STATE HIGHWAY PRESERVATION REPORT

February 2009

What are we doing to protect and improve State Highways?

How do we fund state highway preservation?

NEVADA DEPARTMENT OF TRANSPORTATION

State of Nevada

Department of Transportation

State Highway Preservation Report

Report to the 2009 Legislature
As Required by Nevada Revised Statute 408.203 (3)

February 2009

Nevada Revised Statute 408.203(3)

The director of the Nevada Department of Transportation shall report to the Legislature by February 1 of odd-numbered years the progress being made in the Department's 12-year plan for the resurfacing of state highways. The report must include an accounting of revenues and expenditures in the preceding two fiscal years, a list of the projects which have been completed, including mileage and cost, and an estimate of the adequacy of projected revenues for timely completion of the plan.

State of Nevada
Department of Transportation

Mission

The Department provides a better transportation system for Nevada through unified and dedicated efforts.

Vision

The Department is the nation's leader in delivering transportation solutions, improving Nevada's quality of life.

Values

The efforts of Department employees to attain the Department goals will be governed by the following Department's Core Values:

Integrity – Doing the right thing
Honesty – Being truthful in our actions and our words
Respect – Treating others with dignity
Commitment – Putting the needs of the Department first
Accountability – Being responsible for our actions

Goals

The fulfillment of the Mission of the Department is to be attained within the guidelines of the Department's seven Strategic Plan Goals. They are:

To optimize safety
To be in touch with and responsive to our customers
To innovate
To be the employer of choice
To deliver timely and beneficial projects and programs
To effectively preserve and manage our assets
To efficiently operate the transportation system

Table of Contents

Title	*Page*
EXECUTIVE SUMMARY	*1*
Introduction	*1*
Pavement	*4*
Bridges	*8*
Rough Roads Cost Owners	*10*
Summary	*10*
HIGHWAY PRESERVATION	*12*
Legislature's Role	*12*
Nevada Department of Transportation's Role	*12*
PAVEMENT PRESERVATION	*13*
Funding	*13*
Pavement Management	*14*
Pavement Inventory	*14*
Pavement Condition Survey	*14*
Condition Survey Results	*18*
Backlog of Pavement Work	*20*
Action Plan	*21*
Long-Term Action Plan	*23*
Short-Term Plan	*24*
Project Priorities	*24*
Present vs. Needed Funding	*25*
Pavement Management System Improvements	*27*
Pavement Research	*28*
Biennial Expenditures, Fiscal Years 2007-2008	*29*
Pavement Condition over Time	*31*
Pavement Cost for Owners	*32*
BRIDGE PRESERVATION	*34*
Funding	*34*

Table of Contents

Title	Page
Bridge Management	*35*
Bridge Inventory	*35*
Bridge Condition Survey	*35*
Condition Survey Results	*36*
Backlog of Bridge Work	*43*
Action Plan	*43*
Project Priority	*44*
Present vs. Needed Funding	*44*
Bridge Management System Improvements	*45*
Bridge Research	*47*
Biennial Expenditures, Fiscal Years 2007-2008	*47*
Bridge Condition over Time	*48*
Bridge Collapses Cost Owners	*50*

List of Figures

No.	Title	Page
Figure 1	*Backlog of Pavement & Bridge Preservation Work With Present Funding vs. Needed Funding*	*2*
Figure 2	*Price Trends for Federal-Aid Highway Construction*	*4*
Figure 3	*Pavement Overlay Cost*	*6*
Figure 4	*Pavement Condition vs. Repair Cost - Proactive Pavement Preservation*	*7*
Figure 5	*Pavement Condition on the State-Maintained System By Repair Strategy Required and Functional Class*	*7*
Figure 6	*Condition of Nevada's Bridges*	*8*
Figure 7	*50-Year Old Bridges*	*9*
Figure 8	*Annual Pavement Preservation Funding 2007-2008*	*13*
Figure 9	*Functional Classification of Highways in Nevada*	*15*
Figure 10	*Pavement Condition on the State-Maintained System By Repair Strategy Required and Functional Class*	*18*

List of Figures

No.	Title	Page
Figure 11	*Status of the State-Maintained System By Functional Class and Repair Strategy Required*	*18*
Figure 12	*Roads Planned for Overlay or Reconstruction in Fiscal Years 2009 and 2010*	*19*
Figure 13	*State Maintained System by Age and Functional Class - 2009*	*22*
Figure 14	*State Maintained System by Age and Functional Class - 2007*	*22*
Figure 15	*Pavement Condition vs. Repair Cost - Proactive Pavement Preservation*	*24*
Figure 16	*Backlog of Pavement Needing Overlay or Reconstruction with Present Funding vs. Needed Funding*	*25*
Figure 17	*Traffic-Weighted International Roughness Index (Inch/Mile)*	*27*
Figure 18	*Overlay or Reconstruction Projects advertised in Fiscal Years 2007 and 2008*	*30*
Figure 19	*Pavement Condition on the State-Maintained System by Repair Strategy Required - 1987-2009*	*31*
Figure 20	*Status of the State-Maintained System By Cost of Repair Strategy Needed - 1987-2009*	*32*
Figure 21	*Pavement Condition on the State-Maintained System Inflation Adjusted to 2007 Values Using Composite Consumer Price Index - By Cost of Repair Strategy Needed - 1987-2009*	*32*
Figure 22	*Condition of Nevada's Bridges*	*36*
Figure 23	*Substandard Bridges*	*37*
Figure 24	*When Were Our State Bridges Built?*	*37*
Figure 25	*Structurally Deficient and Functionally Obsolete Bridge Locations*	*38*
Figure 26	*50-Year Old Bridges*	*44*
Figure 27	*Backlog of Bridge Preservation Work with Present Funding vs. Needed Funding*	*45*
Figure 28	*Condition of State Bridges*	*48*
Figure 29	*Substandard State Bridges Eligible for Federal Funding*	*49*
Figure 30	*Condition of Local Bridges*	*49*
Figure 31	*Substandard Local Bridges Eligible for Federal Funding*	*50*

List of Tables

No.	Title	Page
Table 1	Pavement and Bridge Backlog, Costs, and Funding	3
Table 2	Present Backlog of Pavement Work	5
Table 3	Present Backlog of Bridge Work	9
Table 4	Backlog of Pavement and Bridge Work	10
Table 5	Pavement Repair Strategy Determination for Moderate-to-High Volume Routes	16
Table 6	Pavement Repair Strategy Determination for Low-Volume Routes	17
Table 7	Pavement Condition on the State-Maintained System - 2009	20
Table 8	Backlog of Overlay and Reconstruction Work	21
Table 9	Pavement Backlog, Costs, and Funding	26
Table 10	Biennial Expenditures	29
Table 11	Vehicle Owner Costs Incurred in Nevada	33
Table 12	Expected User Costs Incurred by Nevadans if Preservation is Overlooked	33
Table 13	Backlog of Bridge Work	43
Table 14	Bridge Backlog, Costs, and Funding	46
Table 15	Bridge Expenditures	47
Table 16	Number of Bridges Rehabilitated, Replaced, or Seismically Retrofitted	48

EXECUTIVE SUMMARY

Nevada public officials have a major policy choice to make:

1. **Increase current highway pavement and bridge preservation funding of $100 million by approximately $200 million annually to eliminate the backlog over the next 12 years.**

2. **With the present annual funding level of $100 million:**
   - **Let highway pavement and bridges deteriorate at the rate of approximately $300 million annually (averaged over next 12 years); and**
   - **Let user costs to Nevadans, in terms of vehicle maintenance and fuel costs, approach $340 million annually.**

Remember! For every overlay that is being deferred, the marginal cost of reconstruction will be four times as much.

Introduction

The *State Highway Preservation Report* is created biennially by the Nevada Department of Transportation to summarize and report our work to preserve the state highway system. This report also provides the Legislature with a tool to discern whether highway-preservation revenue is adequate. With regard to our state-maintained highways, this report answers the following questions: How do we fund their preservation? How do we care for the state highways? What is their condition? What will they cost to maintain? What are we doing to protect and improve them? How has their condition changed over time? What cost is imposed on roadway users due to poorly maintained highways?

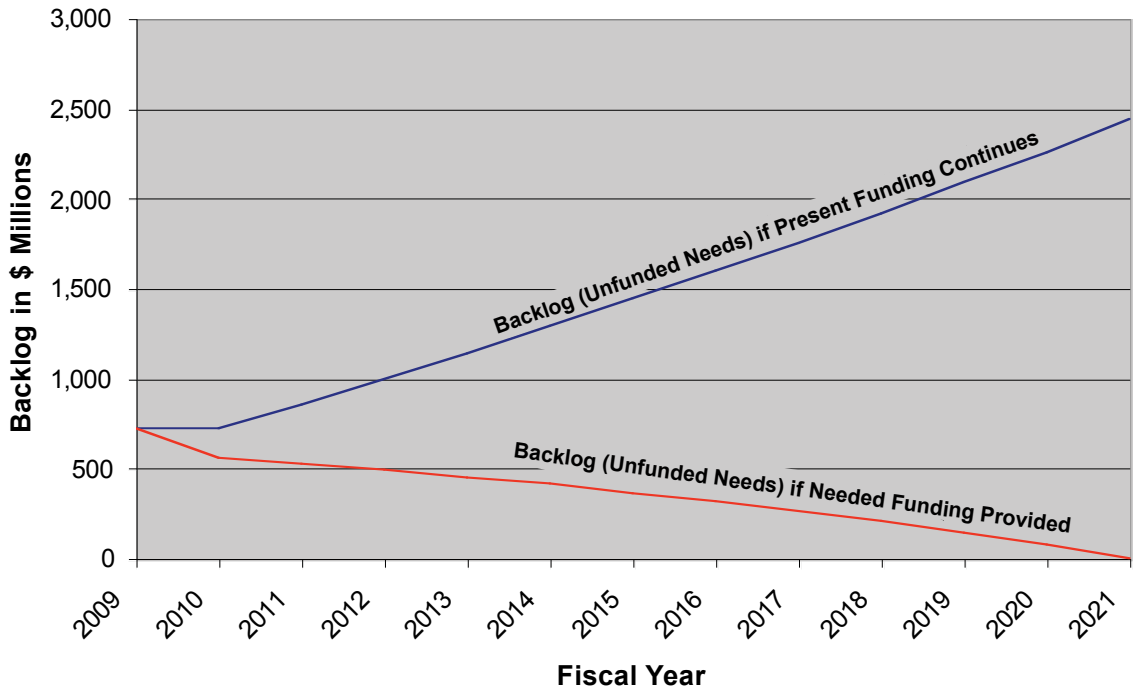
The backlog of pavement and bridge work is $720 million in 2009: $570 million for pavement and $150 million for bridges. Backlog is defined as the unfunded needs that accumulated over the years and can be quantified by the funds required to bring the entire highway system to "good" condition.

The Department of Transportation anticipates an additional $135 million in federal funds for pavement preservation beginning fiscal year 2009. This funding is from the American Recovery and Reinvestment Act - 2009. The future backlog assumes that the $135 million stimulus money would be spent in fiscal year 2009. Under present funding, the pavement and bridge work backlog is expected to jump to $1.0 billion in 2012, and then continue to increase to

$2.4 billion by 2021. This growth in backlog is due to highway-construction inflation that was not matched by revenue increases from fuel taxes and vehicle registration fees. Furthermore, preservation work is forced to compete with congestion relief in our fast-growing state. Eliminating the backlog will cost an additional $200 million annually (averaged over next 12 years).

Figure 1 shows that the backlog of pavement and bridge work is expected to remain high during the next 12 years if needed funding is not provided. Table 1 shows the backlog increase in the next 12 years under the present funding level and the dollar amount required to eliminate the backlog.

Figure 1 - Backlog of Pavement & Bridge Preservation Work With Present Funding vs. Needed Funding



Highway construction is an energy-intensive process, and recent spikes in energy prices have significantly increased preservation costs. Approximately 88 % of state-maintained roads (4,728 of 5,376 miles) are on the federal-aid highway system. Because of construction inflation, the State Highway Fund gasoline tax of 17.65 cents per gallon in 1992 is worth approximately 6.76 cents today. The 2008 Western States construction prices were more than twice that of 1992. A steep rise was observed between 2003 and 2008 when energy prices skyrocketed nationally and locally where the prices of gasoline exceed $4 per gallon in July of 2008. Since July 2008, fuel prices have declined dramatically, but now are rising again.

Table 1 - Pavement and Bridge Backlog, Costs, and Funding

State-Maintained System - 2009

(in millions of dollars)

Present Funding

Fiscal Year	Backlog of Pavement & Bridge Work	Preservation Costs * (Normal Annual Deterioration Costs)			Preservation Funds ** (Funds Planned for Preservation Work)				
		Pavement Total	Bridge Total	Pavement & Bridge Total	State Funding	Federal Funding	State Maintenance		Total
2009	718.4	240.8	13.7	254.5	5.1	232.7	12.3		250.0
2010	722.9	247.4	14.5	261.9	59.3	61.0	12.7		133.0
2011	852.0	249.1	15.4	264.4	54.4	51.0	13.3		118.6
2012	998.1	251.2	16.2	267.4	56.6	53.0	13.8		123.4
2013	1,142.4	258.7	17.1	275.8	58.8	55.2	14.3		128.3
2014	1,290.5	266.4	18.1	284.5	61.2	57.4	14.9		133.5
2015	1,442.3	274.4	19.1	293.5	63.6	59.7	15.5		138.8
2016	1,597.9	282.7	20.2	302.8	66.2	62.0	16.1		144.3
2017	1,757.5	291.2	21.3	312.4	68.8	64.5	16.8		150.1
2018	1,921.0	299.9	22.4	322.3	71.6	67.1	17.4		156.1
2019	2,088.7	308.9	23.6	332.5	74.4	69.8	18.1		162.4
2020	2,260.5	318.2	24.9	343.1	77.4	72.6	18.9		168.9
2021	2,436.6								

Needed Funding

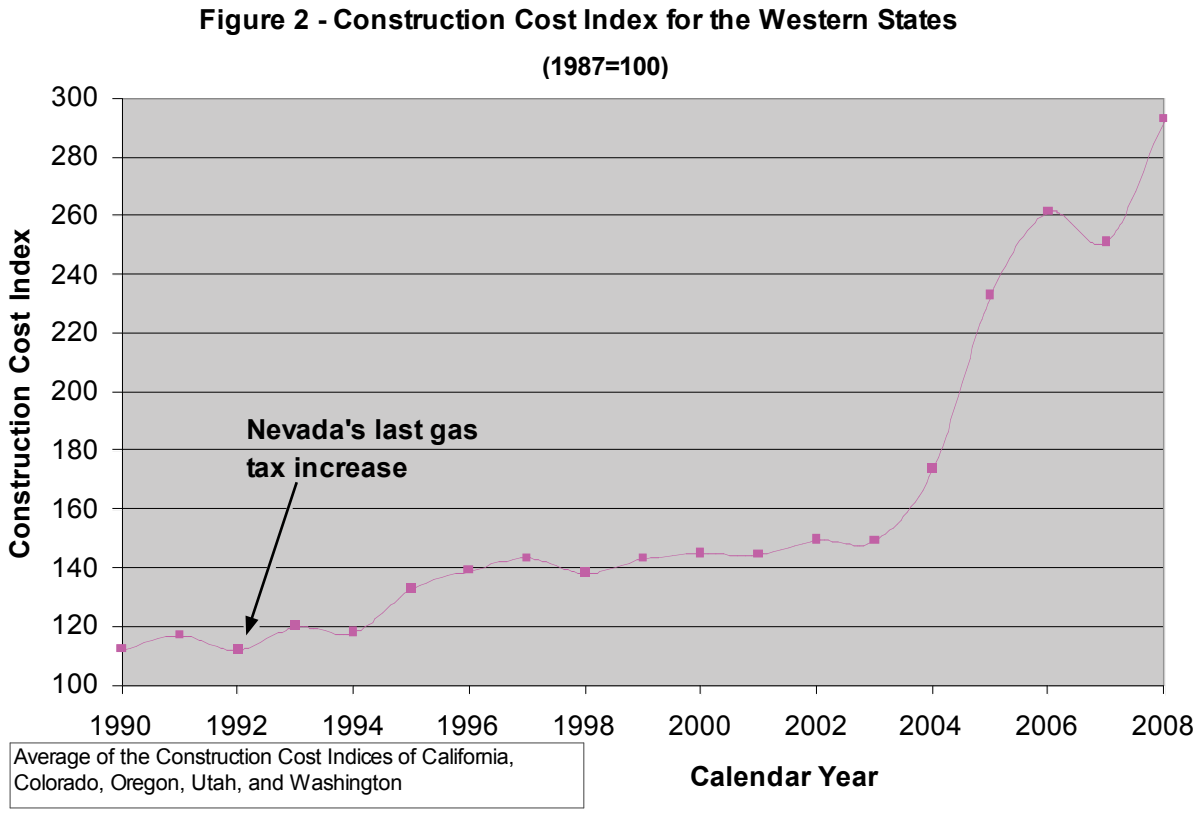
Fiscal Year	Backlog of Pavement & Bridge Work	Preservation Costs * (Normal Annual Deterioration Costs)			Preservation Funds ** (Funds Planned & Needed for Preservation Work)				
					Existing				
		Pavement Total	Bridge Total	Pavement & Bridge Total	State Funding	Federal Funding	State Maintenance	Needed Additional Funds	Total
2009	718.4	240.8	13.7	254.5	5.1	232.7	12.3	159.4	409.4
2010	563.6	247.4	14.1	261.6	59.3	61.0	12.7	165.8	298.7
2011	526.4	249.1	14.6	263.6	54.4	51.0	13.3	172.4	291.0
2012	499.0	251.2	15.0	266.2	56.6	53.0	13.8	179.3	302.7
2013	462.5	258.7	15.5	274.1	58.8	55.2	14.3	186.4	314.8
2014	421.9	266.4	15.9	282.4	61.2	57.4	14.9	193.9	327.4
2015	376.9	274.4	16.4	290.8	63.6	59.7	15.5	201.7	340.5
2016	327.3	282.7	16.9	299.6	66.2	62.0	16.1	209.7	354.1
2017	272.8	291.2	17.4	308.6	68.8	64.5	16.8	218.1	368.2
2018	213.1	299.9	17.9	317.8	71.6	67.1	17.4	226.8	383.0
2019	148.0	308.9	18.5	327.3	74.4	69.8	18.1	235.9	398.3
2020	77.0	318.2	19.0	337.2	77.4	72.6	18.9	245.4	414.2
2021	0.0								

* Inflation assumed at 3.00% per annum.

** Revenue growth rate assumed is 4.00% per annum.

Note: Backlog of pavement and bridge work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

Figure 2 shows the average Construction Cost Index for the Western States since Nevada's gasoline tax was last increased in 1992.



With the national and local economic activity declining, it is impossible to know what the future holds. This report is based on the best information available in January-February 2009.

Pavement

Table 2 shows the fiscal year 2009 backlog for pavements by highway functional classification. At $568 million, the 2009 pavement preservation backlog is $92 million less than the $660 million we reported at the beginning of fiscal year 2007. This backlog reduction is primarily due to the declining construction prices observed in fiscal year 2009. During the past two years, all of the overlay and reconstruction work has been done on the Interstate highways and the other Principle Arterials (US routes). The State Routes received corrective maintenance due to funding limitations. As shown in Table 10, during fiscal years 2007 and 2008, the Department of Transportation spent just $167 million on overlay and reconstruction work. The 2007-08 average preservation funds amount was $156 million less than the inflation-adjusted biennial average committed, as reported in 1993 through 2003.

Table 2 - Backlog of Overlay and Reconstruction Work
State-Maintained System – 2009 (Based on 2007 Condition Data)

	Overlay		Reconstruction		Total	
System	**Lane Miles**	**Cost**	**Lane Miles**	**Cost**	**Lane Miles**	**Cost**
Principal Arterial - Interstate	84	$14,915,409	185	$50,856,332	268	$65,771,741
Principal Arterial - Non-Interstate	245	$43,729,267	595	$163,756,288	840	$207,485,555
Minor Arterial	57	$10,246,315	167	$45,872,577	224	$56,118,892
Major Collector	185	$33,081,520	416	$114,565,797	602	$147,647,317
Minor Collector & Local	229	$40,929,951	181	$49,796,251	410	$90,726,203
Total	**801**	**$142,902,463**	**1,543**	**$424,847,244**	**2,344**	**$567,749,707**

Of the 5,323 miles of state-maintained highways surveyed for pavement condition, 1,028 miles (19 percent) are in need of overlay or reconstruction. Our long-term action plan to address the remaining pavement backlog relies on three strategies:

1. To apply timely overlays on our Interstate and other Principal Arterials, Minor Arterials, and other moderate-to high-volume roads.
2. To further develop economical repair strategies for our low-volume roads.
3. To continue coordinating our routine maintenance activities with overlay and reconstruction work.

Because pavement funding planned for fiscal years 2009 through 2011 is inadequate to accommodate our long-term action plan, we have developed a short-term plan through fiscal year 2011 as follows:

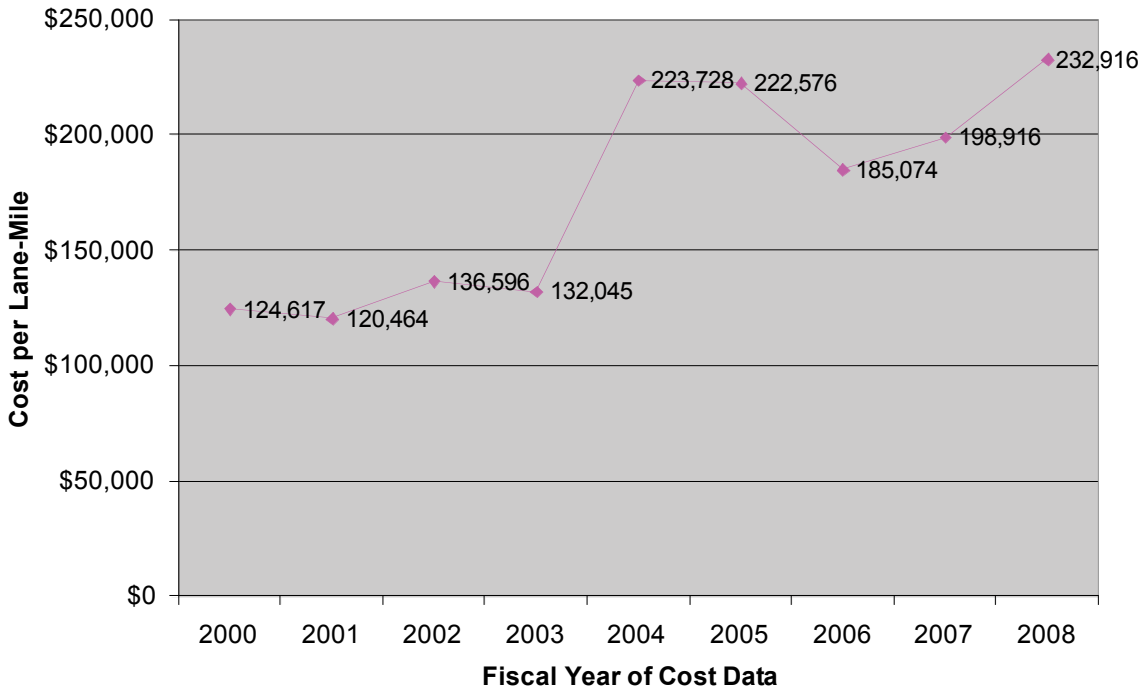
1. Maintain our Interstate and other Principal Arterials system at a high level of serviceability by applying timely overlays as feasible while reconstructing inferior pavement segments.
2. To apply seal coats or other short-term low-cost surface treatments to all other routes.

Nevada's average cost per lane-mile of overlay rose 69 percent from 2003 to 2004. From 2005 to 2006, prices declined 18 percent (for the modest sample of 2006 projects for which data were available). This decrease in construction prices after huge increases mimics the trends experienced in the oil crises of 1973-74, 1979-80. The 2007-08 crises occurred mainly due to speculation that briefly drove crude oil above $140 per barrel. Based on those oil crises,

construction prices probably bottomed in 2006, but increased with overall inflation until 2008.

Recent (fiscal year 2009) contract bids indicate that the overlay costs have decreased by an average of 23 % for near term contracts. Figure 3 shows the increase in pavement overlay costs experienced by Nevada in the past years.

Figure 3 - Pavement Overlay Cost



Huge increases in pavement costs without a commensurate increase in preservation revenue have made it impossible to proactively manage the state highways. **The Nevada Department of Transportation's action plan for pavement preservation hinges on applying timely overlays before expensive reconstruction is needed.**

Figure 4 shows the cost/condition relationship for pavement. On average, reconstructing pavements cost 60 percent more than overlays. But the marginal cost of waiting until pavement needs reconstructing averages four times that of an overlay. Or stated in practical terms, **current inadequate funding for pavement preservation takes four dollars away from highway improvements for every dollar that could have been invested in timely overlays.**

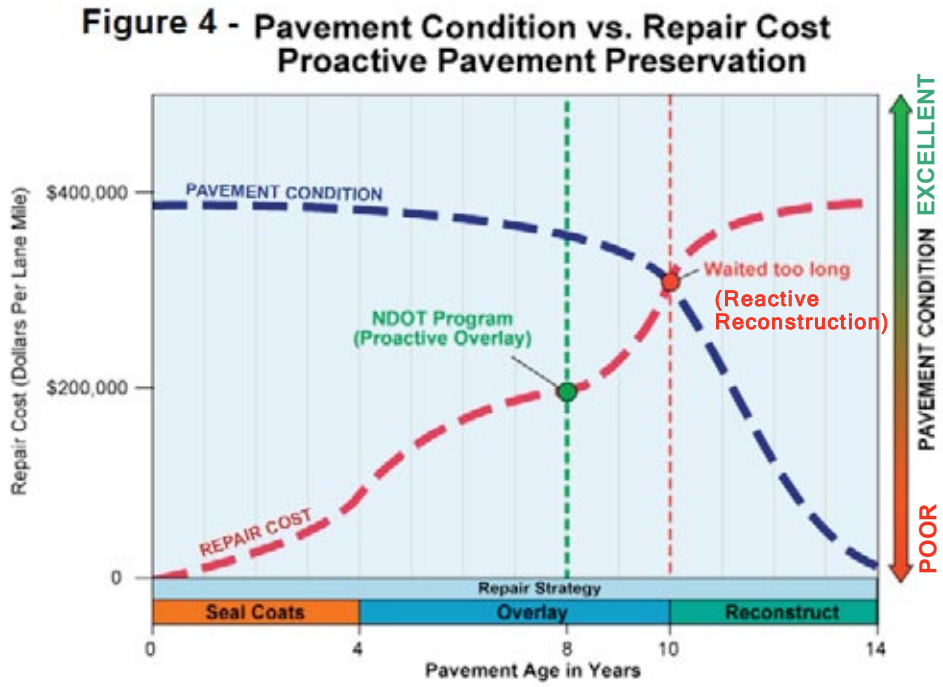
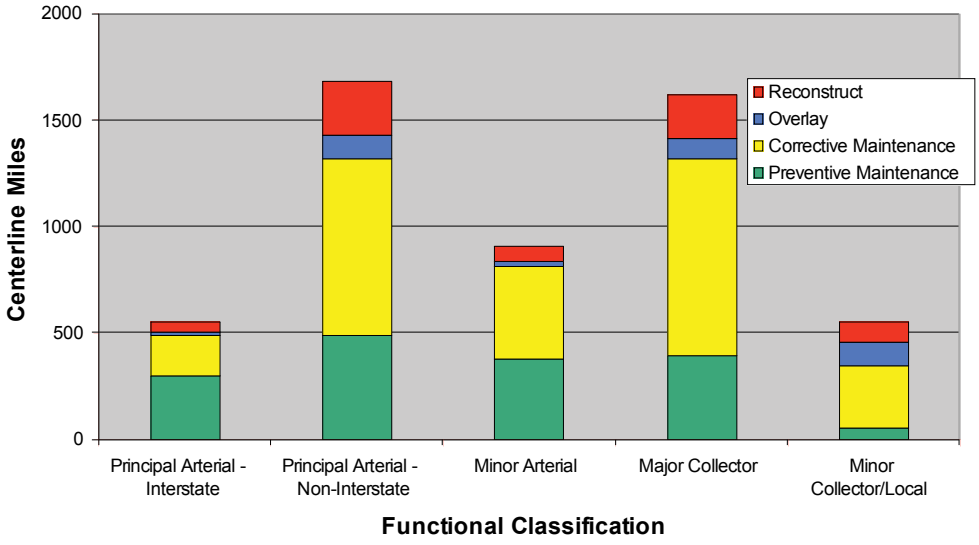


Figure 5 shows the current pavement condition on the state-maintained system. In the past several years, approximately 10% of the resurfaced roadway mileage needs reconstruction; the other 90 % of the section should receive overlay. However, without additional funding for overlay preservation, that percentage of reconstruction will increase significantly.

Figure 5 - Pavement Condition on the State-Maintained System
By Repair Strategy Required and Functional Class
2007 Condition Data



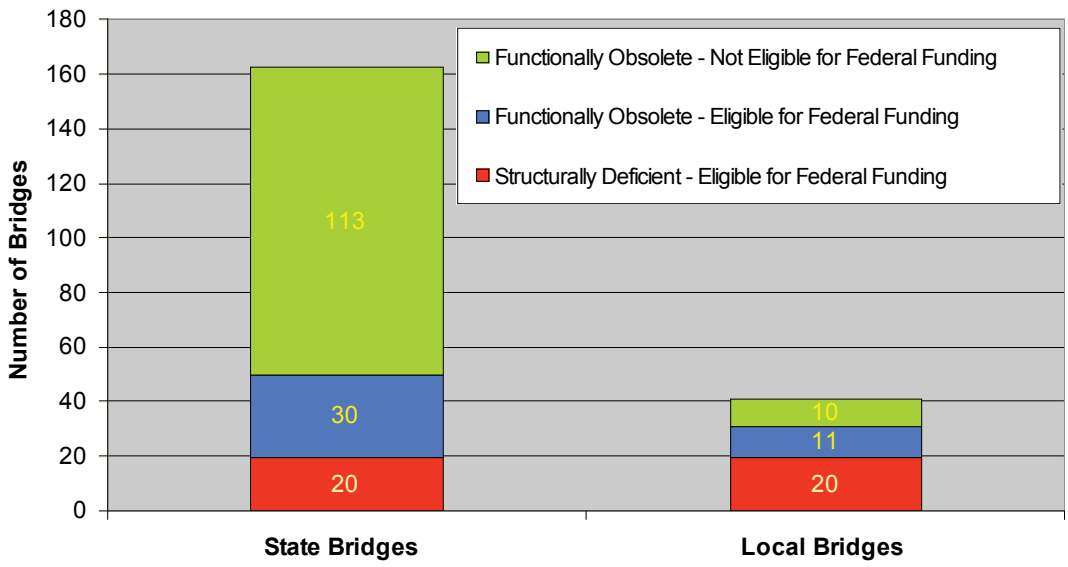
Bridges

Because Nevada's bridges are relatively young and located in a generally warm, arid climate, they are in good condition compared to bridges in most other states. There are 1056 bridges on the state-owned system that were surveyed in 2008. Per our survey, 143 (13.5 %) of those state-owned bridges are functionally obsolete and no longer provide adequate service to the public. Out of these bridges, only 30 bridges are eligible for federal Highway Bridge Program (HBP) funding. The other 113 state bridges are not eligible for federal funding. Another 20 (1.9 %) state bridges are structurally deficient which are eligible for federal Highway Bridge Program (HBP) funding.

There are 701 bridges on the locally-owned system that were surveyed in 2008. Per our survey, 21 (3.0 %) of those locally-owned bridges are functionally obsolete and no longer provide adequate service to the public. Out of these bridges, only 11 bridges are eligible for federal Highway Bridge Program (HBP) funding. The other 10 state bridges are not eligible for federal funding. Another 20 (2.9 %) local bridges are structurally deficient which are eligible for federal Highway Bridge Program (HBP) funding.

Since 1995, when the Nevada Department of Transportation began prioritizing bridges for seismic retrofits, it has retrofitted 101 structures. A high priority exists for seismic retrofit of at least 132 more state-owned bridges. Figure 6 summarizes both state and local substandard bridges.

Figure 6 - Substandard Bridges



Nevada spends approximately $13 million annually on bridge preservation: $10.5 million in federal funds, $1.5 million in state funds, and $1 million in local funds. Federal Highway Bridge Program (HBP) funds are limited and fund the inspection program as well as

rehabilitation/replacement of eligible existing structures. These funds have historically been augmented with additional state funds for maintenance, preservation, and seismic retrofit. The state and federal funds are considered minimally adequate to preserve the state-maintained bridges during the next five years. In the 2007-2008 biennium, the department spent $26 million on preserving and protecting Nevada's bridges. We expect increased bridge preservation costs during the decade beginning in 2010 because many bridges will be due for major work.

Bridges normally have a useful life of about 50 years and Figure 7 shows when Nevada bridges will reach that age. Table 3 shows the $150 million bridge backlog by highway functional classification.

Figure 7 - 50-Year Old Bridges

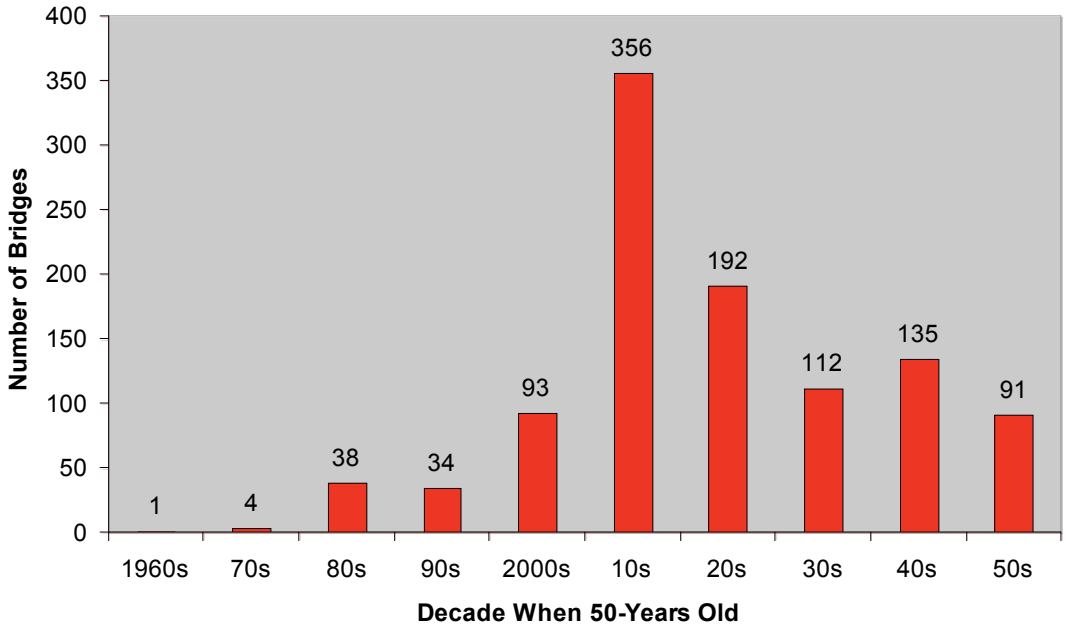


Table 3. Present Backlog of Bridge Work

State-Maintained System – 2009 (Based on 2008 Condition Data)

System	Backlog
Principal Arterial - Interstate	$28,830,000
Principal Arterial - Non-Interstate	$15,550,000
Minor Arterial	$6,650,000
Major Collector	$15,513,000
Minor Collector & Local	$9,177,000
Seismic Retrofit	$75,000,000
Total	**$150,720,000**

Rough Roads Cost Owners

In recent years Nevadans and visitors to Nevada enjoyed driving on some of the best highways in America. However, highway user costs rise when roads deteriorate because rough roadways cause premature aging of vehicles and increase vehicle maintenance costs for shocks, alignment, tires and sometimes axles. Other consequences of rough roadways are reduced fuel economy and an uncomfortable ride.

Recent nationally published reports indicate that each vehicle owners pay an additional cost of $615 in California for vehicle maintenance and repair solely due to poorly maintained roads. If the Nevada roads are allowed to deteriorate similar to road conditions in most of California, Nevada users would spend an additional $160 million per year on their vehicles. If highway preservation needs are continue to be overlooked, eventually Nevada user costs would increase to $1.4 billion per year. Relative to California's rough roads, Nevadans enjoyed a three percent advantage in fuel economy that saved them about $184 million in 2008.

Bridges are an integral part of the highway system. It is important to keep the Nevada bridges in good condition. Nevada Interstate route bridges carry an Average Annual Daily Traffic (AADT) of approximately 100,000 in Northern Nevada urban areas and 250,000 in Southern Nevada urban area. Economic impacts of a bridge collapse and the subsequent activities are widespread. For example, the bridge collapse in Minneapolis in 2007 had an economic impact of $17 million in 2007 and $43 million in 2008 on the state. The additional user cost was estimated as $247, 000 per day due to added travel time. This bridge was carrying an AADT of 140,000 before the collapse.

Summary

The total backlog of pavement and bridge work needed is approximately $720 million. This is shown by functional classification in Table 4.

Table 4 - Backlog of Pavement and Bridge Work
State-Maintained System – 2009 (Based on 2007-2008 Condition Data)

System	Pavement	Bridges	Total
Principal Arterial - Interstate	$65,771,741	$28,830,000	$94,601,741
Principal Arterial - Non-Interstate	$207,485,555	$15,550,000	$223,035,555
Minor Arterial	$56,118,892	$6,650,000	$62,768,892
Major Collector	$147,647,317	$15,513,000	$163,160,317
Minor Collector & Local	$90,726,203	$9,177,000	$99,903,203
Seismic Retrofit		$75,000,000	$75,000,000
Total	**$567,749,707**	**$150,720,000**	**$718,469,707**

The concept of The Nevada Department of Transportation's preservation program is to invest $1 today to avoid a $4 investment tomorrow. How many drivers would save a $100 dollars per year on engine oil to risk paying $3,000 to rebuild an engine every few years? We change our motor oil before metal flakes appear. Similarly, the Nevada Department of Transportation's preservation strategy relies on timely pavement overlays that will postpone for many years the need for more expensive reconstruction.

Presently, Nevada decision-makers are at a major crossroad. In recent years, the Nevada Department of Transportation maintained the best highways in America, but this is changing for several reasons:

1. Since 1992 the state fuel taxes have not changed, we have lost approximately 60% of purchasing power because of construction cost inflation.

2. Since 1990 Nevada's population has grown from 1.2 million to 2.6 million in 2008, and congestion in urban areas has increased dramatically. This congestion has imposed a significant cost in travel time to roadway users, because there is not adequate funding to deal with all of the congestion needs.

3. In the 2007-2008 bienniums, we spent just $100 million annually on highway preservation. Pavement deterioration is approximately $300 million annually (Averaged over next 12 years).

4. To remove the current (2009) preservation backlog of $720 million, an average of $350 million is needed annually over the next 12 years. Under the current funding level, the backlog will continue to grow, and will accelerate by applying maintenance (low cost surface treatments) rather than overlays or reconstruction.

5. At the current preservation funding levels, the roadway-user vehicle costs due to rough roads are expected to reach $340 million annually. It is clear that properly preserving the state highway system will save Nevada drivers millions of dollars in vehicle repairs and energy costs annually. The user costs are derived based on the national studies. The Nevada Department of Transportation needs to initiate a research study to discover user costs based on Nevada conditions.

HIGHWAY PRESERVATION

As required by Nevada Revised Statute 408.203(3), this report details our efforts to preserve Nevada's state highways. The Nevada Department of Transportation maintains 5,376 miles of highways. Of these highways 5,323 miles were surveyed for this report. State-maintained highways constitute only 16 % of the roads in Nevada, but overwhelmingly, these highways are the most important in the state, carrying 56 % of all traffic, 83 % of all trucks and 87 % of heavy trucks. Also, 1,056 of Nevada's 1,915 public bridges are located on these highways.

Legislature's Role

The Nevada Department of Transportation depends on taxes authorized by Congress and the Nevada Legislature to preserve our highways. Since approximately 60 % of our highway-preservation funds are going to be derived from state-levied taxes in 2010 and 2011, the Legislature's involvement is critical to our success in preserving Nevada's highway system. This report provides the Legislature with a tool to determine whether those taxes are adequate.

Nevada Department of Transportation's Role

Our investment in highways is substantial. Today's cost to replace the pavement surface and bridges alone is $3.6 billion. The Nevada Department of Transportation is responsible for constructing and protecting highway assets; therefore preserving existing highways is a top priority.

Highway assets are managed using two systems: a pavement management system and a bridge inventory system. Both systems provide an inventory of our existing assets, their condition, needed repairs, and repair priorities. Known repair costs are used to forecast short- and long-term funding requirements.

Generally, pavement-preservation work consists of sealing, crack filling, patching, milling, overlaying, and reconstructing the highway surface. The low cost surface treatments - Sealing, crack filling, and patching are typically accomplished by Nevada Department of Transportation maintenance crews. Milling, overlaying, or reconstructing the highway surfaces are normally contracted out to private contractors.

Generally, bridge-preservation work consists of rehabilitating or replacing structurally deficient or functionally obsolete structures, seismically retrofitting earthquake-prone structures, sealing or replacing travel surfaces, and replacing worn joints.

PAVEMENT PRESERVATION

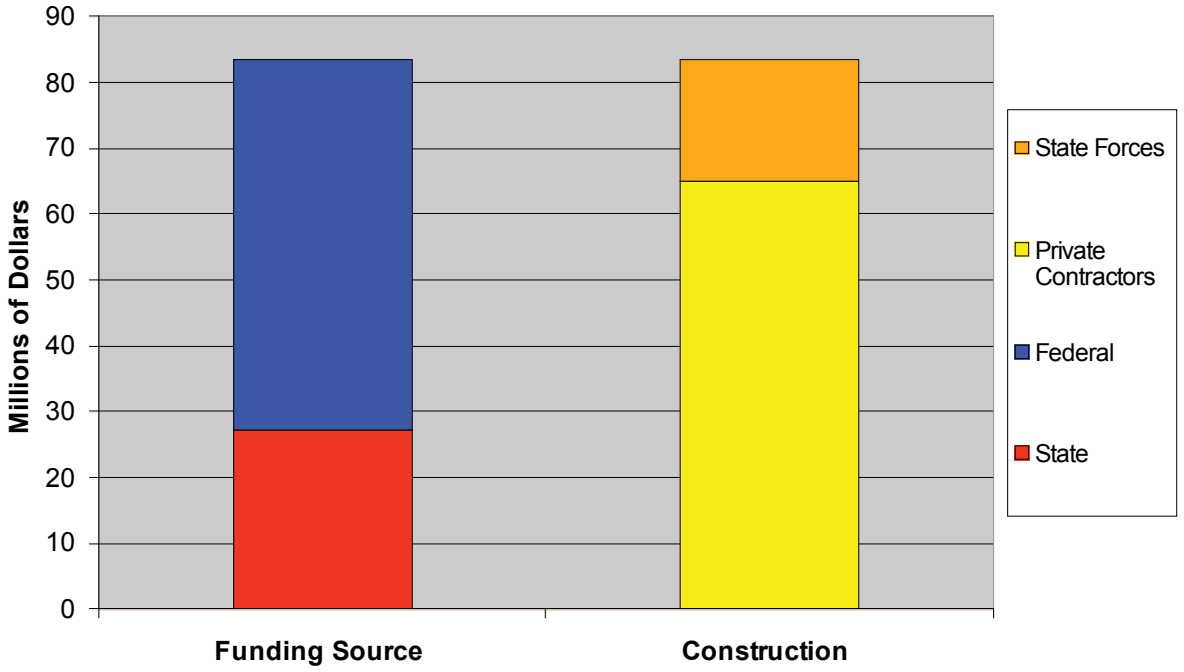
This section provides details concerning preservation funding, our pavement management system, the state-maintained highway inventory, pavement condition, the cost to preserve our pavements, available and needed preservation funding, and an action plan for maintaining high-quality, low-cost pavement.

Funding

(How do we fund state pavement preservation?)

Nevada's state highways are financed by highway-user taxes — predominantly fuel taxes and vehicle registration fees. During the past two years, $84 million was spent annually on pavement-preservation projects: $56 million was federal funds for Interstate maintenance, and $28 million was state funds. Out of the $84 million spent annually, $65 million was contracted and $19 million was performed by the Nevada Department of Transportation maintenance forces. These comparisons are displayed in Figure 8. Preservation refers to preventive maintenance, corrective maintenance, overlay and reconstruction.

Figure 8 - Annual Pavement Preservation Funding 2007-2008



Timely preservation work is critical to achieving low-cost pavements. Preservation work, however, must compete for funding against capacity-improvement projects in our

fast-growing state. During the last two fiscal years, $167 million was spent on pavement preservation work. This expenditure is $156 million less than the inflation-adjusted biennial average from 1993 to 2003.

Pavement Management

(How do we care for the state pavements?)

Pavement assets are monitored via our Pavement Management System. This system provides an inventory of pavement location and its corresponding condition, traffic volumes, weather, maintenance costs, and accidents. The Pavement Management System allows us to improve the efficiency of our decision-making, expand its scope, provide feedback as to the consequences of decisions, and ensure the consistency of decisions made at different levels within the Department.

Pavement Inventory *(What do we maintain?)*

The Nevada Department of Transportation is responsible for maintaining 5,376 miles of highways. Of these highways, 5,323 miles were surveyed for condition in 2007 for this report. These highways are functionally classified based on federal standards. The functional classifications are made to discern the relative importance and capacity of the highway. In this report, state-maintained highways are grouped under the following functional classes: principal arterials-interstate, principal arterials – non-interstate, minor arterials, major collectors, minor collectors, and local roads. Figure 9 shows those functional classes with state-maintained highways depicted by route markers.

Pavement Condition Survey *(How do we assess the health of our pavements?)*

The health of our pavements is assessed based on the age and type of pavement, route type, traffic volume, axle loads, and measured pavement distress. The repair strategies are explained below:

Preventive Maintenance: Repairs or applications that generally protect the road surface, but do not necessarily improve the ride quality. Examples: Asphalt Concrete – flush seals, fog seals, crack seals; Portland Cement Concrete Pavements – reseal joints (no saw cuts)

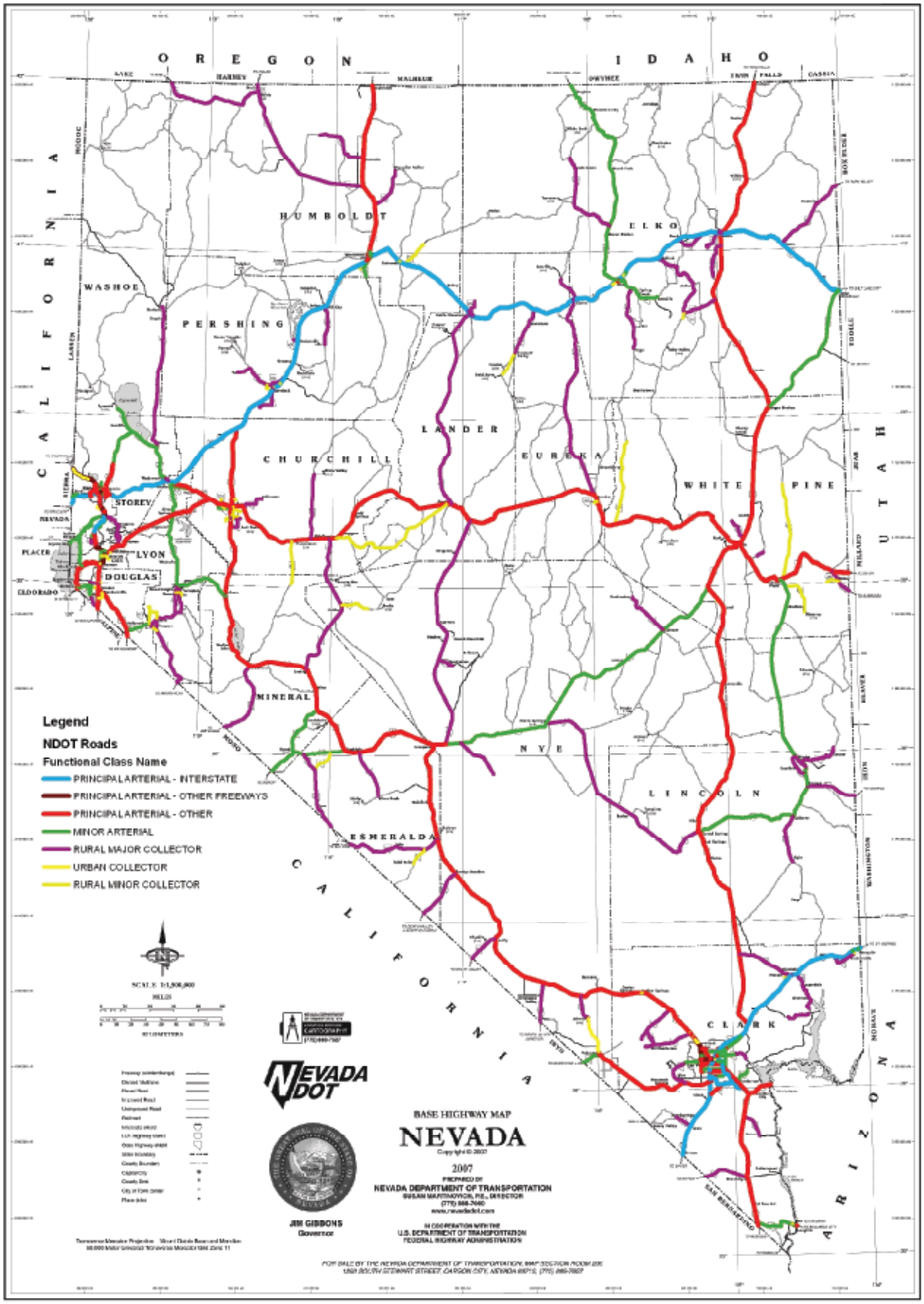


Figure 9 - State Maintained Highways by Functional Classification

Corrective Maintenance: Repairs or applications that generally protect and smooth the road surface, but don't necessarily improve its load-bearing capacity. Examples: Asphalt Concrete - Chip seals, slurry seals, open-graded surfacing; thin overlays (typically one-inch or less). Portland Cement Concrete Pavements – Saw and seal joints, spall repair, slab jacking repair.

Overlay: Overlays of more than one inch, or mill and overlays greater than one inch.

Reconstruct: Roadbed modification or other full-depth (or nearly full-depth) removal and overlay of roadbeds. Pulverizing or crack and seating of Portland Cement Concrete Pavements.

The condition of the moderate-to high-volume routes is based on pavement age and type, route type, traffic volume, and axle loads as shown in Table 5. These routes have two-way

Table 5: Pavement Repair Strategy Determination for Moderate - to - High Volume Routes (Two - Way Average Daily Traffic Greater than 400 Vehicles)

Controlled-access highways, National Highway System routes, and non-controlled-access highways

		Repair Strategy (based on pavement age in years)			
Route Parameters	**Pavement Type**	**Preventive Maintenance**	**Corrective Maintenance**	**Overlay**	**Reconstruction**
Interstates, Freeways, and All Other Controlled-Access Highways	Asphalt	Age ≤ 4 yrs.	4 < Age < 8 yrs.	Age = 8 yrs.	Age > 8 yrs.
	Concrete	Age ≤ 10	10 < Age < 18	N/A	Age > 18
Non-Controlled-Access Highways with: ADT>10,000 or ESAL>540	Asphalt	Age ≤ 4	4 < Age < 10	Age = 10	Age > 10
Non-Controlled-Access Highways with: 1,600<ADT≤10,000 or 405<ESAL≤540 And National Highway System routes with ADT≤10,000	Asphalt	Age ≤ 4	4 < Age < 12	Age = 12	Age > 12
Non-Controlled-Access Highways off the National Highway System with: 400<ADT≤1,600 or 270<ESAL≤405	Asphalt	Age ≤ 4	4 < Age < 15	Age = 15	Age > 15

Notes: < means less than; ≤ means less than or equal to; > means greater than; 4 < Age < 8 yrs. means the age is greater than 4 but less than 8; N/A means Not Applicable

ADT = Average Daily Traffic (in vehicles per day)

ESAL = Equivalent 18,000-pound Single-Axle Loads imparted daily. It takes 2,500 cars to impart a single ESAL but just one fully-loading two-axle delivery truck.

average daily traffic greater than 400 vehicles per day. Generally, the Interstate and other principal arterials, minor arterials, and major collectors are moderate- to high-volume routes; however, some of the minor collector and local routes are also included.

Low-volume roadways have two-way average daily traffic of 400 vehicles or less. They provide access to the higher-volume roads. Generally, they are minor collectors and local routes, but there are some minor arterials and major collectors that are low-volume roads. The condition of these routes is based on a pavement distress system. To measure distress, a section within each one mile segment of highway in both directions of highway is rated. The measured distresses are assigned points. These points are summed and a repair strategy is assigned as follows in Table 6. The severity and extent of the following pavement distresses are measured:

- Road Roughness
- Fatigue Cracking
- Rut Depth
- Transverse
- Cracking
- Patching
- Block Cracking
- Flushing
- Non-Wheel-Path Longitudinal Cracking
- Friction Loss

Table 6: Pavement Repair Strategy Determination for Low -Volume Routes (Two-Way Average Daily Traffic of 400 Vehicles or Less)

Non-controlled-access highways off the National Highway System

		Repair Strategy (based on pavement distress data)			
Route Parameters	**Pavement Type**	**Preventive Maintenance (points)**	**Corrective Maintenance (points)**	**Overlay (points)**	**Reconstruct (points)**
ADT is ≤400 vpd	Asphalt	0 - 49	50 - 399	400 - 699	>700

Notes: > means greater than; ≤ means less than or equal to.

ADT = Average Daily Traffic (in vehicles per day - vpd)

Condition Survey Results *(What is the condition of our pavement?)*

Figures 10 and 11 show the pavement repair strategies required by functional classification.

Figure 10 - Pavement Condition on the State-Maintaned System By Repair Strategy Required and Functional Class 2007 Condition Data

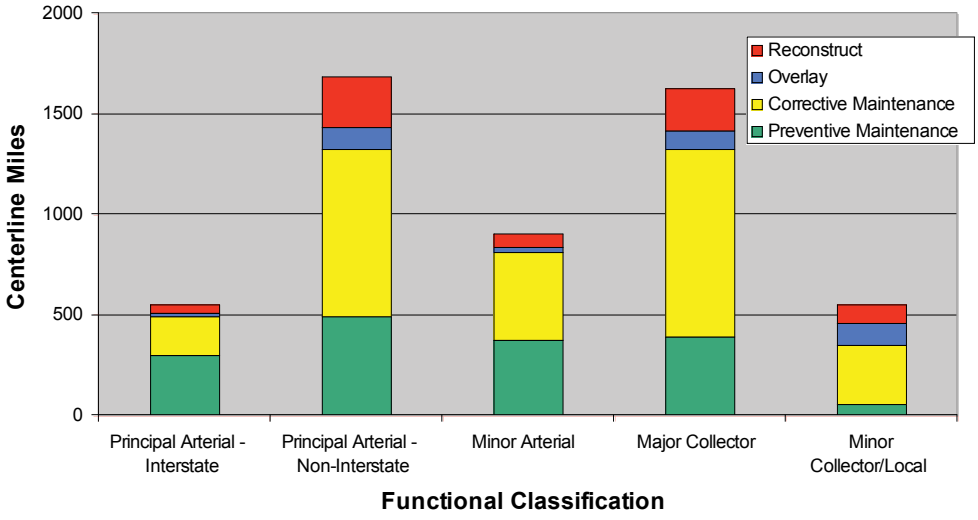


Figure 11 - Status of the State-Maintained System By Functional Class and Repair Strategy Required 2007 Condition Data

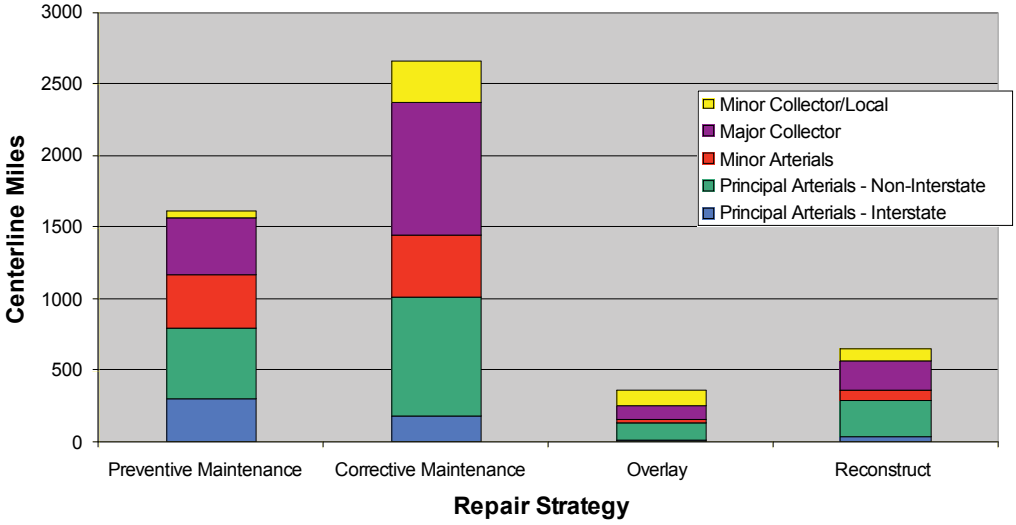


Figure 12 shows those roads that are planned for overlay or reconstruction in the next biennium.

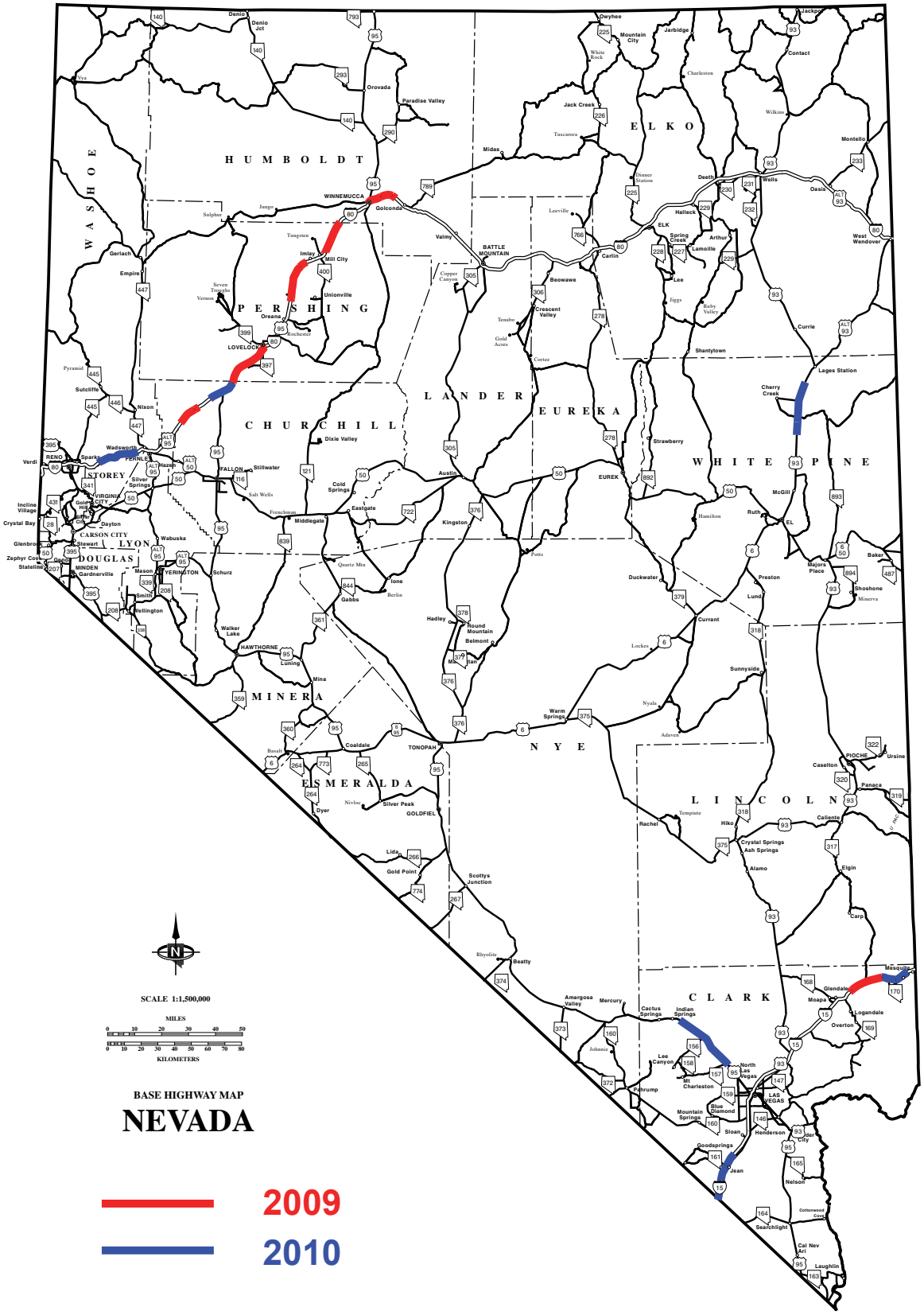


Figure 12. Roadway Projects Planned for Overlay or Reconstruct in Fiscal Years 2009 and 2010

Table 7 - Pavement Condition on the State - Maintained System - 2009
By Repair Strategy Required (Based on 2007 Condition Data)

CENTERLINE MILES

	Repair Strategy Required									
System	Preventive Maintenance		Corrective Maintenance		Overlay		Reconstruct		Total	
Principal Arterial - Interstate	302	5.7%	189	3.5%	20	0.4%	45	0.8%	555	10.4%
Principal Arterial - Non-Interstate	494	9.3%	828	15.6%	114	2.1%	248	4.7%	1,684	31.6%
Minor Arterial	378	7.1%	434	8.2%	27	0.5%	70	1.3%	909	17.1%
Major Collector	394	7.4%	929	17.5%	92	1.7%	208	3.9%	1,623	30.5%
Minor Collector & Local	56	1.1%	292	5.5%	114	2.1%	90	1.7%	552	10.4%
Total	1,624	30.5%	2,671	50.2%	368	6.9%	660	12.4%	5,323	100.0%

LANE MILES

	Repair Strategy Required									
System	Preventive Maintenance		Corrective Maintenance		Overlay		Reconstruct		Total	
Principal Arterial - Interstate	1,307	10.0%	762	5.9%	84	0.6%	185	1.4%	2,338	17.9%
Principal Arterial - Non-Interstate	1,434	11.0%	1,831	14.0%	245	1.9%	595	4.6%	4,104	31.5%
Minor Arterial	962	7.4%	1,033	7.9%	57	0.4%	167	1.3%	2,219	17.0%
Major Collector	793	6.1%	1,863	14.3%	185	1.4%	416	3.2%	3,258	25.0%
Minor Collector & Local	114	0.9%	588	4.5%	229	1.8%	181	1.4%	1,112	8.5%
Total	4,609	35.4%	6,077	46.6%	801	6.1%	1,543	11.8%	13,031	100.0%

Backlog of Pavement Work

(What is the current cost to improve our roads to good condition?)

We want to have our pavements at least in good condition. Table 7 identifies how much work in each repair strategy would be required to achieve this goal. Table 8 shows the current cost to get there is approximately $568 million. Only those pavements from Table 7 that require overlay or reconstruct strategies are included in calculating our current pavement backlog because they need more extensive treatment. Pavements in the preventive and corrective maintenance categories are not included in the backlog because they are in fair to good condition and can be adequately maintained with existing routine-maintenance funds.

Table 8 - Backlog of Overlay and Reconstruction Work

State-Maintained System - 2009 (Based on 2007 Condition Data)

	Overlay		Reconstruction		Total	
System	Lane Miles	Cost	Lane Miles	Cost	Lane Miles	Cost
Principal Arterial - Interstate	84	$14,915,409	185	$50,856,332	268	$65,771,741
Principal Arterial - Non-Interstate	245	$43,729,267	595	$163,756,288	840	$207,485,555
Minor Arterial	57.43	$10,246,315	167	$45,872,577	224	$56,118,892
Major Collector	185.42	$33,081,520	416	$114,565,797	602	$147,647,317
Minor Collector & Local	229	$40,929,951	181	$49,796,251	410	$90,726,203
Total	**801**	**$142,902,463**	**1,543**	**$424,847,244**	**2,344**	**$567,749,707**

The backlog shown in Table 8 includes the cost for pavement, ancillary repairs, and engineering on projects. Ancillary repairs typically include repairing signs and signals, replacing traffic delineators, repairing ditches and culverts, and grading shoulders.

Figure 13 shows the age distribution of state-maintained pavement segments in the Nevada. For comparison, the same information for the year 2007 is shown in Figure 14. Note that most work was done to keep aging pavement on the Interstates in good condition; however, one will note that in 2009, Interstate highway segments that are more than 9 or 10 years old have increased significantly compared to 2007. The condition of much of the non-Interstate system has been allowed to age until funding is available for pavement preservation.

Action Plan

(In general, how will we improve our pavements? How do we prioritize the available resources? What financial resources are needed?)

Preserving high-quality pavement at the lowest cost requires an action plan that optimizes the use of available funds. In the long-term, our action plan is the same as that first detailed in the 2003 State Highway Preservation Report because we accomplished our goal of keeping high to moderate volume roads in superior condition by overlaying them before more expensive reconstruction is needed. In fact, our proactive goal was to increase the historical ratio of overlay to reconstruction work from 3:1 to 9:1. However, due to inflation and budgetary constraints, that ratio is expected to shift to the 5:1 range. Our long-term action plan relies on legislative action to adequately fund preservation, and is listed in priority order as follows:

Figure 13 - State Maintained System by Age and Functional Class 2009

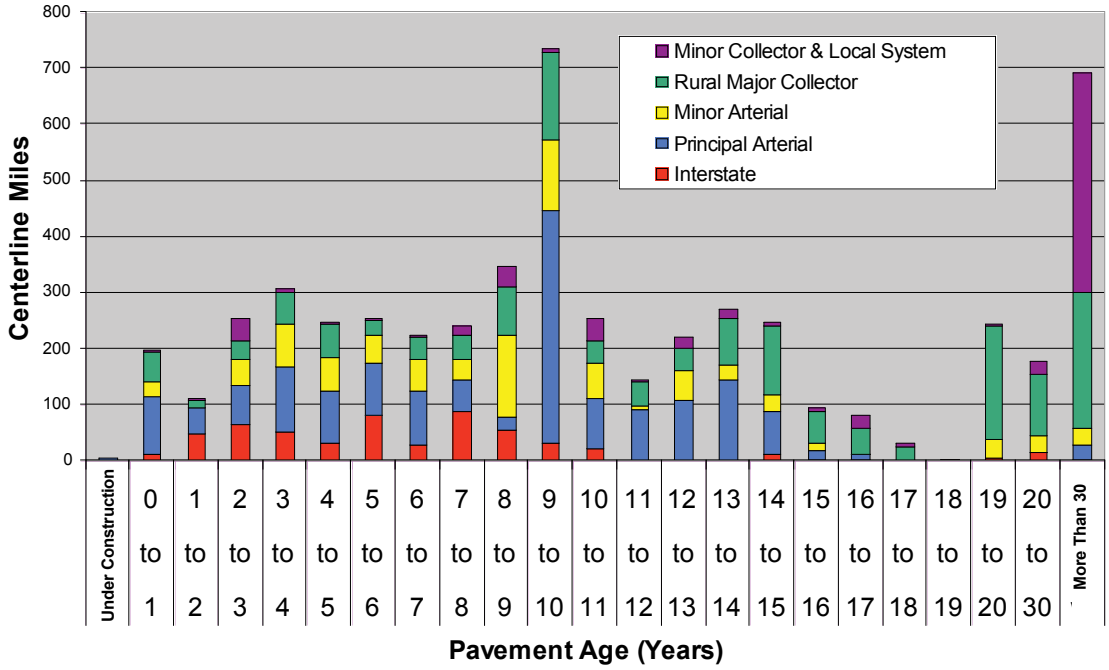
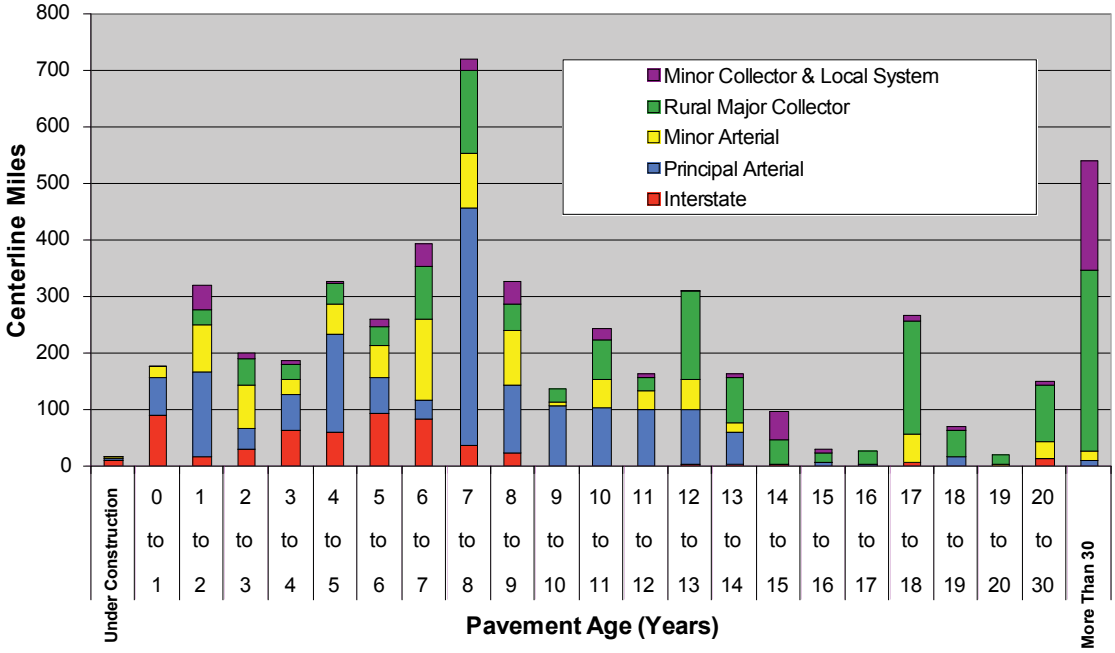


Figure 14 - State Maintained System by Age and Functional Class 2007



Long-Term Action Plan (assumes legislative action regarding preservation funding)

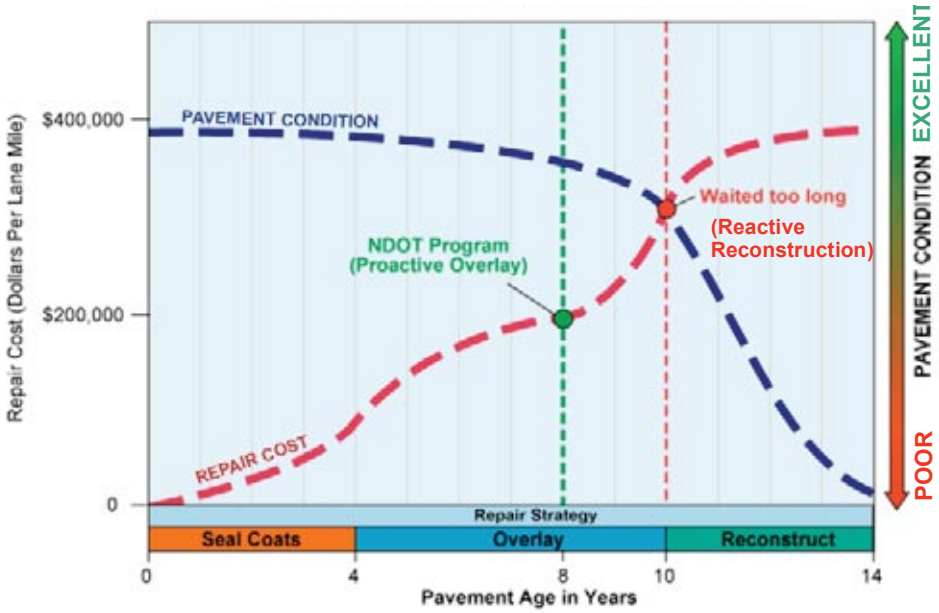
1. Continue to maintain our Interstate system and high-volume roads at a high level of serviceability (excellent pavements) by applying timely overlays and reconstructing inferior segments.
2. Continue to maintain our non-Interstate principal arterials, minor arterials, and other moderate-volume roads at a modest to high level of serviceability (good pavements) by applying timely overlays and reconstructing inferior segments.
3. To further develop economically sound methods to improve our low-volume roads and maintain them at a limited, but acceptable, level of serviceability.
4. To continue coordinating and integrating our routine pavement maintenance activities with planned overlay and reconstruction work.

When even modest pavement distresses appear, the cost to repair a road skyrockets. By continuing our proactive approach of overlaying the road before these distresses appear, we can produce significant savings. This is the impetus behind our plan to apply timely overlays in tasks 1 and 2 of the action plan. Based primarily on pavement age, traffic volume, and traffic loads, we can predict when distresses will appear and perform the overlays in advance of these distresses. This proactive technique is overwhelmingly responsible for reducing the pavement backlog reported in 1999 from $528 million to the $287 million backlog in 2005, despite below-average expenditures during the four fiscal years from 2001 through 2004.

On average, reconstructing pavements cost 60 % more than overlays. But the *marginal* cost of waiting until pavement needs reconstructing averages four times that of an overlay. Or stated in practical terms, **inadequate funding for pavement preservation takes four dollars away from highway users for every dollar they could have invested in timely overlays.** Figure 15 shows the logic behind the long-term action plan in providing cost-effective, proactive pavement maintenance. While recognizing the success of this strategy, it is also understood that budget constraints are a limiting factor. Capacity projects to alleviate congestion compete with preservation work and are prioritized against each other for the highest overall public benefit. Nevada has not applied preservation funding commensurate with normal pavement deterioration, and these effects are becoming obvious to the motoring public.

Unfortunately, planned preservation expenditures for fiscal years 2009 through 2011 are not adequate to accommodate our long-term plan. Consequently, we have developed a short-term plan that protects some of our most valuable pavement assets, while allowing others to fall into the reconstruction category (vs. timely overlay). Our short-term plan is shown next:

Figure 15 – Pavement Condition vs. Repair Cost
Proactive Pavement Preservation



Short-Term Plan (assumes no legislative action regarding preservation funding through fiscal year 2011)

1. Maintain our Interstate system and non-Interstate principal arterials at a high level of serviceability by applying timely overlays as feasible while reconstructing inferior segments.

2. To apply seal coats or other short-term treatments to all other routes.

Although partially reactive, this short-term plan partially protects our pavement assets, especially our high-speed and high-volume highways. However, we must recognize that the pavement backlog will rise from the current level of $568 million to $829 million in 2012.

Project Priorities *(How do we prioritize individual projects?)*

Our action plan tells how we prioritize the highway network as a whole. Within the goals of our action plan, we prioritize individual projects based on pavement age, traffic volume, axle loads, and condition. This prioritization scheme is consistent with the method by which we assess the health of our pavements. Because our preservation finances are in direct competition with capacity projects in our fast-growing state, the funds available are also a key consideration in prioritizing preservation projects.

A list of statewide candidate pavement preservation projects is developed, and the **projects are ranked based on the financial consequences of not doing the projects in a timely manner**. For example, delaying a project on the Interstate system by one year can add several million dollars to the cost; whereas, delays on a moderate- or low-volume road will have a less significant impact. A field-survey team reviews these candidate projects and refines the repair strategy to be used. The team also recommends an appropriate funding level to accomplish our preservation goals for the year. In addition, we include input from our district engineers to fairly allocate the modest funding available for low-volume routes.

Present Funding vs. Needed Funding *(What financial resources are needed to improve our pavements?)*

Under the present user-fee structure, the current $568 million backlog of pavement work will increase to $829 million in 2012, and climb to $2.2 billion in 2021. The needed funding scenario, which requires substantial revenue increases in future years, will close out the backlog in 2021. Figure 16 and Table 9 show how these increases are needed to eliminate the backlog.

Figure 16 - Backlog of Pavement Needing Overlay or Reconstruction With Present Funding vs. Needed Funding

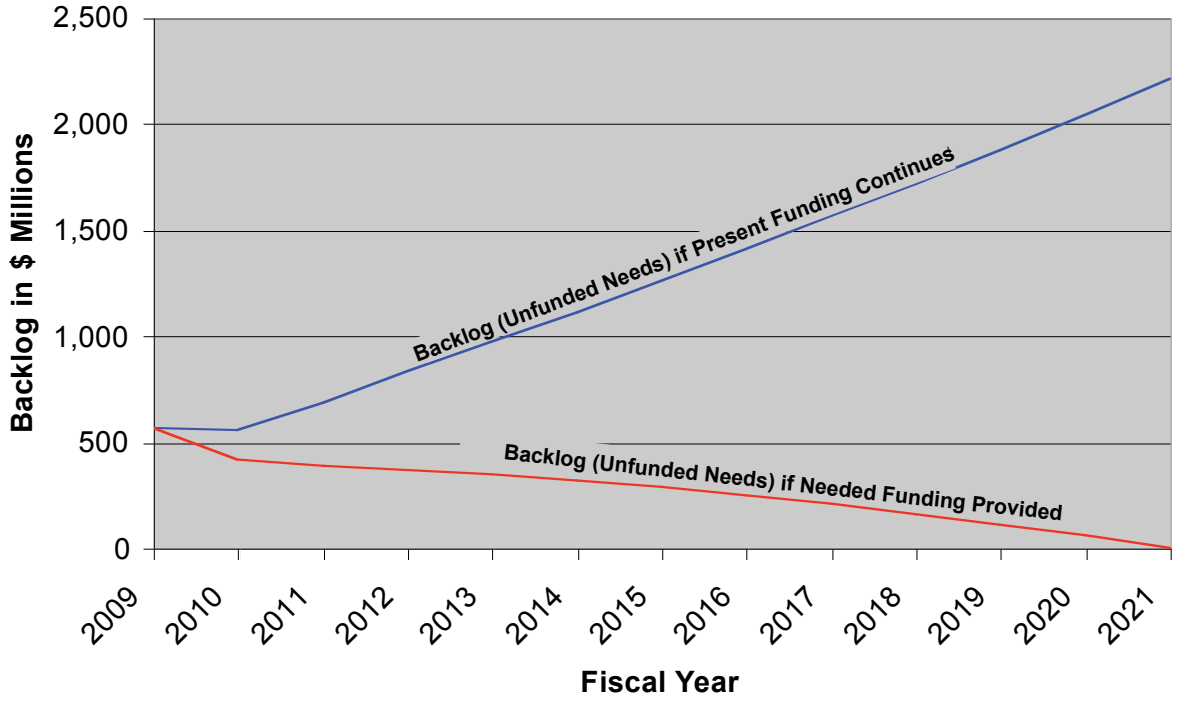


Table 9 - Pavement Backlog, Costs, and Funding
State-Maintained System - 2009
(in millions of dollars)

Present Funding

Fiscal Year	Backlog of Pavement Work	Pavement Preservation Costs * (Normal Annual Deterioration Costs)			Pavement Preservation Funds ** (Funds Planned for Preservation Work)				
		Overlay & Reconstruction	Preventive & Corrective Maintenance	Total	State Overlay & Reconstruction	Federal Overlay & Reconstruction	State Pavement Maintenance		Total
2009	567.7	229.2	11.6	240.8	5.1	232.3	11.6		249.0
2010	559.6	235.5	11.9	247.4	53.3	54.9	11.9		120.1
2011	686.9	236.8	12.3	249.1	48.9	45.9	12.3		107.1
2012	828.8	238.5	12.6	251.2	50.9	47.7	12.6		111.3
2013	968.7	245.7	13.0	258.7	52.9	49.6	13.0		115.6
2014	1,111.8	253.0	13.4	266.4	55.1	51.6	13.4		120.1
2015	1,258.1	260.6	13.8	274.4	57.3	53.7	13.8		124.8
2016	1,407.8	268.4	14.2	282.7	59.5	55.8	14.2		129.6
2017	1,560.8	276.5	14.7	291.2	61.9	58.1	14.7		134.7
2018	1,717.3	284.8	15.1	299.9	64.4	60.4	15.1		139.9
2019	1,877.3	293.3	15.5	308.9	67.0	62.8	15.5		145.3
2020	2,040.9	302.1	16.0	318.2	69.7	65.3	16.0		151.0
2021	2,208.0								

Needed Funding

Fiscal Year	Backlog of Pavement Work	Pavement Preservation Costs * (Normal Annual Deterioration Costs)			Pavement Preservation Funds ** (Funds Planned & Needed for Preservation Work)				
					Existing			Needed Additional Overlay & Reconstruction	
		Overlay & Reconstruction	Preventive & Corrective Maintenance	Total	State Overlay & Reconstruction	Federal Overlay & Reconstruction	State Pavement Maintenance		Total
2009	567.7	229.2	11.6	240.8	5.1	232.3	11.6	146.9	395.9
2010	412.6	235.5	11.9	247.4	53.3	54.9	11.9	152.8	272.9
2011	387.1	236.8	12.3	249.1	48.9	45.9	12.3	158.9	266.1
2012	370.1	238.5	12.6	251.2	50.9	47.7	12.6	165.3	276.6
2013	344.7	245.7	13.0	258.7	52.9	49.6	13.0	171.9	287.5
2014	315.8	253.0	13.4	266.4	55.1	51.6	13.4	178.8	298.9
2015	283.4	260.6	13.8	274.4	57.3	53.7	13.8	185.9	310.7
2016	247.1	268.4	14.2	282.7	59.5	55.8	14.2	193.4	323.0
2017	206.8	276.5	14.7	291.2	61.9	58.1	14.7	201.1	335.8
2018	162.2	284.8	15.1	299.9	64.4	60.4	15.1	209.2	349.1
2019	113.0	293.3	15.5	308.9	67.0	62.8	15.5	217.5	362.9
2020	59.1	302.1	16.0	318.2	69.7	65.3	16.0	226.2	377.2
2021	0.0								

* Inflation assumed at 3.00% per annum.
** Revenue growth rate assumed is 4.00% per annum.

Note: Backlog of pavement work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

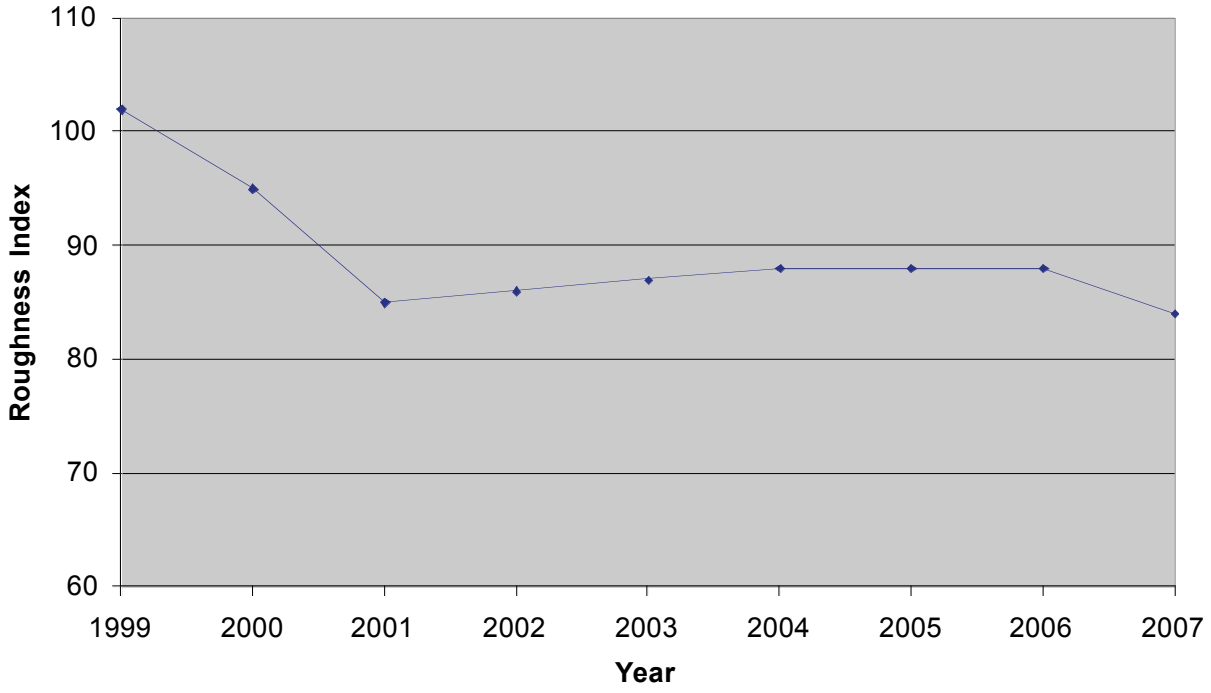
Pavement Management System Improvements *(How will we improve our asset management?)*

Our action plan for preserving pavement was developed to keep costs low and pavement smooth. Based on the overwhelming success of that plan, the Nevada Department of Transportation will not make any major changes with regard to asset management, with the exception of continuing to improve the preservation strategies used for low-volume roads. We have also developed departmental performance measures for managing our assets. The key measure of pavement management is the pavement smoothness seen by an average driver.

Pavement roughness is measured by a global standard called the International Roughness Index (IRI). The Federal Highway Administration considers any pavement with an IRI less than 60 to be in "excellent" condition, 60 to 94 to be "good", 95 to 119 to be "fair" for the Interstate, and 95 to 170 to be "fair" on non-Interstate routes. Nevada's actual values for average traffic-weighted International Roughness Index are "good" as shown in Figure 17.

The slight improvement in the International Roughness Index in 2007 might be the result of structural improvements done on high-volume Interstates and other principal Arterials and the functional improvements done on the other routes.

Figure 17 - Traffic-Weighted International Roughness Index (Inches per Mile)



Pavement Research

(What research are we conducting to improve our pavements?)

The Nevada Department of Transportation, Materials Section, continuously strives to improve the quality of pavement standards and materials used on the highway system. Therefore, the Materials Section conducts or partners with several entities in a variety of capacities to deliver the best products and materials in the most cost-effective manner. Research studies have been completed in the recent past and there are several research activities that are interesting to the transportation community. Recently completed research projects include:

1. A project to find more cost-effective treatments to rehabilitate the State's low volume road system. A major finding was that a saving of over $100,000 per centerline mile can be realized if cold in-place recycle with double chip seal is used instead of hot mix asphalt overlay.

2. Determine suitable joint densities for the longitudinal lane joints on flexible hot mix asphalt pavement. This project concluded that three of the five joint geometrics tested met recommended joint-density specifications.

3. Assess the ability of infrared images to depict flexible hot mix asphalt pavement properties as it was placed. This effort led to recommendations that will assist with reducing hot mix asphalt mixture segregation and will result in pavement density improvement.

4. Development of a rut resistant asphalt mix design. As a result, a modified aggregate gradation for hot mix asphalt mixtures will be implemented on a project in Northern Nevada.

Current research involves several activities that include:

1. Implementation of Superior Performing Asphalt Pavements (SUPERPAVE) to evaluate whether our pavement mix design can be improved.

2. Evaluation of the Mechanistic Empirical Pavement Design Guide which is a new pavement design methodology based on engineering mechanics.

3. Use of recycled asphalt materials in highway construction. Uses include the addition of milled material into base layer aggregates, recycling the milled material as a dust control measure, and dirt road surface treatments.

4. Crack resistant asphalt mixtures. This effort is to determine whether modifications can be made to hot mix asphalt mixtures that will increase the resistance to reflection cracking.

5. Bridge deck-pavement joints. Improvements to these bridge joints will provide better roads to the highway user, and reduce lane-closures and maintenance costs on the highway system.

Biennial Expenditures, Fiscal Years 2007-2008

(What have we expended on pavements?)

During fiscal years 2007 and 2008, the Nevada Department of Transportation obligated $167 million for pavement overlay and reconstruction work, addressing the needs of 185 miles of highways. This is an expenditure of only $32 million less than the previous biennium; however, 103 less miles of roadway received overlay or reconstruction due to huge inflation in construction prices, as shown in Figures 2 and 3. Preventive and corrective maintenance work consisting of patching, sealing pavements and cold in-place recycled (CIR) overlay was completed at a cost of $37 million over the biennium. Table 10 summarizes expenditures and corresponding mileage, and Figure 18 shows those highway sections receiving overlays or reconstruction during the 2007-2008 biennium.

Table 10: Biennial Expenditures

Fiscal	Repair Strategy						
	Preventive & Corrective Maintenance	Overlay		Reconstruct		Total	
Year	Expenditures	Expenditures	Miles	Expenditures	Miles	Expenditures	Miles
2007	$17,861,579	$22,191,086	28	$27,980,289	19	$68,032,954	47
2008	18,711,598	80,461,028	138	0	0	$99,172,626	138
Biennium Total	$36,573,177	$102,652,114	166	$27,980,289	19	$167,205,580	185

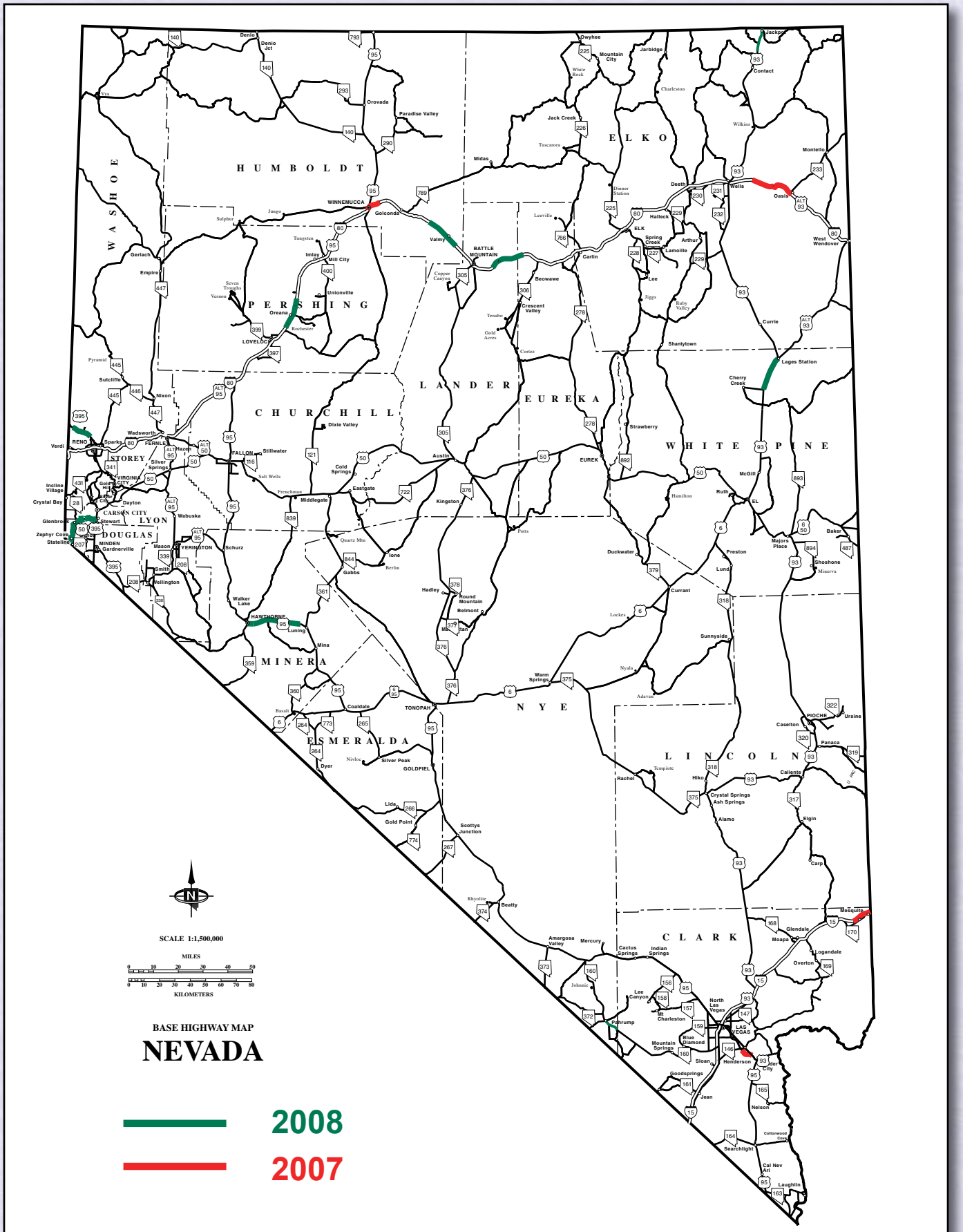


Figure 18. Overlay and Reconstruction Projects Advertised in Fiscal Years 2007 and 2008

Pavement Condition over Time

(How has our pavement condition changed?)

Figure 19 shows how the condition of our pavements has changed since 1987. Generally, the condition has remained fairly consistent. A significant rehabilitation program in 1999 and 2000 along with a proactive action plan that was first detailed in our 1999 preservation report have helped keep the system in fair condition, but these routes are aging and will soon require overlays or reconstruction. While the required overlays have been steady, the required reconstructions have been increasing in recent times.

Figure 19 - Pavement Condition on the State-Maintained System By Repair Strategy Required - 1987-2009

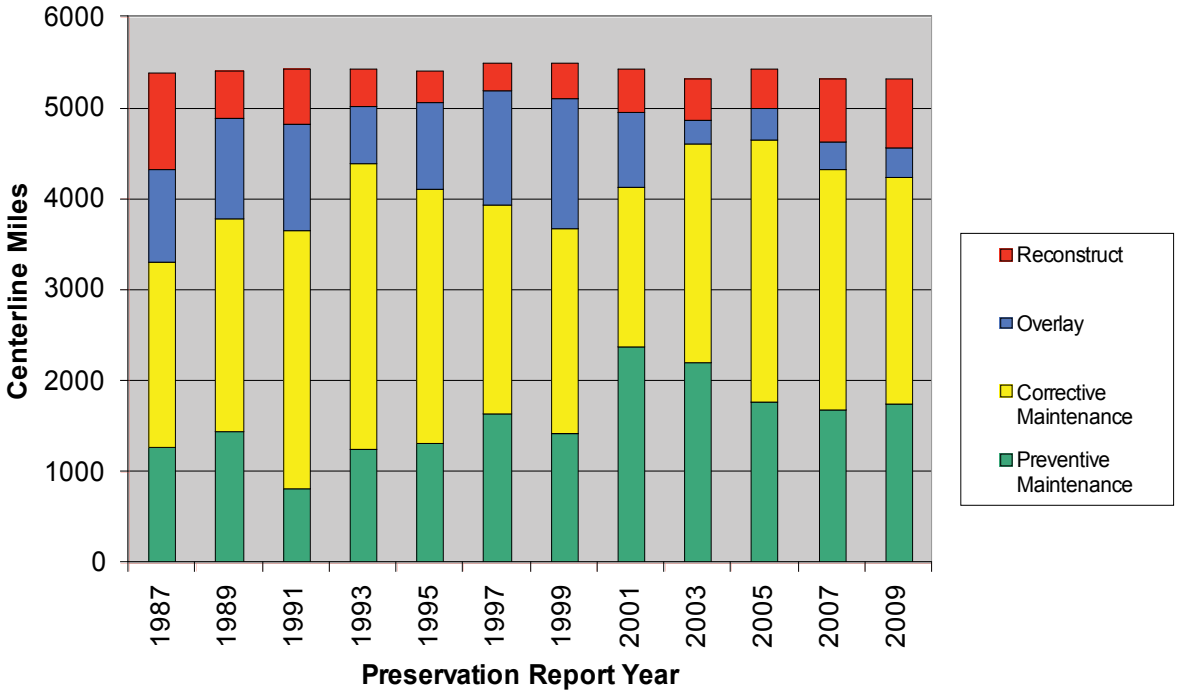


Figure 20 shows how the financial needs for pavement repairs have changed since 1987. Generally, the total needs increased with inflation until 1999, then decreased with the aggressive maintenance program of the late 1990s. Recent financial needs increases are a result of huge highway construction inflation and an inadequate investment in preservation work. However, the financial needs reduction between 2007 and 2009 is solely because of the recent reduction in construction bid prices. Figure 21 shows the financial needs for pavement repairs, as depicted in Figure 20, but inflation-adjusted to 2009 dollars.

Figure 20 - Status of the State-Maintained System by Cost of Repair Strategy Needed - 1987-2009

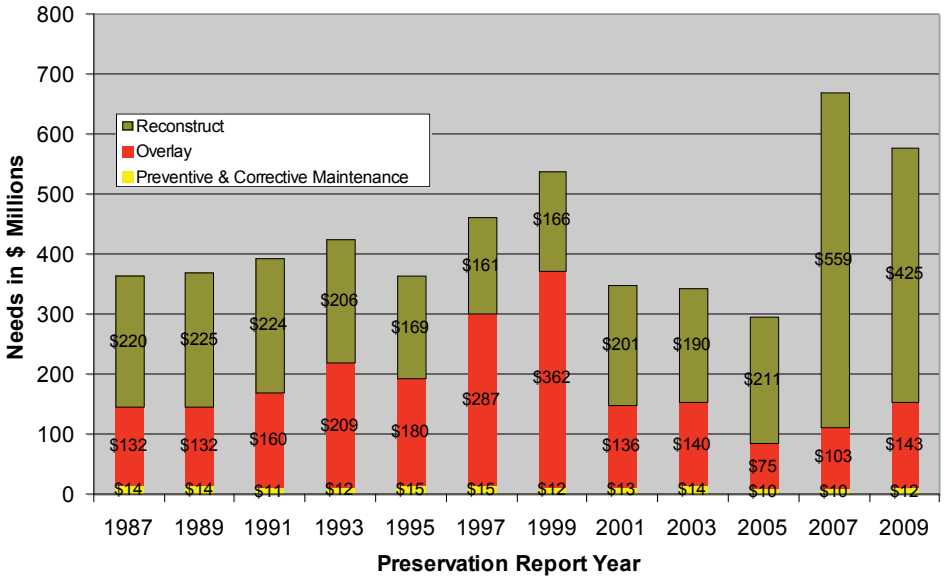
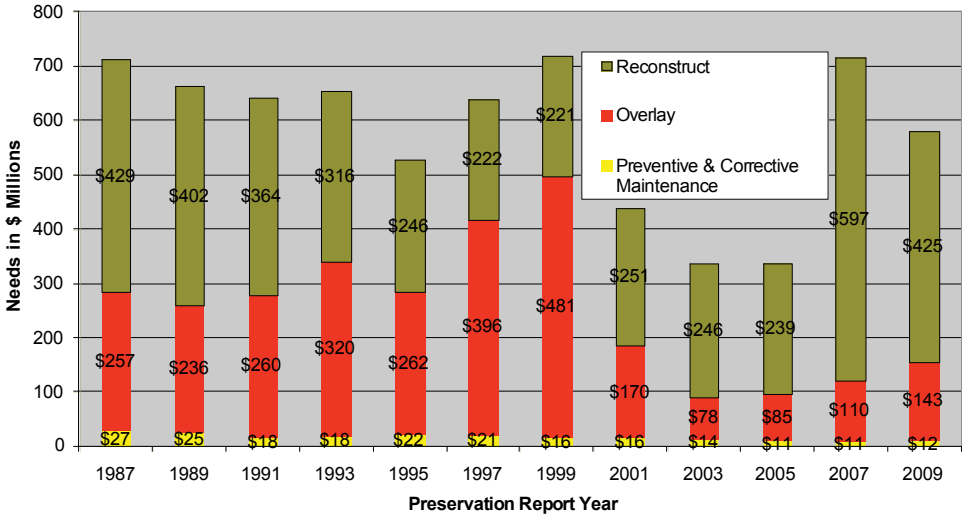


Figure 21 - Pavement Condition on the State-Maintained System Inflation Adjusted to 2009 Values Using Composite Consumer Price Index by Cost of Repair Strategy Needed - 1987-2009



Pavement Cost for Owners

(What cost is imposed on roadway users due to poorly maintained pavements?)

Because there are insufficient funds to properly preserve our highway system, vehicle owner costs are expected to increase within a few years. Recent nationally-published reports have indicated motorists pay on vehicle maintenance and repair between $300 and $800 per year,

solely because of rough roads. The California users spend a median cost of $615 on vehicle maintenance and repair.

The Nevada Department of Transportation is planning to conduct a study on the user cost incurred by the Nevada drivers on our roads. This study will look into the vehicle owner costs on rural and urban highways and on different functional classification of highways.

If the Nevada roads continue deteriorating to similar road conditions of most of the California roads, the Nevada vehicle owners would spend $158 million per year on their vehicle maintenance and repair. If the preservation needs are continue to be overlooked, eventually Nevada's vehicle owner cost would increase to $1.4 billion per year. Table 11 shows the user cost incurred by the Nevadans, if the roads are allowed to deteriorate to the condition of most of California roads.

Table 11 – Vehicle Owner Costs Incurred in Nevada

System Description	Reconstruction (miles)	Poor Pavement Condition	No. of Vehicles	Additional Cost/Year	Total Cost
Principal Arterial-Interstate	185	7.9%	44,550	$615	$27,376,085
Principal Arterial-Non Interstate	595	14.5%	90,693	$615	$55,730,549
Minor Arterial	167	7.5%	38,053	$615	$23,383,641
Major Collector	416	12.8%	6,323	$615	$3,885,330
Minor Collector and Local	181	16.3%	77,058	$615	$47,352,085
Total	1,543				$157,727,690

Table 12 shows the future user cost if the preservation is continuously overlooked. (100 % of the pavements become poor condition). It is assumed that, on average, Nevadans drive 10,000 miles a year.

Table 12 - Expected User Costs Incurred by Nevadans if Preservation is Overlooked

System Description	Reconstruction (miles)	Poor Pavement Condition (%)	No. of Vehicles	Additional Cost/Year	Total Cost
Principal Arterial-Interstate	2,338	100%	563,908	$615	$346,521,658
Principal Arterial-Non Interstate	4,104	100%	625,831	$615	$384,572,926
Minor Arterial	2,219	100%	506,892	$615	$311,485,261
Major Collector	3,258	100%	49,502	$615	$30,418,897
Minor Collector and Local	1,112	100%	473,848	$615	$291,179,321
Total	13,031				$1,364,178,063

BRIDGE PRESERVATION

A bridge is a structure spanning 20 feet or more that carries traffic over a depression or obstruction, and includes multiple box culverts and pipes. Nevada's bridges represent a $1.7 billion investment. To detail how we are protecting that investment, this section provides information concerning bridge preservation funding, the Nevada Department of Transportation bridge management system, the state's bridge inventory, the condition of the Nevada bridges, cost to preserve those bridges, available and needed preservation funding, and an action plan for maintaining high-quality bridges at a lower cost.

Although the focus in this section is on state-maintained bridges, information on other public bridges is also included because they are eligible for federal funds that are administered by the Nevada Department of Transportation. Furthermore, we are responsible for surveying and reporting the condition of all public bridges.

Funding

(How do we pay for bridge preservation?)

Like pavement, we pay for bridges with fuel taxes and vehicle registration fees. About $13 million is spent annually on bridge preservation: $10.5 million in federal funds, $1.5 million in state funds, and $1 million in local funds. Historically, available funding has been sufficient to offset annual deterioration costs.

Federal funds are available for bridge replacement, rehabilitation, or seismic retrofits. To qualify for replacement, the bridge must be either functionally obsolete or structurally deficient and have a sufficiency rating less than 50. To qualify for rehabilitation, the bridge must be either functionally obsolete or structurally deficient and have a sufficiency rating less than 80. (Sufficiency ratings and functionally obsolete or structurally deficient bridges are defined later in the Bridge Condition Survey section.) Typically, about 85 percent of bridge funds are spent on bridge rehabilitation and replacement and about 15 percent on seismic retrofit work.

Under federal funding guidelines, the off-system bridges must receive a minimum of 15 percent of the available federal funds. The remaining money can be used for on/off system bridges. The on-system bridges are located on the federal aid highway system. The off-system bridges are not located on the federal aid highway system. The roads on the federal aid highway system include the Interstates, Urban Collectors, and Rural Minor Arterials while off system roads include Rural Minor Collectors, Rural and Urban Locals. Of the 1,056 state bridges, 982 are on-system and 74 are off-system. Of the 701 county, city, and private bridges, 362 are on-system and 339 are off-system.

Bridge Management

(How do we care for our bridge assets?)

Bridges are managed via the PONTIS Bridge Management System. This system provides an inventory of bridge condition and location, needed repairs, load limits, susceptibility to flooding, and ownership information. A separate inventory allows us to ascertain earthquake susceptibility and risks. Together, these inventories allow us to identify preservation priorities and monitor the state's progress toward eliminating the backlog of bridge work.

Bridge Inventory *(What do we maintain?)*

All bridges in the Nevada, which are open to the public, are included in the Nevada Department of Transportation bridge inventory. There are currently 1,915 public bridges in Nevada. The Nevada Department of Transportation maintains 1,056; county or city governments, 674; federal agencies, 60; private entities, 23; and other local and private agencies, 102.

Bridge Condition Survey *(How do we assess our bridges' health?)*

The serviceability of bridges in Nevada is evaluated by use of a numerical assessment called the sufficiency rating. Sufficiency ratings vary from 0 to 100, with 100 being a bridge with no deficiencies. While the sufficiency rating is primarily used to determine eligibility for federal funding, it also is used to assess the overall condition of a bridge. The sufficiency rating includes three components: a condition assessment, an inventory rating, and an appraisal rating.

The condition assessments are primarily a visual evaluation of the structure. The deleterious effects of age, environment, fatigue, hydrologic scour, settling, and traffic collisions are assessed. Each of the bridges in Nevada is inspected at least once every two years. Bridges in poor condition are inspected more often. Besides impacting condition ratings, visual inspections also affect a bridge's inventory rating.

The inventory rating denotes the strength of the bridge compared to design-truck loading. Structures with low condition or inventory ratings are classified as "structurally deficient". The structurally deficient bridges are not necessarily about to fail. Rather, they become a priority for corrective measures and may be posted to restrict vehicle weights.

The appraisal rating measures how well the bridge serves the public, or its functionality. Included in the appraisal rating are a structural evaluation and a review of the deck geometry, under-bridge clearance, waterway adequacy, and approach geometry. Under the appraisal rating, a substandard structure is termed "functionally obsolete". Like structurally deficient bridges, functionally obsolete bridges are able to serve the public, but are susceptible to more congestion, collisions, or flooding because of their restrictive clearances and geometrics. Although functionally obsolete bridges are generally not as great a concern as structurally deficient ones,

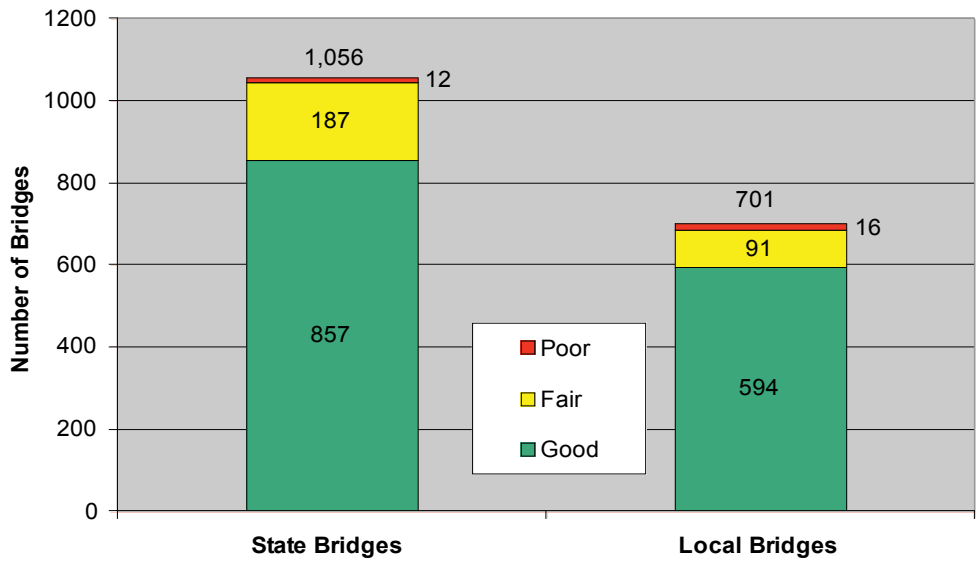
they can also become a priority for corrective measures and can be posted for vehicle weight restrictions.

Separate from the sufficiency rating, a bridge's susceptibility to seismic activity is considered when assessing its health. Nevada is the third most seismically active state behind California and Alaska. The central and western parts of Nevada are the most active, but southern Nevada does have the potential for damaging earthquakes.

Condition Survey Results *(What is the condition of our bridges?)*

Generally, bridges with sufficiency ratings more than 80 can be considered good, ratings of between 50 and 80 can be considered fair, and ratings less than 50 are considered poor. Figure 22 shows the condition of Nevada's bridges. Only 1.6 % of the bridges in Nevada are in poor condition.

Figure 22 - Condition of Nevada's Bridges

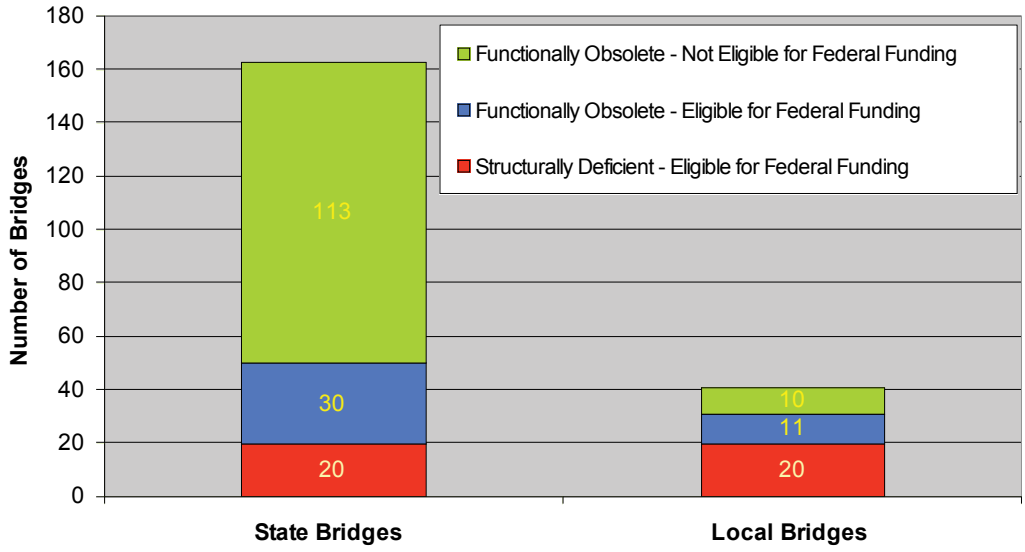


Since seismic prioritization began, the Nevada Department of Transportation has replaced or retrofitted 101 structures at a cost of over $32 million. However, the Nevada Department of Transportation has placed a high priority on 132 more state-owned bridges in need of seismic retrofitting. The cost to upgrade these bridges is estimated at $75 million; however, the Nevada Department of Transportation does not have adequate information to fully assess the need to retrofit non-state bridges.

There are 1056 bridges on the state-owned system that were surveyed in 2008. Per our survey, 143 (13.5 %) of those state-owned bridges are functionally obsolete and no longer provide adequate service to the public. Out of these bridges, only 30 bridges are eligible for federal Highway Bridge Program (HBP) funding. The other 113 state bridges are not eligible for federal funding. Another 20 (1.9 %) state bridges are structurally deficient which are eligible for federal funding.

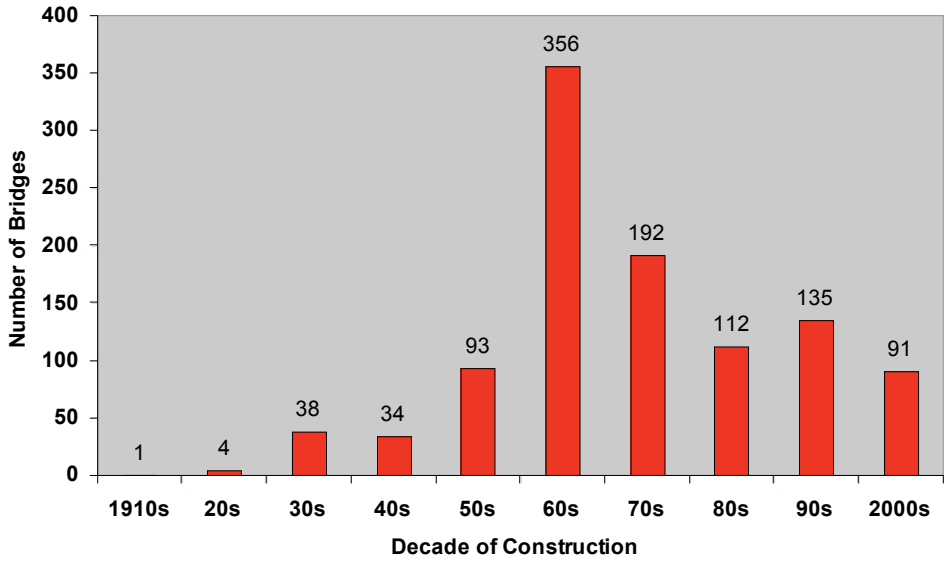
There are 701 bridges on the locally-owned system that were surveyed in 2008. Per our survey, 21 (3.0 %) of those locally-owned bridges are functionally obsolete and no longer provide adequate service to the public. Out of these bridges, only 11 bridges are eligible for federal Highway Bridge Program (HBP) funding. The other 10 state bridges are not eligible for federal funding. Another 20 (2.9 %) local bridges are structurally deficient which are eligible for federal funding. Figure 23 summarizes both state and local substandard bridges.

Figure 23 - Substandard Bridges



Overall, Nevada bridges are in good shape compared to many other states. This is mainly due to our favorable environment and relatively "young" bridges. Most bridges have a useful life of at least 50 years. The age distribution for the state bridges is shown in Figure 24.

Figure 24 - When Were Our State Bridges Built?



Locations of the functionally obsolete and structurally deficient bridges are shown in Figures 25A, 25B, 25C, 25D, and 25E.

Reno Area

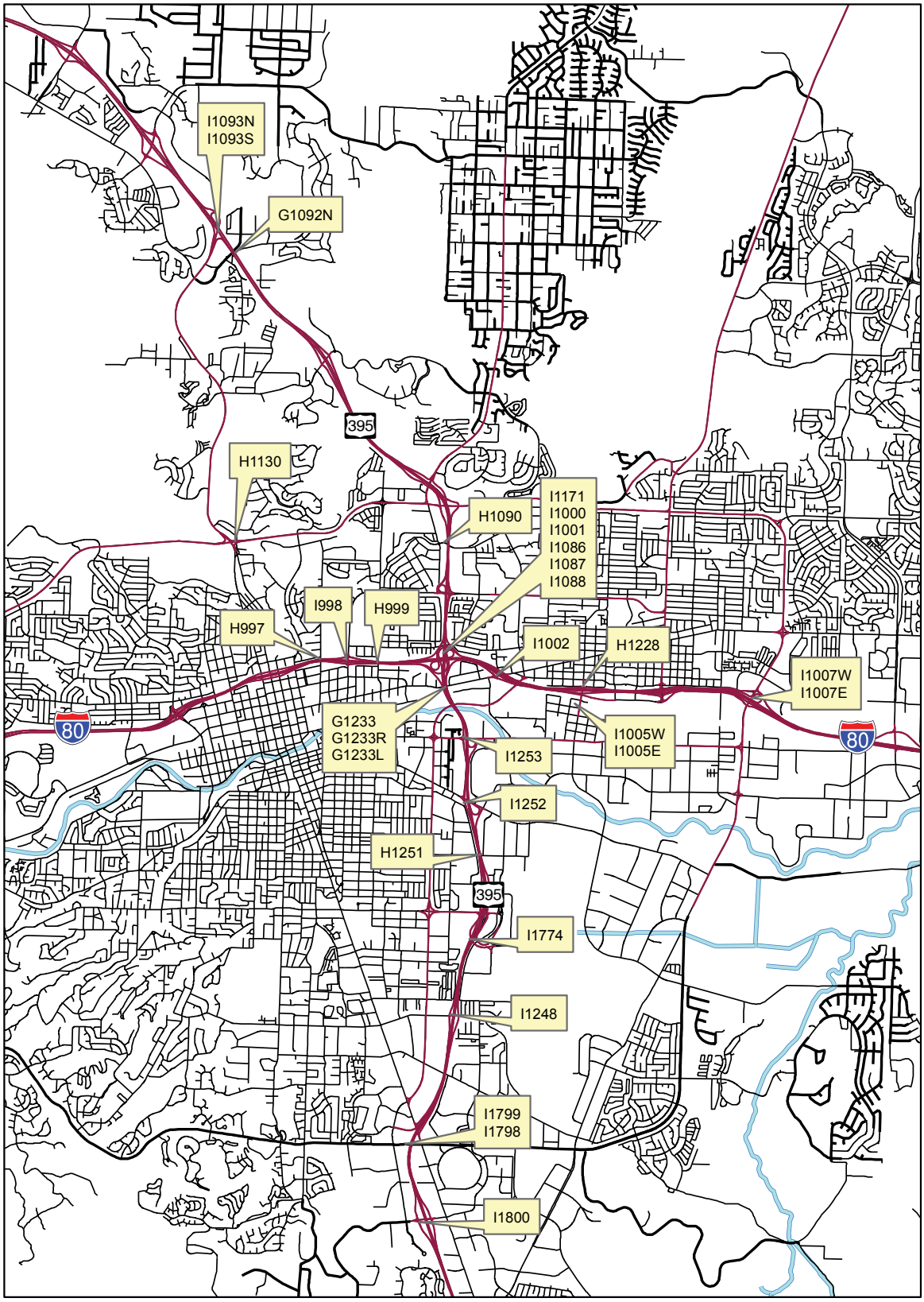


Figure 25A - Locations of Structurally Deficient and Functionally Obselete Bridges

Las Vegas Area

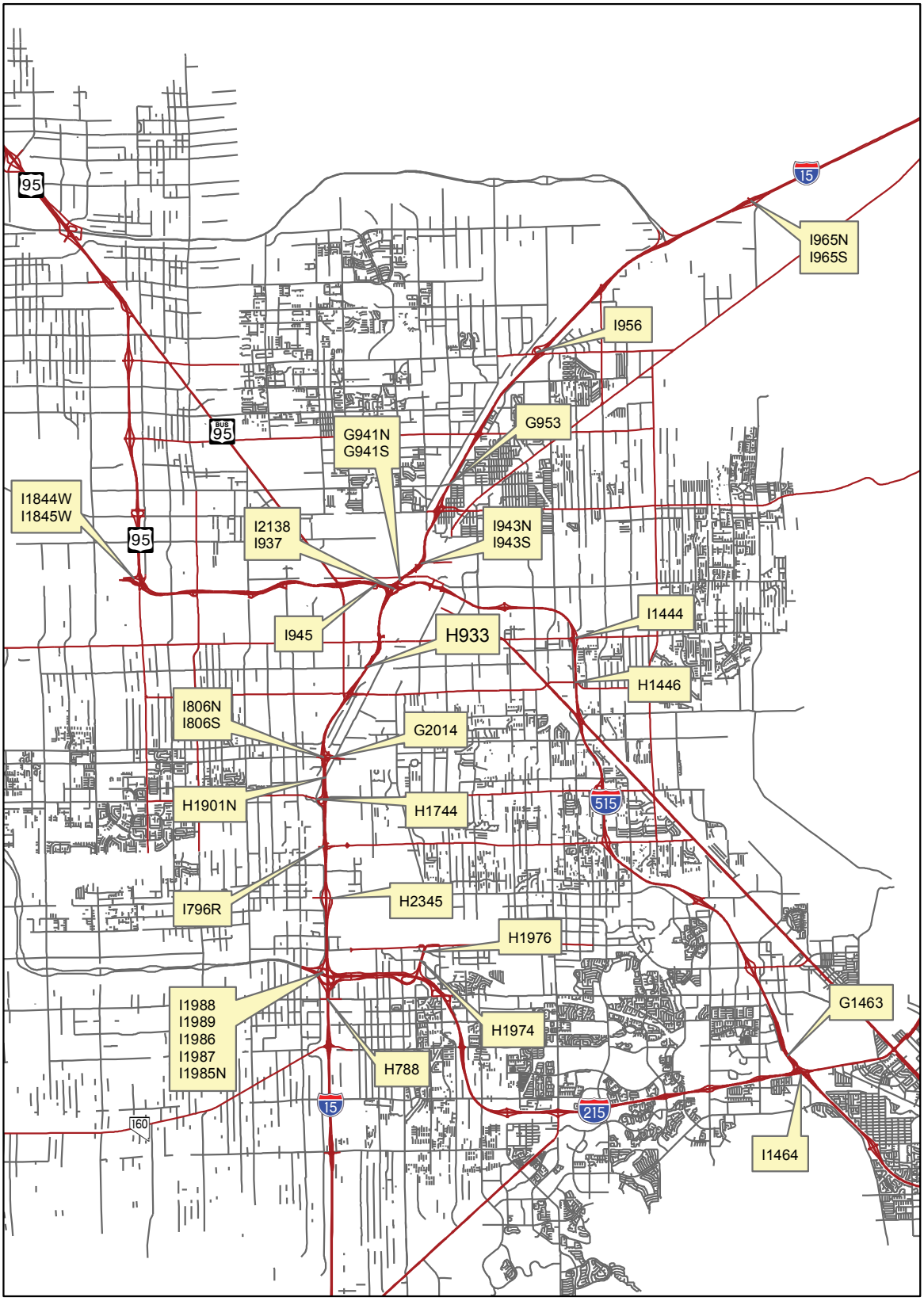


Figure 25B - Locations of Structurally Deficient and Functionally Obselete Bridges

Northeast Nevada

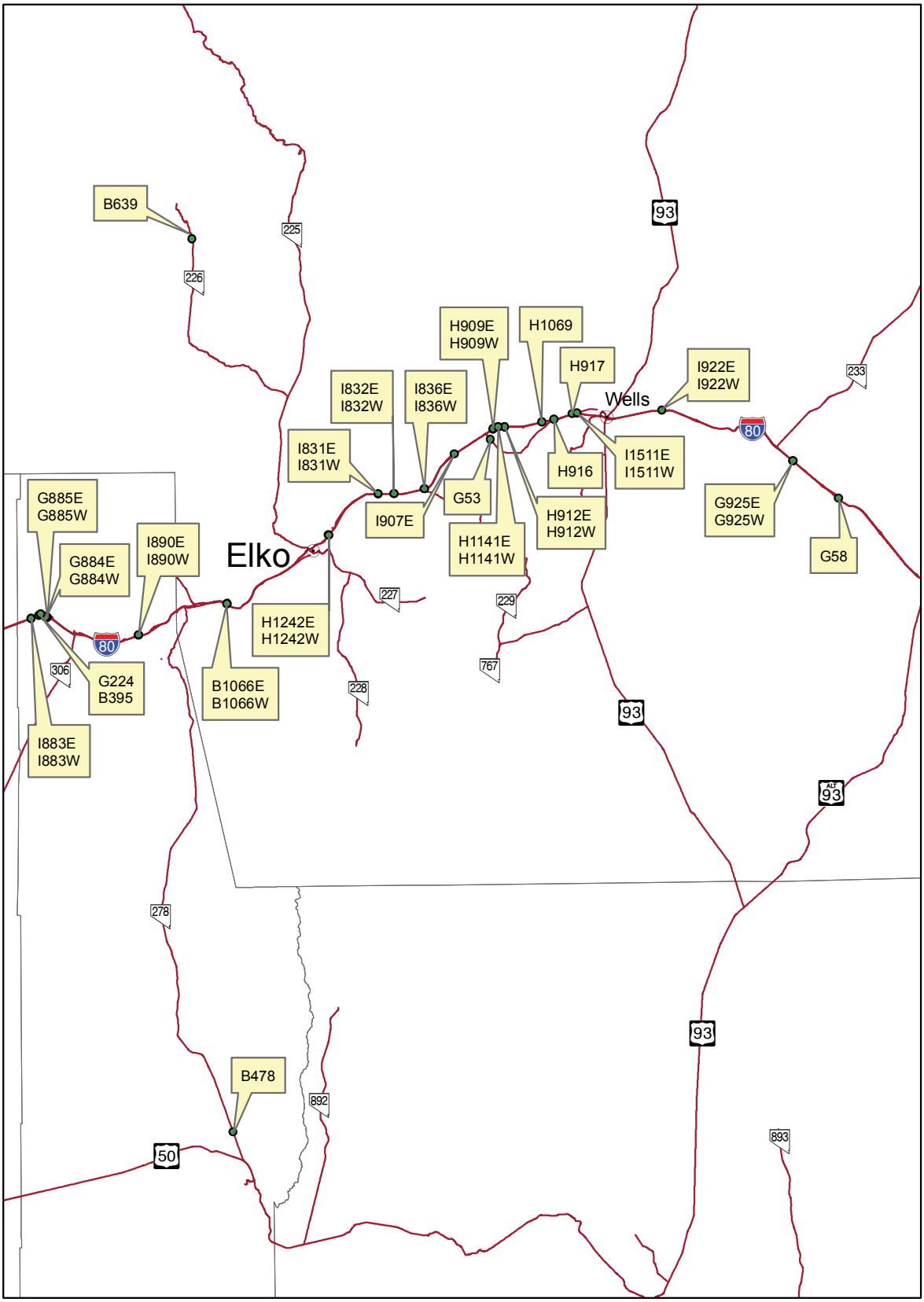


Figure 25C - Locations of Structurally Deficient and Functionally Obselete Bridges

Northwest Nevada

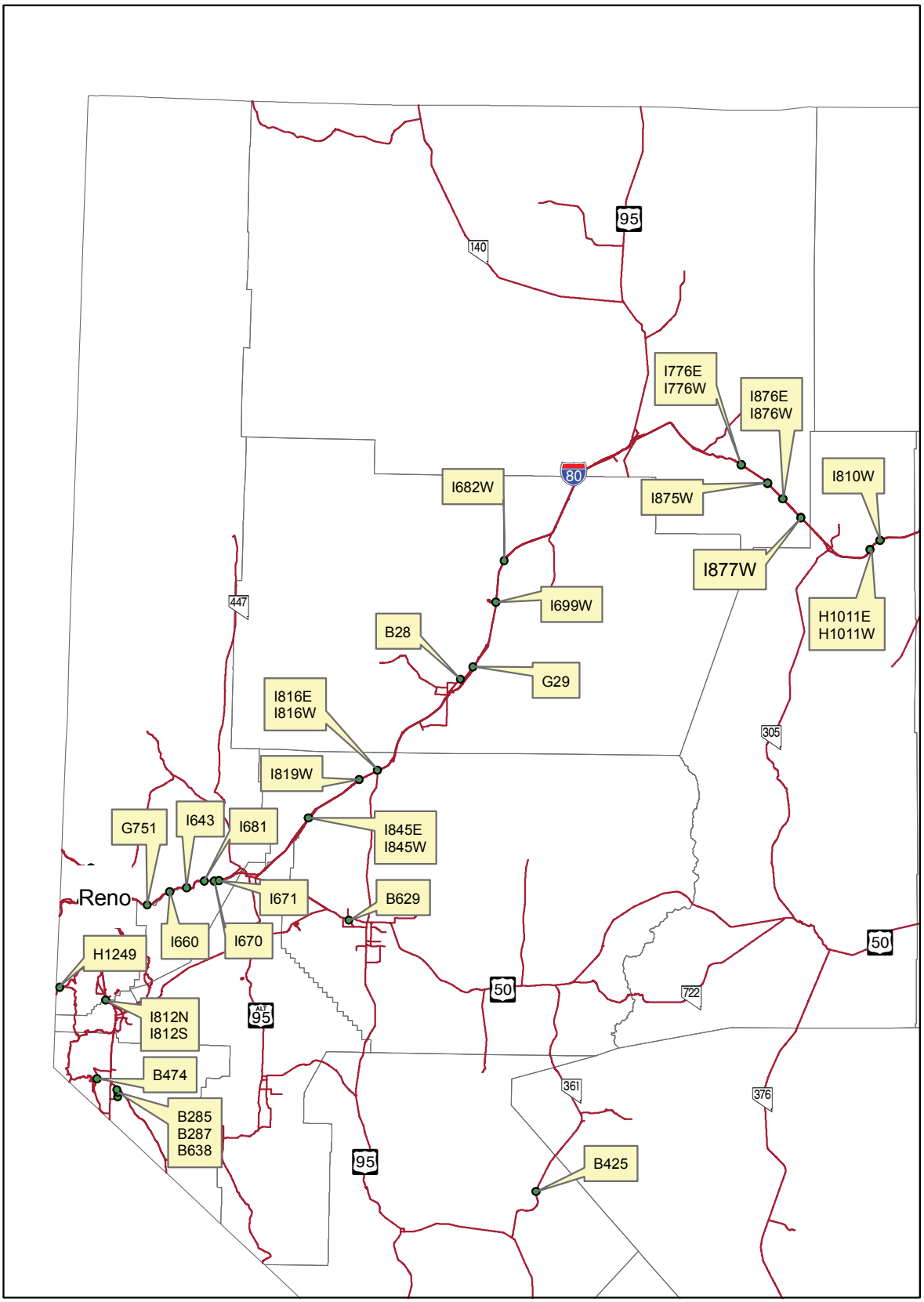


Figure 25D - Locations of Structurally Deficient and Functionally Obselete Bridges

Southern Nevada

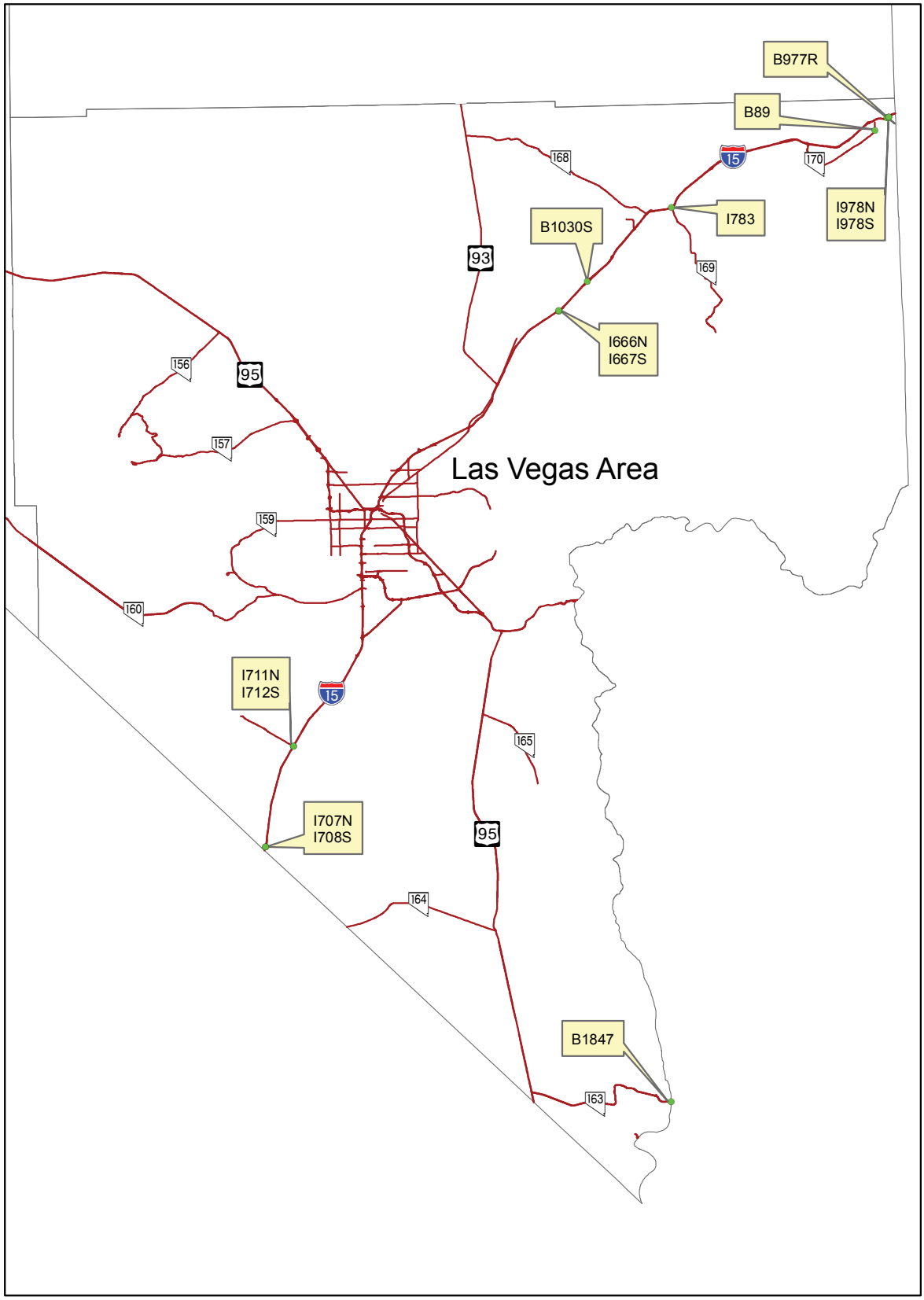


Figure 25E - Locations of Structurally Deficient and Functionally Obselete Bridges

Backlog of Bridge Work

(What is the current cost to improve our bridges to good condition?)

There is currently a $151 million backlog of state bridge work. Table 13 shows the needed bridge repairs. Note that preventive maintenance needs are not included in the bridge backlog because this work is performed using our routine-maintenance funds.

Table 13 - Backlog of Bridge Work

State Bridges - 2009

Based on 2008 Condition Data

	Repair Strategy Required				
System	**Corrective Maintenance**	**Rehabilitation**	**Replace**	**Seismic Retrofit**	**Total**
Principal Arterial - Interstate	$18,480,000	$10,350,000	$0	–	$28,830,000
Principal Arterial - Non-Interstate	$6,400,000	$9,150,000	$0	–	$15,550,000
Minor Arterial	$3,200,000	$3,450,000	$0	–	$6,650,000
Major Collector	$3,040,000	$3,150,000	$9,323,000	–	$15,513,000
Minor Collector & Local	$2,520,000	$3,300,000	$3,357,000	–	$9,177,000
Seismic Retrofit				$75,000,000	$75,000,000
Total	**$33,640,000**	**$29,400,000**	**$12,680,000**	**$75,000,000**	**$150,720,000**

Action Plan

(How will we improve our bridges?)

To preserve Nevada's public bridges in good condition, our action plan in priority order includes the following tasks:

1. Replace or rehabilitate structurally deficient bridges before they become hazardous or overly burdensome to users.

2. Replace or rehabilitate functionally obsolete bridges before they become hazardous or overly burdensome to users.

3. Seismically retrofit bridges that do not meet current seismic standards.

4. Apply timely repairs to existing structures.

Generally, bridges with sufficiency ratings of less than 50 would fall under tasks 1 and 2. Just 1.6 percent (28 of 1,757 bridges assessed) of Nevada's public bridges has sufficiency ratings that low. Only 1.1 percent (12 of 1,056) of state bridges are rated that low. Many of

Nevada's most seismically vulnerable bridges have already been retrofitted. The others in task 3 above have been prioritized for seismic retrofit based on their importance and earthquake vulnerability.

Project Priority *(How do we prioritize individual projects?)*

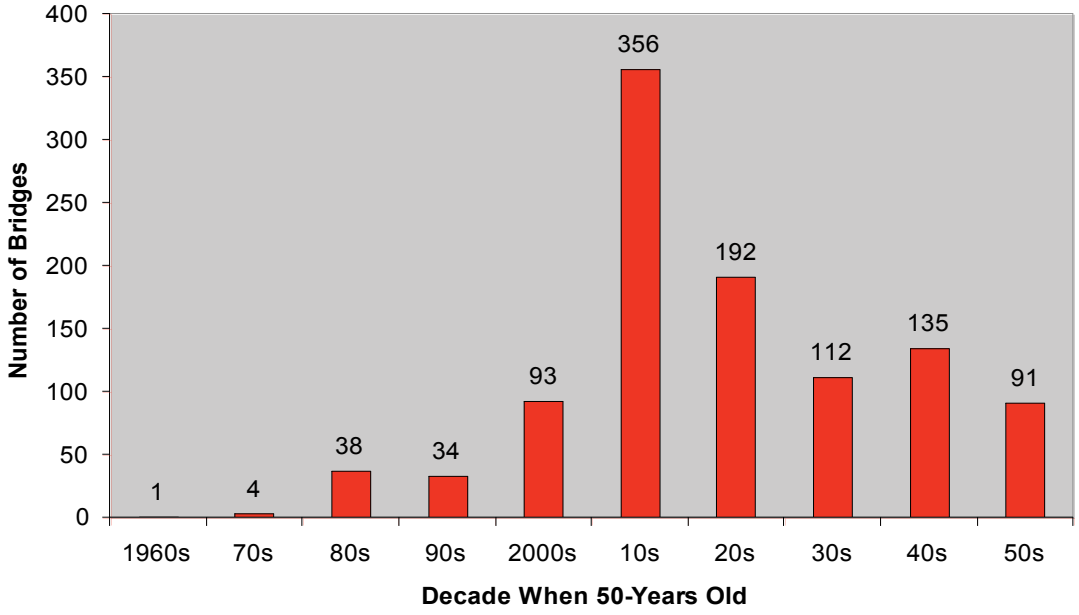
Bridge repairs are normally scheduled when pavement repairs are planned in the same vicinity. However, they may be planned separate from pavement work when we can repair several bridges together.

Our sufficiency rating system guides the prioritization of bridge replacement and rehabilitation work. Since the sufficiency rating contains factors for structural integrity, traffic use, and safety, it is an excellent prioritization tool. Seismic retrofit work is prioritized based on a bridge's earthquake vulnerability and importance. We have investigated the seismic vulnerability of all state-owned bridges. Certain bridge types, such as culverts, do not need seismic retrofit.

Present versus Needed Funding *(What financial resources are needed to improve our bridges?)*

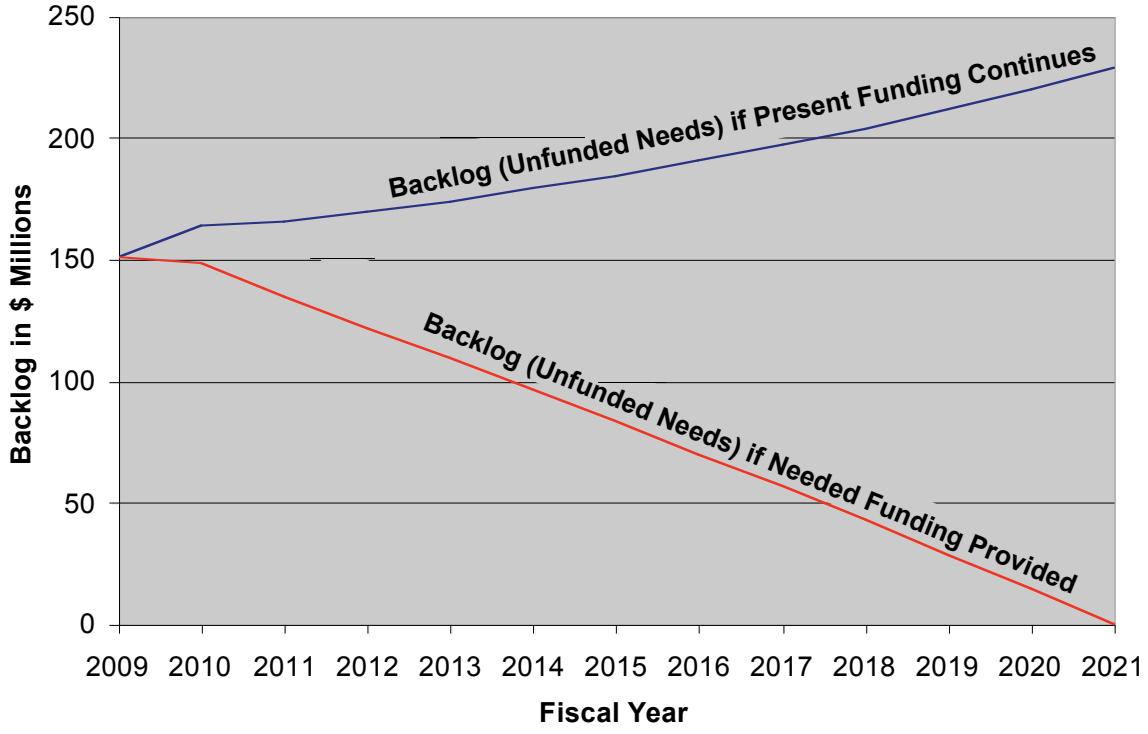
The majority of state bridges were built between the mid-1950s and mid-1970s during Interstate construction. Since bridges normally have a useful life of 50 years, we can forward their construction date 50 years to estimate when the bridges may need rehabilitation or replacement. As shown in Figure 26, many bridges will be due for major work beginning in 2010.

Figure 26 - 50-Year Old Bridges



Under the present user-fee structure, the current $151 million backlog of bridge work will increase gradually to $229 million in 2021. The needed funding scenario, which requires moderate revenue increases in future years, will close out the backlog in 2021. Figure 27 and Table 14 show how these increases are needed to eliminate the backlog.

Figure 27 - Backlog of Bridge Preservation Work With Present Funding vs. Needed Funding



Bridge Management System Improvements *(How will we improve the management system?)*

To improve our management of bridge assets, we have implemented the use of PONTIS software that was developed by the American Association of State Highway and Transportation Officials (AASHTO). The strength of PONTIS is its ability to prioritize bridge replacement, rehabilitation, and major maintenance. Our current sufficiency-rating method prioritizes only replacement and rehabilitation, but not major maintenance. Ultimately, PONTIS will provide objective prioritization of bridge preservation activities.

We will also develop a method to merge seismic-retrofit priorities with our replacement and rehabilitation priorities. Currently, seismic work is prioritized separately from other preservation work because no method exists to merge the two.

Table 14 - Bridge Backlog, Costs, and Funding
State-Maintained System - 2009
(in millions of dollars)

Present Funding

Fiscal Year	Backlog of Bridge Work	Bridge Preservation Costs * (Normal Annual Deterioration Costs)			Bridge Preservation Funds ** (Funds Planned for Preservation Work)				
		Corrective Maintenance, Rehabilitation, Replacement & Reconstruction	Preventive Maintenance	Total	State Corrective Maintenance, Rehabilitation, Replacement & Reconstruction	Federal Corrective Maintenance, Rehabilitation, Replacement & Reconstruction	State Preventive Maintenance		Total
2009	150.7	13.0	0.7	13.7	0.0	0.4	0.7		1.1
2010	163.4	13.8	0.7	14.5	5.9	6.1	0.7		12.7
2011	165.2	14.6	0.7	15.4	5.4	5.1	0.7		11.3
2012	169.3	15.5	0.8	16.2	5.7	5.3	0.8		11.7
2013	173.8	16.4	0.8	17.1	5.9	5.5	0.8		12.2
2014	178.7	17.3	0.8	18.1	6.1	5.7	0.8		12.7
2015	184.2	18.3	0.8	19.1	6.4	6.0	0.8		13.1
2016	190.1	19.3	0.8	20.2	6.6	6.2	0.8		13.7
2017	196.6	20.4	0.9	21.3	6.9	6.5	0.9		14.2
2018	203.7	21.5	0.9	22.4	7.2	6.7	0.9		14.8
2019	211.3	22.7	0.9	23.6	7.4	7.0	0.9		15.3
2020	219.6	24.0	1.0	24.9	7.7	7.3	1.0		16.0
2021	228.6								

Needed Funding

Fiscal Year	Backlog of Bridge Work	Bridge Preservation Costs * (Normal Annual Deterioration Costs)			Bridge Preservation Funds ** (Funds Planned & Needed for Preservation Work)				
		Corrective Maintenance, Rehabilitation, Replacement & Reconstruction	Preventive Maintenance	Total	State Corrective Maintenance, Rehabilitation, Replacement & Reconstruction	Federal Corrective Maintenance, Rehabilitation, Replacement & Reconstruction	State Preventive Maintenance		Total
2009	150.7	13.0	0.7	13.7	0.0	0.4	0.7	15.2	16.3
2010	148.2	13.8	0.7	14.5	5.9	6.1	0.7	15.8	28.6
2011	134.1	14.6	0.7	15.4	5.4	5.1	0.7	16.5	27.7
2012	121.8	15.5	0.8	16.2	5.7	5.3	0.8	17.1	28.8
2013	109.2	16.4	0.8	17.1	5.9	5.5	0.8	17.8	30.0
2014	96.3	17.3	0.8	18.1	6.1	5.7	0.8	18.5	31.2
2015	83.3	18.3	0.8	19.1	6.4	6.0	0.8	19.3	32.4
2016	70.0	19.3	0.8	20.2	6.6	6.2	0.8	20.0	33.7
2017	56.4	20.4	0.9	21.3	6.9	6.5	0.9	20.8	35.0
2018	42.7	21.5	0.9	22.4	7.2	6.7	0.9	21.7	36.4
2019	28.7	22.7	0.9	23.6	7.4	7.0	0.9	22.5	37.9
2020	14.5	24.0	1.0	24.9	7.7	7.3	1.0	23.4	39.4
2021	0.0								

* Inflation assumed at 3.00% per annum.
** Revenue growth rate assumed is 4.00% per annum.

Note: Backlog of bridge work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

Bridge Research

(What research are we conducting to improve our bridges?)

Since bridges represent a major capital investment, we must do what we can to make them perform as well and as long as possible. Through a Nevada Department of Transportation sponsored research project, 40% scale models of precast concrete tub girders were recently tested at the University of Nevada, Reno Large Scale Structures Laboratory.

The purpose of this study was to identify specific design and detailing practices that will best ensure the integrity of the connection between girders and their supports when subjected to seismic loading. Four different girder-to-support connection configurations were analyzed, constructed and tested.

New field trial installations have been initiated for new products/materials that demonstrate significant potential for improving bridge performance and providing bridge protection. Applications include bridge-deck protective overlay systems, bridge-deck crack sealants, and bridge-deck expansion joint systems.

Biennial Expenditures, Fiscal Years 2007-2008

(What have we expended on bridges?)

During fiscal years 2007 and 2008, the Nevada Department of Transportation obligated $26 million for bridge preservation work, as outlined in Table 15.

Table 15 - Bridge Expenditures
Fiscal Years 2007 and 2008

Fiscal Year	Repair Strategy					Total
	Preventive Maintenance	Corrective Maintenance	Rehabilitation	Replacement	Seismic Retrofit	
2007	$781,969	$1,183,662	$0	$6,049,271	$0	$8,014,902
2008	592,835	592,456	0	16,896,774	0	$18,082,065
Biennium Total	$1,374,804	$1,776,118	$0	$22,946,045	$0	$26,096,967

During fiscal years 2007 and 2008, Department of Transportation replaced 6 bridges as shown in Table 16.

Table 16 - Number of Bridges Rehabilitated, Replaced, or Seismically Retrofitted

Fiscal Years 2007 and 2008

Fiscal Year	Entity	Repair Strategy			Seismic Retrofit	Total
		On Federal-Aid System?	Rehabilitation	Replacement		
2007	State	On-System		1		1
	Local/Other	On-System				
		Off-System				
2008	State	On-System		4		4
	Local/Other	Off-System		1		1
Total				6		6

Bridge Condition over Time

(How has the condition of our bridges changed?)

Figure 28 shows that the condition of the state bridges has changed little since 1996. Figure 29 shows that the numbers of functionally obsolete and structurally deficient bridges have decreased significantly since the 1996 until 2006. A significant rise is observed in functionally obsolete bridges in 2008. This was mainly due to the change in the assessment method.

Figure 28 - Condition of State Bridges

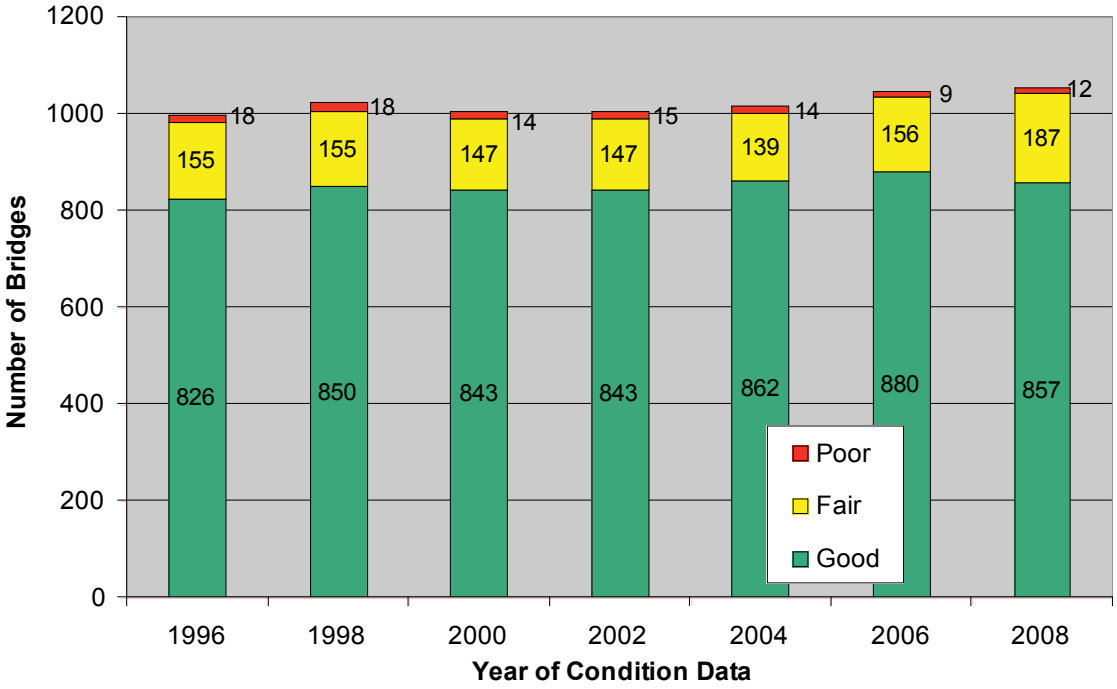
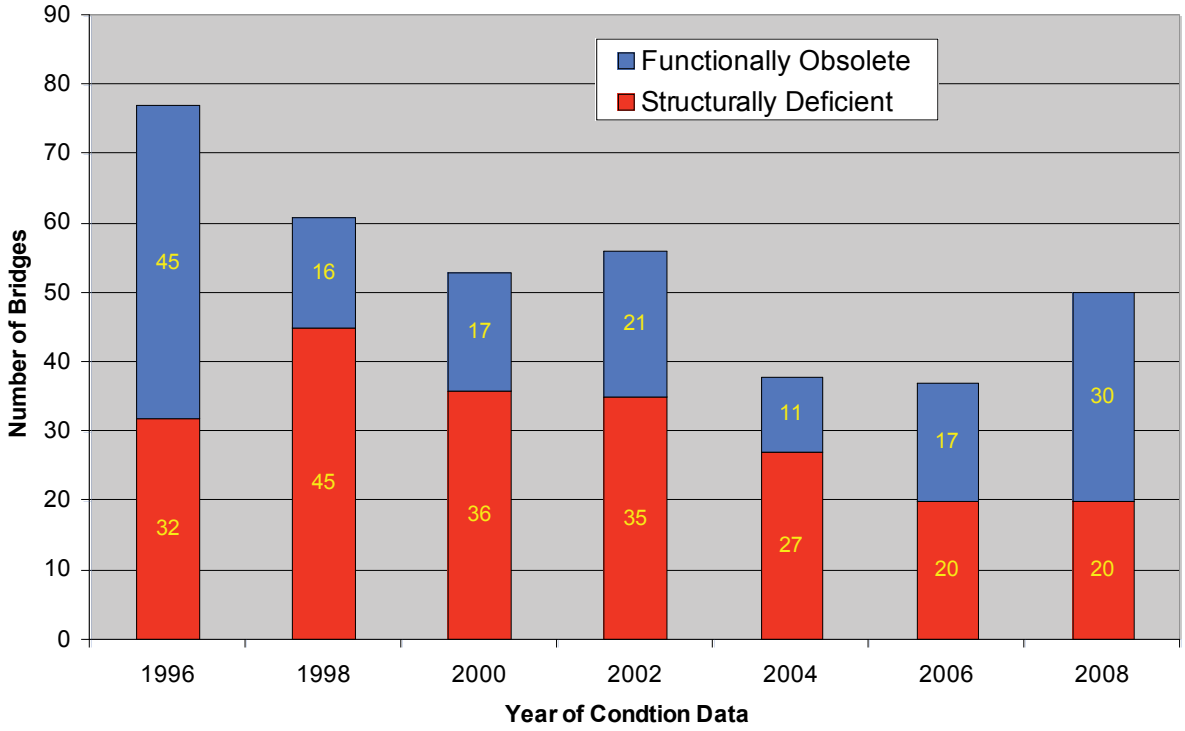


Figure 29 - Substandard State Bridges Eligible for Federal Funding



Figures 30 and 31 show that the condition of locally maintained bridges has changed only moderately since 1996, but there are significantly more bridges.

Figure 30 - Condition of Local Bridges

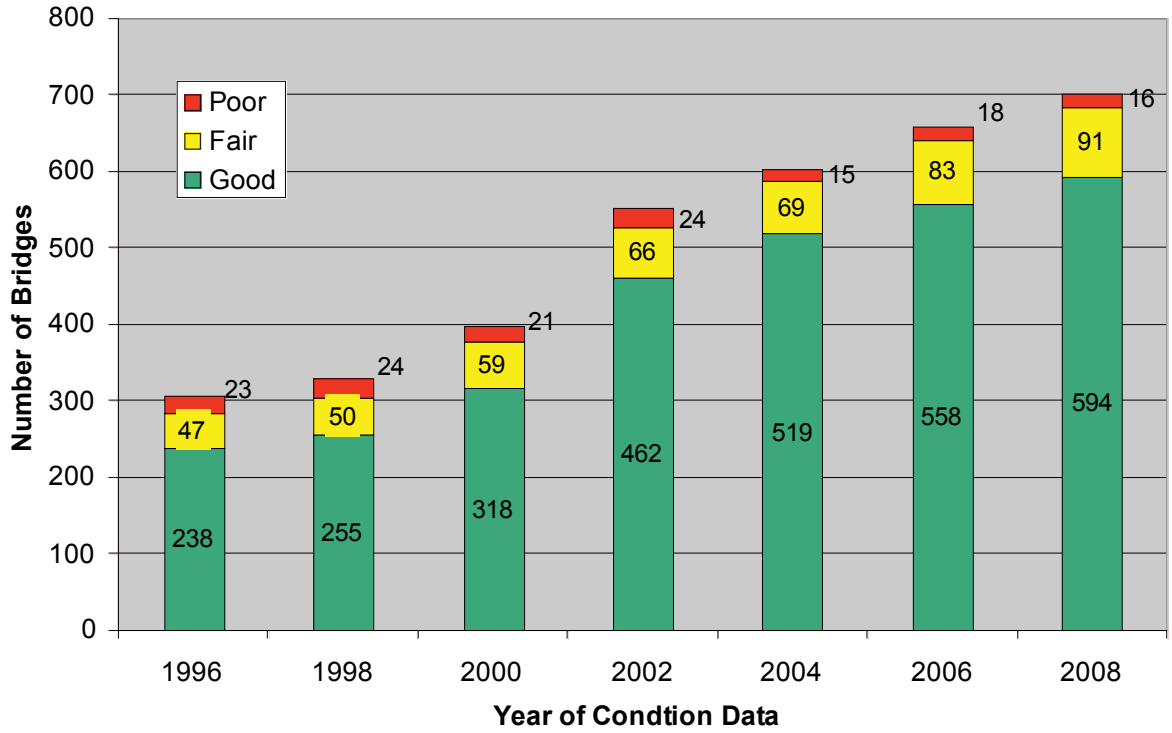
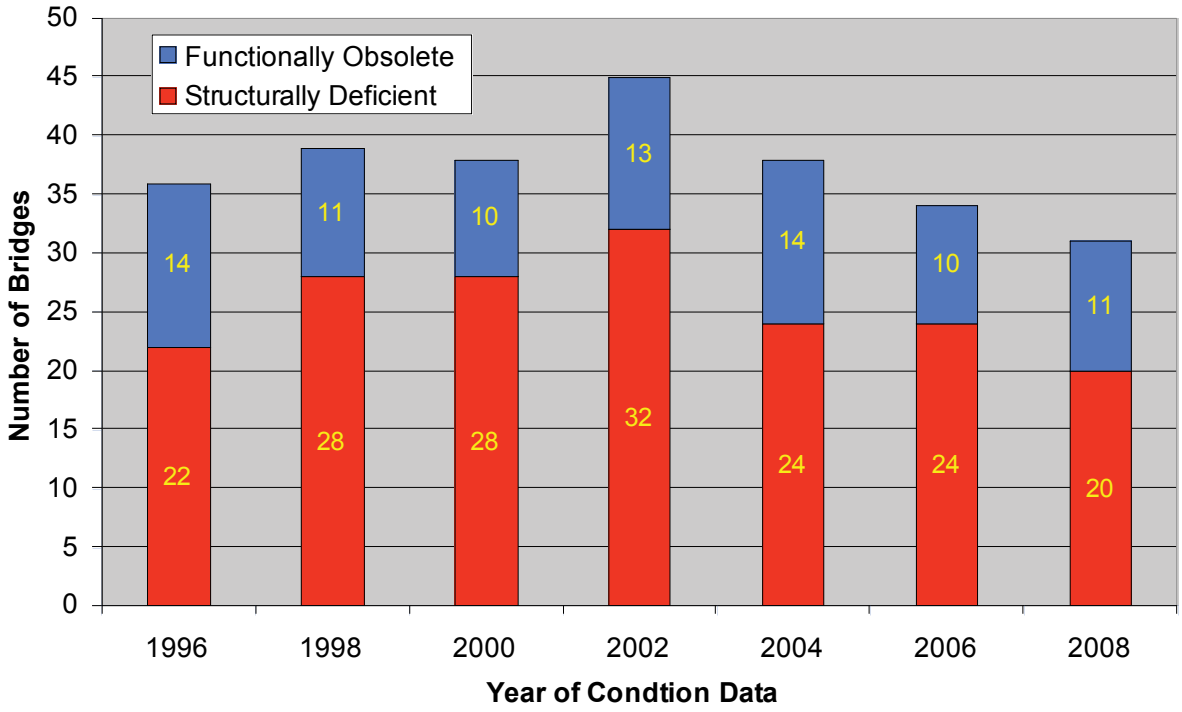


Figure 31 - Substandard Local Bridges Eligible for Federal Funding



Bridge Collapses Cost Owners

Figure 25 shows the structurally deficient and functionally obsolete bridge locations. Principally these are located on I-15 in Las Vegas and I-80 and US-395 in Reno. These routes connect Nevada with the rest of the country and carry thousands of vehicles and trucks. If a bridge in the rural Nevada collapses, the detour might add a few hundred additional miles to the traffic. A bridge collapse and subsequent detours in urban areas will create huge traffic jams and will cause more accidents. In both cases, the user costs due to travel delay add up hundreds of thousands of dollars per day until the replacement of the failed bridge. So it is important to keep the bridges in the Nevada in good condition.

The Nevada Interstates carry more than 100,000 vehicles daily in the Northern Nevada urban areas and approximately 250,000 in the Southern Nevada urban areas. The economic impacts of a bridge collapse and subsequent activities are widespread. For example, the bridge collapse in the Minneapolis, Minnesota in 2007 had an economic impact of $17 million in 2007 and $43 million in 2008 on the state. The additional user cost was estimated as $247, 000 per day due to added travel time. This bridge was carrying 140,000 vehicles daily before the collapse.

Produced by:

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