition with good rideability and pavement crown (3 to 6"). Adequate gravel thickness exists but additional material is necessary in isolated areas. Moderate washboarding (1 to 2" deep) exists over 10 to 25% of the area and moderate rutting (1 to 2" deep) exists, especially in wet weather. Occasional small potholes (<2" deep) and some loose aggregate (<2" deep) also exist. Adequate primary ditches exist on over 50% of the roadway, but secondary ditches are beginning to develop.	10.0	24.3
Fair	21-40	The roadway surface is in fair condition, but travel at slow speeds (<25 mph) is required and there is little or no pavement crown (<3"). Some areas (< 25%) have little or no gravel. Moderate to severe washboarding (>3" deep) exists over 25% of the area and severe rutting (2 to 4" deep) exists on 10 to 20% of the roadway during wet weather. Moderate potholes (2 to 4" deep) exist over 10 to 25% of the area, and severe loose aggregate (4" deep) also exists. Adequate primary ditches exist on less than 50% of the roadway and deep secondary ditches are located along more than 50% of the roadway. Culverts are partially damaged or filled with debris.	715.2	510.1
Poor	0-20	The roadway surface is in poor to failed condition. Travel is very difficult, and the roadway crown is bowl-shaped with extensive ponding. Many areas (>25%) have little or no gravel. Severe rutting (>3") exists on more than 25% of the area, especially in wet weather. Severe potholes (4" deep) exist over 25% of the area. Little if any primary ditches exist and deep secondary ditches are located along most of the roadway. Culverts are damaged or filled with debris.	0.0	164.1

Figure 23: Road Condition Survey Form Example

- periodic rehabilitation necessitated by pavement aging and traffic loading, such as adding gravel to gravel surfaces, overlaying asphalt surfaces, or reconstructing completely failed surfaces;
- surface upgrades warranted by criteria listed in Table 10 and applied only when periodic rehabilitation is needed;
- roadway width improvements warranted by criteria listed in Table 11 and applied only when periodic rehabilitation is needed.

Table 10: Road Surface Type Criteria

Existing Surface Type	Average Daily Traffic	Upgrade to Surface Type
Graded & Drained Earth	10 or greater	Gravel
Gravel	150 or greater	Blotter
Blotter	250 or higher	Asphalt
Asphalt	All	No upgrade needed
Concrete	All	No upgrade needed

Table 11: Road Surface Width Criteria

Jurisdiction	Recommended Roadway Width
County	22 to 26 ft
County Secondary	22 to 24 ft
Township	22 to 24 ft
City	24 to 28 ft

No reconstruction allowed for Average Daily Traffic <50

Based upon the standards for road surface type and width, approximately 13,700 lane-miles (Table 12)

qualify for upgrade, based on current (not future) traffic levels.⁷

Table 12: Roadway Needing Upgrade (lane-miles)

System	Total Lane-Miles	Width Below Standard	Width Below Standard & ADT>50	Surface Type Upgrade Needed
County	46,964	24,400	5,750	1,135
Secondary	16,838	12,737	1,266	839
Township	52,894	44,131	3,794	157
City	8,305	3,572	532	203
Total	125,000	84,840	11,341	2,334

The South Dakota Department of Transportation's Office of Project Development estimated treatment based upon current and recent bid prices for items included in each treatment. Most estimates were substantially higher than in 1998 (Table 13).

Table 13: Example Rehabilitation Unit Costs

Treatment	1998	2008
Regrade gravel surface, add 4" gravel*	\$1.67	\$5.80
Reconstruct gravel road, 6" gravel	\$13.60	\$23.23
Reconstruct 6" base & blotter	\$16.16	\$26.98
Patch alligator-cracked areas (minor), rout and seal cracks, chip seal	\$1.65	\$1.87
Mill asphalt surface, patch, 2.5" overlay	\$6.68	\$12.05
Reconstruct 8" base, 3" asphalt mat	\$23.50	\$48.05

(all costs per square yard)

⁷ The estimate is conservative due to probable misclassification of blotter roads as asphalt roads in recent inventories.

Cost estimates for blading unpaved surfaces were provided by the South Dakota Local Transportation Assistance Program (SDLTAP), based upon costs for equipment rental, fuel, and operator currently experienced by local agencies.

While less intensive and less costly treatments are appropriate for roads and streets in very good condition, rehabilitation costs rise dramatically for roads in poorer condition (Table 14). Costs vary significantly by surface type.

Table 14: Typical Roadway Treatment Costs by Surface Type & Condition

Surface Type	Surface Condition & Treatment Type			
	Very Good	Good	Fair	Poor
	Annual Maintenance	Minor Capital Improvement	Major Capital Improvement	Reconstruct
Graded & Drained Earth	\$100	\$4,000	\$6,000	\$155,000
Gravel	\$1,500	\$14,000	\$183,000	\$296,000
Blotter	\$1,800	\$35,000	\$211,000	\$394,000
Asphalt	\$1,400	\$84,000	\$169,000	\$493,000
Concrete	\$900	\$120,000	\$211,000	\$845,000

Costs are for a centerline mile of roadway.
Costs are illustrative and vary widely by system.

Estimated Road Surface Needs

The final factor influencing the estimate of road surface need is the desired condition level of the local road networks. Two condition levels were analyzed (Table 15):

- the current distribution of poor, fair, good, and very good surfaces on each network;
- a higher target level with no poor road surfaces and a more sustainable mix of fair, good, and very good surfaces.

Table 15: Current & Targeted Road Network Conditions for Calculating Road Surface Needs

System		Poor	Fair	Good	Very Good
County	Current	6%	28%	55%	12%
	Target	0%	30%	40%	30%
Secondary	Current	11%	38%	40%	11%
	Target	0%	40%	35%	25%
Township	Current	9%	37%	53%	2%
	Target	0%	40%	35%	25%
City	Current	7%	22%	43%	28%
	Target	0%	35%	35%	30%

Note: Current values rounded to nearest whole percent

Individual simulations of road surface aging and rehabilitation and maintenance activity were made for each surface family (earth, gravel, blotter, asphalt, and concrete) on each road network (county, county secondary, township, and city) for

each desired condition level (current and targeted). For each simulation, all maintenance and rehabilitation costs were accumulated and then annualized over the 20-year analysis period.

Table 16 lists the estimated annual rehabilitation and maintenance costs, first to maintain the current condition and then to achieve the targeted condition of each local road network. This estimate assumes a “balanced” strategy that invests 25% of capital expenditures in rehabilitation of roads in good condition, 25% in roads in fair condition, and 50% in roads in poor condition.

Table 16: Annual Road Surface Needs with Balanced Investment Strategy (\$ million)

To Maintain Current Condition			
System	Rehabilitation	Maintenance	Total
County	\$55.6	\$20.7	\$ 76.3
Secondary	\$4.3	\$3.3	\$ 7.6
Township	\$9.8	\$10.0	\$ 19.8
City	\$24.5	\$ 9.2	\$ 33.7
Total	\$ 94.2	\$ 43.2	\$ 137.4
To Achieve Target Condition			
System	Rehabilitation	Maintenance	Total
County	\$67.8	\$20.7	\$ 88.5
Secondary	\$5.6	\$3.3	\$ 8.9
Township	\$13.4	\$10.0	\$ 23.4
City	\$25.7	\$ 9.2	\$ 34.9
Total	\$ 112.5	\$ 43.2	\$ 155.7

Table 17: Annual Road Surface Needs with “Worst-First” Investment Strategy (\$ million)

To Maintain Current Condition			
System	Rehabilitation	Maintenance	Total
County	\$94.4	\$20.7	\$ 115.1
Secondary	\$6.2	\$3.3	\$ 9.5
Township	\$10.5	\$10.0	\$ 20.5
City	\$29.2	\$ 9.2	\$ 38.4
Total	\$ 140.3	\$ 43.2	\$ 183.5
To Achieve Target Condition			
System	Rehabilitation	Maintenance	Total
County	\$116.5	\$20.7	\$ 137.2
Secondary	\$8.4	\$3.3	\$ 11.7
Township	\$14.5	\$10.0	\$ 24.5
City	\$31.8	\$9.2	\$ 41.0
Total	\$ 171.2	\$ 43.2	\$ 214.4

Table 17 lists similar estimates assuming a “worst-first” strategy that invests 100% of capital expenditures in rehabilitation of roads in poor condition, and nothing in roads in good or fair condition. This strategy, which is sometimes followed because of political pressure to address the poorest surfaces first, is far less efficient. While an estimated \$137 million per year is needed to maintain the current condition of road surfaces under the balanced strategy, the worst-first strategy

would require \$183 million per year—one third more. Likewise, achieving the target condition level would require \$214 million per year under the worst-first strategy, but only \$156 million per year under the balanced investment strategy.

COMPARISON OF NEED TO CURRENT FUNDING

The analysis of future needs considers only the rehabilitation of major bridges and culverts and the maintenance and rehabilitation of road surfaces. Other expenditures—such as roadside maintenance (including mowing), maintenance of signs and pavement markings, and winter maintenance—are also important to road users. Administrative costs are also necessary. Because no analytical method is readily available to predict these costs in the future, the analysis assumes that they remain constant.

Table 18 shows estimates of expenditures in five broad categories, based upon an apportionment of the estimated total expenditures shown in Figure 3 according to the expenditure distributions reported by local officials (Figure 2). To be consistent with the road surface need analysis incorporating some elements of roadway width and surface type upgrade, 30% of the distribution allocated to system upgrade in Figure 2 are transferred to road surfaces in Table 18.

Table 18: Average Estimated Expenditures by Major Category 2003-2007 (\$ million)

	County & Secondary		Township		City		Total
System Upgrade	8%	\$7.1	4%	\$0.6	28%	\$20.7	\$28.4
Road Surfaces	59%	\$54.7	64%	\$8.5	43%	\$31.9	\$95.2
Major Structures	4%	\$4.0	2%	\$0.3	0%	\$0.3	\$4.7
Roadside, Signs, Markings, Snow	21%	\$19.1	23%	\$3.1	21%	\$15.6	\$37.8
Administrative	8%	\$7.5	6%	\$0.8	7%	\$5.1	\$13.4
Total		\$92.5		\$13.4		\$73.6	\$179.4
(sums not exact due to rounding)							

A comparison of average 2003-2007 expenditures for road surfaces and major structures to the estimated needs reveals a significant shortfall. The estimates shown in Table 19 exclude other categories of expenditures, which are assumed to remain constant throughout the analysis. All figures are expressed in 2008 dollars, without consideration of future inflation.

Table 19: Annual Road Surface & Major Structure Needs versus Current Annual Expenditures (\$ million)

	County & Secondary	Township	City	Total
Road Surfaces	\$ 97.4	\$ 23.4	\$ 34.9	\$155.7
Major Structures	\$ 24.3	\$ 0.0	\$ 0.7	\$ 25.0
Total	\$121.7	\$ 23.4	\$ 35.6	\$180.7
Current Expenditures	\$ 58.7	\$ 8.8	\$ 32.2	\$ 99.7
Shortfall	\$ 63.0	\$ 14.6	\$ 3.4	\$ 81.0

SUMMARY AND CONCLUSIONS

Key findings of the study follow.

Local Funding

Local officials perceive serious challenges in funding local roads and streets. Most report that overall funding levels are inadequate or seriously inadequate, especially for the core functions of providing and maintaining road and bridge infrastructure. Although funding and expenditure levels have remained fairly constant since 1998, purchasing power has declined by 40% as construction and maintenance costs have risen. Agricultural, residential, and industrial development places significant demands on local transportation.

Road and Bridge Needs

Ratings reported by local officials indicate that road surface condition improved from 1998 to 2008. It is likely that most of the improvement occurred during the period of 1999-2003, after a legislated increase in vehicle registration fees but before costs began to escalate rapidly.

Although local agencies accomplished significant bridge repair and replacement, the number of major structures needing treatment increased, primarily because of the number of old bridges on the county system.

Largely because of the increased unit costs in highway and street construction materials, overall road surface and bridge needs have increased significantly since 1998. The condition of roads and bridges will deteriorate at current levels of investment, eroding gains that appear to have been made in the period between 1999 and 2003, before costs began to rise dramatically. Achieving target conditions for road surfaces and major structures in the next 20 years will require an estimated \$81 million annually.

Opportunities for Improved Efficiency

Local officials feel multi-agency collaboration holds the greatest potential for improved efficiency. Joint operations and joint procurement of services, equipment, and materials are currently employed by several agencies. Local officials do not feel agency consolidation would improve efficiency, however.

While local officials feel relaxing standards and specifications would be counterproductive, they generally perceive innovative materials and techniques to be a means to greater efficiency. It is the author's opinion, not supported by the survey of local officials, that greater emphasis on staff development and asset management techniques could help local governments meet financial challenges. As demonstrated by the analysis of road surface need, the chosen strategy ("balanced" versus "worst-first") can make a dramatic difference in the effectiveness of capital investments.

Reporting Needs

Changes to the way local agencies report information related to streets, highways, and finances could facilitate future studies. Evidence suggests that inventory information supplied to the Department of Transportation lags road creation in growing jurisdictions and road abandonment in some rural areas. A pending SDDOT research topic seeks to improve procedures used to maintain these records.

Financial reporting procedures also limit the depth of possible analysis. County and city expenditures are generally attributed to a single highway and bridge category without additional detail. Cities' major capital projects may be partially or entirely reported in other categories not identified as street expenditures.

All of the analysis in this study was performed at a statewide level. The study does not support analysis of any individual agency or consideration of adjustments to any formulas used to distribute funding to individual agencies.

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This work was performed under the direction of a project panel of representatives of the South Dakota Department of Transportation and other state and local organizations (Table 20).

Table 20: Project Technical Panel

Panel Member	Organization
Richard Benda	SD Dept. of Tourism & Economic Development
Robin Bobzien	American Public Works Association
Gail Brock	SD Assn. of Towns & Townships
Toby Crow	Associated General Contractors
Jeff Des Lauriers	City of Sioux Falls
Larry Engbrecht	American Concrete Paving Association
Brenda Forman	Ag Unity
John Foster	SDDOT Research
Bruce Lindholm	SDDOT Local Programs
Ben Orsbon	SDDOT Office of the Secretary
Raymond Roggow	SD Highway Superintendents Association
Hal Rumpca	SDDOT Research
Ken Skorseth	SD Local Transportation Assistance Program
Ken Swedeen	Dakota Asphalt Paving Association
Yvonne Taylor	SD Municipal League
Dale Tech	City of Rapid City
Todd Thompson	SDDOT Bridge Design
Bob Wilcox	SD County Commissioners Association

Several organizations contributed significantly to this accomplishment of the work:

- SD Association of Towns & Townships
- SD Association of Counties
- SD Municipal League
- SD Local Transportation Assistance Program
- SD Department of Tourism & State Development
- SDDOT Offices of Bridge Design, Project Development, Research, Local Programs
- SD Department of Legislative Audit
- Applied Pavement Technology

DISCLAIMER

The contents of this report reflect the views of the authors who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the South Dakota Department of Transportation, the State Transportation Commission, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.