County of Amador

Pavement Management Program Update Report

Submitted to:
County of Amador
810 Court Street
Jackson, CA 95642

NCE
501 Canal Boulevard Suite I Richmond CA 94804
(510) 215-3620 Phone / (510) 215-2898 Fax
NCE Project No. 749.01.55

October 2015

Table of Contents

Appendix A:

Section Description Inventory Report – Sorted by Road Name
Section Description Inventory Report – Sorted by PCI (Descending)

Appendix B:

Maintenance and Rehabilitation Decision Tree

Appendix C:

Budget Needs – Projected PCI/Cost Summary Report
Budget Needs – Preventive Maintenance Treatment/Cost Summary Report
Budget Needs – Rehabilitation Treatment/Cost Summary Report

Scenarios 1 – 9:

Cost Summary Report
Network Condition Summary Report

Appendix D:

Section selected for Treatments – Scenario 2

Appendix E:

PCI Maps
Current Pavement Network Conditions
Pavement Network Condition Projections from Scenarios 1-9

Appendix F:

Pavement Preventive and Rehabilitation Strategies

List of Tables

List of Figures

Background

The County of Amador (County) has historically utilized a pavement management program (PMP) using the MicroPaver pavement management software. However, the database was not maintained and the decision was made to convert to the StreetSaver PMP. NCE was selected by the County in 2015 to convert to the StreetSaver PMP and train member agency personnel to maintain in the future.

Broadly, a *"... pavement management [program] system is designed to provide objective information and useful data for analysis so that ... managers can make more consistent, cost-effective, and defensible decisions related to the preservation of a pavement network."* [1]

In other words, a PMP is designed to assist the County and cities answer typical questions such as:

- What does the County's road network consist of? How many miles of roads are eligible for federal, state or other funds? How many are subjected to traffic from buses or heavy trucks?
- What is the existing condition of the County's maintained roads? Is this an acceptable level for the County? If not, what is an acceptable level? How much additional funding is needed to achieve an acceptable level?
- Are there roads in specific areas that are much worse than others, and if so, how much worse?
- How will the condition of the County's maintained roads respond over time under existing funding levels?
- What maintenance and rehabilitation strategies should be implemented to improve current road conditions?
- What impact would either additional funding or a decrease in funding, have on the condition of the overall pavement network?
- What is the backlog of maintenance and rehabilitative work that should be done? What are the future maintenance and rehabilitation needs? Are there different needs for different classes of roads, i.e., arterials vs. local residentials?
- Under different funding levels, what is the most cost-effective way to implement a multi-year capital improvement program? Maintenance work program?
- What are the road repair priorities, given different budgeting scenarios?
- Determine the most cost effective maintenance and preservation methods which should be implemented.

In order to answer the questions above, the County made the decision to implement the Metropolitan Transportation Commission's (MTC's) StreetSaver™ pavement management system.

[1] AASHTO "Guidelines for Pavement Management Systems". American Association of State Highway and Transportation Officials, Washington DC, July 1990.

NCE next updated the County's pavement management system by performing field condition surveys of the County's entire pavement network and airport. The network consists of 1.77 centerline miles of arterials, 189.58 centerline miles of collectors, 193.13 centerline miles of local roads, and 309,400 square feet of airport pavements. Field surveys were completed in May 2015 and all survey data have been entered into the County's StreetSaver database.

The County's maintenance and rehabilitation (M&R) decision tree and unit cost were also updated in StreetSaver. The County's GIS map was also linked to the StreetSaver database – the shapefiles include the roads and county boundaries.

Finally, the pavement funding needs were determined, and nine budgetary scenarios were analyzed for the pavement network.

Purpose

The purpose of this report is to assist decision makers at the County of Amador in utilizing the results of the StreetSaver Pavement Management Program (PMP). Specifically, this report links the PMP recommended repair program costs to the County's current budget and projected budget alternatives to improve overall maintenance and rehabilitation strategies. This report assesses the adequacy of ideal and projected revenues to meet the maintenance needs recommended by the PMP program. It also maximizes the returns from expenditures by:

1) Implementing a multi-year road rehabilitation and maintenance program;
2) Developing a preventive maintenance program; and
3) Selecting the most cost effective repairs.

This report assists the County with identifying maintenance priorities specific to its needs. It examines the overall condition of the road network and highlights options for improving the current network level pavement condition index (PCI). These options were developed through "what-if" analyses. By varying the budget amounts available for pavement maintenance and repair, one can show how different funding strategies affect the County's roads over the next twenty years.

Network Description

As noted earlier, the County of Amador oversees the repair and maintenance of approximately 385 centerline miles of pavement, or 945 pavement sections. Table 1 below summarizes the entire pavement network by functional class. Note that the Amador County Airport (Westover Field) includes runway and taxiway.

Table 1: Summary Statistics of Pavement Network

Functional Class	Sections	Centerline Miles	Lane Miles	% of the Entire Network (by Pavement Area)
Arterials	3	1.77	3.54	0.9%
Collectors	397	189.58	379.16	52.8%
Residential/Local	543	193.13	386.08	45.6%
Other (Airport)	2	309,400 Square Feet		0.7%
Total	945	384.48	768.78	100%

The network replacement value is estimated to be approximately $120.6 million. This is the amount needed to fund the full reconstruction of the County's pavement network and does not include related infrastructure assets such as sidewalks, signals, markings, signs, etc.

A listing of all roads in the network and their corresponding pavement condition index (PCI) at the time of inspection and other attribute data is included in Appendix A. For convenience, there are two listings – one sorted by road name and the other sorted by descending PCI. The PCI map of the entire networks (the Airport is not included) is also included in Appendix E.

Current Pavement Condition

The pavement condition index, or PCI, is a measurement of the pavement condition and ranges from zero to 100. A newly constructed street will have a PCI of 100, while a failed street will have a PCI of 25 or less. The pavement condition is primarily affected by the climate, traffic loads and volumes, construction materials and age. The symptoms manifested by the pavement as it ages or fails are determined by the distress types that are present, which include:

1. Alligator (fatigue) cracking
2. Block cracking
3. Distortions
4. Longitudinal and transverse cracking
5. Patching and utility cut patching
6. Rutting and depressions
7. Weathering and raveling

A more detailed description of each distress type is available in the MTC distress manual[2].

Figure 1 illustrates the definitions of the five pavement condition categories. The "fair" category includes roads with both non-load related (weathering and raveling) and load related (e.g. alligator cracking) distresses. Since these distresses are markedly different, the treatments assigned are also correspondingly different, and the costs associated with them. Generally, roads with load-related will require higher costs for repairs. The two categories are identified by II (non-load related) and III (load related). The StreetSaver program will assign the appropriate treatments and costs to roads identified with each category. Note that the StreetSaver "Maintenance and Rehabilitation Decision Tree" in Appendix B assigns different condition category titles from those in Figure 1.

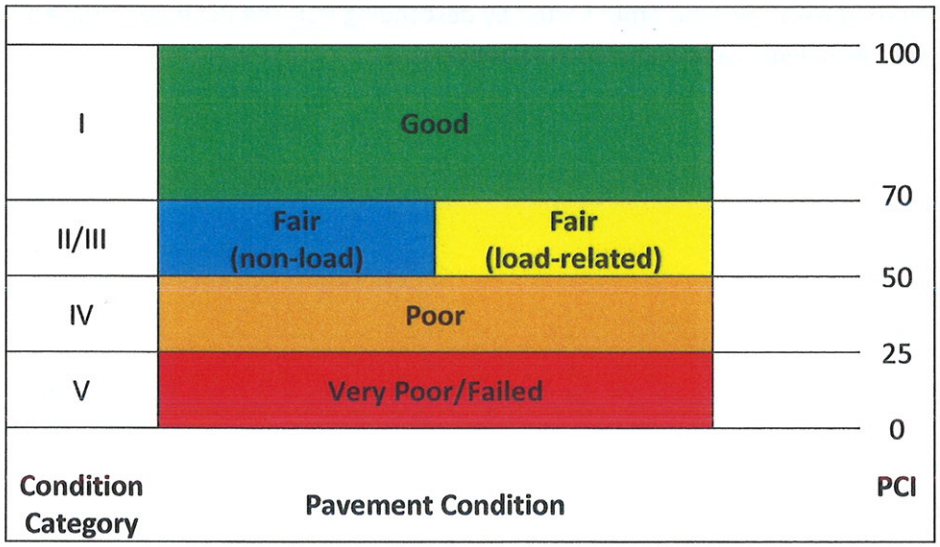

Figure 1: Pavement Condition Categories

[2] "Pavement Condition Index Distress Identification Manual for Asphalt and Surface Treatment Pavements". Metropolitan Transportation Commission, CA, April, 2012.

The photos in Figure 2 illustrate roads with a range of PCIs.

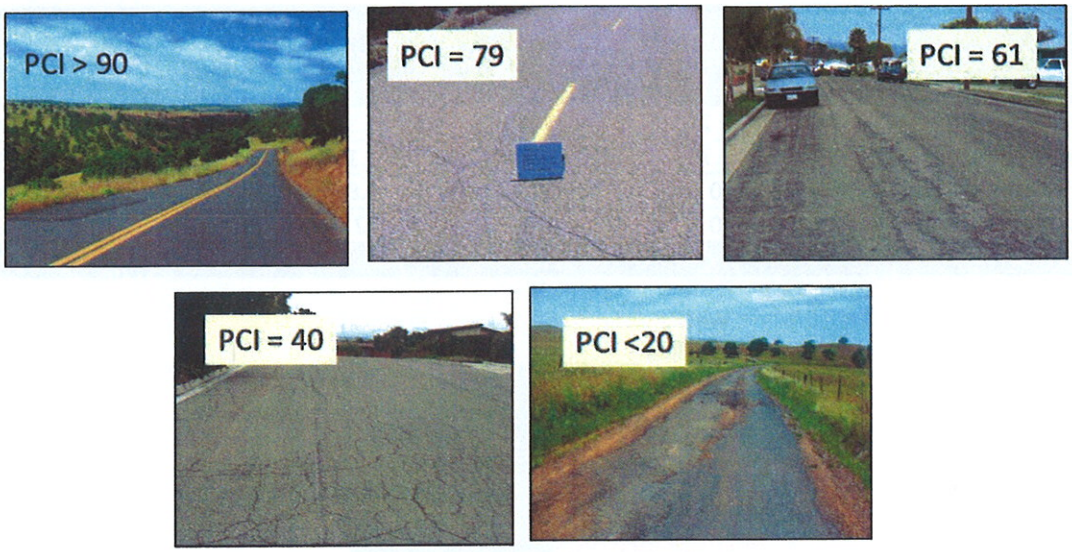

Figure 2: Examples of Roads with Different PCIs

The average 2015 PCI of the County's entire road network is 57. Note that these values are projected and area-weighted calculations from StreetSaver. The remaining service life (RSL) is estimated to be approximately 11 years for the roads (this is the average time required for pavements to reach a "Very Poor/Failed" condition if no maintenance occurs).

It should also be noted that the County previously reported a PCI of 28 in the 2014 California Statewide Local Needs Assessment Study[3]. This was projected data from surveys that were completed in the County almost fifteen years ago. At the time, the MicroPAVER software was used but unfortunately, the database and any corresponding reports were not found for this project.

If the default prediction models were used to arrive at the PCI of 28, then they are probably conservative for the County's roads, i.e., the predicted deterioration rate was higher than what actually occurred. This is due to the fact that the default models are a straight line and based on a 20 year pavement life. However, traffic volumes are significantly lower for many of the County's roads when compared with urban cities/counties, and pavement lives are therefore expected to be significantly longer for the County's roads.

Table 2 and Figures 3 to 4 on the next page detail the pavement condition breakdown for the roads by PCI ranges or condition category. Around 30% of the entire County's roads for 2015 are in the "Good" condition category. In addition, 38.8% of the pavement area falls in the "Poor" or "Very Poor/Failed" condition categories.

[3] www.SaveCaliforniaStreets.org

Table 2: 2015 Pavement Condition Breakdowns by Area

Condition Category	PCI Range	Arterial (%)	Collector (%)	Residential /Local (%)	Other (Airport) (%)	Entire Network (%)
Good (I)	70-100	0.2	18.3	10.5	0.7	29.7%
Fair (II/III)	50-69	0.7	19.7	11.1	0	31.5%
Poor (IV)	25-49	0	12.7	18.8	0	31.5%
Very Poor/Failed (V)	<25	0	2.1	5.2	0	7.3%
Total		0.9%	52.8%	45.6%	0.7%	100%

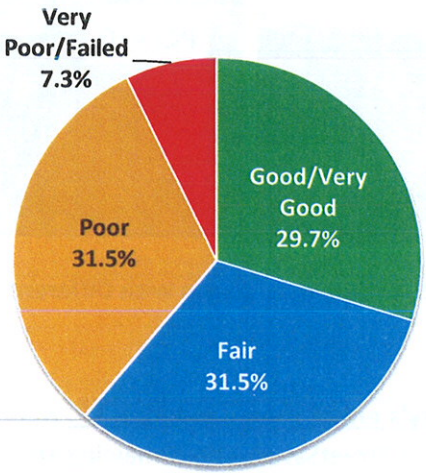

Figure 3: Pavement Condition Summary by Condition Categories (Roads and Airport by Area - 2015)

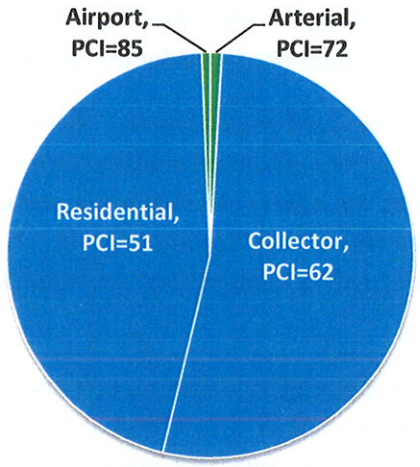

Figure 4: Pavement Condition Summary by Functional Classification (Roads and Airport Area - 2015)

To compare the County's PCI with other neighboring agencies, data from the 2014 California Statewide Local Roads and Roads Needs Assessment[4] survey was used. The results are shown in Figure 5 below and as can be seen, the County has a pavement condition that is in the bottom third.

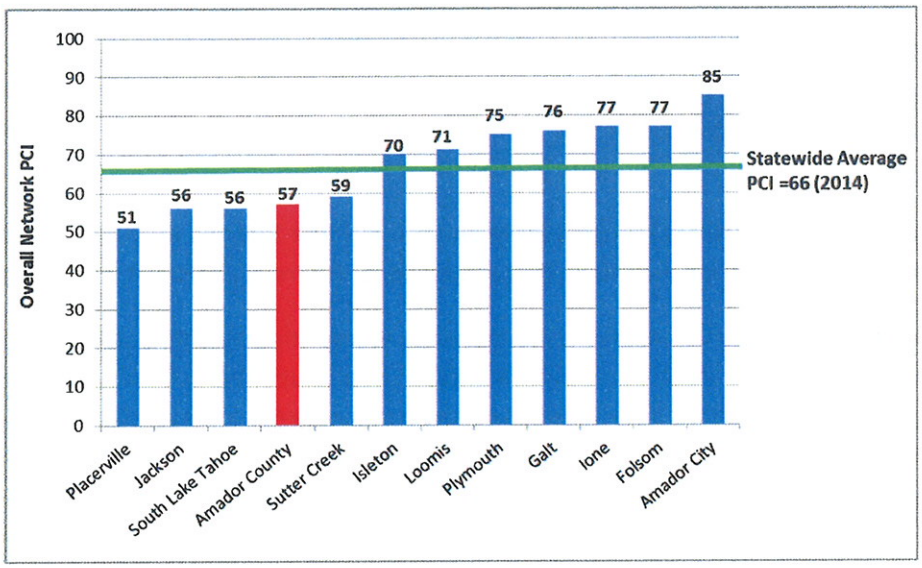

Figure 5: 2015 Pavement Condition Breakdowns for Neighboring Cities

[4] "California Statewide Local Streets and Roads Needs Assessment 2014 Update". Nichols Consulting Engineers, Chtd, CA, October 2014.

Maintenance and Rehabilitation

Historically, the County has only utilized a program of hot mix asphalt (HMA) overlays and chip seal as maintenance and rehabilitation strategies. Surface treatments, such as slurry seals, are often utilized as a preventive maintenance technique when the pavements are in "Good" condition or above. As the pavement condition deteriorates, thin and thick asphalt overlays, typically with milling, are applied. Digouts are typically used as preparation prior to overlays and surface seals as necessary. These pavement treatments are formalized in the maintenance and rehabilitation decision tree shown in Appendix B.

All available data from past historical records were entered into the StreetSaver database and the data used to develop custom prediction models so that projected, or future conditions can be predicted.

Figure 6 below demonstrates that pavement maintenance follows the old colloquial saying of "pay me now, or pay me *more* later". History has shown that it costs much less to maintain roads in good condition than to repair roads that have failed. By allowing pavements to deteriorate, roads that once cost $2.50 per square yard ($/sy) to surface seal; may soon cost $21.00/sy to overlay or $30.50/sy for full depth reclamation (FDR). In other words, significant delays in repairs can cost over 12 times more.

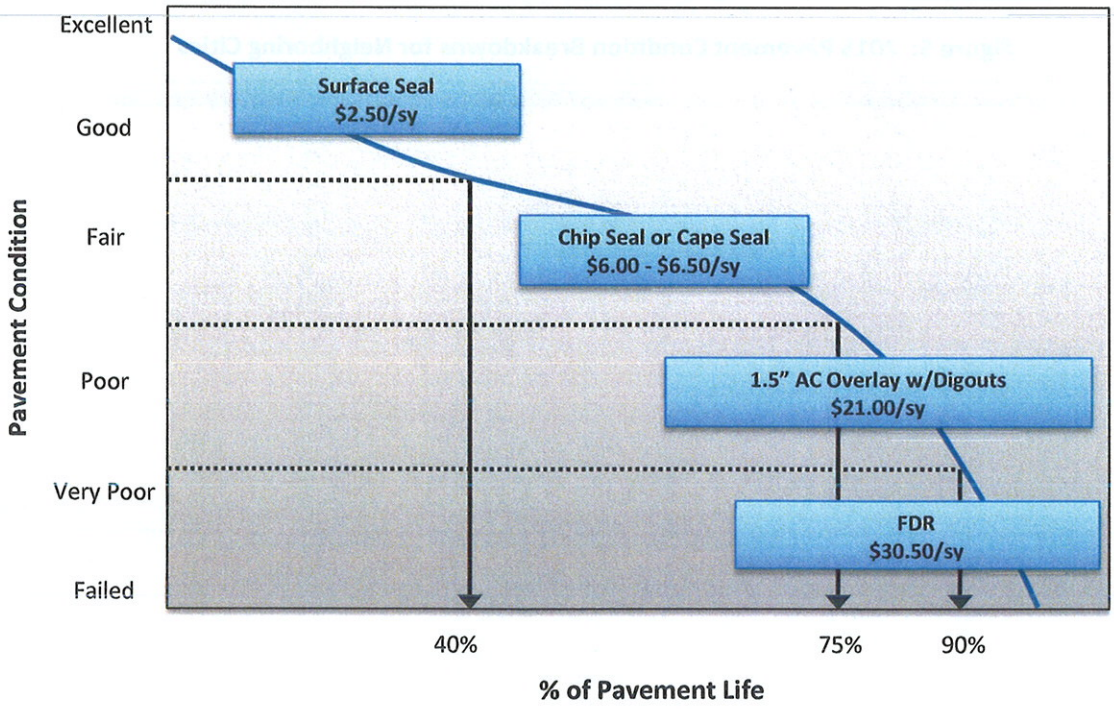

Figure 6: Costs of Maintaining Pavements over Time

Budget Needs

Based on the principle that it costs less to maintain roads in good condition than those listed in bad condition, the PMP strives to develop a maintenance strategy that will improve the overall condition of the network to an optimal PCI and then sustain it at that level. By not addressing the maintenance needs, the quality of the road network will inevitably decline. In order to correct these deficiencies, the implementation of a cost effective funding and maintenance and rehabilitation strategy is necessary.

The first step in developing a cost effective maintenance and rehabilitation strategy is to determine the maintenance "needs" of the pavement network. Using the StreetSaver budget needs module with an inflation rate of 5.0%, the maintenance needs over the next twenty years estimate at approximately $164.6 million for the roads. If the County follows the strategy recommended by the program, the average road PCI will increase to the high-70s to low-80s (also known as "state of good repair") by 2034. If, however, no maintenance is applied over the next twenty years, already distressed roads will continue to deteriorate, and the road PCI will drop from 57 to 29 by 2024, and keep decreasing to 10 by 2034. The results of the budget needs analysis are summarized in Table 3.

Table 3: Summary Results from Needs Analysis for Roads

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
PCI Untreated	57	54	51	48	45	42	38	35	32	29	-
PCI Treated	71	74	76	80	81	82	82	83	82	81	-
Needs ($Millions)	26.5	12.4	11.9	13.4	6.8	7.7	5.8	7.6	4.3	4.2	
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
PCI Untreated	26	24	22	19	17	16	14	13	11	10	-
PCI Treated	81	80	79	78	79	79	79	79	78	77	-
Needs ($Millions)	4.0	3.7	2.6	4.5	10.5	7.6	9.0	7.5	5.0	9.6	164.6

The budget needs analysis represent the ideal funding strategy recommended by the StreetSaver PMP. Of the approximately $164.6 million in maintenance needs shown, approximately $22.2 million (13.5%) is earmarked for preventive maintenance or life extending treatments, while $142.4 million (86.5%) is allocated for the more costly rehabilitation and reconstruction treatments.

Budget Scenarios

Having determined the maintenance needs of the roads, the next step in developing a cost effective maintenance and rehabilitation strategy is to conduct several "what-if" analyses. Using StreetSaver's budget scenario module, the impacts of various budget "scenarios" may be evaluated. The program projects the effects of the different scenarios on pavement condition index (PCI), deferred maintenance (unfunded backlog), and average remaining service life of the network. By examining the effects on these performance measures, the advantages and disadvantages of different funding levels and maintenance strategies become clear.

Scenario 1: Unconstrained Budget – This scenario assumes an unconstrained budget is available over 20 years. With a total of $164.6 million, the overall PCI will be maintained in the high-70s to low-80s, and the deferred maintenance will be eliminated by 2021.

Scenario 2: Existing Budget ($150K/Yr) - Based on the current funding level of $150K per year, this scenario predicts the consequences on the road network. The results show that by 2034, the deferred maintenance increases dramatically from $26.5 million to $274.2 million and the overall PCI deteriorates from 57 to 11 over the next 20 years.

Scenario 3: Maintain PCI at 57 – This scenario seeks to maintain the overall pavement network PCI at 57 over the next 20 years. A total $98.8 million (approximately $4.9 million/year) is required, of which 1% will be allocated to preventive maintenance treatments. However, the deferred maintenance will increase to $106.4 million by 2034.

Scenario 4A: Improve PCI to 70 by 2024 – This scenario will improve overall PCI to 70 over 10 years. A total $66.3 million over 10 years is required to improve overall PCI to 70 by 2024, and approximately $6.1 million/year is needed to maintain PCI at 70 over the subsequent 10 years. The deferred maintenance will increase to $46.7 million by 2034.

Scenario 4B: Improve PCI to 70 by 2034 – This scenario will improve overall PCI to 70 over 20 years. With a total $129.4 million, the PCI will increase 1 to 2 points per year and improve to 70 by 2034. The deferred maintenance will increase to $51.4 million by 2034.

Scenario 5: Funding Level $375K/Yr – This scenario assumes an additional $225,000 per year from a sales tax over the next 20 years, resulting in a total funding level of $375,000/year. A total budget of $7.5 million is available, and most of the budget is allocated towards rehabilitation treatments. The overall PCI will still decrease from 57 to 14, and the deferred maintenance will increase to $263.5 million by 2034.

Scenario 6: Funding Level $600K/Yr – This scenario assumes an additional $450,000 per year from a sales tax over the next 20 years, resulting in a total funding level of $600,000/year. With a total budget of $12 million, the deferred maintenance will increase to $252.8 million by 2034, and the PCI will drop to 17 by 2034.

Scenario 7A: Improve PCI to 65 by 2024 – This scenario will improve the PCI of arterials and collectors to 70, and PCI of residentials to 60 (average PCI is 65) over 10 years. A total of $61.1 million over 10 years is required to improve overall PCI to 65 by 2024, and approximately $5.4 million/year is needed to maintain PCI at 70 over the subsequent 10 years. The deferred maintenance will increase to $72.3 million.

Scenario 7B: Improve PCI to 65 by 2034 – This scenario will improve the PCI of arterials and collectors to 70, and PCI of residentials to 60 (average PCI is 65) over 20 years. With a total of $119.3 million, the PCI will improve to 65 by 2034. The deferred maintenance will increase to $71 million by 2034.

Scenario 8: Improve PCI to 80 – This scenario will improve overall PCI to 80 over 10 years. A total of $89.3 million over 10 years is required to improve overall PCI to 80 by 2024, and approximately $6.7 million/year is needed to maintain it at 80 over the subsequent 10 years. The deferred maintenance will decrease to $2.8 million by 2034.

Scenario 9: Additional State Funding $1.496M/Yr – This scenario assumes an additional $1.496 million per year will be available over 10 years from various state sources. Then, funding will drop back to $150,000/year over the next 10 years. In this scenario, the overall PCI will drop to 38 by 2024, and keep decreasing to 22 by 2034. The deferred maintenance will increase to $236.0 million by 2034.

Note: The term "deferred maintenance" consists of pavement maintenance that is needed, but cannot be performed due to lack of funding. Shrinking budgets have forced many cities and counties to defer much needed pavement maintenance. By deferring maintenance, not only does the frequency of citizens' complaints about the condition of the network increase, but the cost to repair these roads rises as well. More detailed results of the budget needs and scenarios are included in Appendix C.

Appendix D provides a list of candidate sections selected for treatments in all scenarios. Appendix E contains maps generated from the GIS Toolbox in StreetSaver, which illustrate the results of each scenario. The maps show the entire pavement network, highlighting the color-coded condition category of each pavement section in 2034 for Scenarios 1 to 8.

Scenario 1: Unconstrained Budget ($164.6 Million)

This scenario assumes an unconstrained budget is available over 20 years. With a total of $164.6 million, the overall PCI will be maintained in the high-70s to low-80s. Note that $39 million is required in the first two years, i.e., the budget is front-loaded. Further, 100% of pavements will be in "Good" condition by 2034. The deferred maintenance will keep decreasing from current $26.5 million and be eliminated by 2021. The projected remaining service life (RSL) of the overall network will be approximately 22 years in 2034.

Table 4: Summary Results for Scenario 1

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	26.5	12.4	11.9	13.4	6.8	7.7	5.8	7.6	4.3	4.2	--
Def. Maintenance ($ M)	21.3	18.1	13.8	6.9	4.2	1.4	0.0	0.0	0.0	0.0	--
PCI	71	74	76	80	81	82	82	83	82	81	--
RSL (Years)	18	20	21	23	24	24	24	25	24	24	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	4.0	3.7	2.6	4.5	10.5	7.6	9.0	7.5	5.0	9.6	164.6
Def. Maintenance ($ M)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--
PCI	81	80	79	78	79	79	79	79	78	77	--
RSL (Years)	24	23	23	22	23	23	23	23	22	22	--

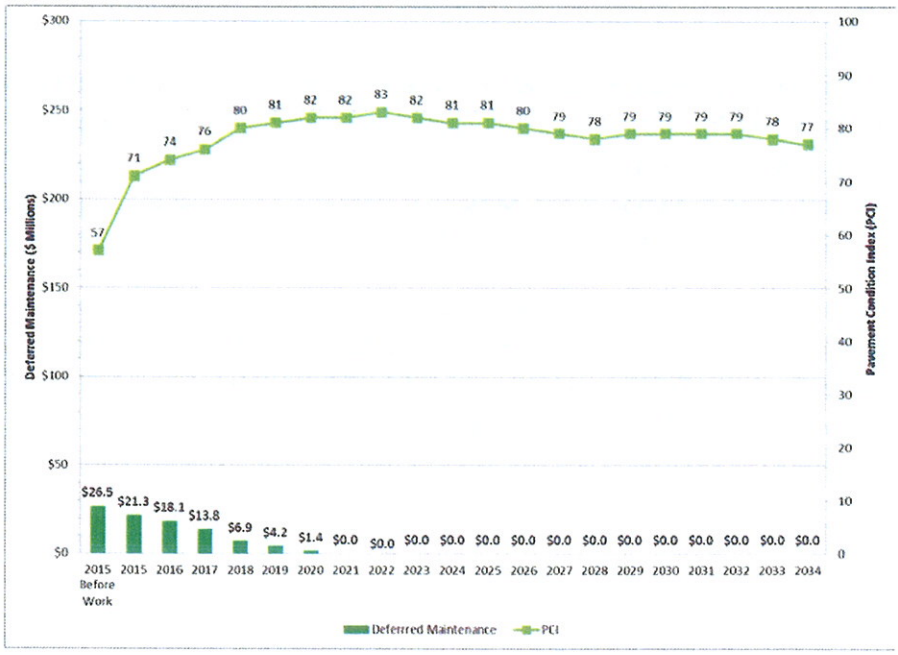

Figure 7: PCI vs Deferred Maintenance for Scenario 1

Scenario 2: Existing Budget ($150K/Yr)

This scenario determines the consequences of the existing budget over the next 20 years. The PCI will decrease 2-3 points a year, and then drop to 11 by 2034. Approximately 78% of the network will be in "Very Poor/Failed" condition, while only 7.9% of the network will be in "Fair" and "Good" condition. The deferred maintenance will increase to $274.2 million in 2034. The projected remaining service life of the overall network is expected to be approximately 2 years by 2034.

Table 5: Summary Results for Scenario 2

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	--
Def. Maintenance ($ M)	47.7	55.1	62.0	70.7	79.8	89.8	100.0	109.9	120.1	130.2	--
PCI	57	54	51	48	45	42	39	36	33	30	--
RSL (Years)	11	10	9	9	8	7	6	6	5	5	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	3.0
Def. Maintenance ($ M)	143.9	157.6	169.7	183.9	196.9	209.7	224.4	239.6	255.0	274.2	--
PCI	27	25	23	21	19	17	16	14	13	11	--
RSL (Years)	4	4	4	3	3	3	2	2	2	2	--

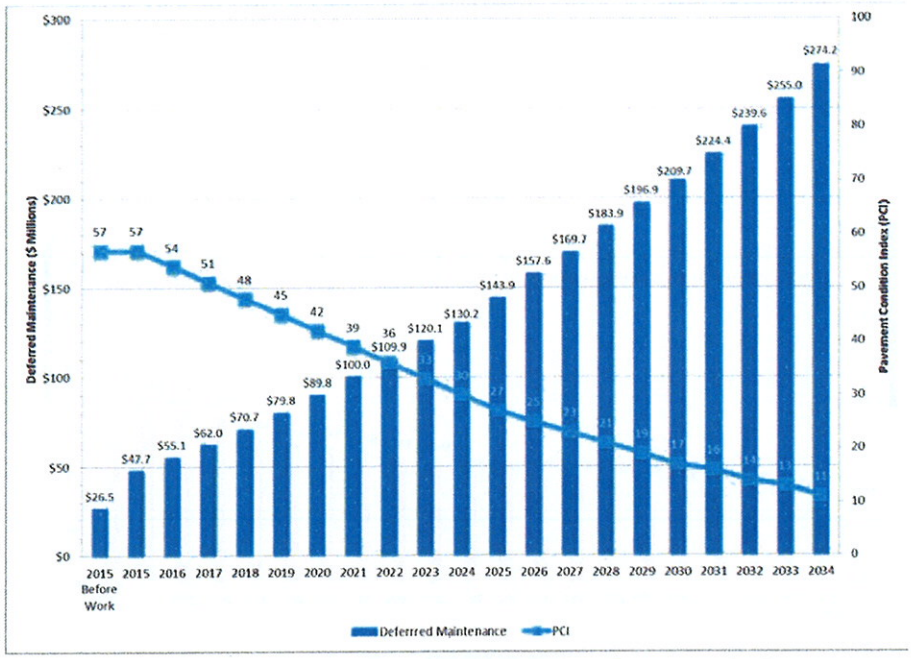

Figure 8: PCI vs Deferred Maintenance for Scenario 2

Scenario 3: Maintain PCI at 57 ($98.9 Million)

This scenario will maintain the overall pavement network PCI at its current value of 57 over the next 20 years; a total of $98.8 million is needed. Approximately 57% of the network will be in "Good" condition, but over one-third of the network will still be in "Poor" or "Very Poor/Failed" condition by 2034. The deferred maintenance will more than double to $106.4 million. The projected remaining service life of the overall network is expected to be approximately 17 years by 2034.

Table 6: Summary Results for Scenario 3

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	0.6	4.0	6.0	7.0	6.5	4.9	4.0	4.2	4.5	4.5	--
Def. Maintenance ($ M)	47.3	50.8	51.7	52.8	54.5	57.2	58.6	59.4	61.2	62.7	--
PCI	57	57	57	57	57	57	57	57	57	57	--
RSL (Years)	11	12	12	13	14	15	15	15	16	16	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	4.4	4.5	4.0	3.9	3.5	3.4	4.4	7.0	8.8	8.9	98.8
Def. Maintenance ($ M)	66.5	70.8	73.3	76.4	79.6	81.8	94.4	94.9	104.7	106.4	--
PCI	57	57	57	57	57	57	57	57	57	57	--
RSL (Years)	16	16	17	17	17	16	16	16	16	17	--

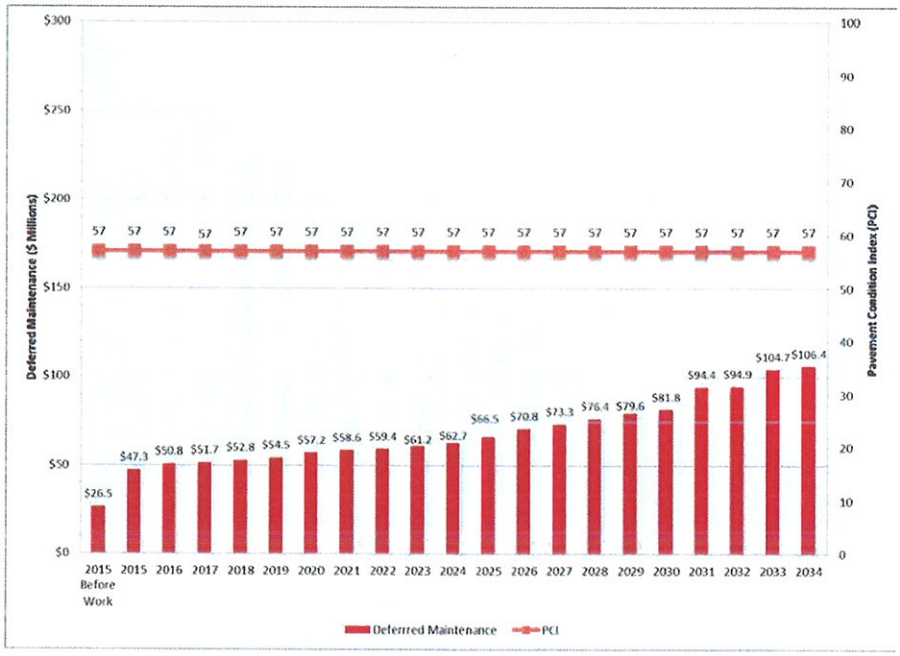

Figure 9: PCI vs Deferred Maintenance for Scenario 3

Scenario 4: Improve PCI to 70 ($127.3 Million or $129.4 Million)

This scenario will improve the overall PCI to 70 over 10 years (Scenario 4A) and 20 years (Scenario 4B). In Scenario 4A, a total of $66.3 million over 10 years is required to improve PCI to 70 by 2024, and approximately $6.1 million per year is needed to maintain the PCI at 70 over the next 10 years. The deferred maintenance will increase to $46.7 million by 2034. In Scenario 4B, with a total of $129.4 million, the overall PCI will climb 1 point a year and increase to 70 by 2034. The deferred maintenance will increase to $51.4 million over 20 years. The pavement in "Good" condition will increase to 76.9% with 5.2% pavement in "Very Poor" condition. The projected remaining service life of the overall network is expected to be approximately 21 years by 2034.

Table 7: Summary Results for Scenario 4A

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	1.9	5.0	7.0	7.0	8.0	7.6	7.9	7.0	8.0	7.0	--
Def. Maintenance ($ M)	46.0	48.5	48.2	49.1	48.7	46.2	42.9	40.5	38.1	36.6	--
PCI	58	58	58	59	61	63	65	67	69	70	--
RSL (Years)	12	12	13	14	16	17	19	20	20	21	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	4.7	4.5	4.0	4.0	4.5	5.2	6.9	8.5	9.9	9.0	127.3
Def. Maintenance ($ M)	39.2	41.5	41.8	42.4	43.7	44.0	51.0	49.1	51.3	46.7	--
PCI	70	70	70	70	70	70	70	70	70	70	--
RSL (Years)	21	21	21	21	21	21	20	20	20	21	--

Table 8: Summary Results for Scenario 4B

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	0.9	4.0	6.0	8.0	6.0	5.7	6.0	6.0	6.0	6.0	--
Def. Maintenance ($ M)	46.9	50.4	51.3	51.4	53.2	53.9	52.9	51.7	51.8	51.8	--
PCI	58	57	57	58	58	59	60	61	62	63	--
RSL (Years)	11	12	12	13	14	15	16	17	18	19	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	5.7	6.0	6.0	6.0	6.0	6.6	6.9	7.9	11.9	12.0	129.4
Def. Maintenance ($ M)	54.2	56.4	55.5	54.6	54.8	53.4	57.9	56.6	58.9	51.4	--
PCI	64	65	66	67	67	68	68	68	69	70	--
RSL (Years)	19	20	20	20	20	20	20	20	21	21	--

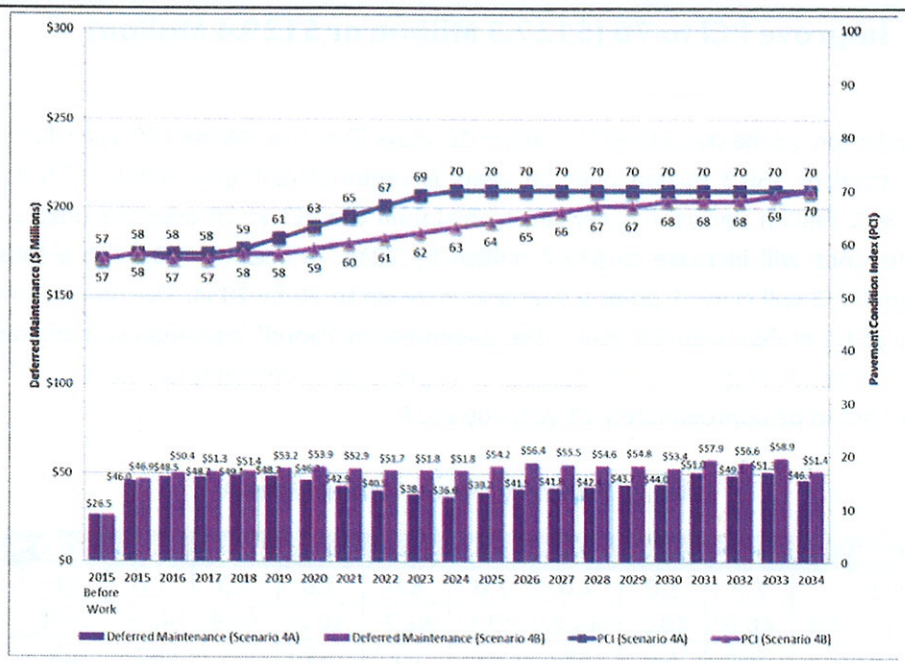

Figure 10: PCI vs Deferred Maintenance for Scenario 4

Scenario 5: Funding Level ($375K/Yr)

This scenario assumes an additional $225,000 per year from a sales tax over the next 20 years, resulting in a total funding level of $375,000/year. The network PCI will decrease 2-3 points a year, and then drop to 14 by 2034. Approximately three quarters of the network will be in "Very Poor/Failed" condition, while only 11% of the network will be in "Fair" and "Good" condition. The deferred maintenance will increase to $263.5 million in 2034. The projected remaining service life of the overall network is expected to be approximately 3 years by 2034.

Table 9: Summary Results for Scenario 5

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	--
Def. Maintenance ($ M)	47.5	54.7	61.3	69.6	78.3	88.0	97.6	107.1	116.8	126.4	--
PCI	57	54	52	49	46	43	40	37	34	31	--
RSL (Years)	11	10	10	9	8	8	7	6	6	6	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	0.375	7.5
Def. Maintenance ($ M)	139.2	151.9	163.1	176.6	189.5	201.5	215.6	230.2	245.1	263.5	--
PCI	29	27	25	23	21	19	18	16	15	14	--
RSL (Years)	5	5	4	4	4	3	3	3	3	3	--

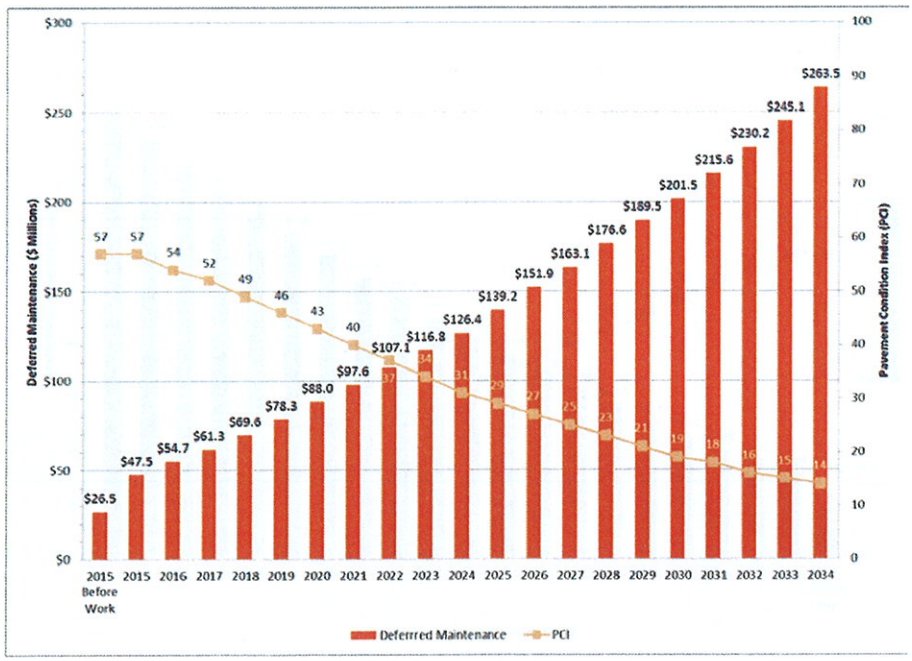

Figure 11: PCI vs Deferred Maintenance for Scenario 5

Scenario 6: Funding Level ($600K/Yr)

This scenario assumes an additional $450,000 per year from a sales tax over the next 20 years, resulting in a total funding level of $600,000/year. The network PCI will decrease 1-2 points a year, and then drop to 17 by 2034. With a total $12 million funding, approximately 71% of the network will be in "Very Poor/Failed" condition, while only 6.8% of the network will be in "Good" condition. The deferred maintenance will increase to $252.8 million in 2034. The projected remaining service life of the overall network is expected to be approximately 3 years by 2034.

Table 10: Summary Results for Scenario 6

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	--
Def. Maintenance ($ M)	47.3	54.2	60.6	68.6	77.0	86.1	95.3	104.3	113.5	122.5	--
PCI	57	55	52	49	46	43	41	38	35	33	--
RSL (Years)	11	10	10	9	9	8	7	7	7	6	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	12
Def. Maintenance ($ M)	134.3	146.4	156.5	169.5	182.0	193.7	206.8	220.9	235.0	252.8	--
PCI	30	28	26	25	23	21	20	19	18	17	--
RSL (Years)	6	5	5	5	4	4	4	4	3	3	--

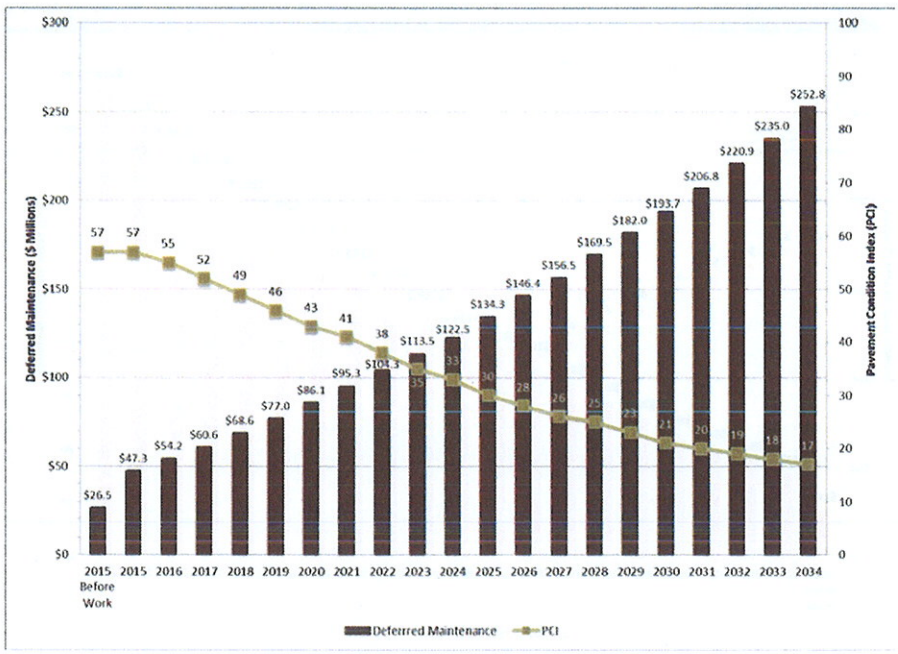

Figure 12: PCI vs Deferred Maintenance for Scenario 6

Scenario 7: Improve PCI to 65 ($114.8 Million or $119.3 Million)

This scenario aims to improve the PCI of arterials and collectors to 70 and residentials to 60 over 10 years (Scenario 7A) and 20 years (Scenario 7B). In Scenario 7A, a total $61.6 million over 10 years is required to improve PCI to 65 by 2024, and approximately $5.4 million per year is needed to maintain it at 65 over the subsequent 10 years. The deferred maintenance will increase to $72.3 million by 2034. In Scenario 7B, with a total of $119.3 million, the overall PCI will increase to 65 by 2034, and the deferred maintenance will increase to $71 million over 20 years. The pavements in "Good" condition will increase to 61.2% with 20% pavement in "Poor" and "Very Poor/Failed" condition. The projected remaining service life of the overall network is expected to be approximately 18 years by 2034.

Table 11: Summary Results for Scenario 7A

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	1.5	4.4	5.9	6.9	6.9	7.1	6.9	6.8	6.8	7.8	--
Def. Maintenance ($ M)	46.3	49.4	50.3	51.4	52.4	52.9	51.4	49.3	48.1	45.5	--
PCI of Arterial/Collector	63	63	63	64	65	65	66	67	68	70	--
PCI of Residential	52	52	53	53	54	55	55	57	59	60	--
Overall PCI	58	58	58	59	60	60	61	62	64	65	--
RSL (Years)	12	12	13	14	15	16	17	18	18	19	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	4.7	3.9	4.9	4.9	4.9	4.7	4.8	5.9	7.7	7.4	114.8
Def. Maintenance ($ M)	47.7	51.6	52.0	52.7	54.0	54.9	62.3	64.0	72.8	72.3	--
PCI of Arterial/Collector	70	70	70	70	70	70	70	70	70	70	--
PCI of Residential	60	60	60	60	60	60	60	60	60	60	--
Overall PCI	65	65	65	65	65	65	65	65	65	65	--
RSL (Years)	19	19	19	19	19	18	18	18	18	18	--

Table 12: Summary Results for Scenario 7B

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	1.9	3.9	5.9	5.9	5.9	6.6	6.9	4.9	5.9	4.9	--
Def. Maintenance ($ M)	46.0	49.6	50.4	52.6	54.6	55.8	55.1	55.5	55.3	56.1	--
PCI of Arterial/Collector	63	62	62	62	62	62	63	63	64	64	--
PCI of Residential	53	54	54	55	55	56	56	56	57	57	--
Overall PCI	58	58	58	59	59	59	60	60	61	61	--
RSL (Years)	12	12	13	14	15	16	16	17	17	17	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	5.2	6.3	5.4	5.4	6.3	5.7	5.8	5.9	10.8	9.8	119.3
Def. Maintenance ($ M)	58.1	60.3	60.4	61.4	61.6	61.5	67.3	69.0	73.9	71.0	--
PCI of Arterial/Collector	64	65	66	66	67	67	68	68	69	70	--
PCI of Residential	57	58	58	58	59	59	59	59	59	60	--
Overall PCI	61	62	62	62	63	63	64	64	64	65	--
RSL (Years)	17	18	18	18	18	18	18	18	18	18	--

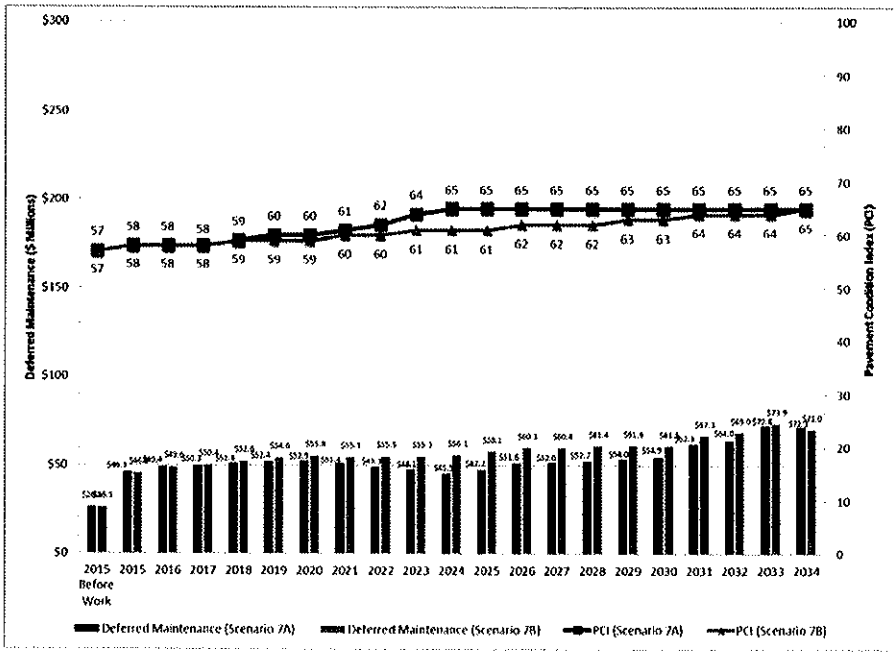

Figure 13: PCI vs Deferred Maintenance for Scenario 7

Scenario 8: Improve PCI to 80

This scenario will improve overall PCI to 80 over 10 years. A total of $89.3 million over 10 years is required to improve PCI to 80 by 2024, and approximately $6.7 million per year is needed to maintain it at 80 over the subsequent 10 years. The deferred maintenance will decrease to $2.8 million by 2034. Over 97% of pavement will be in "Good" condition. The projected remaining service life of the overall network is expected to be approximately 23 years by 2034.

Table 13: Summary Results for Scenario 8

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	2.8	8.0	8.0	9.0	9.0	9.5	9.6	10.0	12.0	11.4	--
Def. Maintenance ($ M)	45.0	44.5	43.0	41.7	39.6	34.6	29.2	22.8	16.1	10.5	--
PCI	59	60	61	64	67	70	72	75	78	80	--
RSL (Years)	12	13	14	16	18	20	21	22	23	24	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	7.9	5.8	5.4	6.0	6.0	6.0	7.0	7.0	8.5	7.8	156.5
Def. Maintenance ($ M)	8.9	7.7	6.2	5.0	5.3	5.5	5.0	5.1	2.7	2.8	--
PCI	80	81	80	80	80	80	80	80	79	79	--
RSL (Years)	24	24	24	24	24	24	24	24	24	23	--

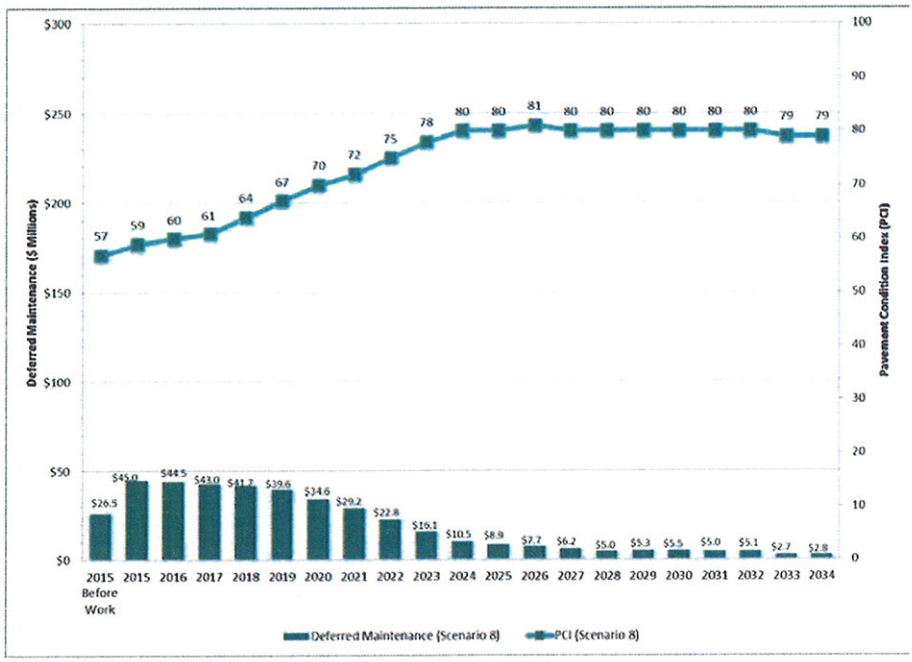

Figure 14: PCI vs Deferred Maintenance for Scenario 8

Scenario 9: Additional State Funding $1.496M/Yr

This scenario assumes an additional $1.496 million per year will be available over 10 years from various state sources. Then, funding will drop back to the existing $150,000/year over the subsequent 10 years. The PCI will drop 1-3 points a year, and reach 22 by 2034. The pavement in "Poor" and "Very Poor/Failed" condition will be 76.7% with only 5.8% of pavement in "Good" condition. The deferred maintenance will decrease to $236 million by 2034. The projected remaining service life of the overall network is expected to be approximately 4 years by 2034.

Table 14: Summary Results for Scenario 9

Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
Budget ($ M)	1.496	1.496	1.496	1.496	1.496	1.496	1.496	1.496	1.496	1.496	--
Def. Maintenance ($ M)	46.4	52.4	57.8	64.7	71.7	78.9	86.4	93.8	101.0	108.2	--
PCI	58	56	53	51	49	46	44	42	39	38	--
RSL (Years)	11	11	11	10	10	10	9	9	9	8	--
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	
Budget ($ M)	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	16.46
Def. Maintenance ($ M)	118.5	129.4	138.6	149.3	159.5	171.9	187.8	200.8	216.4	236.0	--
PCI	35	33	32	30	29	27	26	24	23	22	--
RSL (Years)	8	7	7	7	6	6	5	5	5	4	--

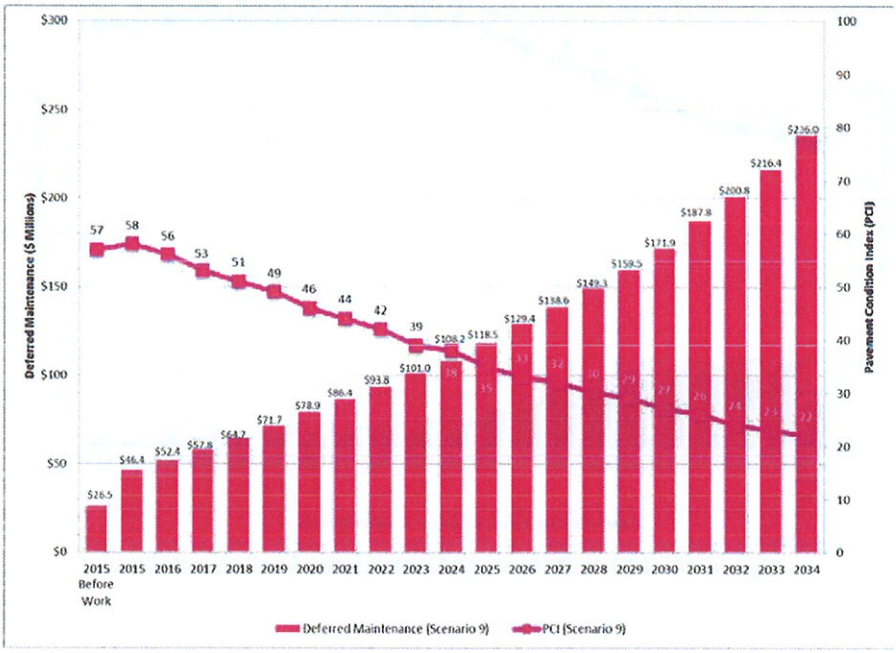

Figure 15: PCI vs Deferred Maintenance for Scenario 9

Scenario Comparisons

The following two figures illustrate the annual changes in PCI and deferred maintenance for Scenarios 1 to 9. Tables 15 and 16 below summarize the results of all the scenarios performed. Figure 16 on the next page illustrates the changes in PCI over time for the different budget scenarios. Clearly, Scenarios 2 (Existing Budget), 5 (Funding Level $375K/Yr), 6 (Funding Level $600K/Yr), and 9 (Additional State Funding $1.496M/Yr) will result in dramatic drops of the PCIs to 11, 14, 17, and 22, respectively. Scenario 3 will maintain the current PCI level at 57. Scenarios 4, 7 and 8 will increase the PCI to 70, 65 and 80 respectively.

Table 15: Summary Results for Pavement Condition by Scenarios

Scenarios/Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1: Unconstrained Budget	71	74	76	80	81	82	82	83	82	81
2: Existing Budget ($150K/yr)	57	54	51	48	45	42	39	36	33	30
3: Maintain PCI at 57	57	57	57	57	57	57	57	57	57	57
4A: Improve PCI to 70 by 2024	58	58	58	59	61	63	65	67	69	70
4B: Improve PCI to 70 by 2034	58	57	57	58	58	59	60	61	62	63
5: Funding $375K/yr	57	54	52	49	46	43	40	37	34	31
6: Funding $600K/yr	57	55	52	49	46	43	41	38	35	33
7A: Improve PCI to 65 by 2024	58	58	58	59	60	60	61	62	64	65
7B: Improve PCI to 65 by 2034	58	58	58	59	59	59	60	60	61	61
8: Improve PCI to 80	59	60	61	64	67	70	72	75	78	80
9: Add. state Funding $1.496M/yr	58	56	53	51	49	46	44	42	39	38
Scenarios/Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1: Unconstrained Budget	81	80	79	78	79	79	79	79	78	77
2: Existing Budget ($150K/yr)	27	25	23	21	19	17	16	14	13	11
3: Maintain PCI at 57	57	57	57	57	57	57	57	57	57	57
4A: Improve PCI to 70 by 2024	70	70	70	70	70	70	70	70	70	70
4B: Improve PCI to 70 by 2034	64	65	66	67	67	68	68	68	69	70
5: Funding $375K/yr	29	27	25	23	21	19	18	16	15	14
6: Funding $600K/yr	30	28	26	25	23	21	20	19	18	17
7A: Improve PCI to 65 by 2024	65	65	65	65	65	65	65	65	65	65
7B: Improve PCI to 65 by 2034	61	62	62	62	63	63	64	64	64	65
8: Improve PCI to 80	80	81	80	80	80	80	80	80	79	79
9: Add. state Funding $1.496M/yr	35	33	32	30	29	27	26	24	23	22

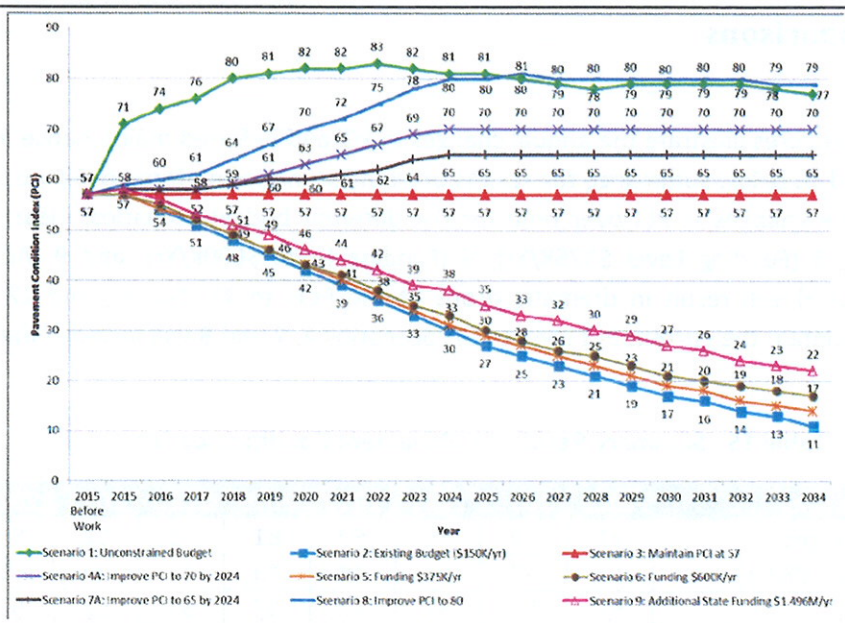

Figure 16: Annual Pavement Condition Index by Scenarios

Figure 17 below illustrates the changes in deferred maintenance over time for the different budget scenarios. The most dramatic change is shown for Scenarios 2, 5, 6, and 9, where the deferred maintenance increases by more than nine-fold to over $236.0 million to $274.2 million. Scenarios 3, 4 and 7 will also increase deferred maintenance to $106.4 million, $46.7 million, and $72.3 million, respectively. In Scenario 8, the deferred maintenance will drop to $2.8 million by 2034. In Scenario 1, the deferred maintenance will be eliminated by 2021.

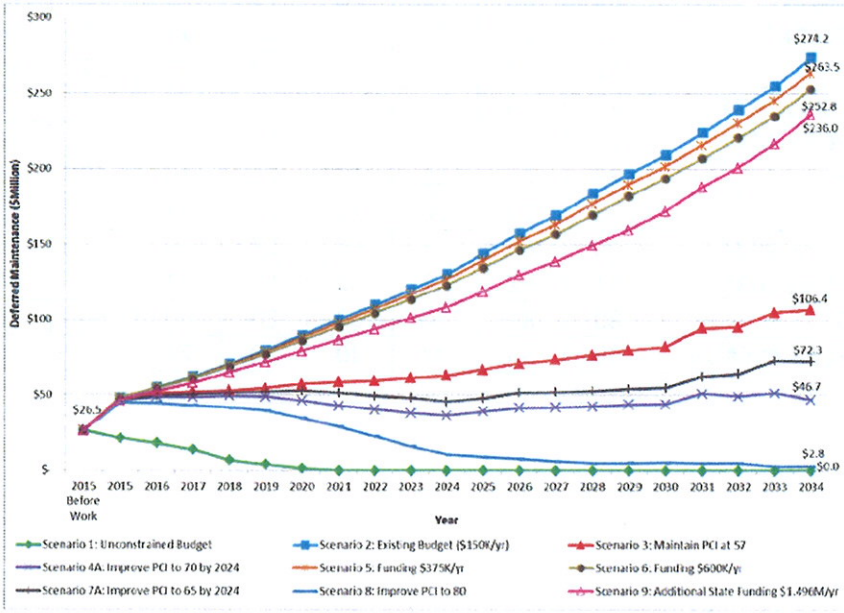

Figure 17: Annual Deferred Maintenance by Scenario

Table 16: Summary Results for Deferred Maintenance by Scenarios

Scenarios/Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
1: Unconstrained Budget	21.3	18.1	13.8	6.9	4.2	1.4	0.0	0.0	0.0	0.0
2: Existing Budget ($150K/yr)	47.7	55.1	62.0	70.7	79.8	89.8	100.0	109.9	120.1	130.2
3: Maintain PCI at 57	47.3	50.8	51.7	52.8	54.5	57.2	58.6	59.4	61.2	62.7
4A: Improve PCI to 70 by 2024	46.0	48.5	48.2	49.1	48.7	46.2	42.9	40.5	38.1	36.6
4B: Improve PCI to 70 by 2034	46.9	50.4	51.3	51.4	53.2	53.9	52.9	51.7	51.8	51.8
5: Funding $375K/yr	47.5	54.7	61.3	69.6	78.3	88.0	97.6	107.1	116.8	126.4
6: Funding $600K/yr	47.3	54.2	60.6	68.6	77.0	86.1	95.3	104.3	113.5	122.5
7A: Improve PCI to 65 by 2024	46.3	49.4	50.3	51.4	52.4	52.9	51.4	49.3	48.1	45.5
7B: Improve PCI to 65 by 2034	46.0	49.6	50.4	52.6	54.6	55.8	55.1	55.5	55.3	56.1
8: Improve PCI to 80	45.0	44.5	43.0	41.7	39.6	34.6	29.2	22.8	16.1	10.5
9: Add. state Funding $1.496M/yr	46.4	52.4	57.8	64.7	71.7	78.9	86.4	93.8	101.0	108.2
Scenarios/Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
1: Unconstrained Budget	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2: Existing Budget ($150K/yr)	143.9	157.6	169.7	183.9	196.9	209.7	224.4	239.6	255.0	274.2
3: Maintain PCI at 57	66.5	70.8	73.3	76.4	79.6	81.8	94.4	94.9	104.7	106.4
4A: Improve PCI to 70 by 2024	39.2	41.5	41.8	42.4	43.7	44.0	51.0	49.1	51.3	46.7
4B: Improve PCI to 70 by 2034	54.2	56.4	55.5	54.6	54.8	53.4	57.9	56.6	58.9	51.4
5: Funding $375K/yr	139.2	151.9	163.1	176.6	189.5	201.5	215.6	230.2	245.1	263.5
6: Funding $600K/yr	134.3	146.4	156.5	169.5	182.0	193.7	206.8	220.9	235.0	252.8
7A: Improve PCI to 65 by 2024	47.7	51.6	52.0	52.7	54.0	54.9	62.3	64.0	72.8	72.3
7B: Improve PCI to 65 by 2034	58.1	60.3	60.4	61.4	61.6	61.5	67.3	69.0	73.9	71.0
8: Improve PCI to 80	8.9	7.7	6.2	5.0	5.3	5.5	5.0	5.1	2.7	2.8
9: Add. state Funding $1.496M/yr	118.5	129.4	138.6	149.3	159.5	171.9	187.8	200.8	216.4	236.0

Figures 18 and 19 on the next two pages illustrate the pavement condition changes for the nine scenarios. As noted earlier, 29.7% of the network is in the "Good/Very Good" condition category with 31.4% in "Poor" and 7.3% in "Very Poor/Failed" condition categories.

However, in Scenarios 1 and 8, essentially all pavements will be in "Good/Very Good" condition. For Scenarios 2, 5, and 6, around three quarters of pavements will drop to the "Very Poor" condition. In Scenario 9, approximately 62% of pavement will be in "Very Poor" condition, with only 6% of pavement in "Good" condition. To maintain the PCI at 57 (Scenario 3), pavement in the "Good" condition will increase to 57%, but approximately one quarter of the network will remain in "Very Poor" condition.

The results for both Scenarios 4 and 7 are similar; the pavements in "Good" condition will be approximately 77% and 61% respectively.

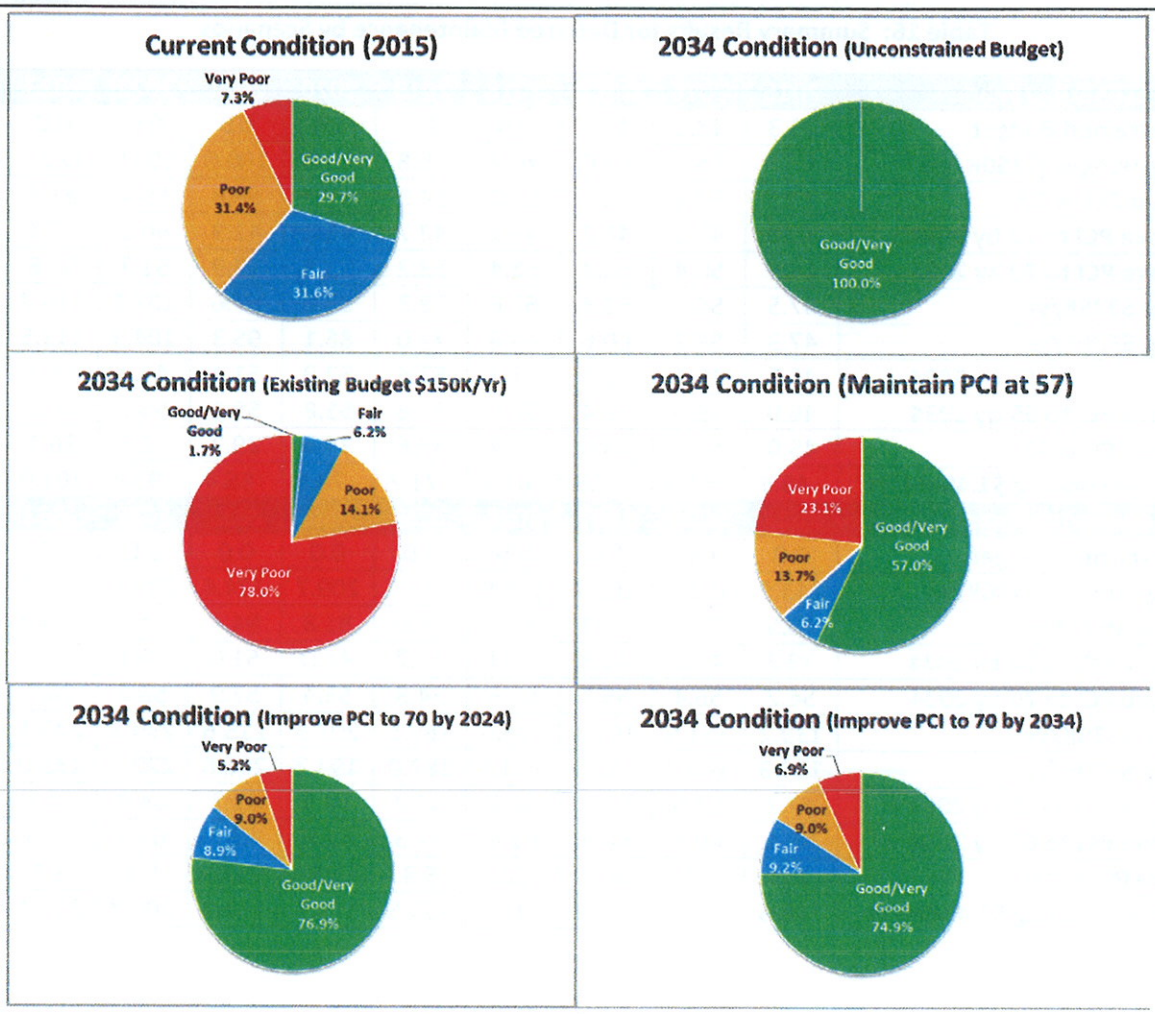

Figure 18: Pavement Condition Changes for Scenarios 1 to 4

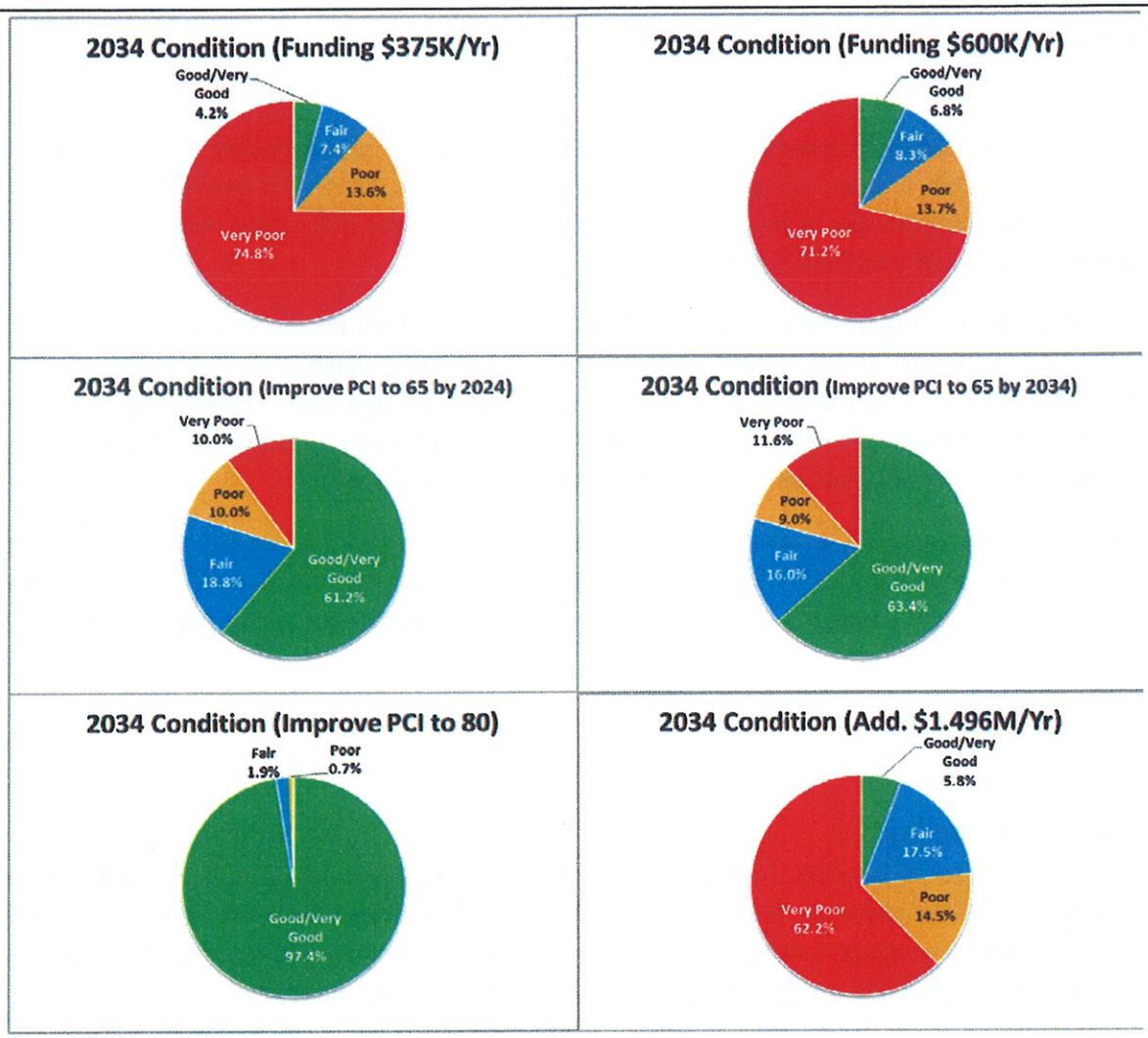

Figure 19: Pavement Condition Changes for Scenarios 5 to 9

Summary

To summarize, the County of Amador has a substantial investment of approximately $120.6 million in the pavement network. Overall, the pavement network is in "Fair" condition with a current network PCI of 57. Of the 384.48 centerline miles of County-maintained roads, over 61% of the roads currently fall into the "Fair" to "Good" condition categories.

Although the County's pavement network is in "Fair" condition with an overall PCI of 57, the current County funding (Scenario 2) will result in the network deteriorating significantly in the next twenty years. Furthermore, the analyses indicate that the County needs to spend approximately $164.6 million in pavement maintenance and rehabilitation in order to essentially repair all roads. By doing so, roads can be maintained in good condition with on-going preventive maintenance.

The most desirable scenario is to reduce the deferred maintenance to zero, but this is not possible for many reasons, and is unrealistic for most agencies. However, the goal should be to offer residents a safe and functional pavement network without unduly increasing the maintenance burden in the future.

Recommendations

A. Pavement Budget

The recommended scenario for the County of Amador is Scenario 4A (Improve PCI to 70 by 2024), with a total budget of $127.3 million over 20 years ($66.3 million over 10 years is required to improve PCI to 70 by 2024, and approximately $6.1 million per year is needed to maintain it at 70 over the next 10 years). This scenario will improve the current network PCI in the "Good" to "Fair" categories.

B. Pavement Maintenance Strategies

The County's pavement maintenance strategies primarily include overlays and chip seals. Since a large percentage of pavements are in "Fair" condition, it is important to preserve good pavements. Crack sealing is relatively inexpensive and can keep moisture out of pavements and prevent the underlying aggregate base from premature failures. Life-extending surface seals such as slurry seal and chip seals are also cost-effective for pavements currently in good condition. Various preventive maintenance and rehabilitation strategies might be considered on different pavement conditions. A brief discussion of these strategies are located in Appendix F.

NCE recommends that the County implement a well-funded preventive maintenance program. This is necessary to at least maintain roughly half of the road network that is in "Good" and "Fair" condition and avoid escalating the deferred maintenance even more.

C. Re-inspection Strategies

In order to continue monitoring the road network, and to make appropriate decisions, it is recommended that arterial and collector roads continue to be inspected every two years and residential roads every four to five years.

D. Maintenance and Rehabilitation Treatment Strategies

The maintenance and rehabilitation treatment strategies and associated unit costs should be reviewed and updated annually to reflect new construction techniques/costs so that the budget analysis results can continue to be reliable and accurate.

A significant unknown fact is the future cost of rehabilitation; with the recent volatility in oil prices, we recommend that the County carefully monitor future construction costs and be ready to adapt to large increases if necessary. Figure 20 illustrates the changes in the Asphalt Price Index (source: Caltrans) since 1999. As can be seen, asphalt prices have been extremely volatile since 2007. Accurate pavement maintenance costs are essential for accurate results.

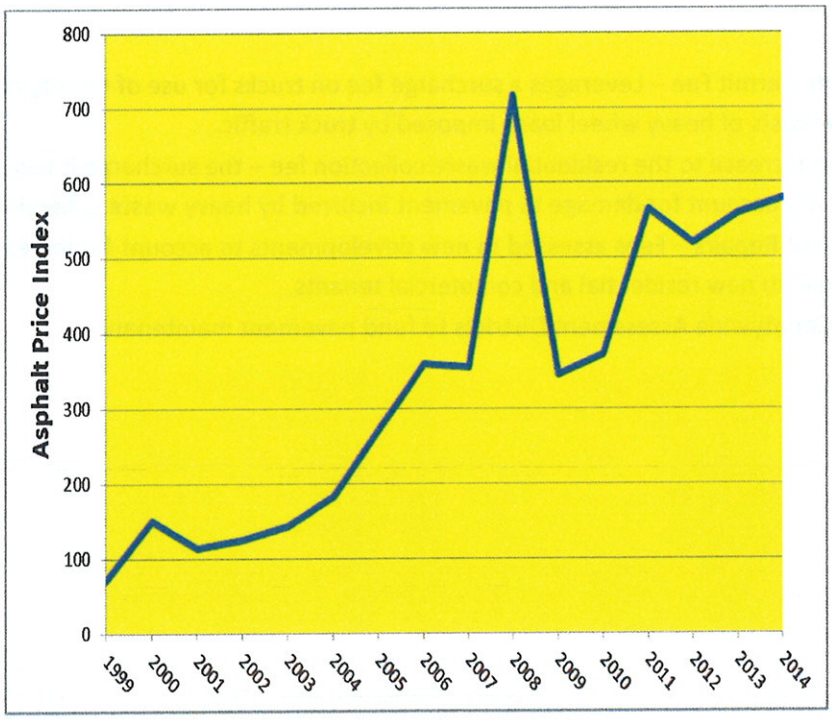

Figure 20: Asphalt Price Index (1999-2014, Caltrans)

E. Next Steps

To summarize, we recommend that the County undertake the following steps:

- Maintain an aggressive preventive maintenance strategy.
- Pursue additional pavement funding sources to ensure that Scenario 4 is feasible. Examples of some funding sources are listed on the next page:

Federal

- Community Development Block Grants (CDBG)
- Highway Safety Improvement Program (HSIP)
- Safe Routes to School (SRTS)

State

- Bicycle Transportation Account (BTA)
- Safe Routes to School (SR2S)
- CalRecycle grants
- State Local Partnership Program (SLPP)
- Traffic Congestion Relief (TCRP)
- Transportation Development Act (TDA)
- Transportation Uniform Mitigation Fee (TUMF)

Local

- Truck Route Permit Fee – Leverages a surcharge fee on trucks for use of County roads to help recoup the costs of heavy wheel loads imposed by truck traffic.
- Request an increase to the residential waste collection fee – the surcharge is leveraged on waste companies to account for damage to pavement incurred by heavy waste collection trucks.
- Development Repairs – Fees assessed to new developments to account for increased traffic associated with new residential and commercial tenants.
- Establish Countywide Assessment Districts to fund pavement maintenance.

APPENDIX A

Section Description Inventory Report

Section Description Inventory Report

This report lists a variety of section description information for each of the County's pavement sections. It lists the road and section identifiers, limits, functional class, surface type, number of lanes, lengths, widths, last calculated PCI, and area identifier.

All of the County's pavement sections are included in the report. Two versions of the report are included. One sorted alphabetically by Road Name and Section ID, and another by descending PCI. The field descriptions in this report are listed below:

COLUMN	DESCRIPTION
Road Name	The name of the road as indicated by road signs in the field.
Street ID	Road Identification - A code up to ten characters/digits to identify the road. Generally, the road name is truncated to six characters. The Street ID should be unique for each road.
Section ID	Section Identification - A code up to ten characters/digits to identify the section number. The combination of Section ID and Street ID must be unique.
Begin Location	Beginning limit of the section.
End Location	Ending limit of the section.
Length (FT)	Length of the section in feet.
Width (FT)	Average width of the section in feet.
Area (SQFT)	Estimated area of section, typically based on a direct product of the section length and width.
Surface Type (ST)	Surface Type (A = AC Pavement, O = AC Overlay of AC Pavement, AC/PCC = AC Overlay of PCC Pavement, GRAVEL = Gravel surface and base/subgrade, PCC = PCC Pavement, ST = Surface treatment over gravel base/subgrade).
Functional Class (FC)	Functional Classification (RMiA = Rural Minor Arterial (4), MaC = Major Collector (5), RMaC = Rural Major Collector (6), RMiC = Rural Minor Collector, R = Residential/Local, O = Other (Airport)).
PCI Date	The date of the recent PCI survey.
PCI	The resulting value from the last calculated PCI for the section. The value may be calculated from either a visual survey or maintenance event.