2025
Pavement Management
Report

for

The City of Canon City
Public Works Department

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1 Introduction

The City of Canon City (City) maintains an extensive road network consisting of approximately 104.9 center-line miles of paved roads. Approximately 100.6 miles have an AC surface and 4.3 centerline-miles have a PCC surface. This road network is a major City asset that requires ongoing maintenance and rehabilitation to provide a desirable level of service to the traveling public. The City also maintains 34 at-grade parking lots with a total paved area of 556,356 square feet.

In April 2025, the City commissioned MDS Technologies, Inc. (MDST) to evaluate the condition of the City's road network and estimate the effect that various pavement rehabilitation budgets would have on the long-term condition of the road network. The project also included creation of a 12-year pavement rehabilitation plan. We also assessed the condition of the City's parking lots.

The processes used to perform this analysis are described below. Key findings of the study are also provided and discussed in this report.

MDST used the PAVER pavement management application to perform the analysis needed for this project. The data and analysis results discussed in this report have been provided to the City in both Excel spreadsheet and GIS format.

2 Field Data Collection

The City provided MDST with a GIS pavement centerline file that defined the roads belonging to the City. This file was loaded into a cell-phone app that also allowed the streets driven by the vehicle operator to be tracked. This allowed the vehicle operator to track progress of the field work and ensure that all roads maintained by the City were evaluated.

A roof mounted camera was used to capture high resolution, geo-referenced digital images of the road surface and adjacent right-of-way in JPG format. Images were captured at half second intervals so that each image partially overlapped the previous one, thus ensuring full coverage of the entire surface of each road. The image capture process was monitored in real time by the vehicle operator to ensure that the quality of the captured images met the standard required for pavement condition assessment in the office.

Field data collection was performed on April 9th and 10th, 2025.

3 Pavement Condition Assessment Method

The location of each image was acquired through GPS technology and stored in each JPG image as images were captured in the field. Once in the office, the location data was extracted from each JPG image and loaded into GIS. This allowed the images to be associated with the corresponding road segment.

MDST staff analyzed the sequential images to determine the type, severity, and extent of the distresses that existed on a road segment. This data was then loaded into the PAVER system and used to calculate a numeric score representing the condition of each road segment.

The condition of each road segment is reflected in its Pavement Condition Index (PCI) score. The method used to calculate the PCI was originally developed by the US Army Corps of Engineers and is now standardized in ASTM D6433. This method of pavement condition evaluation is used by hundreds of municipal governments across the country. Using this method, the severity and extent of up to twenty (20) types of distresses are visually assessed. The distresses assessed using the ASTM D6433 method are shown in Table 1.

Table 1
Pavement Distress Evaluated in ASTM D6433

AC Pavements	PCC Pavements
Alligator Cracking	Blowup/Buckling
Bleeding	Corner Break
Block Cracking	Divided Slab
Bumps and Sags	Durability "D" Cracking
Corrugation	Faulting
Depression	Joint Seal Damage
Edge Cracking	Lane/Shoulder Drop Off
Joint Reflection Cracking	Linear Cracking
Lane/Shoulder Drop Off	Large Patching
Longitudinal/Transverse Cracking	Small Patching
Patching and Utility Cut Patching	Polished Aggregate
Polished Aggregate	Popouts
Potholes	Pumping
Railroad Crossing	Punchouts
Rutting	Railroad Crossing
Shoving	Scaling/Map Cracking/Crazing
Slippage Cracking	Shrinkage Cracking
Swell	Corner Spalling
Weathering	Joint Spalling
Raveling	

The PCI model calculates a numeric score on a scale of one hundred (100) to zero (0). A score of 100 indicates that a pavement is exhibiting no distress and a score of 0 indicates that a pavement is very heavily distressed. The PCI scale can be broken down into ranges and corresponding condition categories as shown in Table 2.

Table 2
PCI Ranges and Corresponding Condition Category

PCI Range	Condition Category
85 - 100	Good
70 - 85	Satisfactory
55 - 70	Fair
40 - 55	Poor
25 - 40	Very Poor
10 - 25	Serious
0 -10	Failed

4 Results of Pavement Condition Analysis

The results of the current condition analysis for the City's roads and parking lots are discussed below. It is important to note that the PCI score of each segment and parking lot represents its condition at the time that the condition data was collected in April 2025.

4.1 Road Network

The condition of the City's 104.9 centerline line mile road network is summarized in Figure 1. This bar chart shows the percentage of the City's roads that fall into the various PCI ranges or categories. The data is weighted by area to account for the fact that the segments vary in size. An image of a typical City road that falls into each of these categories is provided below to give context to the numbers.

Approximately 17.7 percent of the City's roads have a PCI score of 40 or less.   A PCI score of 40 or less indicates that a road segment falls into the Very Poor, Serious, or Failed category. Pavements in the high end of this range (PCI above 25) may be candidates for mill, base repair, and overlay. Reconstruction is an appropriate strategy for pavements at the low end of this range (PCI of 15 or less) since these pavements are experiencing significant structural deficiencies.

An additional 14.1 percent of the City's roads had a PCI score in the 40 to 55 range. Pavements with PCI scores in this range are considered to be in Poor condition. These pavements are typically candidates for some form of major rehabilitation such as mill and overlay. Base repair may or may not be necessary in these cases.
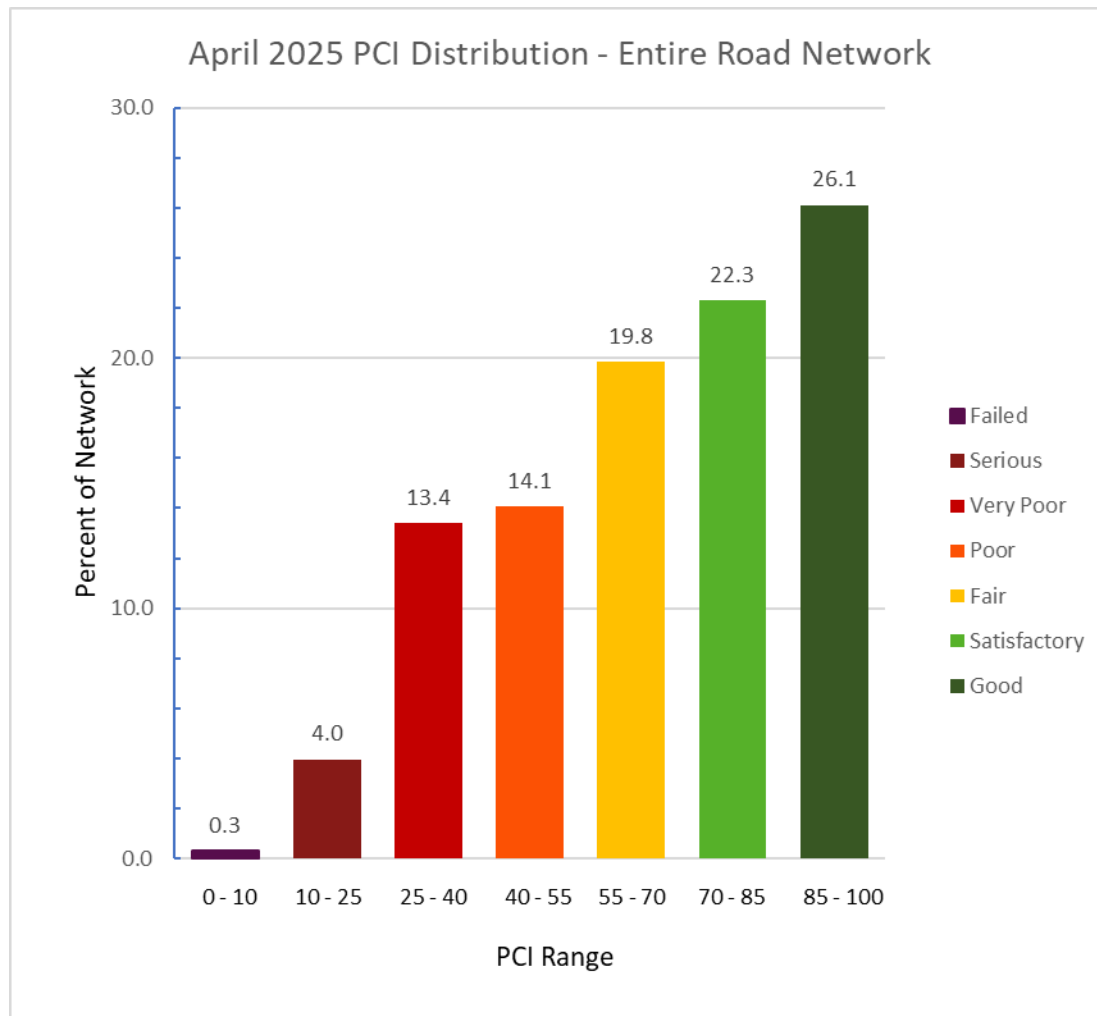
Figure 1: Condition of City Roads – April 2025

About 19.8 percent of the road network is in Fair condition with PCI scores in the range of 55 to 70. Roads in this condition may be candidates for major rehabilitation if a functional or structural deficiency exists, or they may be candidates for a preventative maintenance treatment that temporarily halts or slows deterioration. These pavements are at a critical point in their service lives. The cost to administer an effective maintenance/rehabilitation strategy to these pavements may still be relatively low. However, if continued deterioration is allowed, the cost to properly rehabilitate these pavements can be expected to increase significantly in a relatively short period of time.

About 48.4 percent of the City's roads have a PCI score above 70 and are in Good or Satisfactory condition. Pavements that fall into these categories generally do not require rehabilitation. However, pavements in the low end of this range may be candidates for preventative maintenance such as chip seal.

Overall, the City's road network had an average PCI score of 66.9 as of April 2025.
To provide context to the PCI numbers, images of Canon City roads that fall into each PCI category are shown below in Figures 2 through 8.
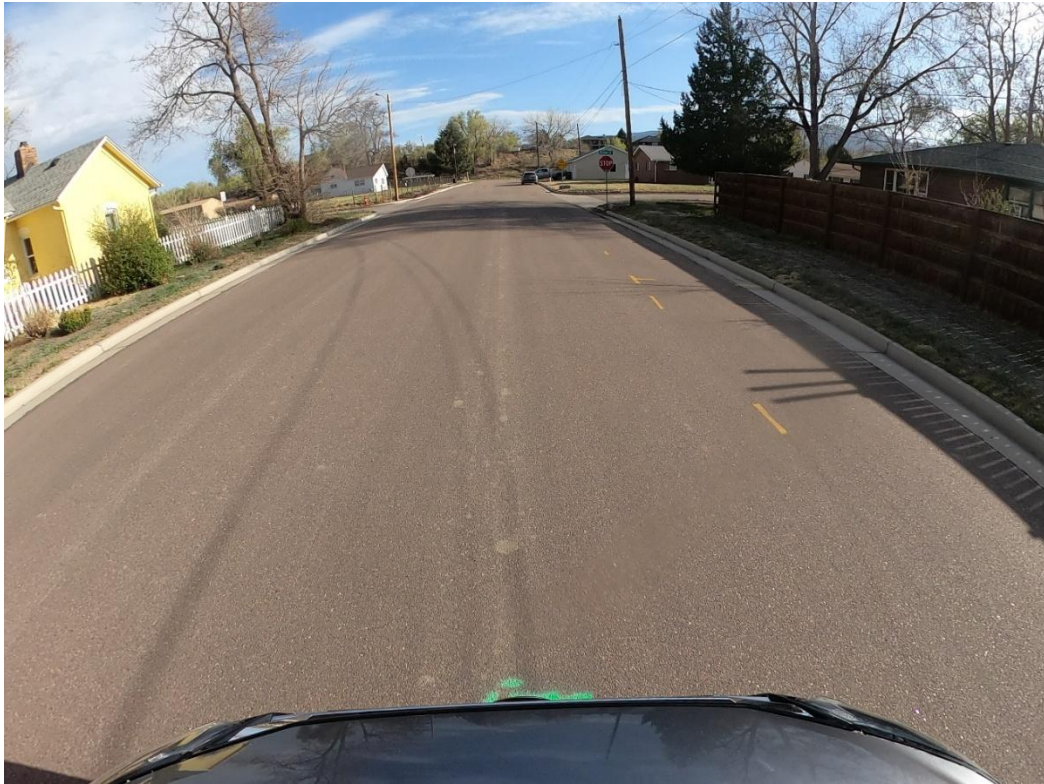
Figure 2: PCI Range 85 to 100 – Good
S 8th St between Myrtle Ave and Bridge St – PCI = 100

Figure 3: PCI Range 70 to 85 – Satisfactory
N 5th St between High St and Skyline Loop – PCI = 76.9

Figure 4: PCI Range 55 to 70 – Fair
Wild Rose Dr between Bob White Loop and Blue Grouse Dr – PCI = 62.2

Figure 5: PCI Range 40 to 55 – Poor
Cameron Ct between Cameron Ave and West End– Actual PCI 48.0

Figure 6: PCI Range 25 to 40 – Very Poor
Independence Rd between Justice Center Rd and East End – PCI = 32.0

Figure 7: PCI Range 10 to 25 - Serious
S Cottonwood Ave between Fowler Ave and E Main St – Actual PCI 17.1

Figure 8: PCI Range 0 to 10 − Failed
Allison Ave between N 9th St and N 10th St − PCI 6.1

A map showing road condition with PCI ranges color coded in the same manner as the PCI distribution in Figure 1 is provided in Figure 9.

A GIS file and Excel spreadsheet containing this information has been provided to the City.

4.2 Parking Areas

MDST also assessed the condition of 34 at-grade parking lots that together have a paved areas of approximately 556,256 square feet. The PCI scores for these parking lots range from 18.0 (Serious Condition) at Mountain View Park to 100 (Good Condition) at Centennial Park. The PCI score for each parking lot is provided in Table 3.

A GIS file and Excel spreadsheet containing this information has been provided to the City.

Table 3
PCI Scores for Parking Lots

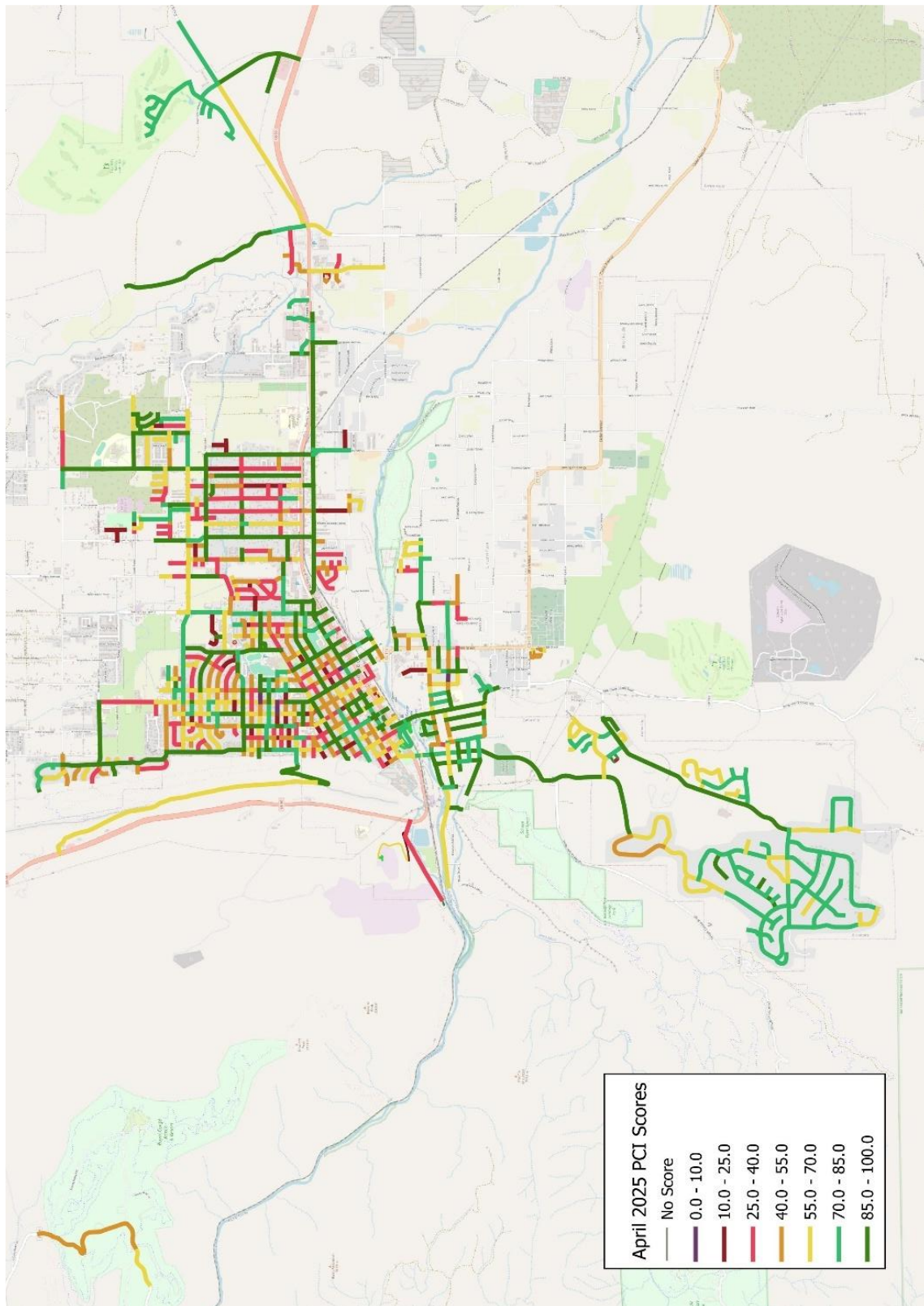| Cart. ID	Name	Lot	Road Type	Area (sq ft)	PCI
40	Mountain View Park	Entrance road	AC	10856.1	18.0
41	Water Treatment Plant	Holcim Access Road	AC	29759.4	18.1
17	Mountain View Park		AC	56511.5	23.9
23	Rudd Park		AC	9482.6	23.9
25	816 RGB		AC	3480.3	27.6
2	Police Dept	Front (East)	AC	17350.4	28.2
8	Museum	Alley	AC	4541	29.2
27	402 Valley Road	Southwest Lot	AC	16260	29.7
3	Police Annex	Parking Lot	AC	17327.8	30.0
7	Museum	East Lot	AC	6487.9	32.0
9	Museum	Southwest Lot	AC	1122	33.3
33	Public Works	west lot	AC	73044.6	44.8
1	Police Dept	Back (West)	AC	22583.5	46.3
32	Equipment Repair Shop		AC	17751.8	49.0
12	Spencer's Sports		AC	12130.2	49.5
6	Museum	Back Lot (Behind Museum)	AC	2166.4	52.3
38	Public Works	Fuel station	AC	13563.3	59.4
42	530 Royal Gorge Blvd.		AC	9058.8	62.5
15	Public Works	Front (East)	AC	10354.1	64.8
10	Museum	Southeast Lot	AC	2571.8	68.0
36	Water Treatment Plant	Access Road	AC	41530.2	68.4
4	City Hall	West Lot	AC	5433.4	71.9
35	Water Treatment Plant	East Lot	AC	10617.9	72.4
5	City Hall	South Lot (US50)	AC	17387.9	78.9
13	Train Parking		AC	60976.2	79.2
34	Tunnel Drive		AC	6994.2	85.7
28	402 Valley Road	Northwest Lot	PCC	11044	90.7
22	Library		AC	4111.9	95.5
11	Peabody Mansion Lot		PCC	22183.4	96.0
29	402 Valley Road	Southeast Lot	PCC	9616.2	99.0
18	Centennial Park	West Lot	AC	17811.3	100.0
19	Centennial Park	Tennis Courts	AC	5282.1	100.0
20	Centennial Park	Pond	AC	1280	100.0
21	Centennial Park	Splash Pad	AC	5583.5	100.0

Figure 9: Road Condition by Segment

5 Pavement Deterioration Model

Pavement deterioration models were used in the analysis to predict future PCI scores. The model used for pavements with an Asphaltic Concrete surface is shown in Figure 10. This is a typical model available in PAVER that is built on the premise that asphalt pavements are designed for a 20-year life.   The curve below shows that after 20 years the PCI deteriorates to a score of about 50 which is the point at which a pavement typically requires significant rehabilitation.

The City also maintains roads with a PCC surface. These segments were assigned to a different curve that represents the longer life expectancy of PCC pavements. Equations that describe both curves are shown in Figure 10.
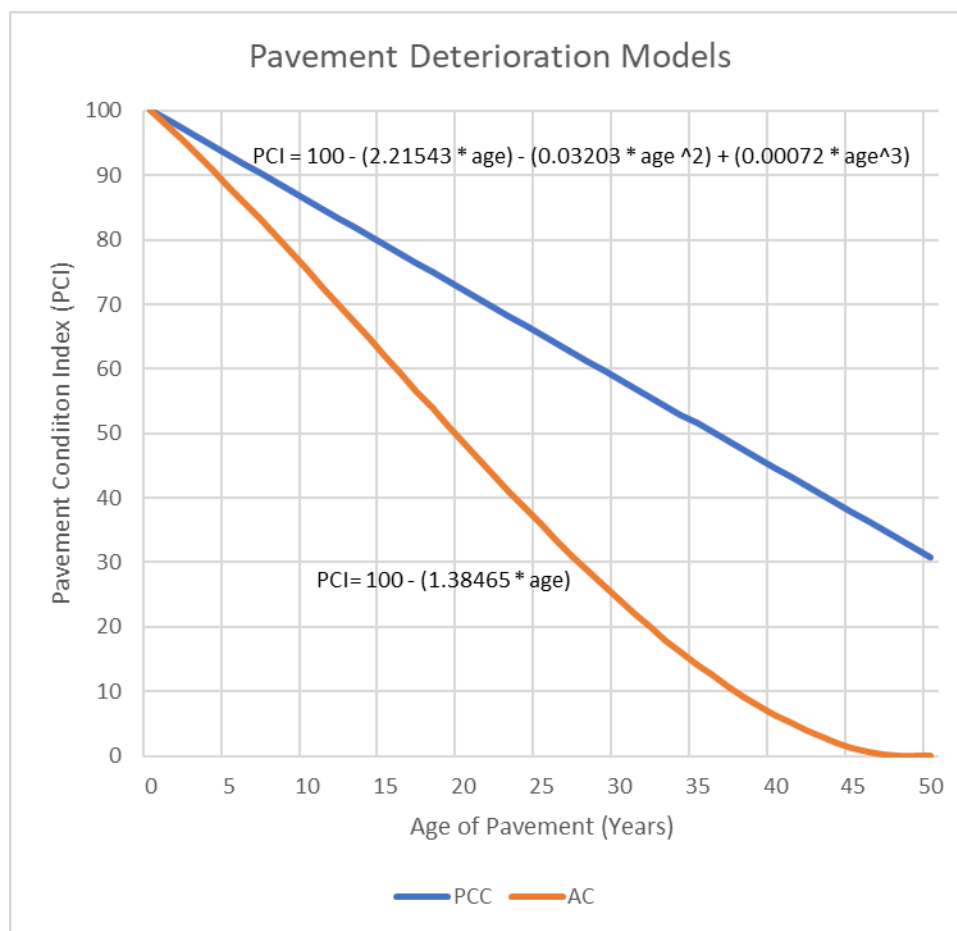

Figure 10 chart: Pavement Deterioration Models

PCI = 100 - (2.21543 * age) - (0.03203 * age ^2) + (0.00072 * age^3)

PCI= 100 - (1.38465 * age)

Figure 10: AC and PCC Pavement Deterioration Models

6 Budget Analysis Parameters

The PAVER system can analyze the impact that a budget/funding scenario will have on the future condition of a road network. Several budget scenarios were analyzed as part of this project. Prior to conducting this analysis, the system was configured to reflect the conditions, policies, and practices of the City as described below.

General Inputs

All budget scenarios were run over a 12-year period from August 2025 to July 2036. The analysis was run in manner in which the program prioritizes segments with higher PCI scores first since pavements higher up on the performance curve typically cost less to maintain. However, the program was not allowed to consider roads with a PCI score above 45 for Reconstruction, Full Depth Reclamation (FDR), or Mill and Overlay.

PAVER allows a portion of the total budget to be allocated to "Global" Maintenance and Rehabilitation (M&R) and "Major" M&R.   Global M&R encompasses strategies that cover the entire surface area of a pavement but do not provide strengthening. They also do not restore the pavement to its original profile. Chip Sealing and other forms of surface treatment are considered Global M&R strategies. Major M&R encompasses strategies that do provide a strengthening component and they also restore the pavement to its original (or a new) profile. Reconstruction and Mill and Overlay are examples of Major M&R.

For each budget analyzed for this project, 16.7 percent of the budget was allocated to Global M&R and 83.3 percent of the budget was allocated to Major M&R.

Rehabilitation Strategies and Unit Costs

The pavement rehabilitation actions currently used by the City are Chip Seal, Mill and Overlay, FDR, and Reconstruction. The rehabilitation strategies and unit costs used in the analysis are shown in Table 4 below. The unit cost for each strategy was provided by City staff. These unit costs include an allocation for localized subgrade repair, curb and gutter removal and replacement and sidewalk removal and replacement.

Table 4
Rehabilitation Strategies and Unit Costs

Rehabilitation Strategy	PCI Range	Unit Cost ($/ft^2)	Effect on PCI
Chip Seal	65 – 90	$2.22	Hold for 6 Years[1]
Mill and Overlay	25 - 45	$5.56	Increase to 100
Full Depth Reclamation	10 - 25	$16.67	Increase to 100
Reconstruction	0 - 10	$27.78	Increase to 100

[1] PAVER boosts the PCI score by the number required so that PCI returns to the original score at the end of the hold period. Therefore, application of a Chip Seal treatment on a segment increases the overall PCI of the network.

Budget Scenarios

Analysis was performed on three budget scenarios using the PAVER system. The budget scenarios analyzed were:

1. Zero Expenditure
2. $500,000 Annually (without one percent street sales tax)
3. $6.0 Million Annually (with one percent street sales tax)

The City has already determined its pavement rehabilitation program for 2025 and 2026. Several road segments from the 2025 and 2026 rehabilitation program have been deferred by the City. For analysis purposes, it was assumed that these segments will be reconstructed as part of the 2027 program. These road segments, and their associated reconstruction cost, were included in the analysis of all budget scenarios. In the case of the $500,000 budget and the $6.0M budget, 16.7 percent of the annual budget was allocated to Global M&R.

Due to the uncertainties associated with predicting future construction costs, all analysis was done in 2025 dollars.

Analysis Results

The results of the analysis are provided below. Tables 5 through 7 provide the key outputs of the analysis for each budget scenario. In these tables, ”Ave PCI” is the average PCI score (weighted by area) for the entire road network after the rehabilitation program has been implemented for that year. The Average PCI of the road network was 66.9 in April 2025. “Percent Below 40” is the percentage of the road network that

would have a PCI score below 40 (Very Poor). Roads with a PCI score below 40 are considered to be deficient. This percentage was 17.7 in April 2025.

The network average PCI scores for each budget scenario are shown graphically in Figure 11.

Zero Expenditure Budget

The effect of a zero expenditure budget (after rehabilitation work that has already been committed to has been done) is shown in Table 5. A zero expenditure budget represents the worst case scenario and clearly shows the significant consequences of deferring rehabilitation over a significant period of time. In this scenario, the PCI of the network drops from 67.1 (Fair) in 2025 to 42.7 (Poor) in 2036, a decrease of 24.4 points on the PCI scale. The percentage of the network in a deficient state rises from 17 percent in 2026 to 46 percent in 2036, a 171 percent increase.   This very clearly underscores the importance of consistent investing in infrastructure renewal.

Table 5
Effect of Zero Expenditure Budget on Network Performance

Year	Budget ($M)			Network Performance	
	Major M&R	Global M&R	Total	Ave PCI	% ↓ 40
2025	$9.64	$0	$9.64	67.1	17
2026	$15.05	$0	$15.05	66.3	20
2027	$2.43	$0	$2.43	64.1	22
2028	$0	$0	$0	61.7	24
2029	$0	$0	$0	59.3	27
2030	$0	$0	$0	56.8	28
2031	$0	$0	$0	54.4	30
2032	$0	$0	$0	52.0	33
2033	$0	$0	$0	49.7	36
2034	$0	$0	$0	47.3	39
2035	$0	$0	$0	45.0	43
2036	$0	$0	$0	42.7	46

$500,000 Annual Budget

This is the budget expected by City staff if the one percent sale tax initiative is not adopted. In this scenario, the average PCI decreases from 67.2 (Fair) in 2025 to 46.7 (Poor) by 2036 as shown in Table 6. This is a decrease of 22.5 points on the PCI scale. The percentage of the network in a deficient state increases from 17 in 2025 to 44 in 2036. Funding at this level is clearly insufficient to maintain the network in a desirable state and would lead to a severe degradation of the network over time if implemented.

Table 6
Effect of $0.5 Million Annual Budget on Network Performance

Year	Budget ($M)			Network Performance	
	Major M&R	Global M&R	Total	Ave PCI	% ↓ 40
2025	$9.64	$0.08	$9.72	67.2	17
2026	$15.05	$0.08	$15.13	66.4	19
2027	$2.43	$0.08	$2.51	64.2	22
2028	$0.42	$0.08	$0.5	62.0	23
2029	$0.42	$0.08	$0.5	59.8	27
2030	$0.42	$0.08	$0.5	57.5	27
2031	$0.42	$0.08	$0.5	55.3	30
2032	$0.42	$0.08	$0.5	53.0	32
2033	$0.42	$0.08	$0.5	50.9	35
2034	$0.42	$0.08	$0.5	48.8	37
2035	$0.42	$0.08	$0.5	46.7	41
2036	$0.42	$0.08	$0.5	44.7	44

$6.0 Million Annual Budget

City staff expect an annual pavement M&R budget of $6.0M if the one percent sales tax initiative is adopted. The results of this analysis are shown in Table 7. In this scenario, the average PCI of the road network remains essentially constant over the 12 year analysis period. The percentage of the network with a PCI score increases from 17 to 21 in the first three years of the program and then steadily decreases to 13 in 2036. This is the level of funding required to maintain road network at its current condition level.

Table 7
Effect of $6.0 Million Annual Budget on Network Performance

Year	Budget ($M)			Network Performance	
	Major M&R	Global M&R	Total	Ave PCI	% ↓ 40
2025	$9.64	$1.0	$10.64	67.5	17
2026	$15.05	$1.0	$16.05	67.0	20
2027	$5.0	$1.0	$6.0	66.2	21
2028	$5.0	$1.0	$6.0	66.3	19
2029	$5.0	$1.0	$6.0	66.2	19
2030	$5.0	$1.0	$6.0	66.1	18
2031	$5.0	$1.0	$6.0	66.0	16
2032	$5.0	$1.0	$6.0	66.1	16
2033	$5.0	$1.0	$6.0	66.3	16
2034	$5.0	$1.0	$6.0	66.3	15
2035	$5.0	$1.0	$6.0	66.9	15
2036	$5.0	$1.0	$6.0	67.6	13

6 Twelve-Year Rehabilitation Plan

MDST created two 12-year pavement rehabilitation plan for the City beginning in 2025. One plan assumes an annual budget of $6.0 million will be available due to adoption of the one (1) per cent street sales tax. The other plan assumes a baseline budget of $0.5 million annually without adoption of the street sales tax. In both cases, the first two years (and part of the third year) of the plan consists of projects that have already been determined by the City. For the $6.0 million budget, beginning in 2027, approximately 10 to 20 percent of the budget was allocated to Reconstruction and FDR, 60 to 70 percent of the budget was allocated to Mill and Overlay, and 10 to 20 percent of the budget was allocated to Chip Sealing. For the $0.5 million budget, beginning in 2027, the entire budget was allocated to Chip Sealing as City staff have indicated that they would act to preserve as many roads as possible in that scenario.

Road segments were included in the programs based on their PCI score and a Priority Factor that was assigned based on functional classification and pavement condition as shown in Table 8. An Adjusted PCI score for each segment was determined by dividing the PCI score by the Priority Factor. Roads with the lowest Adjusted PCI scores were inserted into the rehabilitation plan first. Also, effort was made to group segments together to create a continuous corridor and/or area of upgraded pavement encompassing a number of road segments. This approach minimizes overall cost because it minimizes the amount of mobilization/demobilization that needs to be done by the contractor. Also, this approach is generally well received by the public.

A series of maps showing the 12-year rehabilitation plan for a $6.0 million annual budget are provided in Figures 12 through 15.   A second series of maps showing the 12-year rehabilitation plan for a $0.5 million annual budget are provided in Figures 16 through 19. Note that several parking lots are included in the $6.0 million program. No parking lots are included in the $0.5 million program.

This data has been provided to the City in both GIS and Excel spreadsheet format. Please refer to these files to see the rehabilitation strategy (i.e., reconstruction, full depth reclamation, mill and overlay, or chip seal) assigned to each segment.

Table 8
Segment Priority Factor

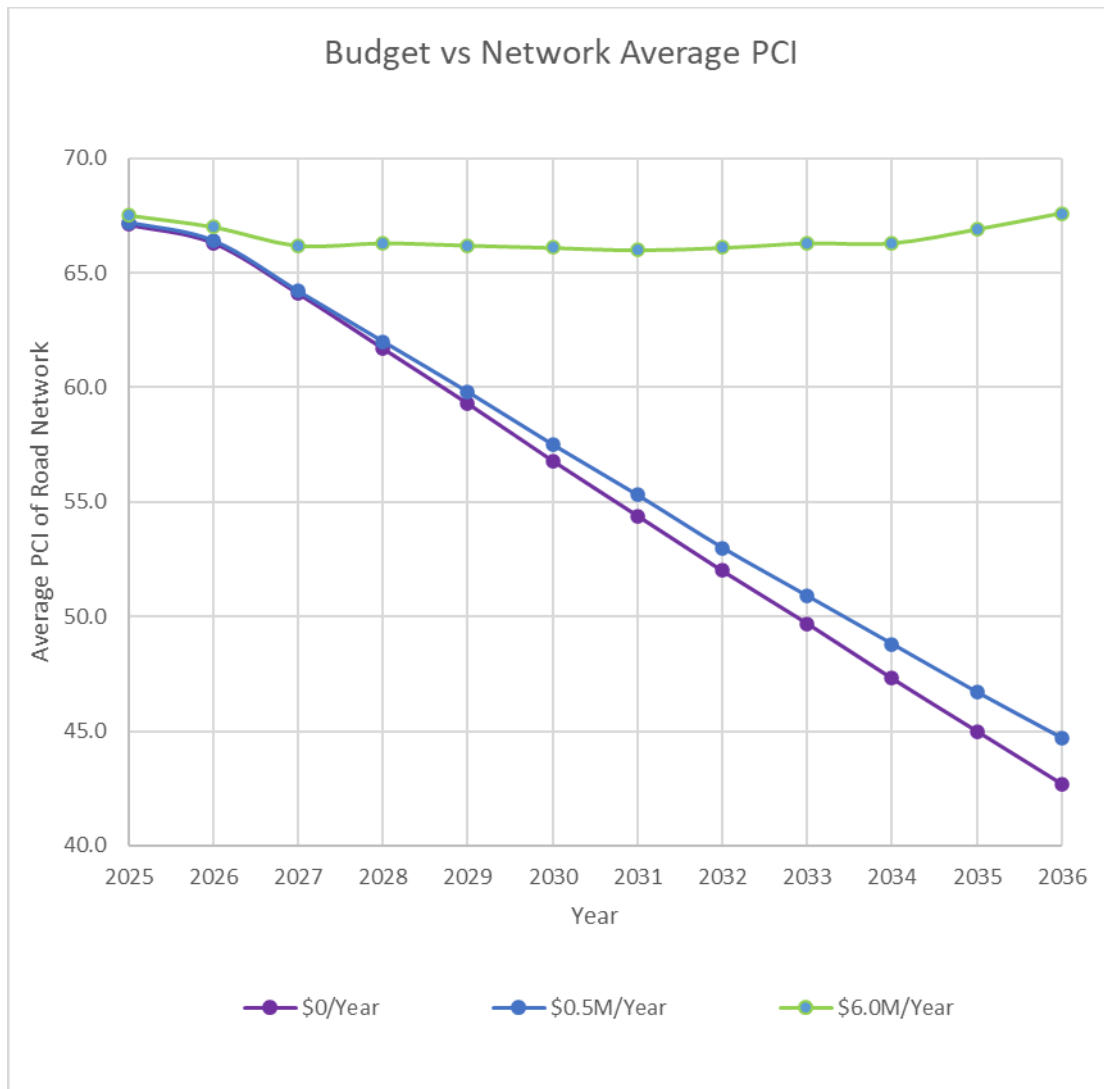| PCI Range	Arterial	Collector	Local
0 − 25	2.2	2.0	1.0
25 − 40	2.0	1.8	1.0
40 − 65	1.8	1.6	1.0
65 − 80	1.6	1.4	1.0
80 − 100	1.0	1.0	1.0

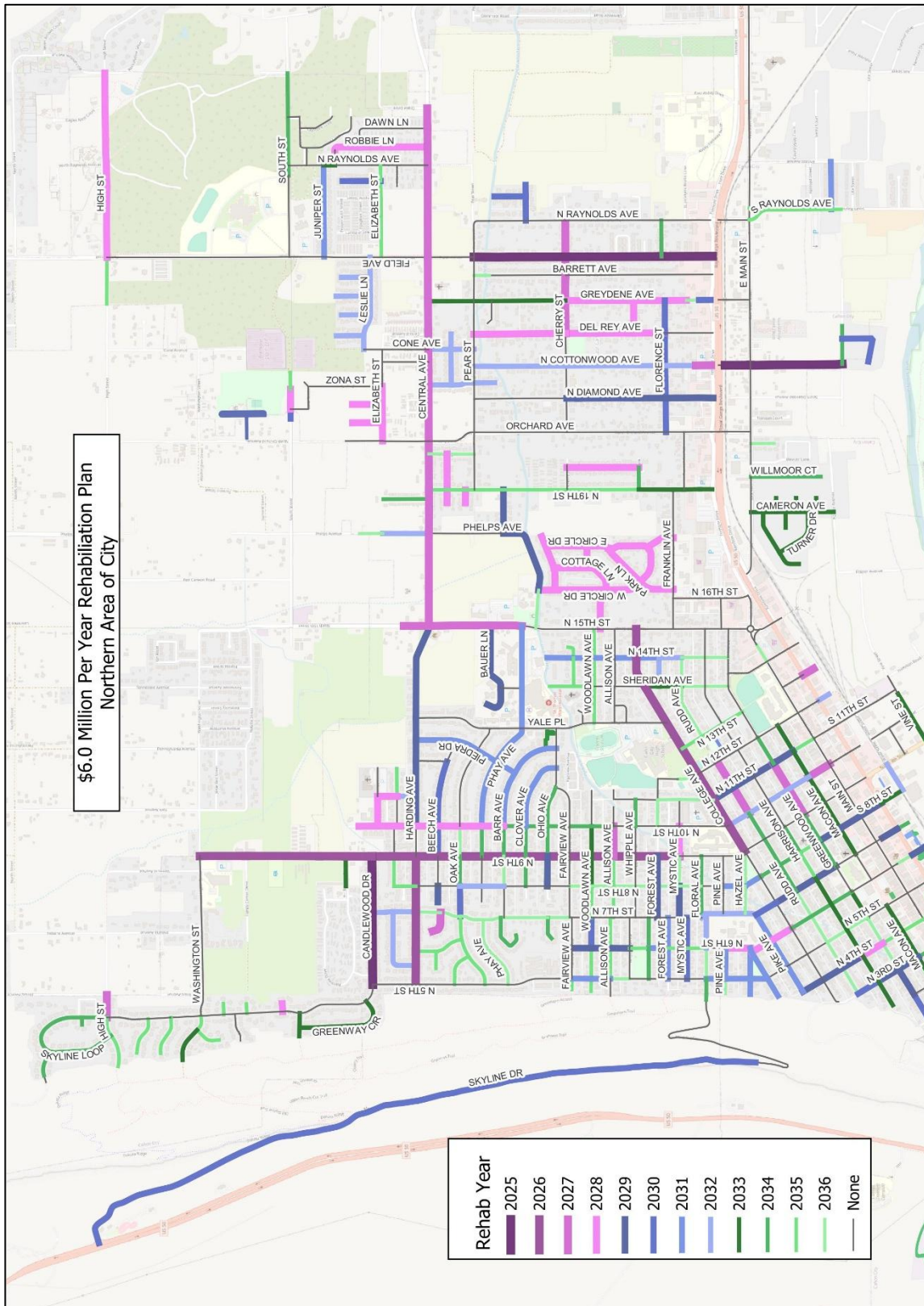**Figure 11: Effect of Various Budgets on Condition of Road Network**

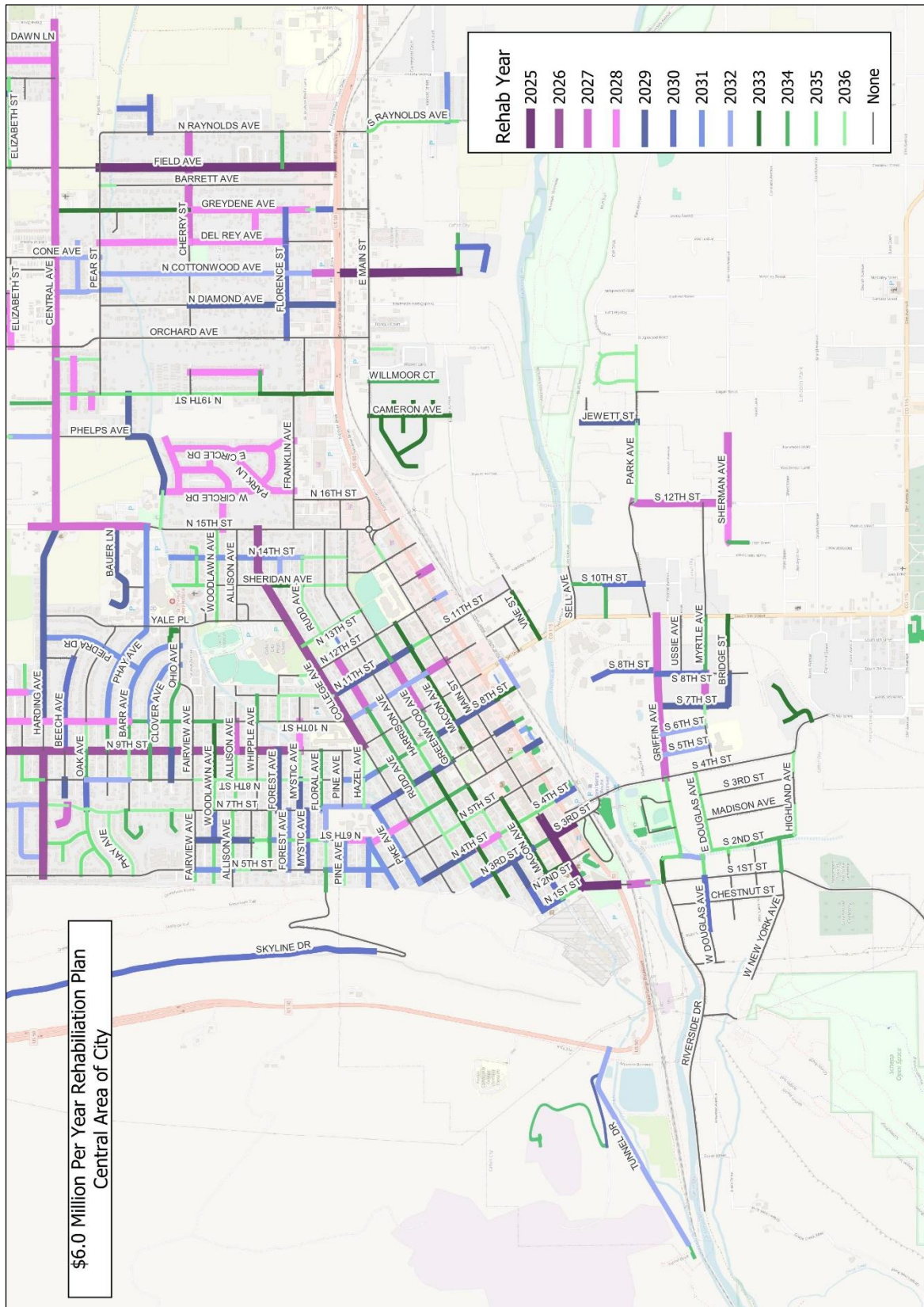**Figure 12: $6.0 Million/Year Rehabilitation Plan – Northern Area of City**

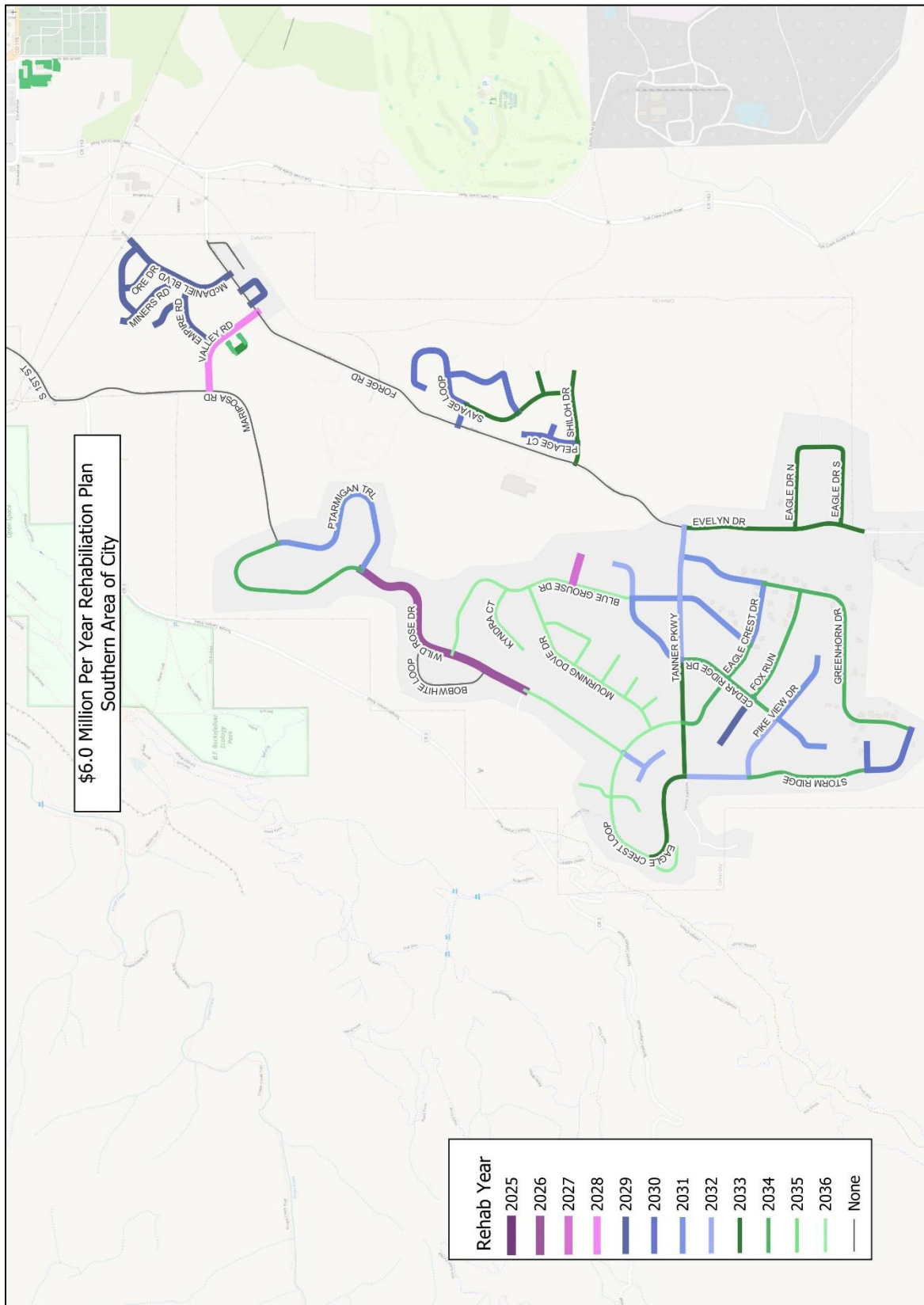**Figure 13: $6.0 Million/Year Rehabilitation Plan – Central Area of City**

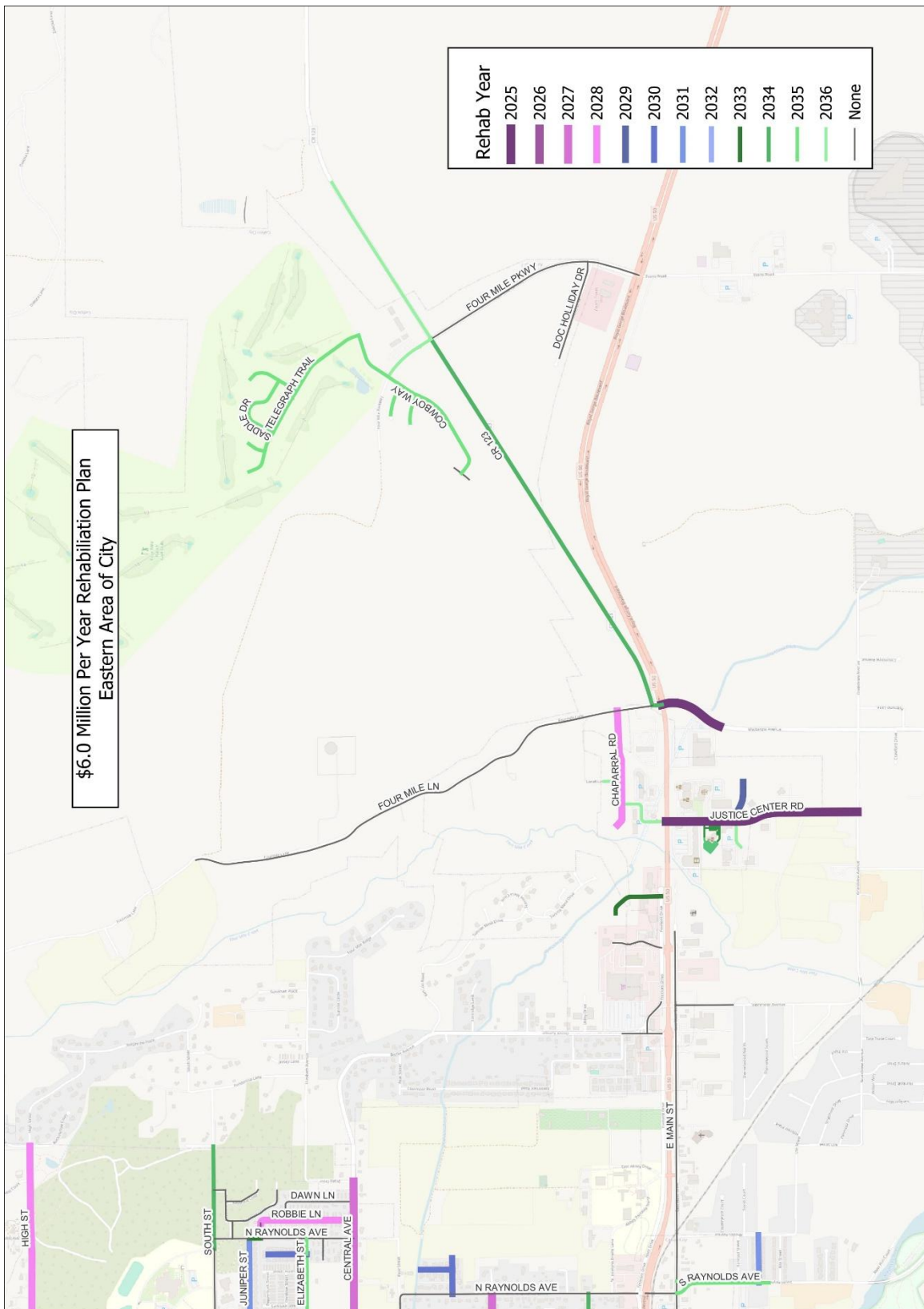**Figure 14: $6.0 Million/Year Rehabilitation Plan – Southern Area of City**

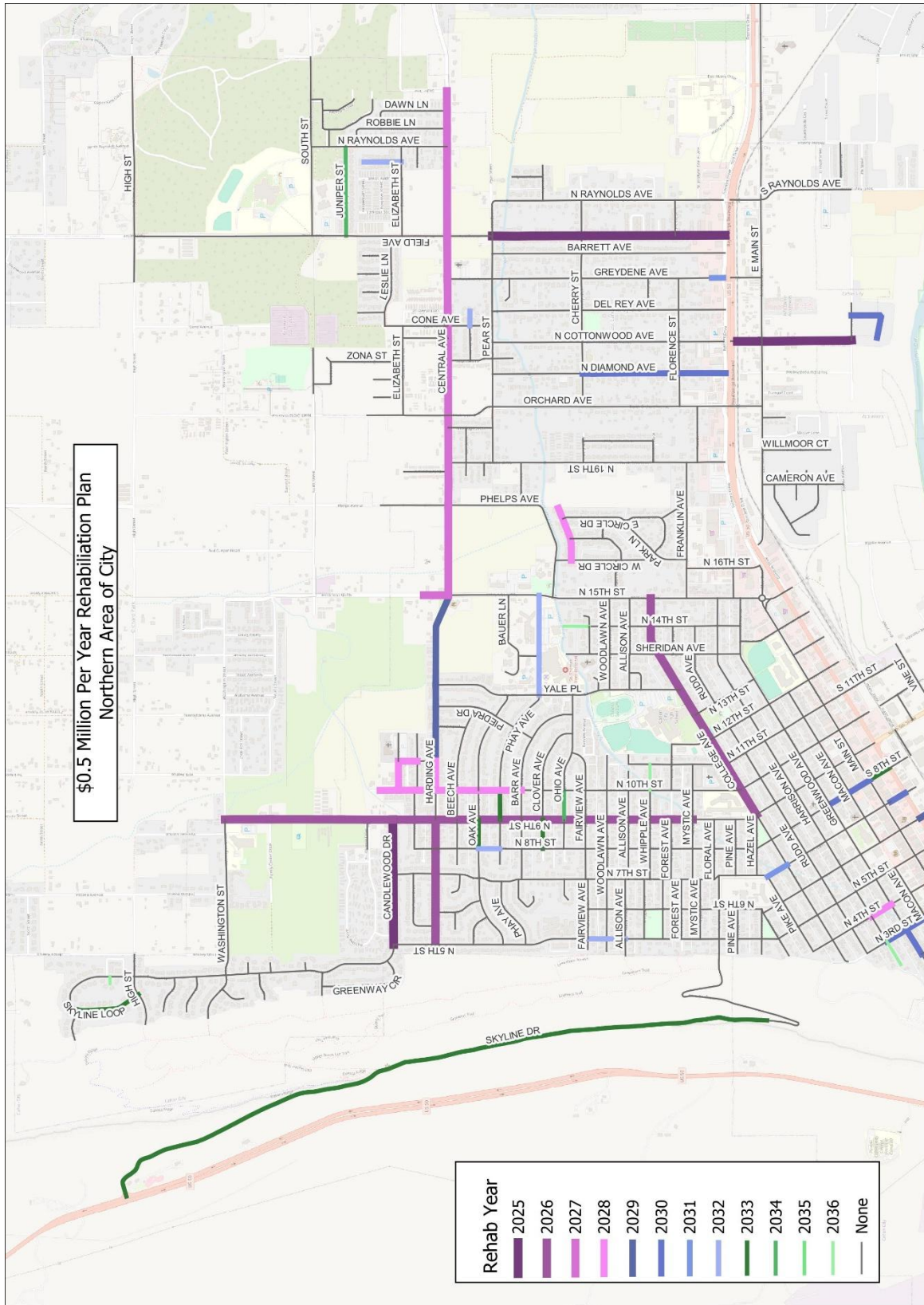**Figure 15: $6.0 Million/Year Rehabilitation Plan – Eastern Area of City**

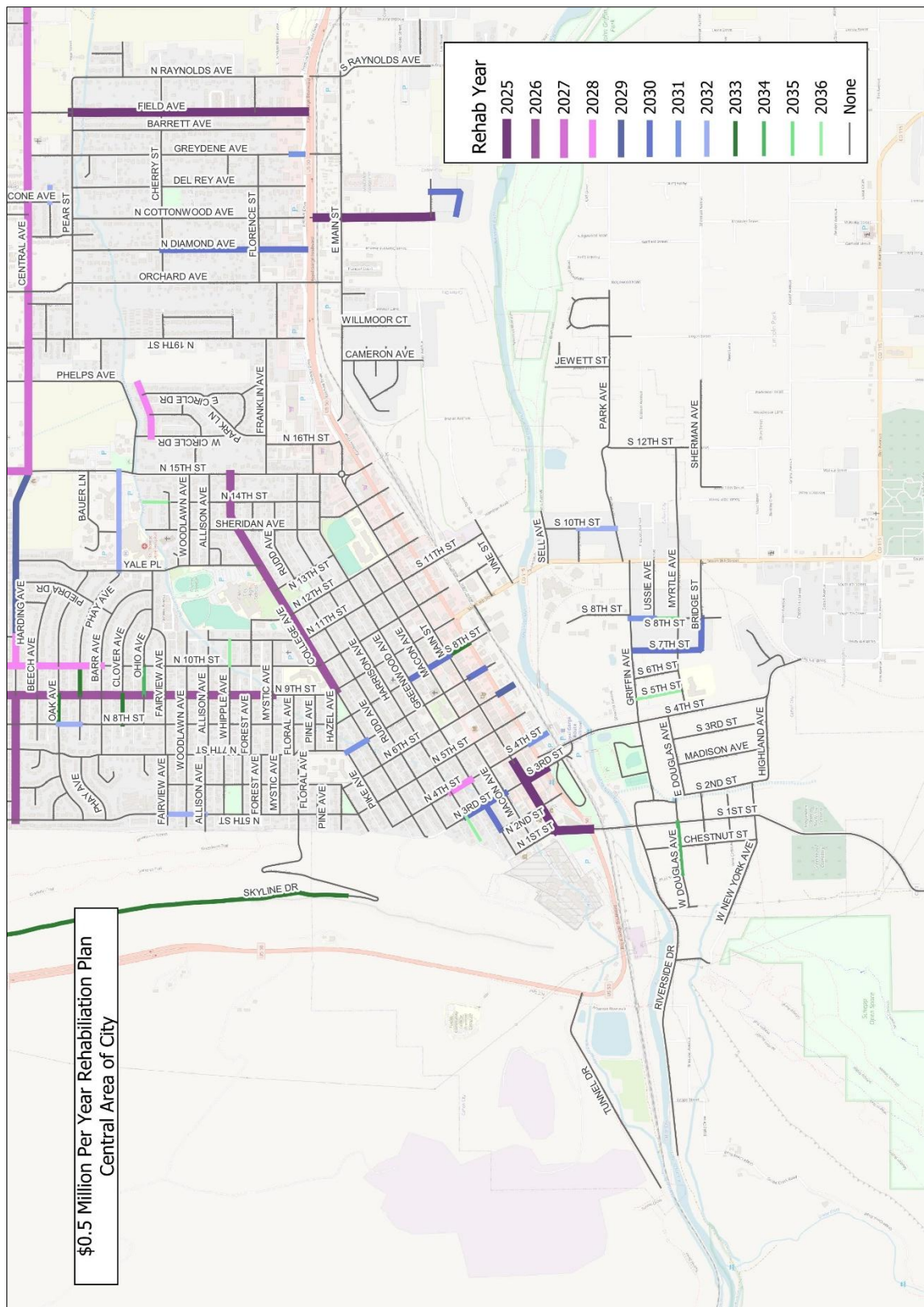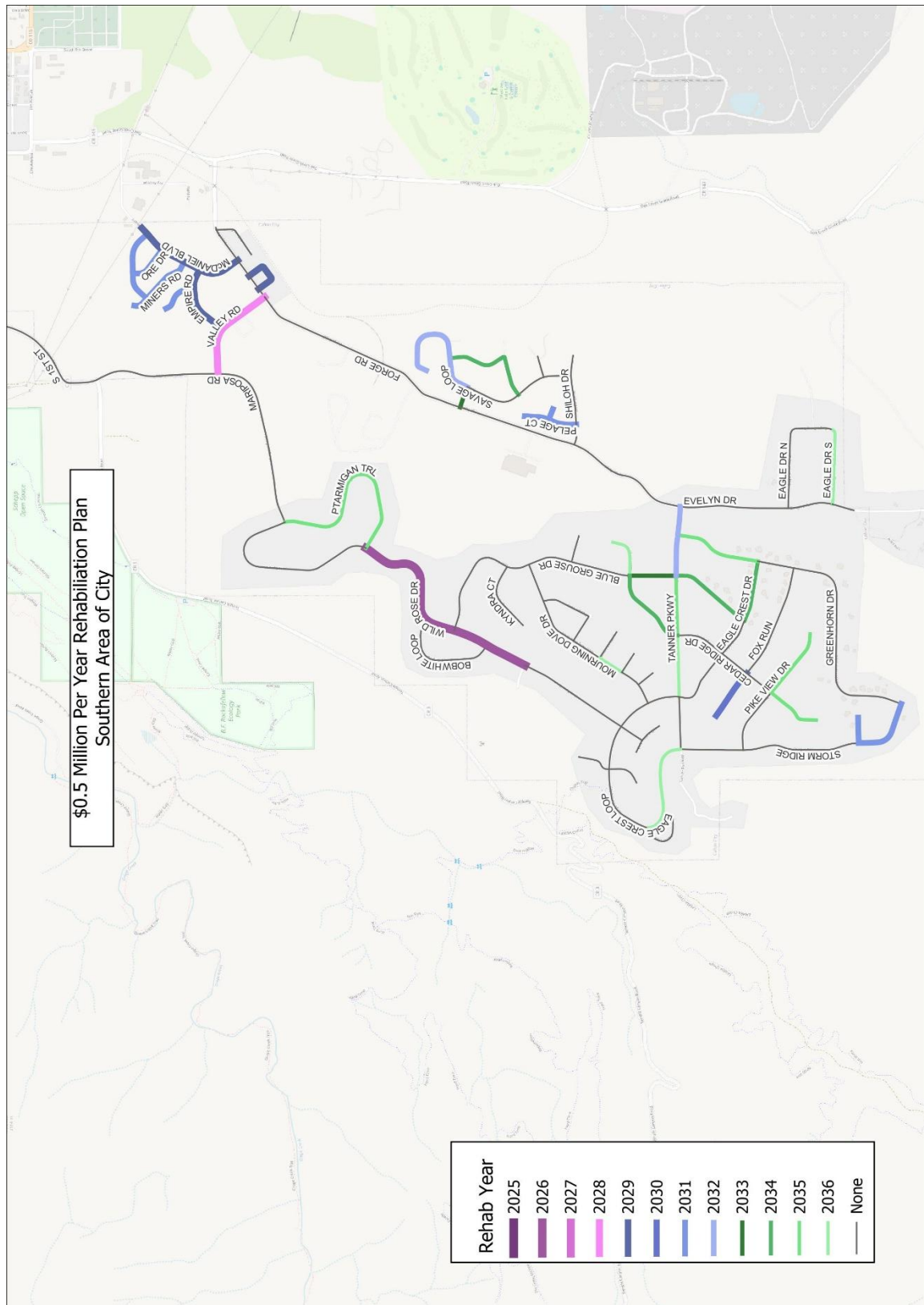**Figure 16: $0.5 Million/Year Rehabilitation Plan – Northern Area of City**

Figure 17: $0.5 Million/Year Rehabilitation Plan – Central Area of City

Figure 18: $0.5 Million/Year Rehabilitation Plan – Southern Area of City
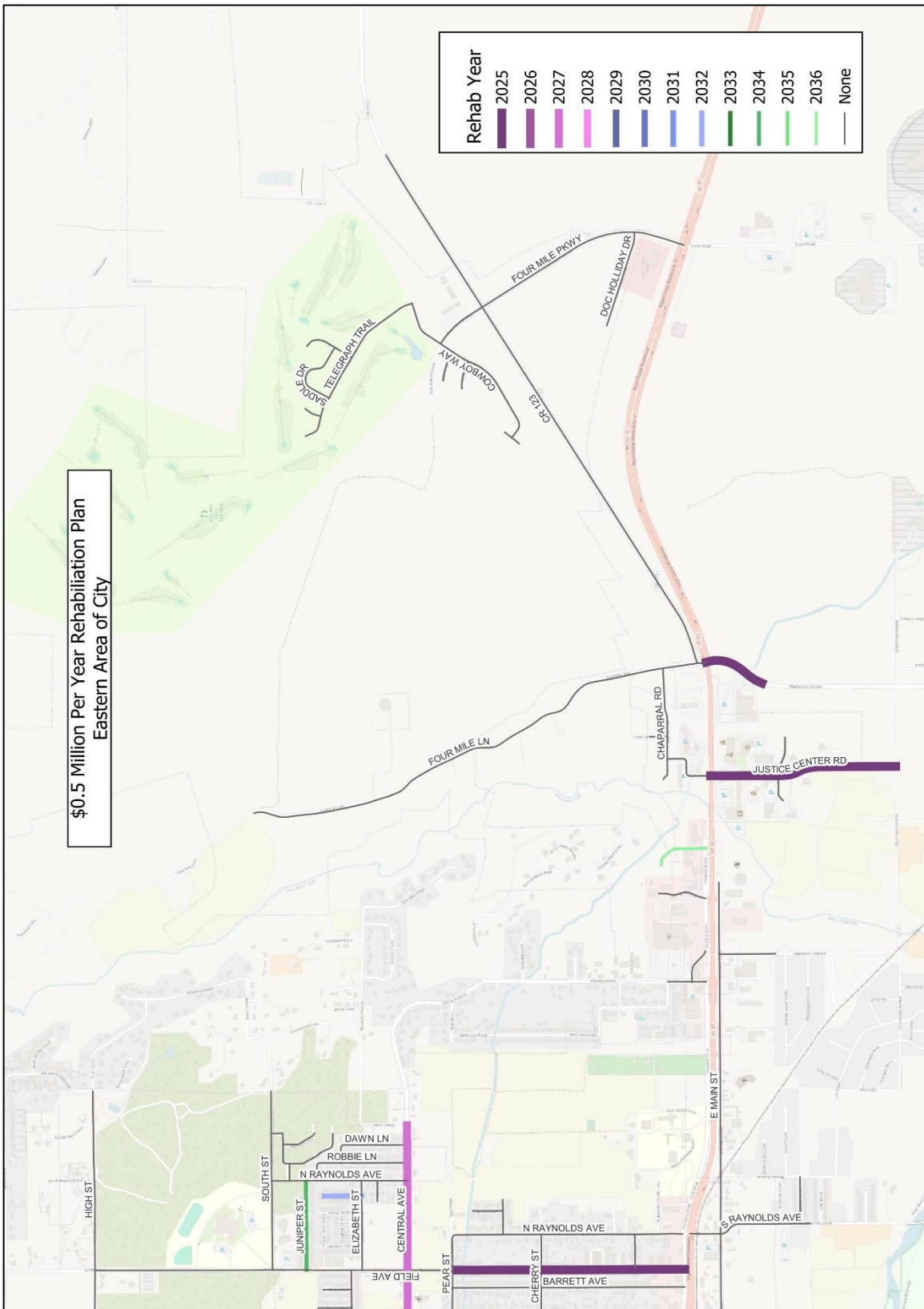
Figure 19: $0.5 Million/Year Rehabilitation Plan – Eastern Area of City

7 Conclusions and Recommendations

The analysis shows that a budget of approximately $6,000,000 per year is needed to maintain the City's road network at the current level.   If current funding is less than this level, the City should consider ways to supplement the existing budget to this level. Also, if construction costs increase, there will need to be a proportional increase in the rehabilitation budget to achieve the desired results.

Analysis of smaller budgets clearly shows the pronounced effect that long-term underfunding of pavement rehabilitation will have on the condition of the City's road network. This leads to a decline in the average PCI of the network, an increase in the percentage of the network that is considered deficient in terms of road condition, and an increase in the backlog of unfunded projects. The zero-expenditure budget in particular has very significant long-term negative implications and underscores the need for the City to invest annually in infrastructure renewal.

Pavement condition is constantly changing, so over time the inspection data will begin to diverge with the actual conditions in the field. The shelf life of the inspection data is about three years. Therefore, the City should re-inspect the road network, update the PAVER database with new inspection data and re-analyze the network in Spring of 2028 at the latest.