

Final Report

2023 Regional Pavement Analysis

Sacramento Transportation Authority

Sacramento Transportation Authority

801 12th Street, 5th Floor
Sacramento, CA 95814

May 2024



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Executive Summary

In 2023, Nichols Consulting Engineers, Chtd. (NCE) was selected by the Sacramento Transportation Authority (STA) to perform regional pavement management services for Sacramento area agencies including the County of Sacramento, and the Cities of Citrus Heights, Elk Grove, Folsom, Isleton, Galt, Rancho Cordova, and Sacramento. This report summarizes the results of the 2023 region-wide analysis. Its purpose is to help educate policy makers about the current condition of the Sacramento area street network and the impact of various funding scenarios on future pavement condition.

The region-wide pavement network consists of 5,200 centerline miles of roads and streets, which represents a substantial investment of approximately \$8.3 billion. Overall, the region's pavement network is currently in "Fair" condition with an average pavement condition index (PCI) of 53. Approximately 31 percent of the network is in "Good" condition with 16.9 percent in "Failed" condition.

Assuming an annual inflation rate of 4 percent¹, the budget needs analysis indicated that region needs to spend approximately \$381.4 million per year for the next thirty years to bring the street network to a condition that can be maintained with on-going preventive maintenance in the most cost-effective way. Five alternative scenarios were performed to illustrate the impacts of different funding levels and goals. Table E1 summarizes each scenario with its corresponding average annual budget along with the region-wide PCI after ten and thirty years.

Table E1. Summary of the Budgetary Analysis

Scenario	Description	Region-wide Ave Budget/Year (\$M)	Region-wide 2033 PCI	Region-wide 2053 PCI
Needs	Budget Needs Analysis	381.4	83	80
1	Improve PCI to 70	344.1	61	71
2	Maintain PCI	229.6	53	53
3	Existing Budget	79.4	38	21
4	Existing Budget with New Sales Tax Measure	143.6 (64.5 from Sales Tax Measure)	43	32
5	Existing Budget with Additional General Funds (Selected Agencies Only)	See Section 5.6 on page 19		

¹ Note: Individual agencies may use different inflation rates and decision trees for their custom agency analyses, which will result in outcomes different than those presented herein. For example, in 2022, the City of Elk Grove used an inflation rate of 3 percent for their budget scenarios, the City of Rancho Cordova used 4 percent, and the City of Sacramento used 3.5 percent.

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1 Introduction

In 2023, Nichols Consulting Engineers, Chtd. (NCE) was selected by the Sacramento Transportation Authority (STA) to perform regional pavement management services for Sacramento area agencies including the County of Sacramento, and the Cities of Citrus Heights, Elk Grove, Folsom, Galt, Isleton, Rancho Cordova, and Sacramento (See Figure 1).

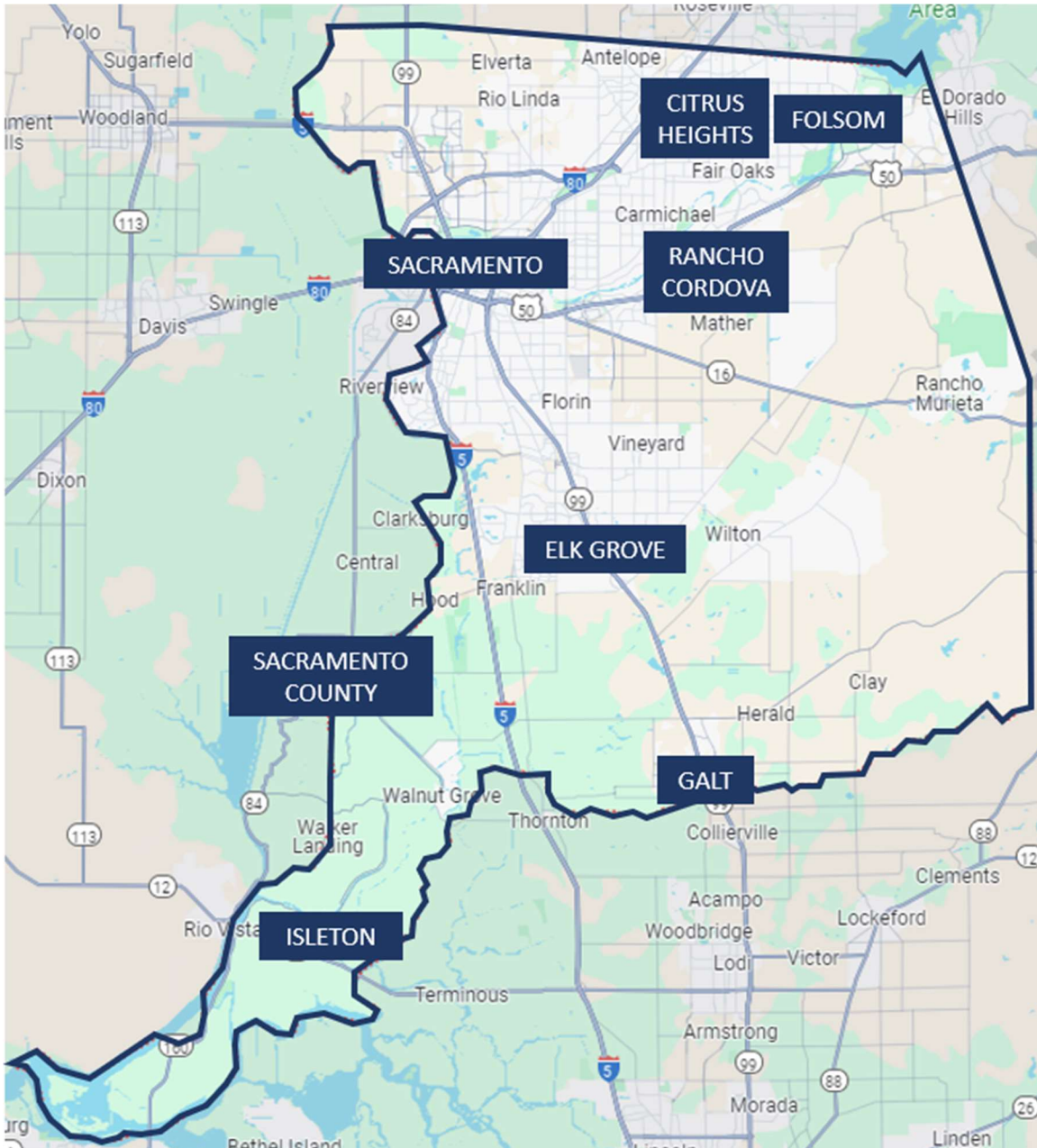


Figure 1. Map of Sacramento Area Agencies

In general, pavement management programs (PMPs) are “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.²”

Seven of the eight Sacramento area agencies use StreetSaver[®] as a decision-support tool for their PMPs. The City of Isleton does not use StreetSaver[®] or other decision-support software.

The regional pavement management services included summarizing the region-wide network, coordinating the license of a regional StreetSaver[®] account, calculating the network pavement condition, developing a region-wide decision tree, and performing several long-term budget analyses.

This report answers the following region-wide questions for the STA:

- What does the region-wide network include?
- What is the current pavement condition of the Sacramento area agencies as well as the average region-wide pavement condition?
- What are typical maintenance and rehabilitation (M&R) strategies and costs for the Sacramento area?
- How much funding is required to perform all needed M&R treatments throughout the region over the next thirty years?
- What effect will the agencies’ existing funding have on pavement condition?
- What effect will other funding levels have on pavement condition?
- What funding levels are required to improve or maintain the pavement condition?

² AASHTO “Guidelines for Pavement Management Systems”. American Association of State Highway and Transportation Officials, Washington, DC, July 1990.

2 Network Summary

Together, the Sacramento area agencies maintain 5,200 centerline miles of streets, or over 33,000 pavement management sections. Each management section is a project-sized portion of a street. Table 1 summarizes the region-wide network by agency. The majority of the region-wide network is represented by the County (44.3%) and the City of Sacramento (27.8%). Note that since the City of Isleton does not have a pavement management database, their portion of the network pavement area is unknown.

Table 1. Network Summary Statistics

Agency	Number of Sections	Centerline Miles	Network Area (%)
Citrus Heights	1,355	243	4.1%
Elk Grove	2,924	559	10.0%
Folsom	2,163	296	6.3%
Galt	619	91	2.0%
Isleton	Unknown	6	Unknown
Rancho Cordova	1,149	258	5.5%
Sacramento	16,943	1,530	27.8%
Sacramento County	8,361	2,217	44.3%
Total	33,514	5,200	100%

The region-wide pavement network replacement cost is estimated to be approximately \$8.3 billion. This can be viewed as the value of the pavement network and is the amount needed to fund a reconstruction of the entire paved network. It does not include related infrastructure assets such as sidewalks, signals, markings, signs, or storm drains.

3 Pavement Condition

Pavement condition is typically quantified using the pavement condition index (PCI), which ranges from 100 (best condition) to 0 (worst condition). Pavement condition is affected by the environment, traffic loads and volumes, construction materials, and age. Figure 2 shows examples of streets with varying PCIs.

The PCI scale is divided into four general condition categories. Pavements in “Good” condition have a PCI above 70, pavements in “Fair” condition have a PCI between 50 and 69, pavements in “Poor” condition have a PCI between 25 and 49, and finally pavements in “Very Poor/Failed” condition have a PCI below 25.



Figure 2. Examples of Streets with Different PCIs

Each agency is managed separately, consequently each agency performs condition inspections on their own schedule. Table 2 summarizes the year during which each agency performed their most recent pavement condition inspections and the frequency with which they have performed condition inspections for each functional classification. The data collected during these inspections informed the region-wide summaries and analyses presented in this report.

³ Note: StreetSaver® divides the “Fair” condition category to separate pavements with primarily non-load-related distresses (e.g. longitudinal cracking) from those with load-related distresses (e.g. alligator cracking).

Table 2. Most Recent Pavement Condition Inspection and Frequency by Agency

Agency	Year of Most Recent Inspection	Inspection Frequency (Years)	
		Arterial/Collector	Residential
Citrus Heights	2019	5	5
Elk Grove	2022*	2	4
Folsom	2019/2020	5	5
Galt	2018	Unknown	Unknown
Isleton	NA	Not Applicable	Not Applicable
Rancho Cordova	2022	2	2
Sacramento	2021	2	4
Sacramento County	2018**	5	5

* Elk Grove completed additional pavement condition inspections at the end of 2023, after the region-wide analyses were completed.

**Sacramento County is planning to perform pavement condition inspections during the summer of 2024.

3.1 Pavement Condition Index

The region-wide average PCI is 53. This value is an area-weighted calculation projected to 2023 from the most recent pavement condition surveys performed by each agency and the historical maintenance records in each agency’s database. Since the City of Isleton does not have a PMS, their PCI was assumed to be equal to the PCI reported in the 2023 “California Statewide Local Streets and Roads Needs Assessment.” Figure 3 shows the region-wide PCI compared to each agency’s average PCI. As illustrated, the region-wide PCI is toward the lower end of the range as it is heavily influenced by the condition of the County, which constitutes more than 40 percent of the region-wide network.

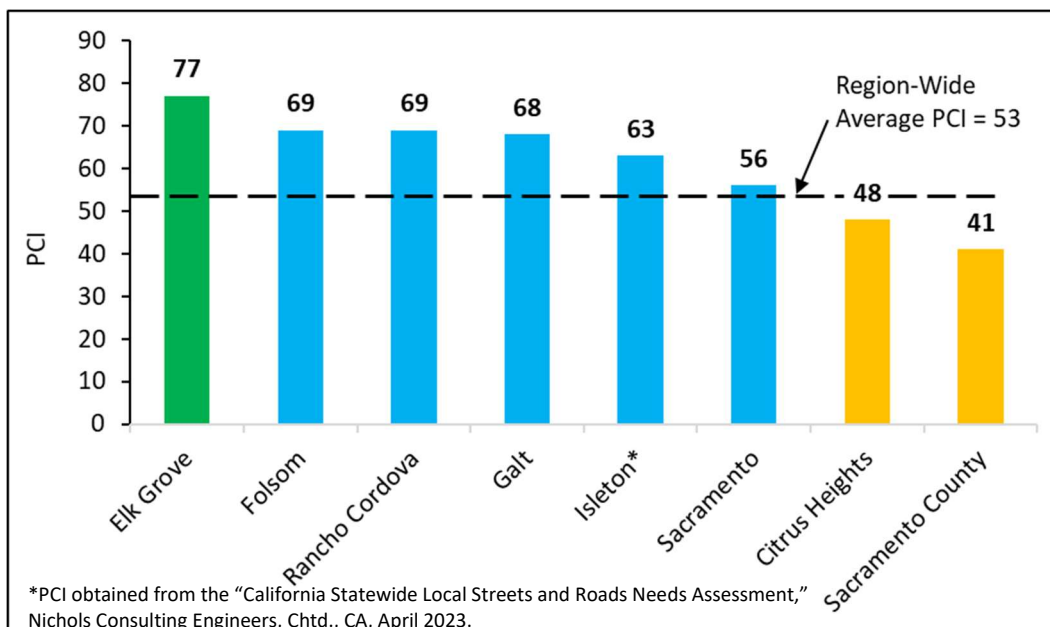


Figure 3. Sacramento Area Agency Average PCIs

3.2 Network Condition Breakdown

Figure 4 shows the region-wide pavement condition breakdown while Figure 5 summarizes the pavement condition breakdown by agency. Throughout the region, approximately a third of pavements are in “Good” condition, with approximately a fourth in “Fair” condition, and a fourth in “Poor” condition. The remaining 16.9 percent of the region’s pavements are in “Failed” condition. With regard to the individual agencies, the City of Elk Grove has the highest proportion of pavements in “Good” condition, while the County has the highest proportion in “Failed” condition. These trends are not unexpected considering the City of Elk Grove is newer than the other agencies, and considering the County manages many rural, low-volume roads.

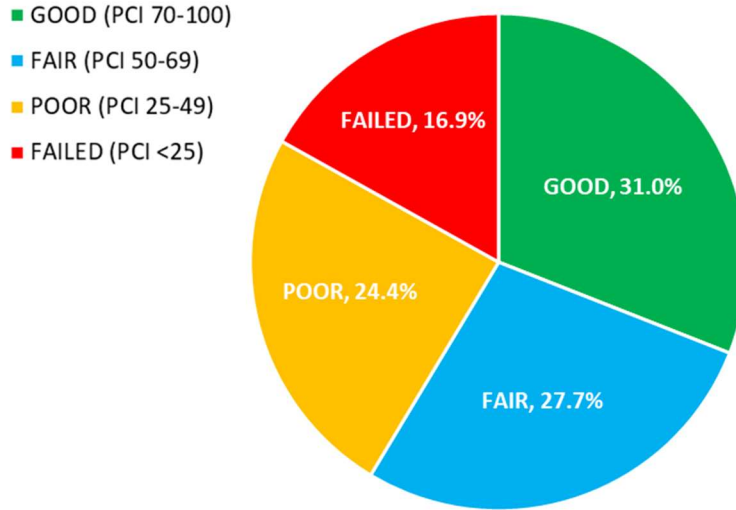


Figure 4. Region-wide Network Condition Breakdown

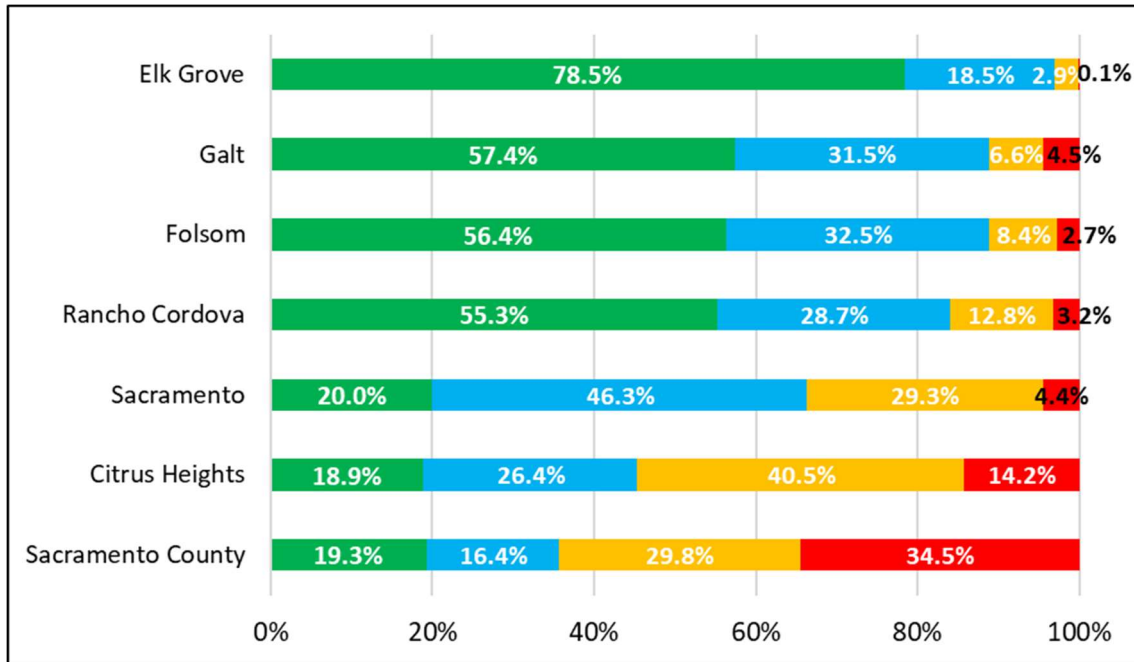


Figure 5. Network Condition Breakdown by Agency

4 Maintenance and Rehabilitation Strategies

A decision tree represents a strategy for assigning M&R treatments to pavement management sections. Typically, decision trees are grouped by functional classification, and include treatments for each pavement condition category and corresponding unit costs. The decision tree is instrumental in performing the budget analyses.

Ideally, each agency in a regional analysis would have a customized decision tree as part of its PMP. However, since some agencies have not recently updated their M&R treatment strategies and unit costs, a region-wide decision tree was developed. The treatments included in the region-wide decision tree were based on a review of all available agency decision trees and their included treatments. The corresponding unit costs were estimated from recent bid tabulations provided by the agencies in the region. The fully loaded unit costs included material and construction costs as well as an additional 20-40 percent for other costs (e.g., curb ramp updates, traffic control, mobilization, striping) based on functional classification and treatment type, an additional 15 percent for design and construction management, and an additional 10 percent for contingencies.

The region-wide M&R strategies, briefly illustrated in Figure 6, include cost-effective and recyclable treatments. In general, slurry seals will be applied to pavements in “Good” condition; pavements in “Fair” condition will receive a surface seal with digouts if no load-related distresses are present, or a thin mill and overlay if load-related distresses are present; pavements in “Poor” condition will receive a thick mill and overlay; and Full Depth Reclamation (FDR) will be performed on pavements in “Failed” condition. **These treatments and corresponding unit costs represent average strategies and costs for the region and therefore may be more/less aggressive, or more/less expensive than those used by an individual agency.** The complete region-wide decision tree is provided in Appendix A.

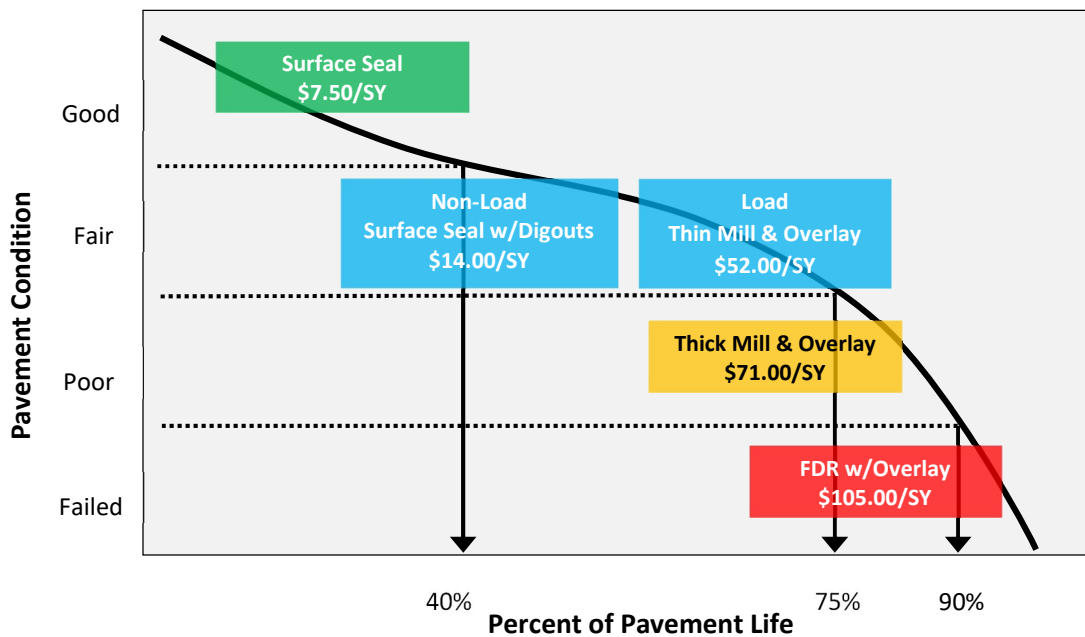


Figure 6. Typical Costs of Maintaining Arterial Pavements Over Time

Experience and research have shown that it costs much less to maintain pavement in good condition than to repair pavement that has already failed. By allowing pavements to deteriorate, roads that once cost \$7.50/square yard (SY) to seal may soon cost \$71.00/SY to overlay or \$105.00/SY to rehabilitate or reconstruct. In other words, delaying repairs can significantly increase M&R costs. Note that a surface seal can be placed on approximately 14 times as many lane miles as those requiring FDR.

5 Budget Analyses

In consultation with the STA, NCE performed five funding scenarios in addition to the budget needs analysis:

- **Scenario 1: Improve PCI to 70**
- **Scenario 2: Maintain PCI**
- **Scenario 3: Existing Agency Budget**
- **Scenario 4: Existing Agency Budget with New Sales Tax Measure**
- **Scenario 5: Existing Agency Budget with Additional General Funds**

The scenarios were selected based on an iterative process that considered financial feasibility. For instance, *Scenario 1: Improve PCI to 70* is a common scenario used by local agencies to quantify the funding needed to achieve an agency-wide PCI of 70, which is the threshold for “Good” pavement condition. STA felt that the budget required to achieve Scenario 1 was well beyond the current funding available and consequently added *Scenario 2: Maintain PCI*. Since the project scope was limited to five scenarios, the remaining three scenarios were selected by STA to consider the effects of the existing budget and associated variations. Specifically, to quantify the improvement in regional PCI associated with additional funds added above and beyond the existing budget. STA staff felt that the five scenarios were adequate to support further discussion with the STA Governing Board on potential recommendations.

The budget needs analysis and budget scenarios were performed using StreetSaver[®], based on an inflation rate of 4 percent⁴ for an analysis period of thirty years. The results of each scenario are presented in the following subsections. Note that since the City of Isleton does not have a StreetSaver[®] database and license, they were not included in the five scenarios. However, since the City of Isleton is the very small it was assumed to have a minimal impact on the regional results.

The budget needs analysis and budget scenarios are not intended to replace or provide the same results as an individual agency’s own pavement analysis. The regional analysis does not get into the details of an individual agency’s procedures or pavement management approach, but instead takes a uniform set of assumptions and applies them at the regional level. Its purpose is to provide a regional perspective on regional pavement needs and funding.

⁴ Note: Individual agencies may use different inflation rates for their custom agency analyses. For example, in 2022, the City of Elk Grove used an inflation rate of 3 percent for their budget scenarios, the City of Rancho Cordova used 4 percent, and the City of Sacramento used 3.5 percent.

5.1 Budget Needs Analysis

The total budget needs for the region-wide network represents the cost associated with performing M&R treatments at the optimal time – optimal meaning the PCI is maximized and the cost is minimized – over the analysis period. This was done by performing a budget needs analysis in StreetSaver® with an inflation rate of 4 percent for an analysis period of thirty years without any fiscal constraint.

The results of the budget needs analysis are presented in Figure 7, which shows the total 30-year budget needs for each Sacramento area agency, and Figure 8, which shows the region-wide treated and untreated PCI over time. Since the City of Isleton does not have a StreetSaver® database, their budget needs were extrapolated based on the average budget needs per centerline mile for the seven other agencies. The region-wide total 30-year budget needs is estimated at \$11.4 billion, which is approximately 381.4 million per year. As expected, Sacramento City and Sacramento County, with the largest networks and lowest conditions, have the greatest funding needs.

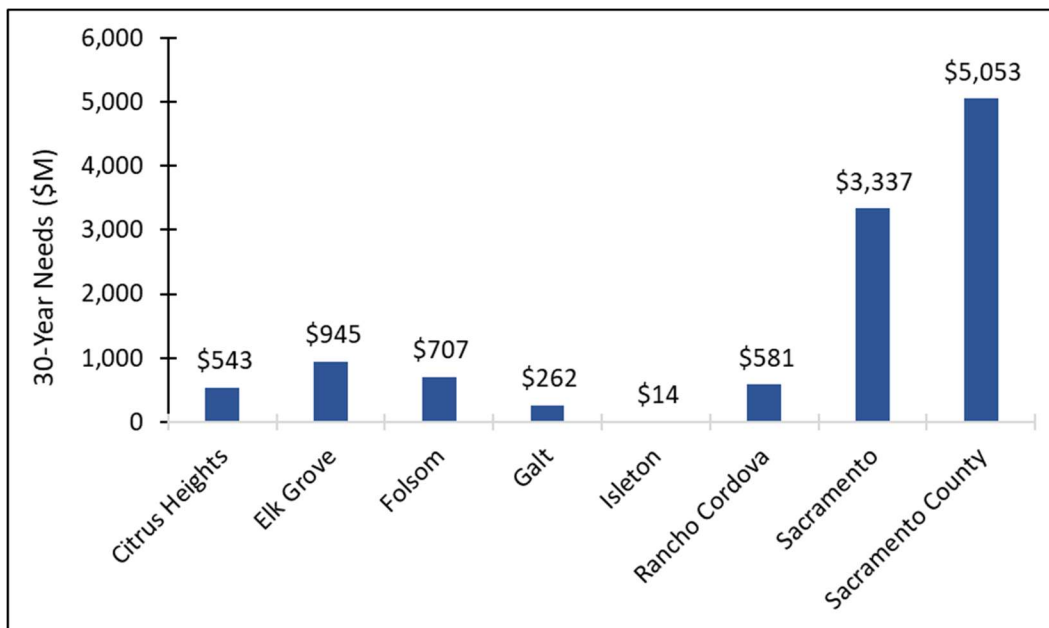


Figure 7. 30-Year Budget Needs by Agency

If the region follows this ideal strategy of addressing all the current deferred maintenance, or backlog, in the first year and then maintaining the network with preventive maintenance thereafter, the average network PCI will immediately increase and then stabilize near a PCI of 80 as shown in Figure 8. In 2033, the region-wide PCI will be 83 and at the end of the analysis period, in 2053, the region-wide PCI will be 80. This type of budget, that addresses all the deferred maintenance in the first year, is known as front-loaded. Alternatively, if no maintenance is performed over the next thirty years, the region-wide PCI will drop to 6.

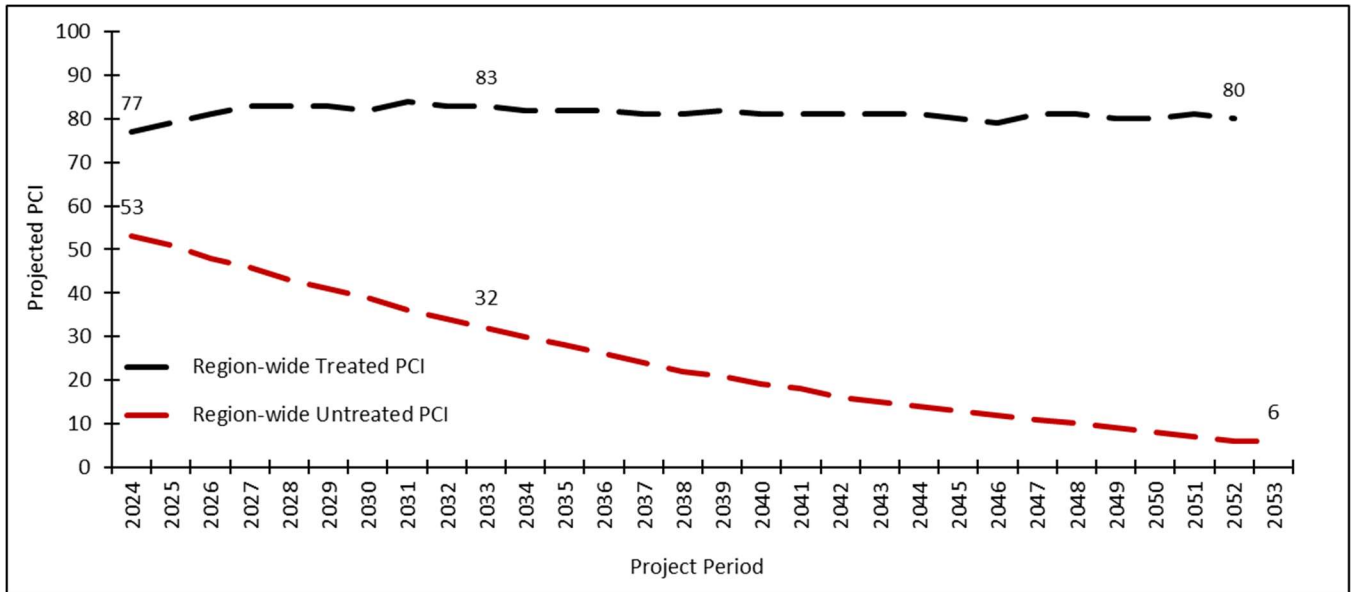


Figure 8. PCI Results for Budget Needs Analysis

The results of the budget needs analysis form the foundation for performing other budget scenario calculations, the results of which are presented in the following sections.

5.2 Scenario 1: Improve PCI to 70

This scenario aims to bring the region-wide PCI into “Good” condition. Specifically, agencies with a current PCI of less than 70 will be improved to a PCI of 70 by the 20-year mark and then be maintained at that level for the next decade. Agencies with a current PCI greater than 70 will be maintained at their current level throughout the analysis period. This will result in a 2033 region-wide PCI of 61 and a 2053 region-wide PCI of 71. Figure 9 illustrates the PCI over time for this Scenario. Figure 10 shows the 30-year financial commitment required for each agency to achieve this goal. Region-wide this scenario will require a total of \$344.1 million per year.

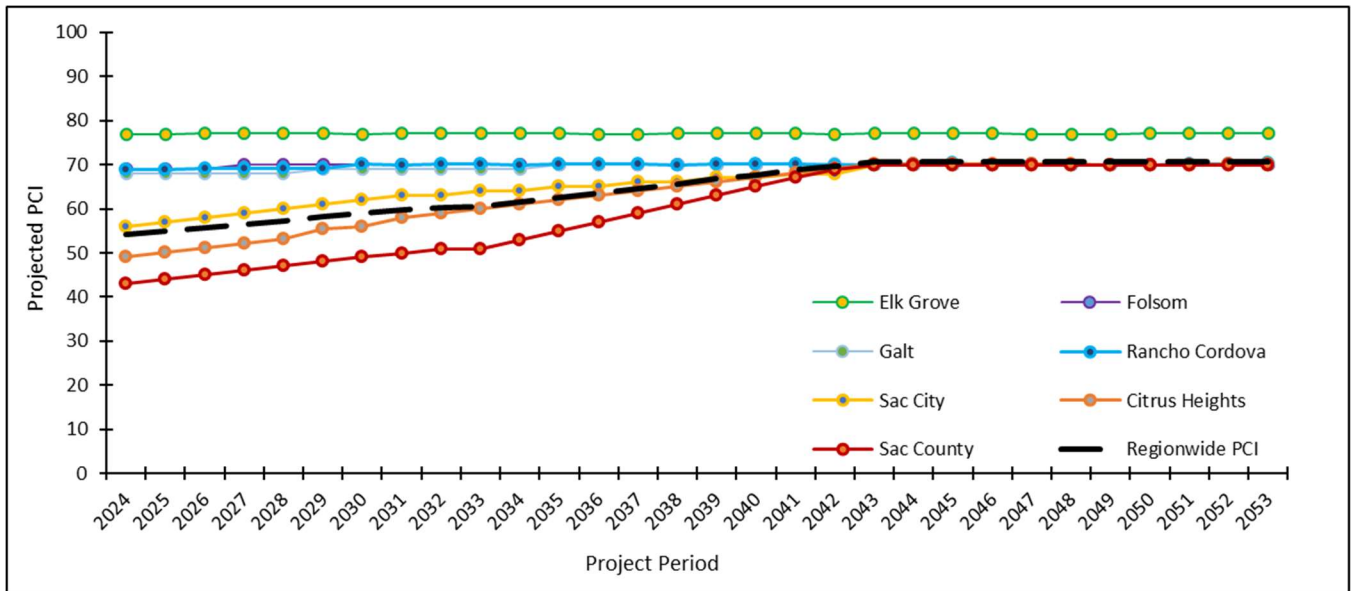


Figure 9. PCI Results for Scenario 1

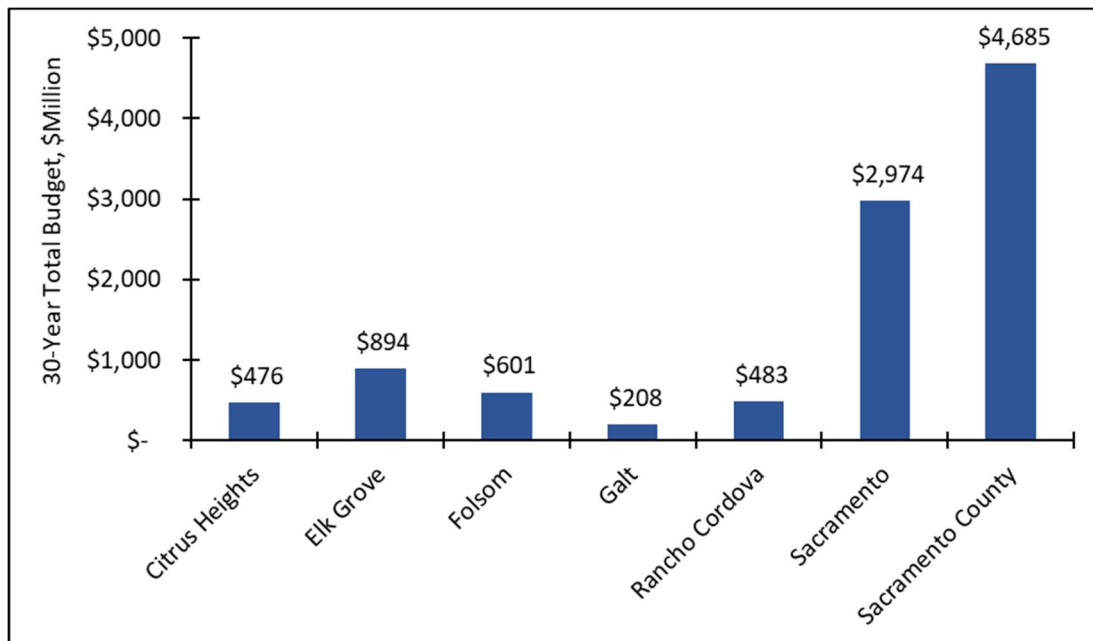


Figure 10. 30-Year Total Budget for Scenario 1 by Agency

5.3 Scenario 2: Maintain PCI

This scenario aims to maintain each agency’s current PCI over the next thirty years. As a result, the region-wide PCI will also be maintained. This results in a region-wide PCI of 53 being maintained throughout the analysis period. Figure 11 illustrates the PCI over time for this Scenario. Figure 12 shows the 30-year financial commitment required for each agency to achieve this goal. Region-wide this scenario will require a total of \$229.6 million per year.

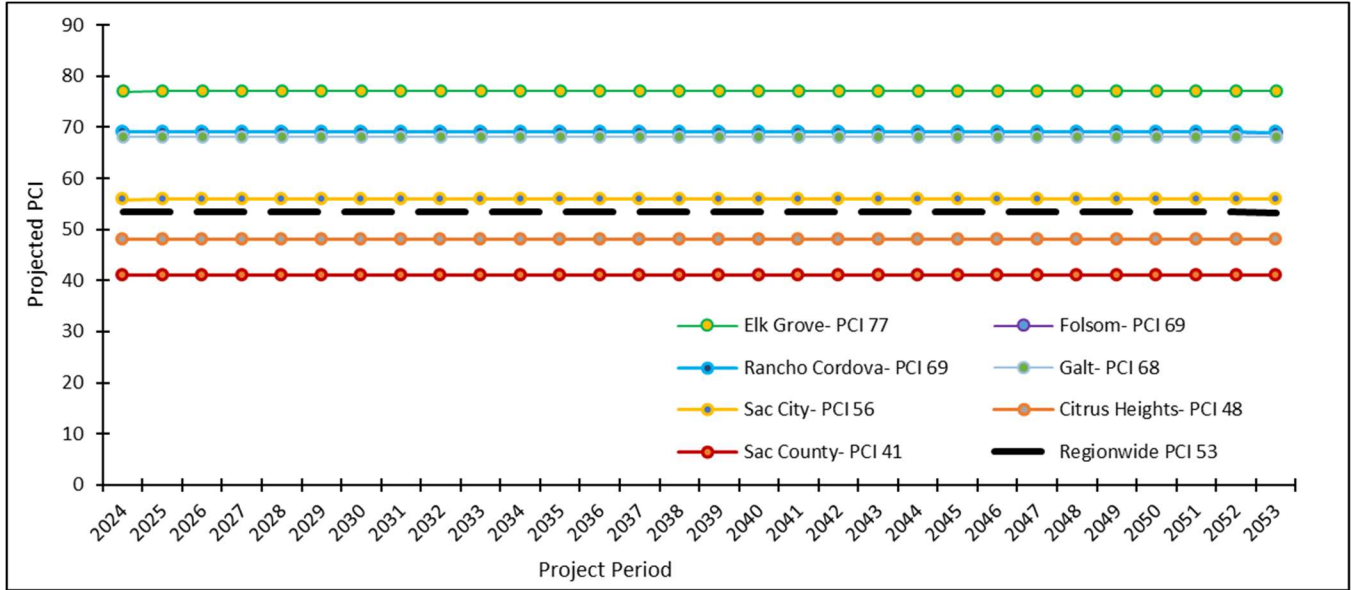


Figure 11. PCI Results for Scenario 2

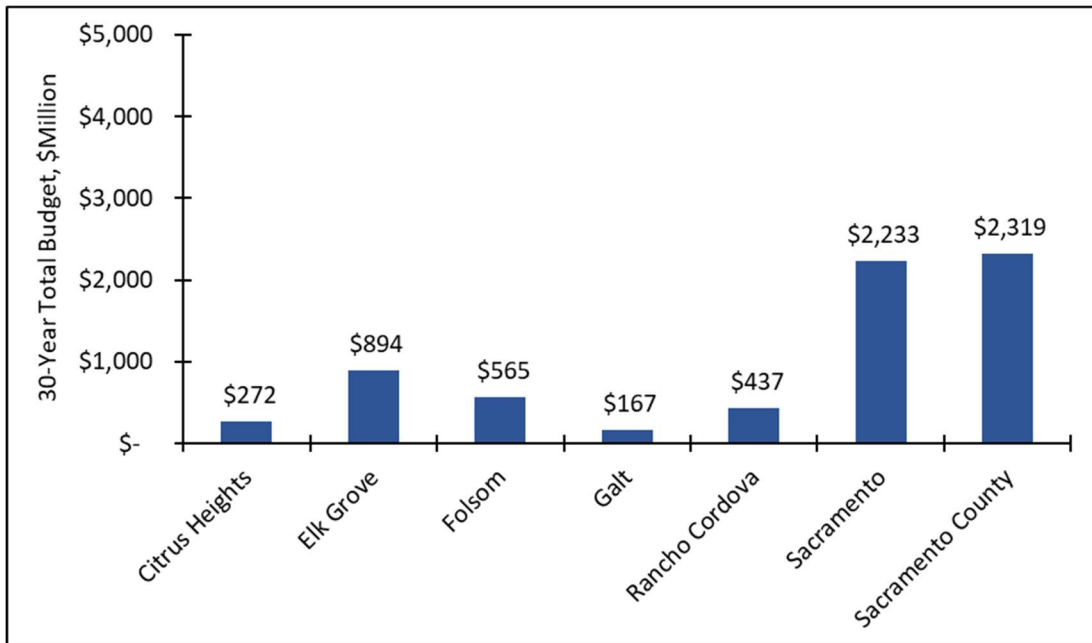


Figure 12. 30-Year Total Budget for Scenario 2 by Agency

5.4 Scenario 3: Existing Budget

This scenario assumes each agency will maintain their existing budget for pavement M&R, with no change, over the next thirty years as outlined in Table 3 for a region-wide total budget of \$79.4 million per year. Figure 13 compares the existing budget for each agency with the 30-year budget needs. As shown, for most agencies, the existing budget only constitutes a portion of the needed budget. Region-wide, the existing budget represents approximately one-fifth (21%) of the total 30-year budget needs.

Table 3. Annual Budget Summary for Scenario 3

Revenue Source	Citrus Heights	Elk Grove	Folsom	Galt	Isleton	Rancho Cordova	Sacramento City	Sacramento County
Local Assessment Districts						\$300,000		
Maintenance CFDs		\$1,650,000						
Local (Street Trench Fees)	\$50,000		\$50,000		\$5,000	\$4,437	\$25,000	
Measure A	\$1,000,000	\$5,390,000	\$1,000,000		\$100,000	\$1,701,078		\$6,000,000
Gas Tax	\$400,000	\$900,000		\$656,600	\$50,000	\$2,034,095	\$325,560	\$100,000
SB1 RMRA	\$1,800,000	\$4,390,000	\$1,500,000		\$30,000	\$1,497,700	\$12,500,000	\$30,000,000
SB1 Local Partnership Program	\$125,000	\$549,000			\$50,000		\$770,000	\$900,000
Federal Funding		\$1,986,400			\$100,000		\$1,500,000	
Total	\$3,375,000	\$14,865,400	\$2,500,000	\$656,600	\$335,000	\$5,537,310	\$15,120,560	\$37,000,000

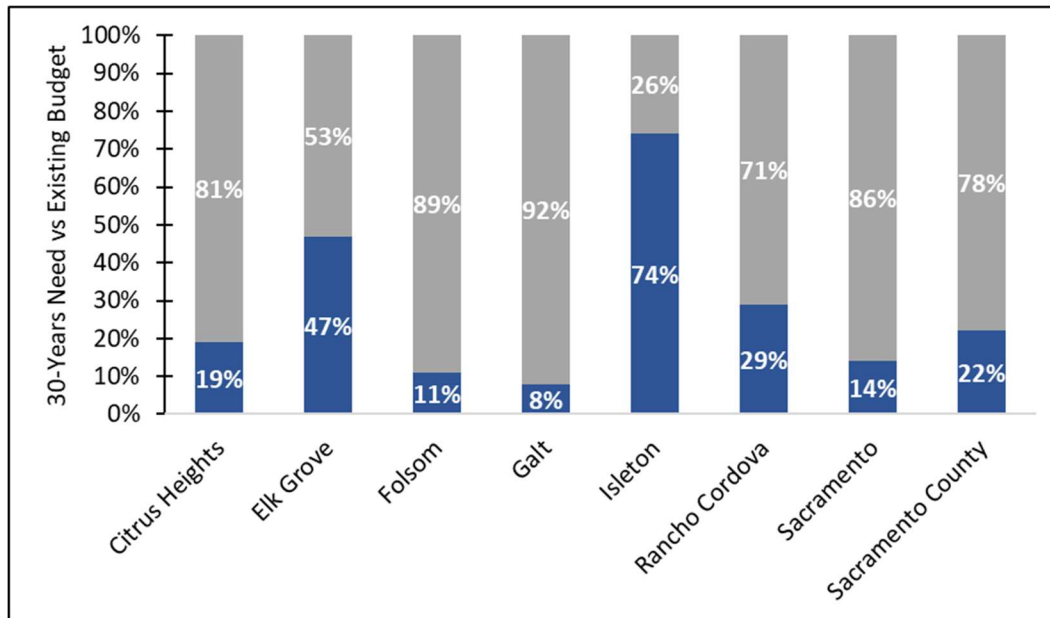


Figure 13. Existing Budget Compared to Budget Needs

for the purposes of the regional analysis, some background information is provided on a few of the funding sources.

Maintenance CFDs: The City of Elk Grove is unique in the fact that it is the only agency to include maintenance CFD funding in its pavement management program budget. The City of Elk Grove began conditioning new development in the 2000s to pay for road maintenance as they determined that new development does not provide sufficient revenues to cover the cost of maintenance of new city streets. They also did not want to further burden existing taxpayers for the maintenance of new developments.

Measure A: Measure A is a Sacramento county-wide transportation sales tax, 30 percent of which goes to city street and county road maintenance. Historically, these funds have increased 6 percent per year. For Fiscal Year 2022-2023, the Measure A revenue was \$51.6 million. Of that total, approximately \$15 million (29%) went to pavement maintenance and rehabilitation. For example, the City of Elk Grove and Sacramento County use 93 percent and 29 percent, respectively, for pavement maintenance in their agencies. The reason 100 percent is not used directly for pavement maintenance is that many agencies use a portion of Measure A funds for other maintenance purposes such as fixing potholes, repairing bridges and structures, pavement sweeping, routine landscape and irrigation maintenance and repair, and servicing of signs, guardrails, traffic signals, and lighting standards.

Gas Tax and SB1 RMRA: With the transition to hybrid and electric vehicles and higher fuel efficiency standards, gas related tax revenue is expected to decrease over time. Over the next ten years, these funds are anticipated to be reduced somewhere between 6 and 25 percent⁵.

Federal Funding: The amount of Federal funding each agency has assumed in their existing budget is likely consistent with the result of the Sacramento Area Council of Government (SACOG) 2023 regional funding round awards. Since that time, SACOG has created a regional funding round working group to revise how they approach this competitive program. The results of this working group and future SACOG board action could affect the level of Federal and State funding received for pavement maintenance and rehabilitation in the future.

⁵ "Assessing California's Climate Policies – Implications for State Transportation Funding and Programs," Gabriel Petek, Legislative Analyst's Office, December 2023.

The results of the existing funding level on each agency’s PCI over the next three decades is shown in Figure 14, and Table 4. As shown, each agency’s PCI will decrease over time. At the end of the 30-year analysis period, the City of Elk Grove will have the highest PCI while Sacramento City will have the lowest PCI. The region-wide PCI in 2033 will be 38, while at the end of the analysis period, 2053, it will be 21.

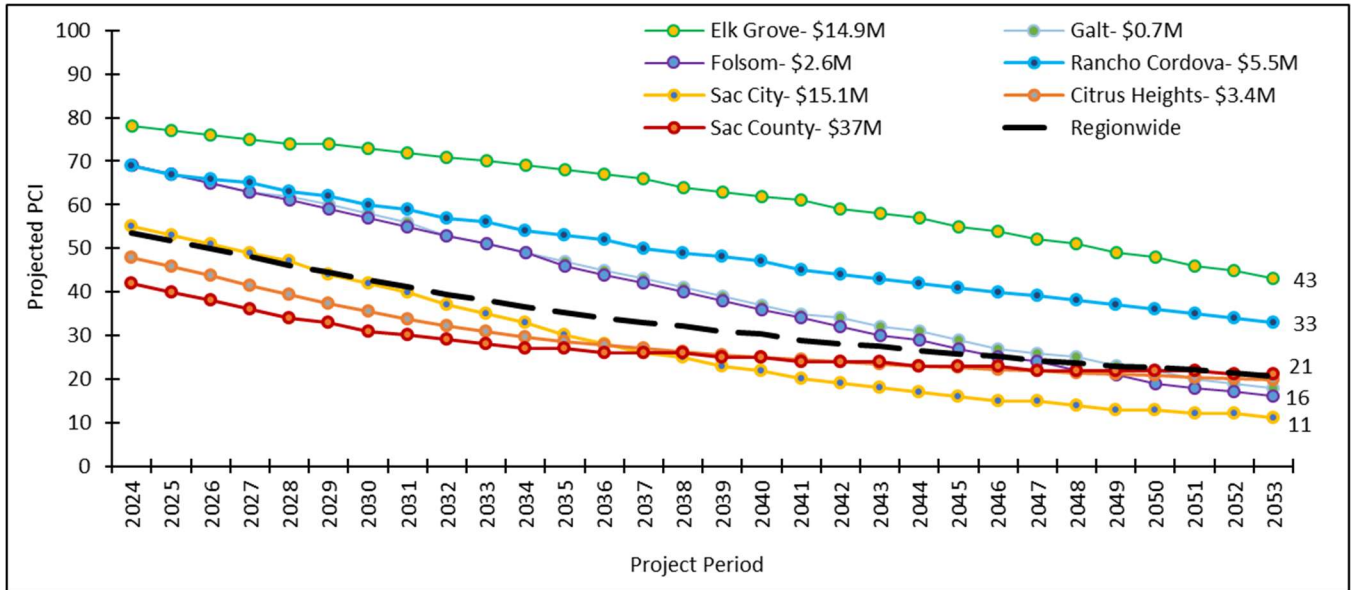


Figure 14. PCI Results for Scenario 3

Table 4. Results for Scenario 3

Agency	Current PCI	2033 Projected PCI	2053 Projected PCI
Citrus Heights	48	31	20
Elk Grove	77	70	43
Folsom	69	51	16
Galt	68	51	18
Rancho Cordova	69	56	33
Sacramento	56	35	11
Sacramento County	41	28	21
Region-Wide	53	38	21

5.5 Scenario 4: Existing Budget with New Sales Tax Measure

This scenario looks at the effect of passing a new sales tax measure and dedicating a portion of those revenues (\$64.5 million per year) to pavement M&R at the agency level in addition to each agency’s existing budget as outlined in Table 5. As shown in Figure 15, and Table 6, the agency PCIs will still decrease over the analysis period, but at a lower rate compared to Scenario 3. An increase in dedicated funding from a new sales tax measure has the power to increase the average PCI by approximately 5 points at the end of ten years (PCI of 43 in 2033) and by approximately 11 points at the end of thirty years (PCI of 32 in 2053) when compared to Scenario 3. However, adding \$64.5 million per year from sales tax revenue to the existing budget for a total of \$143.6 million per year is insufficient to maintain the PCI at the current condition.

Table 5. Annual Budget Summary for Scenario 4

Revenue Source	Citrus Heights	Elk Grove	Folsom	Rancho Cordova	Sacramento City	Sacramento County	Galt
Existing Funding (See Scenario 3)	\$3,375,000	\$14,865,400	\$2,500,000	\$5,537,310	\$15,120,560	\$37,000,000	\$656,000
New Sales Tax Measure	\$3,360,163	\$7,111,148	\$3,418,161	\$3,396,620	\$20,194,885	\$25,677,284	\$924,752
Total	\$6,735,163	\$21,976,548	\$5,967,161	\$8,933,930	\$35,315,445	\$62,677,284	\$1,580,752

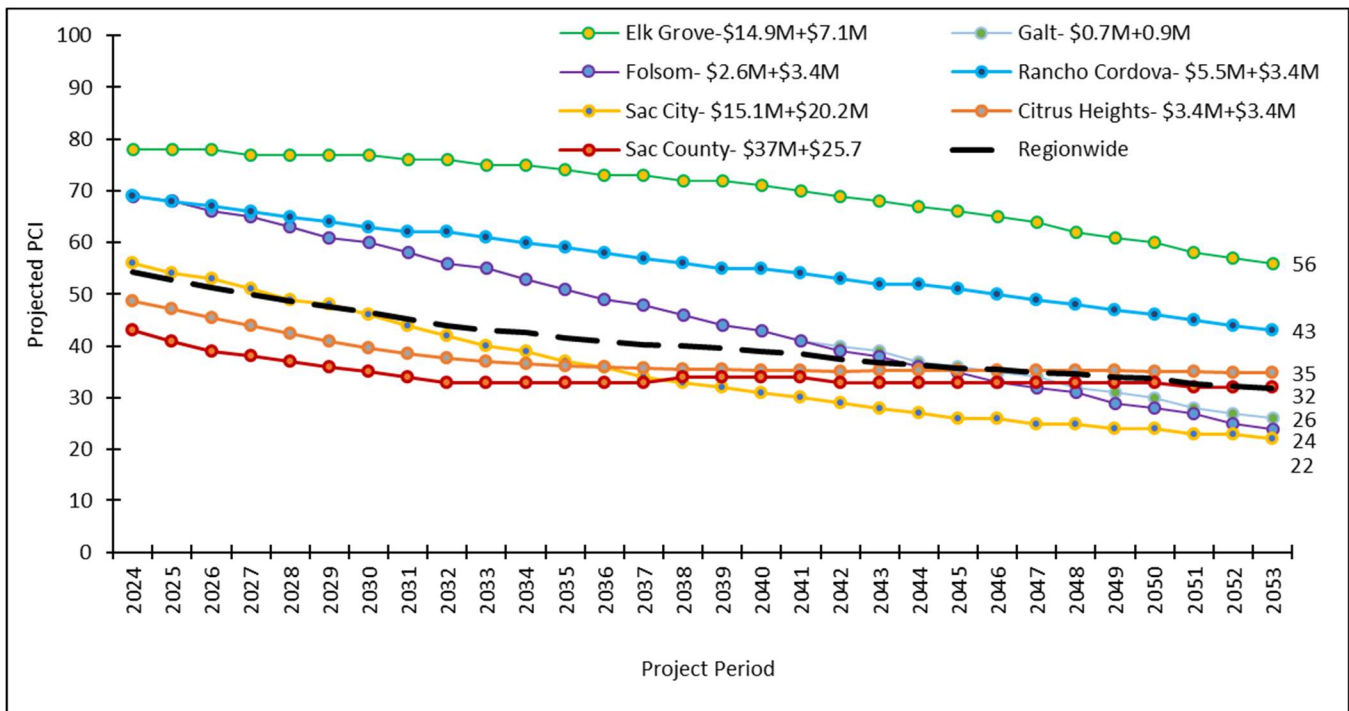


Figure 15. PCI Results for Scenario 4

Table 6. Results for Scenario 4

Agency	Current PCI	2033 Projected PCI	2053 Projected PCI
Citrus Heights	48	37	35
Elk Grove	77	75	56
Folsom	69	55	24
Galt	68	55	26
Rancho Cordova	69	61	43
Sacramento	56	40	22
Sacramento County	41	33	32
Region-Wide	53	43	32

5.6 Scenario 5: Existing Budget with Additional General Funds

Some of the Sacramento area agencies have the potential to add general funds from sources such as Measure E, Measure H, and Measure R in addition to their existing budgets as outlined in Table 7. This scenario looks at the effect of including those general funds for the Cities of Citrus Heights, Elk Grove, Rancho Cordova, and Sacramento County. As shown in Figure 16 and Table 8, the agency PCIs will still decrease over the analysis period, but at a lower rate compared to Scenario 3. Including general funds will have the greatest impact on the City of Citrus Heights resulting in a 2033 and 2053 PCI that is 7 and 12 points higher, respectively, than in Scenario 3.

Table 7. Annual Budget Summary for Scenario 5

Revenue Source	Citrus Heights	Elk Grove	Rancho Cordova	Sacramento County
Existing Funding (See Scenario 3)	\$3,375,000	\$14,865,400	\$5,537,310	\$37,000,000
Additional General Funds	\$4,000,000	\$1,590,000	\$2,500,000	\$20,000,000
Total	\$7,375,000	\$16,455,400	\$8,037,310	\$57,000,000

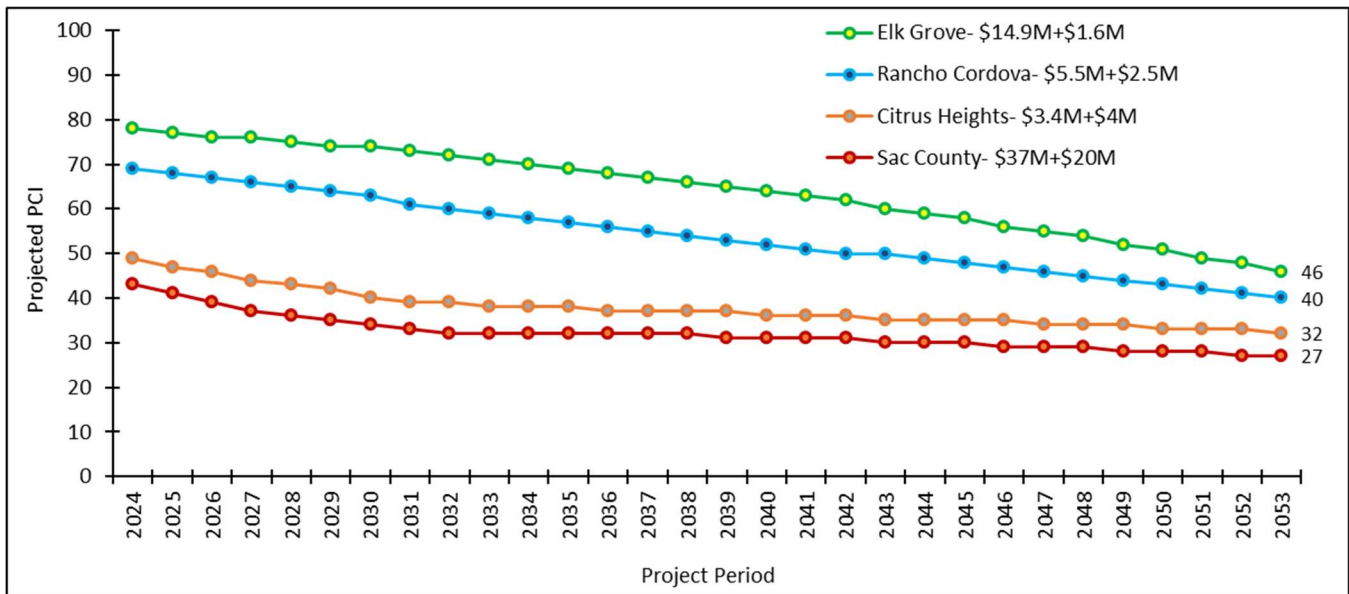


Figure 16. PCI Results for Scenario 5

Table 8. Results for Scenario 5

Agency	Current PCI	2033 Projected PCI	2053 Projected PCI
Citrus Heights	48	38	32
Elk Grove	77	71	46
Rancho Cordova	69	59	40
Sacramento County	41	32	27

6 Conclusion and Recommendations

In summary, the Sacramento area agencies have a substantial investment of \$8.3 billion in the pavement network. Overall, the region's pavements are in "Fair" condition with an estimated 2023 network PCI of 53. Approximately 31 percent of the region's pavements are in "Good" condition with 16.9 percent in "Failed" condition.

The analyses indicate that the Sacramento area agencies combined need to spend a total of \$11.4 billion over 30 years, or \$381.4 million per year, on pavement M&R to optimally repair all pavement sections, thus bringing the network into a condition that can be maintained with on-going preventive maintenance. If instead the Sacramento area agencies only commit the expected \$79.4 million per year, the region-wide network PCI will drop to 21 by 2053.

Based on the results presented in this report, NCE offers the following recommendations.

1. **Funding** - The primary goal of PMPs should be to offer users a safe and functional pavement network without unduly increasing the maintenance burden in the future. With that in mind, NCE recommends pursuit of a local sales tax measure, leveraging local funding as a match for federal/state funds, leveraging utility projects to include paving, considering implementation of utility cut impact fees or heavy vehicle impact fees, and including Maintenance CFDs in conjunction with new developments.
2. **Pavement Management Strategies** – Since a significant portion of the region's streets are currently in "Good" condition (31 percent), it is important to maintain that condition to the extent possible. Preservation occurs when streets with PCIs higher than 70 receive treatments such as surface seals (crack, slurry, microsurfacing, etc.). Seals are relatively inexpensive treatments that prevent moisture ingress and thus preserve the integrity of the underlying base material. NCE recommends that the agencies balance preventive maintenance with rehabilitation and reconstruction projects to preserve pavements in "Good" condition, improve pavements in "Poor" condition, and avoid increasing the deferred maintenance.
3. **Reinspection Strategies** – In order to make appropriate management decisions based on current data, NCE recommends performing condition inspections on arterials and collectors every 2 years and on residential at least every 4 to 5 years. Additionally, since StreetSaver[®] and other prediction models do not yet take into account the effect of specialized materials such as asphalt-binders with rubber or polymers, the actual performance of pavements may not be fully captured in the analysis models. For this additional reason, NCE recommends regular pavement condition surveys to ensure model accuracy and relevance.
4. **M&R Decision Tree** – NCE recommends each agency perform an annual review and update of their M&R treatment strategies and associated unit costs in the decision tree to reflect current construction techniques and changing costs. This will ensure that the results for the budget analyses are reliable and as accurate as possible. Note that the analysis results performed as part of this region-wide effort will likely differ from those performed by individual agencies. This can in part be attributed to the use of a region-wide decision tree as opposed to custom decision trees for each agency.
5. **Recycling Treatments** – NCE recommends a focus on including recycling treatments such as cold-in place recycling, cold central plant recycling, and full-depth reclamation. Not only do these treatments

provide sustainability benefits, but they provide substantial cost savings at the level of 20-30% less than conventional treatment options. Such a focus will allow the agencies to be more cost-effective pavement managers.

6. **Joint Procurement** – Small agencies may not have the economies of scale to obtain competitive bid prices for paving projects. Therefore, joint procurement or policies where multiple agencies can partner together (e.g the County and the City of Galt or the City of Isleton) are encouraged so that lower bid prices are possible.
7. **Simple Cost Savings Measures** – Agencies should consider additional efforts to increase cost-effectiveness of pavement maintenance treatments:
 - a) Reduce design and construction management time and cost commensurate with lower level of complexity of typical pavement maintenance treatments.
 - b) Advertise pavement maintenance projects prior to the beginning of the construction season to encourage more bidding and lower bid results.
 - c) Develop pavement maintenance projects that can be easily constructed with minimal risk to ensure low bid results.

6.1 Case Study – Elk Grove

For the purposes of this report, a case study was conducted to evaluate the long-term effects implementing these recommendations may have on an individual agency. Since the City of Elk Grove is already implementing many cost-saving and effective management practices, it was selected for the case study.

As shown in Figure 17, if the City follows most of the cost-saving strategies and effective management practices recommended in this report, their existing budget of \$14.9 million per year is expected to maintain their network PCI close to 80 for about 15 years, after which it will begin to show gradual signs of decline due to inflation and pavement age. This emphasizes the benefit associated with implementing the outlined recommendations.

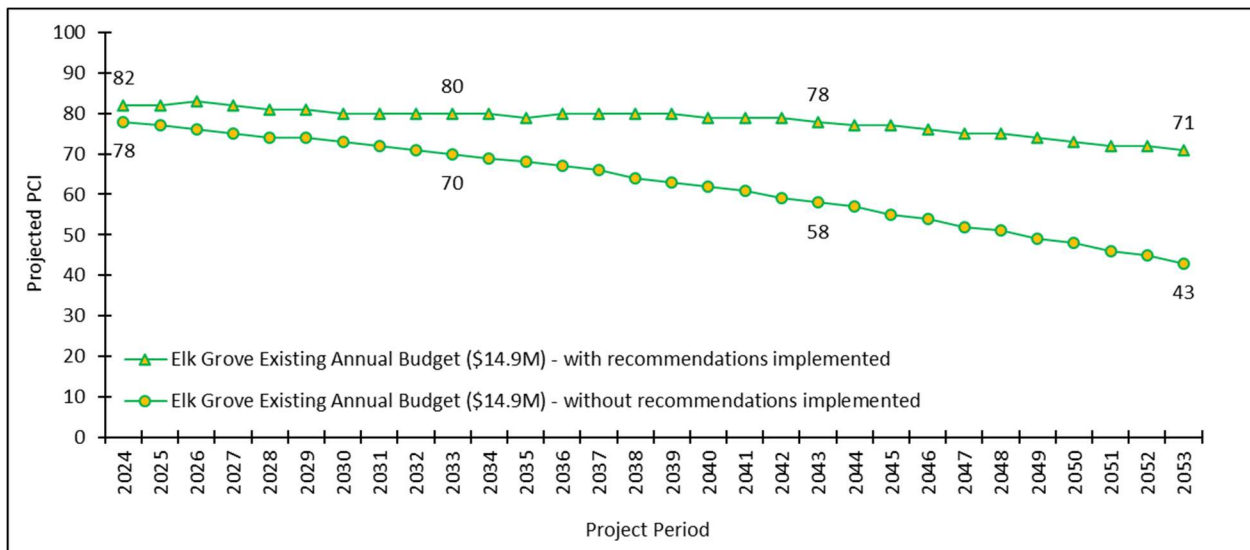


Figure 17. Case Study PCI Results for City of Elk Grove

The practices and strategies recommended in this report are more in line with the city of Elk Grove’s standard practices than those typical of the region. For instance, in addition to securing funding for new developments through CFDs, the city also employs simple cost-saving measures to reduce the cost of preventive maintenance treatments such as crack and slurry seals. Since a significant portion of the city’s streets are in “Good” condition (more than three-quarters of the network), the city places importance on preservation by performing preventive maintenance treatments on a 7-year cycle. This is in combination with performing maintenance and reconstruction on streets with low PCIs. The City is also proactive in collecting pavement condition data regularly (half of the arterials and collectors as well as a quarter of the residential are inspected annually) and the M&R strategies and costs in the decision tree are reviewed and updated annually. These strategies and efforts along with making pavement maintenance a priority for funding have enabled the city to steadily increase their PCI from a 68 in 2015 to a 77 in 2023.

Appendix A

Regional Decision Tree

Decision Tree

Printed: 3/13/2024

Functional Class	Surface	Condition Category	Treatment Type	Treatment	Cost/Sq Yd, except Seal Cracks in LF:	Yrs Between Crack Seals	Yrs Between Surface Seals	# of Surface Seals before Overlay	
Arterial	AC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	3			
			Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.50		6		
			Restoration Treatment	DO NOTHING	\$0.00			99	
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$14.25		6		
		III - Good, Load Related		MILL AND THIN OVERLAY	\$52.00				
			IV - Poor		MILL AND THICK OVERLAY	\$70.75			
	V - Very Poor			FDR W/ HMA OVERLAY	\$105.25				
	AC/AC		I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	3		
				Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.50		6	
				Restoration Treatment	DO NOTHING	\$0.00			99
			II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$14.25		6	
			III - Good, Load Related		MILL AND THIN OVERLAY	\$52.00			
			IV - Poor		MILL AND THICK OVERLAY	\$70.75			
			V - Very Poor		FDR W/ HMA OVERLAY	\$105.25			
	Arterial	AC/PCC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	3		
Surface Treatment				SURFACE SEAL (SLURRY/MICRO)	\$7.50		6		
Restoration Treatment				DO NOTHING	\$0.00			99	
II - Good, Non-Load Related				SURFACE SEAL W/ DIGOUTS	\$14.25		6		
III - Good, Load Related				SURFACE SEAL W/ DIGOUTS	\$20.25		6		
			IV - Poor		MILL AND OVERLAY	\$81.00			
V - Very Poor				MILL AND OVERLAY	\$81.00				
PCC			I - Very Good	Crack Treatment	DO NOTHING	\$0.00	3		
				Surface Treatment	DO NOTHING	\$0.00		15	
				Restoration Treatment	DO NOTHING	\$0.00			99
			II - Good, Non-Load Related		RUBBER CAPE SEAL	\$18.50		6	
			III - Good, Load Related		RUBBER CAPE SEAL	\$18.50		6	
			IV - Poor		AC OVERLAY W/ SLAB REPAIR	\$78.25			
			V - Very Poor		AC OVERLAY W/ SLAB REPAIR	\$78.25			

- Functional Class and Surface combination not used
- Selected Treatment is not a Surface Seal

Decision Tree

Printed: 3/13/2024

Functional Class	Surface	Condition Category	Treatment Type	Treatment	Cost/Sq Yd, except Seal Cracks in LF:	Yrs Between Crack Seals	Yrs Between Surface Seals	# of Surface Seals before Overlay
Collector	AC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4		
			Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.25		7	
			Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$13.75			
		III - Good, Load Related		MILL AND THIN OVERLAY	\$41.75			
		IV - Poor		MILL AND THICK OVERLAY	\$63.50			
		V - Very Poor		FDR W/ HMA OVERLAY	\$80.00			
	AC/AC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4		
			Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.25		7	
			Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$13.75			
		III - Good, Load Related		MILL AND THIN OVERLAY	\$41.75			
		IV - Poor		MILL AND THICK OVERLAY	\$63.50			
		V - Very Poor		FDR W/ HMA OVERLAY	\$80.00			
	AC/PCC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4		
			Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.25		7	
			Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$13.75		7	
		III - Good, Load Related		SURFACE SEAL W/ DIGOUTS	\$19.50		7	
		IV - Poor		MILL AND OVERLAY	\$70.00			
		V - Very Poor		MILL AND OVERLAY	\$70.00			
	PCC	I - Very Good	Crack Treatment	DO NOTHING	\$0.00	9		
			Surface Treatment	DO NOTHING	\$0.00		15	
			Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		RUBBER CAPE SEAL	\$18.50		7	
		III - Good, Load Related		RUBBER CAPE SEAL	\$18.50		7	
		IV - Poor		AC OVERLAY W/ SLAB REPAIR	\$62.50			
		V - Very Poor		AC OVERLAY W/ SLAB REPAIR	\$62.50			

- Functional Class and Surface combination not used
- Selected Treatment is not a Surface Seal

Decision Tree

Printed: 3/13/2024

Functional Class	Surface	Condition Category	Treatment Type	Treatment	Cost/Sq Yd, except Seal Cracks in LF:	Yrs Between Crack Seals	Yrs Between Surface Seals	# of Surface Seals before Overlay
Residential/Local	AC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4		
			Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.00		8	
			Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$13.25		8	
		III - Good, Load Related		RUBBER CAPE SEAL	\$22.50		8	
		IV - Poor		MILL AND THICK OVERLAY	\$60.50			
		V - Very Poor		RECONSTRUCT STRUCTURE (AC)	\$72.50			
	AC/AC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4		
			Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.00		8	
			Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$13.25		8	
		III - Good, Load Related		RUBBER CAPE SEAL	\$22.50		8	
		IV - Poor		MILL AND THICK OVERLAY	\$60.50			
		V - Very Poor		RECONSTRUCT STRUCTURE (AC)	\$72.50			
	AC/PCC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4		
			Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.00		8	
			Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$13.25		8	
		III - Good, Load Related		SURFACE SEAL W/ DIGOUTS	\$17.25		8	
		IV - Poor		MILL AND OVERLAY	\$59.50			
		V - Very Poor		MILL AND OVERLAY	\$59.50			
	PCC	I - Very Good	Crack Treatment	DO NOTHING	\$0.00	4		
			Surface Treatment	DO NOTHING	\$0.00		15	
			Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		RUBBER CAPE SEAL	\$18.50		8	
		III - Good, Load Related		RUBBER CAPE SEAL	\$18.50		8	
		IV - Poor		AC OVERLAY W/ SLAB REPAIR	\$46.50			
		V - Very Poor		AC OVERLAY W/ SLAB REPAIR	\$46.50			

- Functional Class and Surface combination not used
- Selected Treatment is not a Surface Seal

Decision Tree

Printed: 3/13/2024

Functional Class	Surface	Condition Category	Treatment Type	Treatment	Cost/Sq Yd, except Seal Cracks in LF:	Yrs Between Crack Seals	Yrs Between Surface Seals	# of Surface Seals before Overlay	
Other	AC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4			
			Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.00		8		
			Restoration Treatment	DO NOTHING	\$0.00			99	
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$13.25		8		
		III - Good, Load Related		RUBBER CAPE SEAL	\$22.50		8		
		IV - Poor		MILL AND THICK OVERLAY	\$60.50				
		V - Very Poor		RECONSTRUCT STRUCTURE (AC)	\$72.50				
		AC/AC	I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4		
				Surface Treatment	SURFACE SEAL (SLURRY/MICRO)	\$7.00		8	
				Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		SURFACE SEAL W/ DIGOUTS	\$13.25		8		
		III - Good, Load Related		RUBBER CAPE SEAL	\$22.50		8		
		IV - Poor		MILL AND THICK OVERLAY	\$60.50				
		V - Very Poor		RECONSTRUCT STRUCTURE (AC)	\$72.50				
		AC/PCC		I - Very Good	Crack Treatment	SEAL CRACKS	\$1.50	4	
Surface Treatment	SURFACE SEAL (SLURRY/MICRO)				\$7.00		8		
Restoration Treatment	DO NOTHING				\$0.00			99	
II - Good, Non-Load Related				SURFACE SEAL W/ DIGOUTS	\$13.25		8		
III - Good, Load Related				SURFACE SEAL W/ DIGOUTS	\$17.25		8		
		IV - Poor		MILL AND OVERLAY	\$59.50				
		V - Very Poor		MILL AND OVERLAY	\$59.50				
		PCC	I - Very Good	Crack Treatment	DO NOTHING	\$0.00	9		
				Surface Treatment	DO NOTHING	\$0.00		15	
				Restoration Treatment	DO NOTHING	\$0.00			99
		II - Good, Non-Load Related		RUBBER CAPE SEAL	\$18.50		8		
		III - Good, Load Related		RUBBER CAPE SEAL	\$18.50		8		
		IV - Poor		AC OVERLAY W/ SLAB REPAIR	\$46.50				
		V - Very Poor		AC OVERLAY W/ SLAB REPAIR	\$46.50				

- Functional Class and Surface combination not used
- Selected Treatment is not a Surface Seal