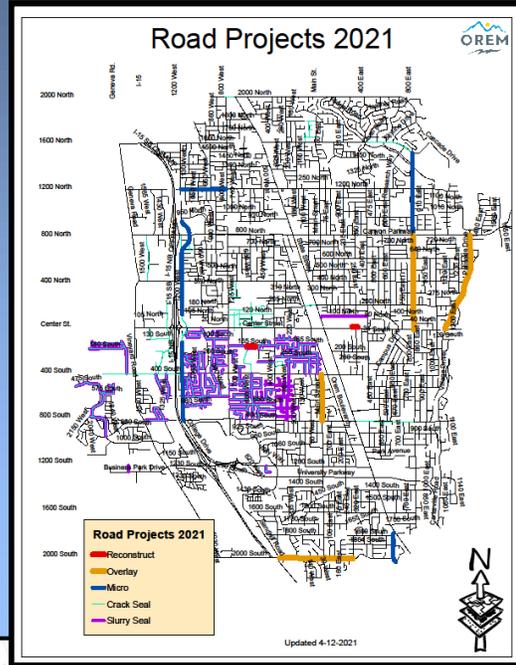
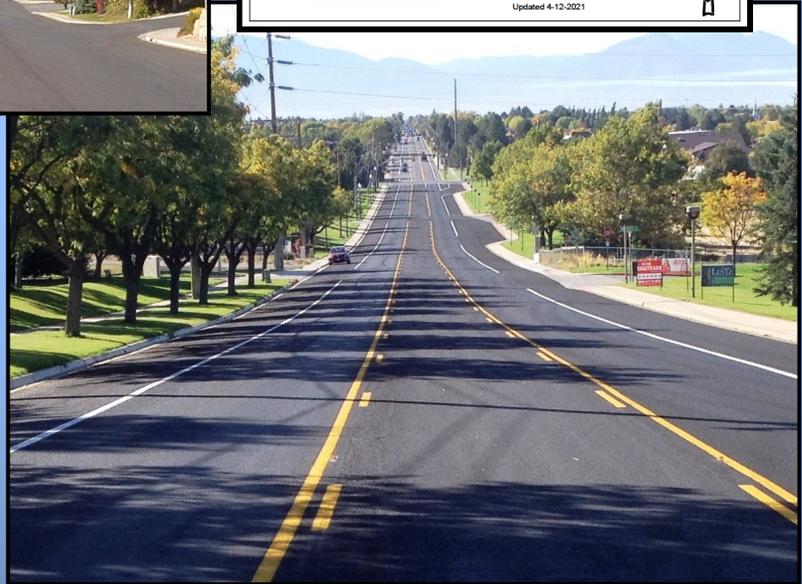


# STATE OF THE STREETS 2021



**Partnering with the citizens to help build and preserve a community in which we all want to live**

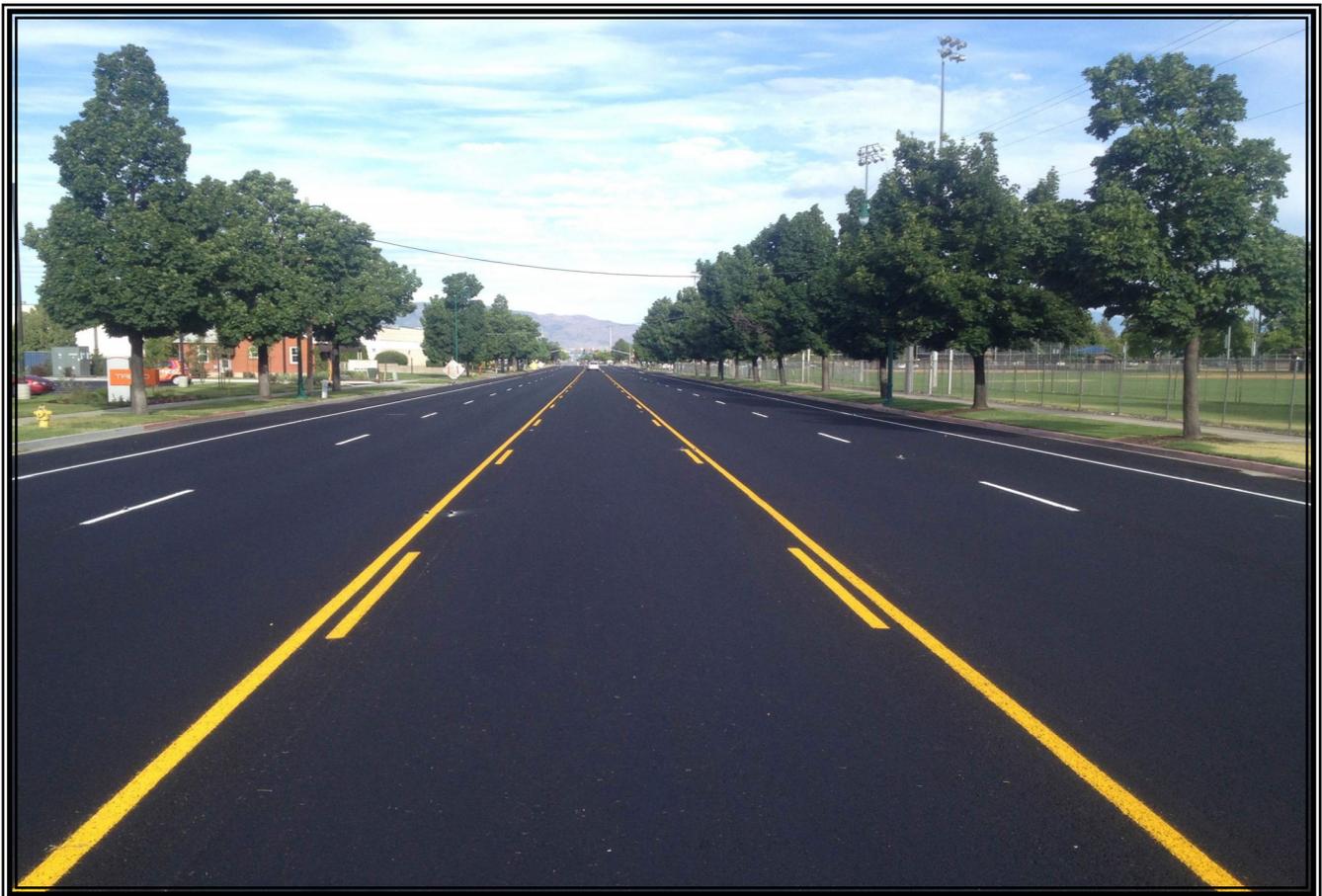


City of Orem's Pavement Management Program  
Public Works Maintenance Division



## Table of Contents:

<u>Section</u>	<u>Page</u>
Figures and Tables.....	iv
Objective.....	1
Executive Summary.....	2
Facts and Information.....	3
Pavement Management Program.....	4
Current Conditions.....	6
Orem Pavement Life Cycle and Decision Matrix.....	12
Preventive Maintenance and Rehabilitation, Comparisons, and Timing...15	
Budget .....	21
Challenges and Improvements.....	26
Summary and Recommendations.....	28



## Figures and Tables:

<b><u>Figures</u></b>	<b><u>Page</u></b>
Figure 1. Pavement Management Rating Description.....	4
Figure 2. Current Rating Breakdown.....	6
Figure 3. Pavement Life Cycle with No Maintenance.....	12
Figure 4. Pavement Life Cycle with Performed Maintenance.....	13
Figure 5. Maintenance Timing Guideline.....	21
Figure 6. 2005-2018 OCI Average.....	23
Figure 7. OCI Forecast According to Funding Levels.....	25

<b><u>Tables</u></b>	<b><u>Page</u></b>
Table 1. Slurry Seal and Asphalt Overlay Comparison.....	20
Table 2. Overlay and Micro-Surfacing Compared to Reconstruction.....	20
Table 3. Current Budget Allocation.....	22
Table 4. Budget and OCI Relationship from 2005-2018.....	23
Table 5. Recommended Budget and Allocation.....	24
Table 6. Pavement Management Recommendation.....	28

# Objective

This State of the Streets report is intended to provide information concerning the City of Orem's street network. This report describes the purpose and role of the Pavement Management program, the maintenance and rehabilitation work that has been completed over the past several years, and the current conditions of Orem City streets. It will also highlight maintenance and analysis methods used, and propose an aggressive detailed street maintenance plan to ensure a high level of service and long-term sustainability of City streets.

This report has been created to provide useful street maintenance information to persons who may not have much experience in this field, but are in a position to provide the means and direction in undertaking a successful maintenance program.

A great investment has been made in the City's street network. This report will outline the steps needed to preserve this investment in a productive and fiscally responsible manner. The Pavement Management Staff and Street Section take great pride and responsibility in helping manage and maintain the City streets.



*"The quality of preservation work performed on streets directly determines the surface life, future maintenance cost, ride quality, and ultimate user cost... Our primary responsibility is to insure the tax-payer gets his moneys worth."  
Duane Blank - Forum for Future*

## Executive Summary

In 2003, Orem's streets were inspected and examined to determine condition, ride quality and remaining service life. Each street segment received an Overall Condition Index (OCI) rating based on its condition. This data was analyzed and a course of action was determined. Money was allocated, through a General Obligation Road Bond, to help improve the City streets. This money, combined with B&C Road Funds received from the tax on fuel, was used to upgrade "Poor" or "Failed" OCI rated streets, through reconstruction and asphalt overlays. Roads with a "Good" OCI rating were maintained with preventative maintenance practices. MAG, CDBG, and other funding sources have also been used.

The initial bond work began in 2005 and was completed in 2010. Annual maintenance and rehabilitation continued thereafter. As of Jan, 2021, 72 of the City's 244 centerline miles have received an asphalt overlay or total reconstruction. A total of 387 centerline miles have received crack seal, with some roads having received multiple applications. Slurry seal has been applied to 286 centerline miles and over 27 miles have received micro-surfacing. Over \$38 million has been used for road rehabilitation and maintenance since 2005.

Anticipated funding decreased after the GO Road Bond work was completed. This primarily affected Local road maintenance and rehabilitation. The overall condition of the City streets currently rates as "Good" but maintaining the investment made to the street system along with continued improvements and updated standards, requires additional attention and resources, specifically for the Local roads

Recent new funding, has been received through the County sales tax. This funding, combined with the current funding sources, has allowed for an updated rehabilitation and maintenance plan. This plan may help maintain the current quality of roads along with upgrading some deficient areas.

Planning, continued use of the current preventive maintenance programs, understanding the impacts of delaying needed maintenance, and identifying and implementing other proven maintenance and rehabilitation options can continue to help the City maintain a quality street system.

## Facts and Information

The City currently maintains 244 centerline street miles and 550+ lane miles.

There are 190 centerline miles classified as Local streets, 16.5 classified as Arterial and 37.5 as Collector.

The total square footage of maintainable street area is just over 48 million.

The estimated value of the City streets is approximately \$204 million. This estimate includes asphalt and base replacement only, at \$4.25 sf.

Since 2005:

- A total of 72 centerline miles have received an asphalt overlay or have been reconstructed. This includes 39 miles of Local, 21 miles of Collector, and 12 miles of Arterial streets.
- A total of 387 centerline street miles have received crack seal. Some streets have received multiple applications.
- Slurry seal has been applied to 286 centerline miles.
- Over 27 miles of micro-surfacing has been completed.

The current Overall Condition Index (OCI) of the City is 80



Local streets average 34' in width, equaling 180,000 sf per mile.

Collectors and Arterial streets average 52' in width, equaling 275,000 sf per mile.

All costs are based on the most current City contracted prices of the general requirement of 4" of asphalt over 8" of base for Local roads, and 5" and 6" of asphalt over 8" of base for Collector and Arterial roads.

# Pavement Management Program

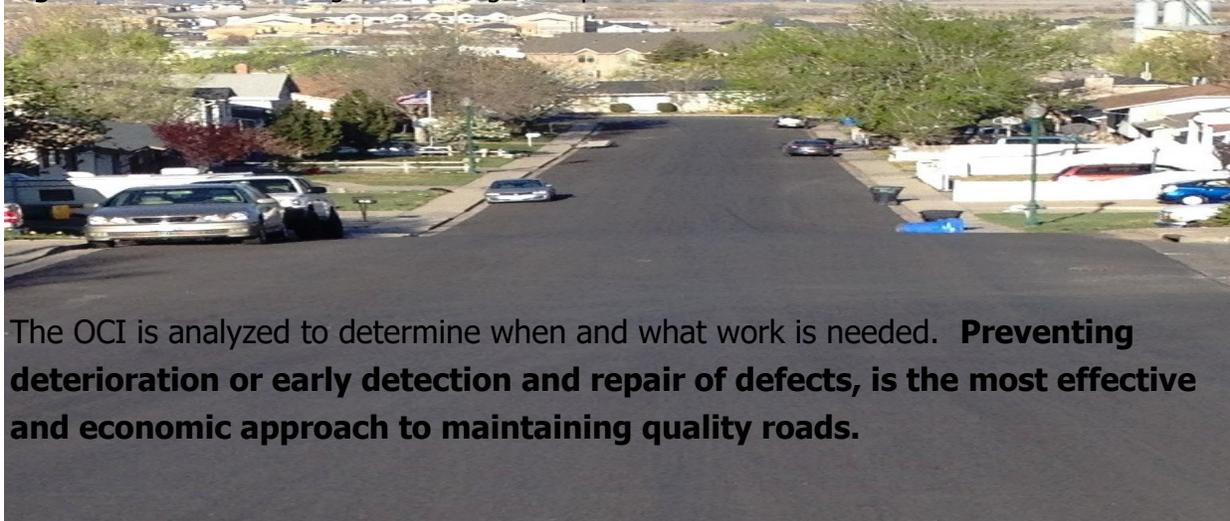
The Pavement Management Program refers to individuals, computer software, and available resources, working together to determine, recommend, and implement the most cost effective course of action concerning the maintenance and repair of the City’s street system. Inspections, analysis, testing, performance, and experience can help determine when to apply needed maintenance or repair to the right street, at the right time, in a fiscally responsible manner.

All City streets are inspected for surface defects and deterioration at least once every three years. Defects and deterioration are recorded, and each street receives a value or OCI (Overall Condition Index) rating. **The Pavement Management Rating Description value ranges were recently modified to more accurately depict a consistent number comparison and breakdown. With this change, an OCI of 80 is now our average, as opposed to 81.9**

Figure 1 outlines the rating system.

Excellent	Good	Fair	Poor	Failed
OCI 100-90	OCI 85-70	OCI 65-50	OCI 45-30	OCI 25-0
New or almost new pavement. Pavement is structurally sound with little surface wear.	Pavement structure is good. Minor cracking, depressions, and surface wear.	Moderate Cracking, surface wear and depressions. Pavement is generally structurally sound.	Major cracking and surface wear. Pavement is structurally deficient. Base may be unstable.	Major distresses. Pavement is structurally unsound. Base may be unstable.

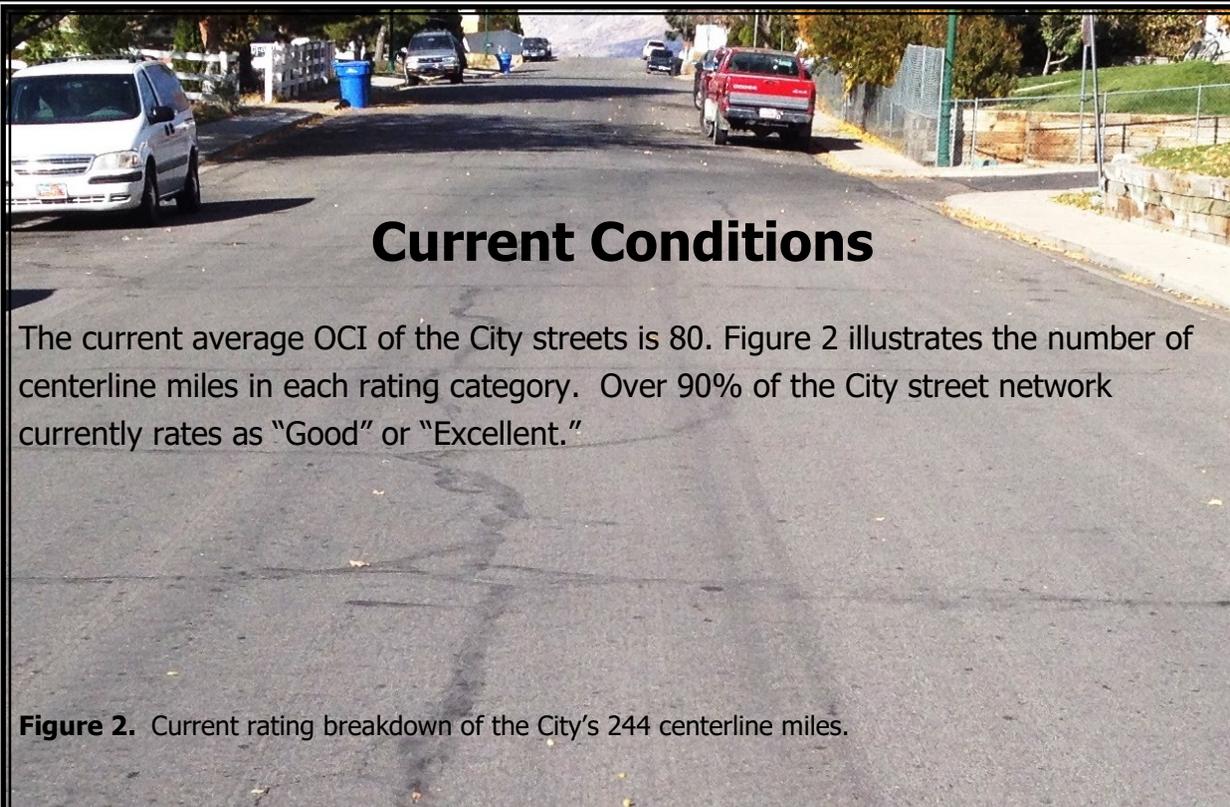
**Figure 1.** Pavement Management Rating Description.



The OCI is analyzed to determine when and what work is needed. **Preventing deterioration or early detection and repair of defects, is the most effective and economic approach to maintaining quality roads.**

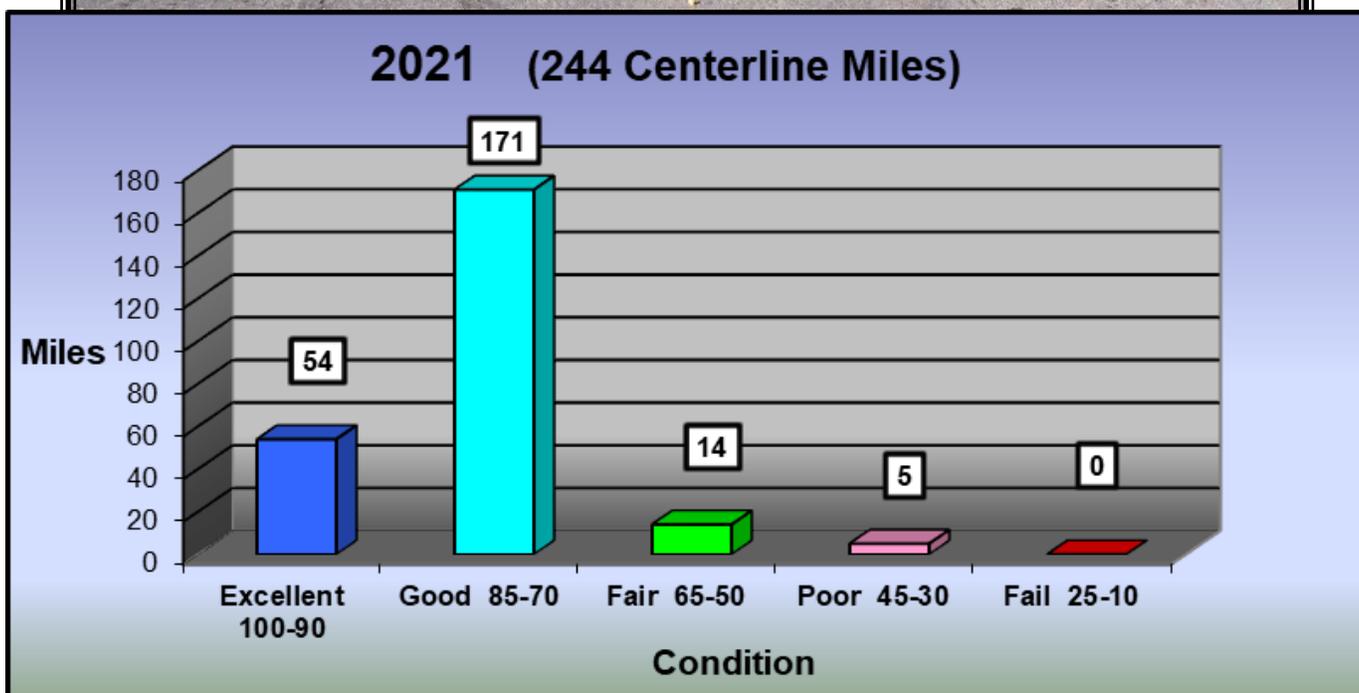
## Examples of Street OCI Ratings.



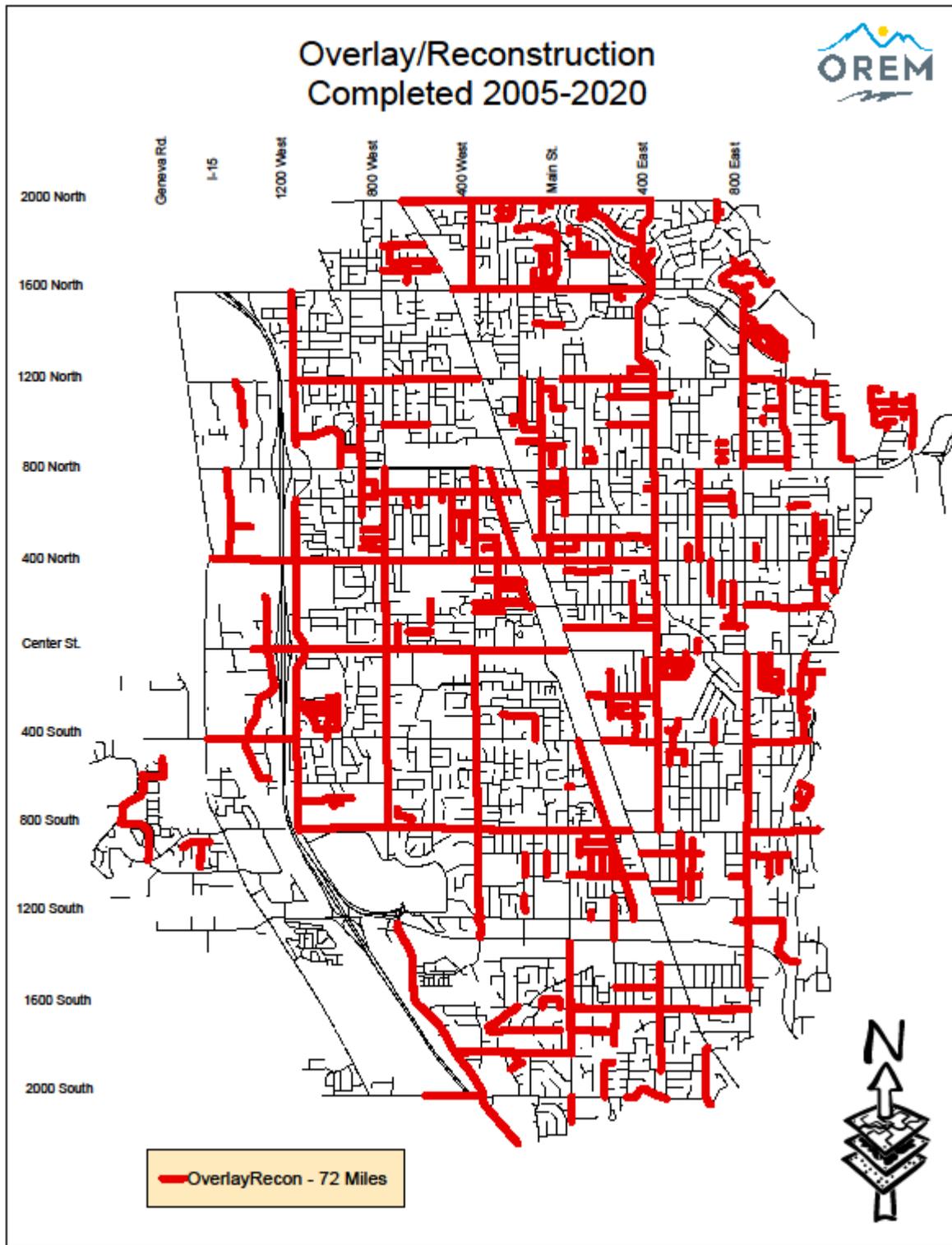


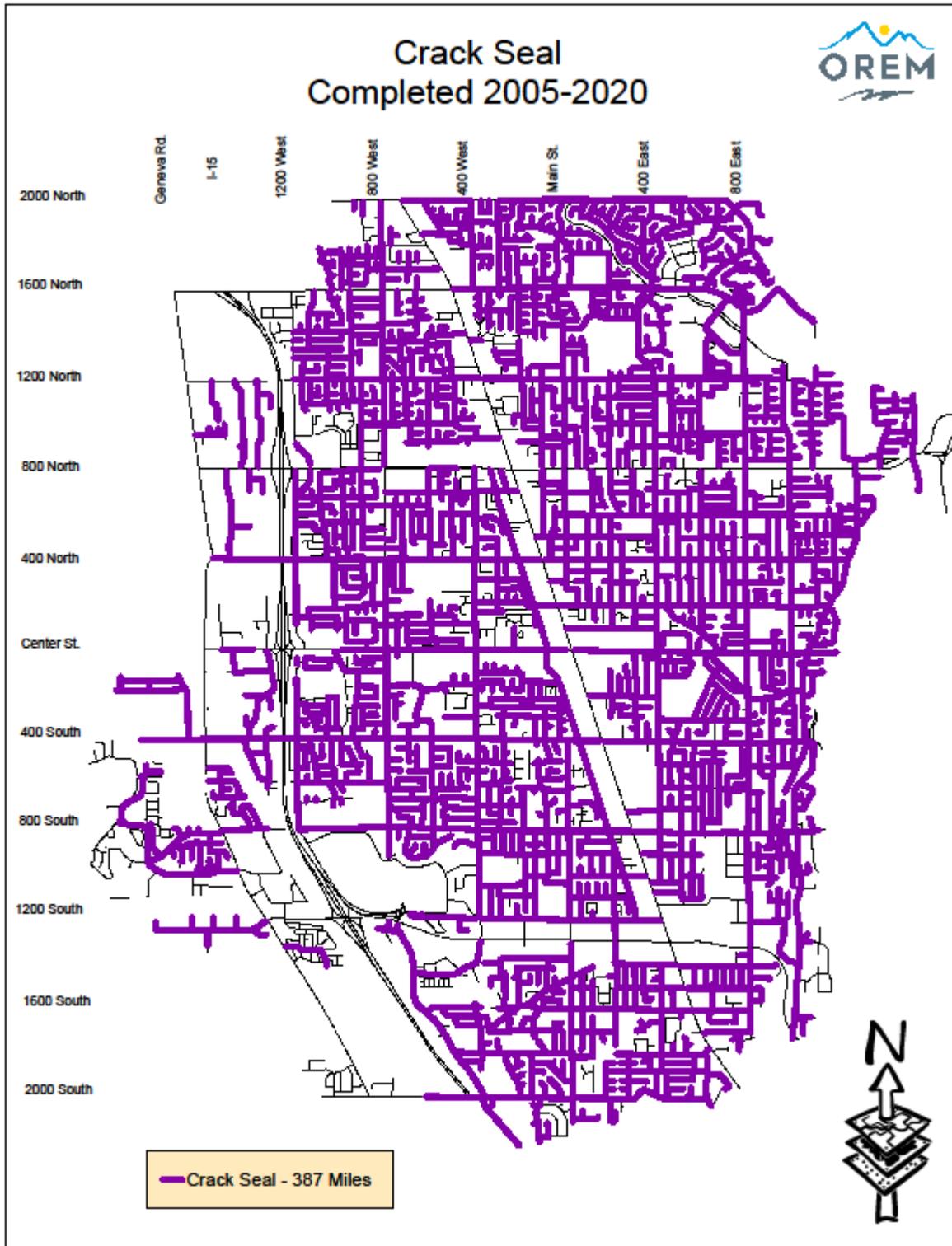
The current average OCI of the City streets is 80. Figure 2 illustrates the number of centerline miles in each rating category. Over 90% of the City street network currently rates as "Good" or "Excellent."

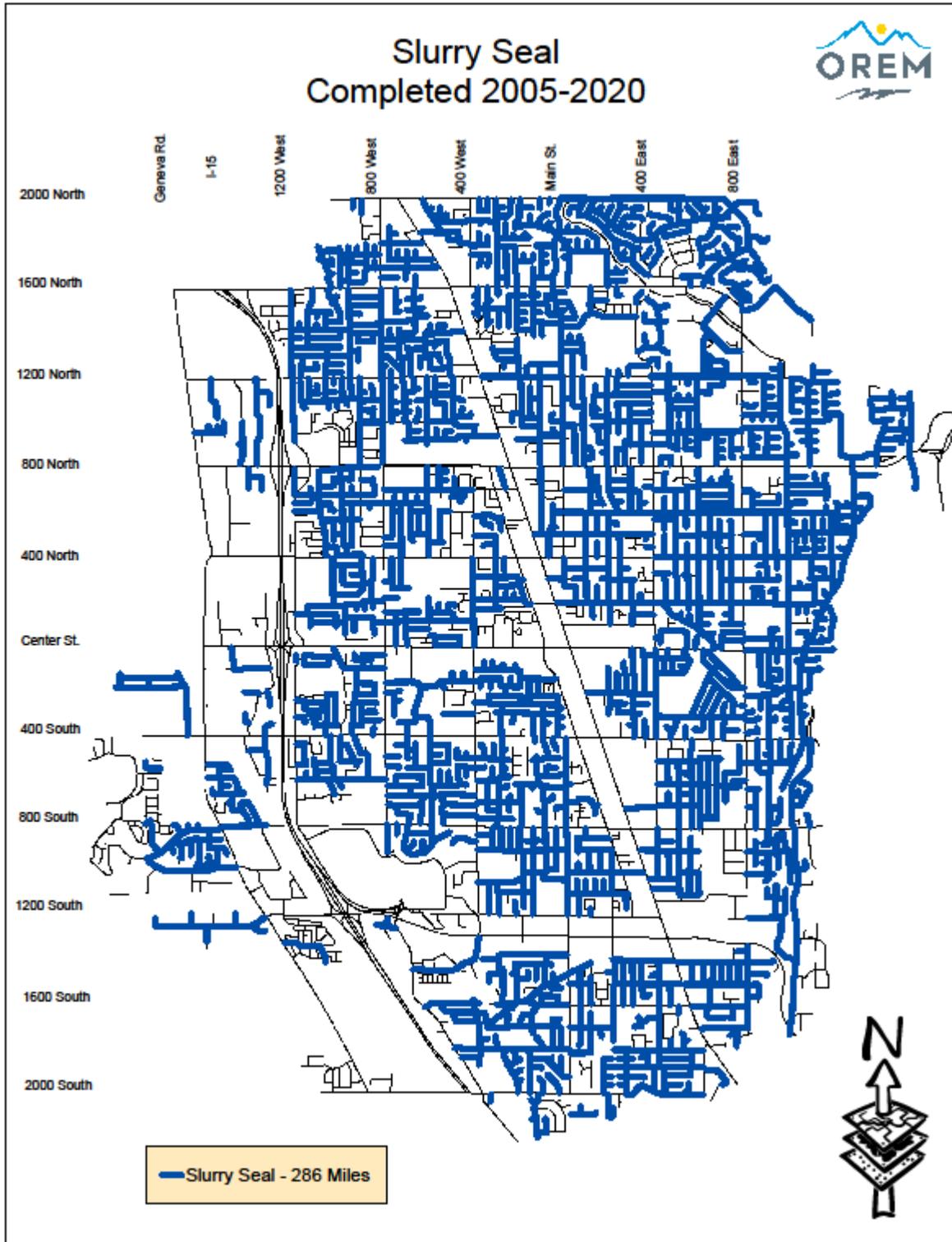
**Figure 2.** Current rating breakdown of the City's 244 centerline miles.

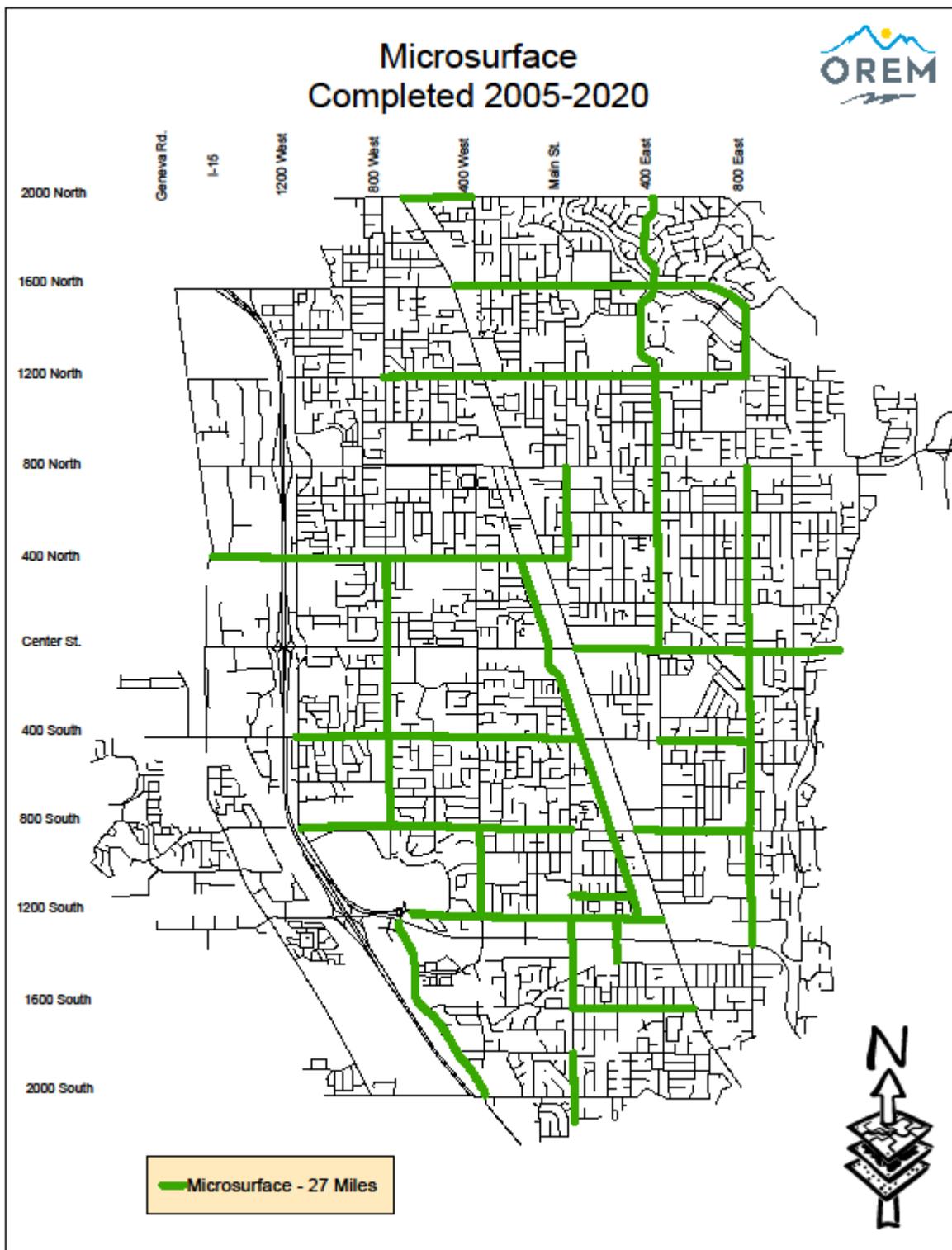


The following maps illustrate the maintenance and rehabilitation activities completed from 2005-2021.

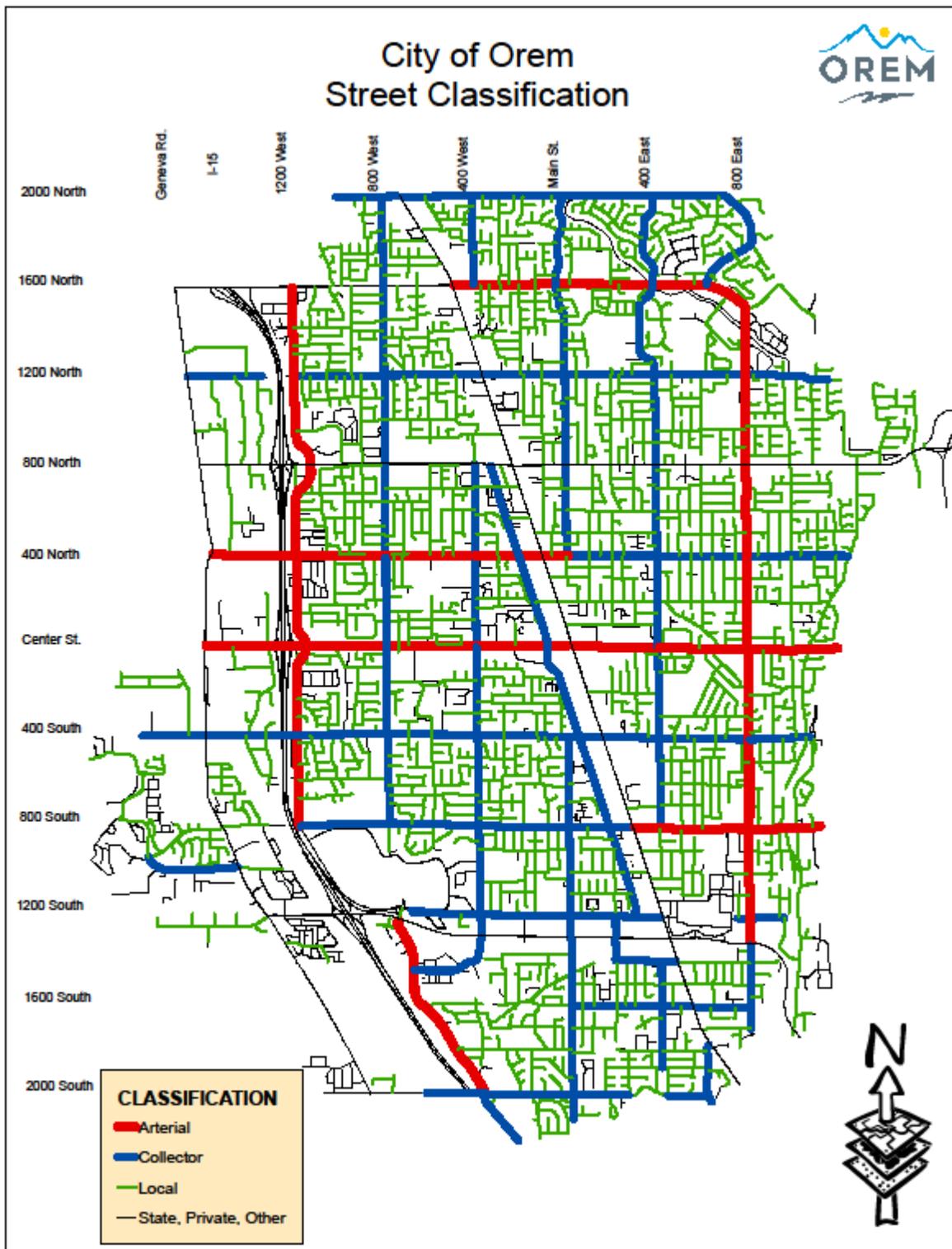








The following map illustrates the City street classifications.

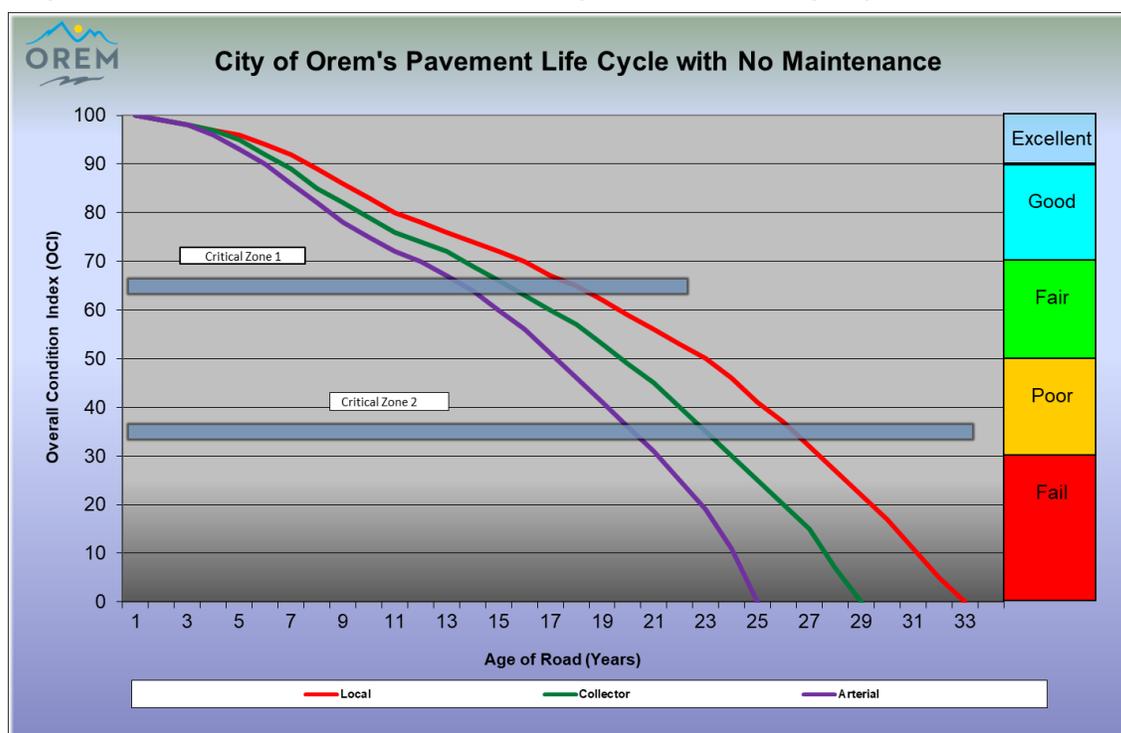


## City of Orem’s Pavement Life Cycle

Understanding the service life of a street enables the correct treatments to be applied at the optimal time. The average life cycle of each of the City’s street classifications is represented in Figure 3. It illustrates the life of a street if maintenance is not performed.

Due to the amount of traffic, traffic loads and original design, our Arterial streets have shown the shortest life cycle. On average, Local streets last 30% longer than Arterial streets, and approximately 15% longer than Collector streets. Arterial streets lose approximately 4% service life per year. Collector streets lose 3.5%, and Local streets 3%. The overall average service life loss is approximately 3.1% per year.

Critical zones represent transitional points in a street’s life cycle. If the proper preventive maintenance treatment is performed before passing through these zones, the costs are substantially less. If maintenance is delayed or not performed, the street is likely to deteriorate to a condition that requires more costly repairs.



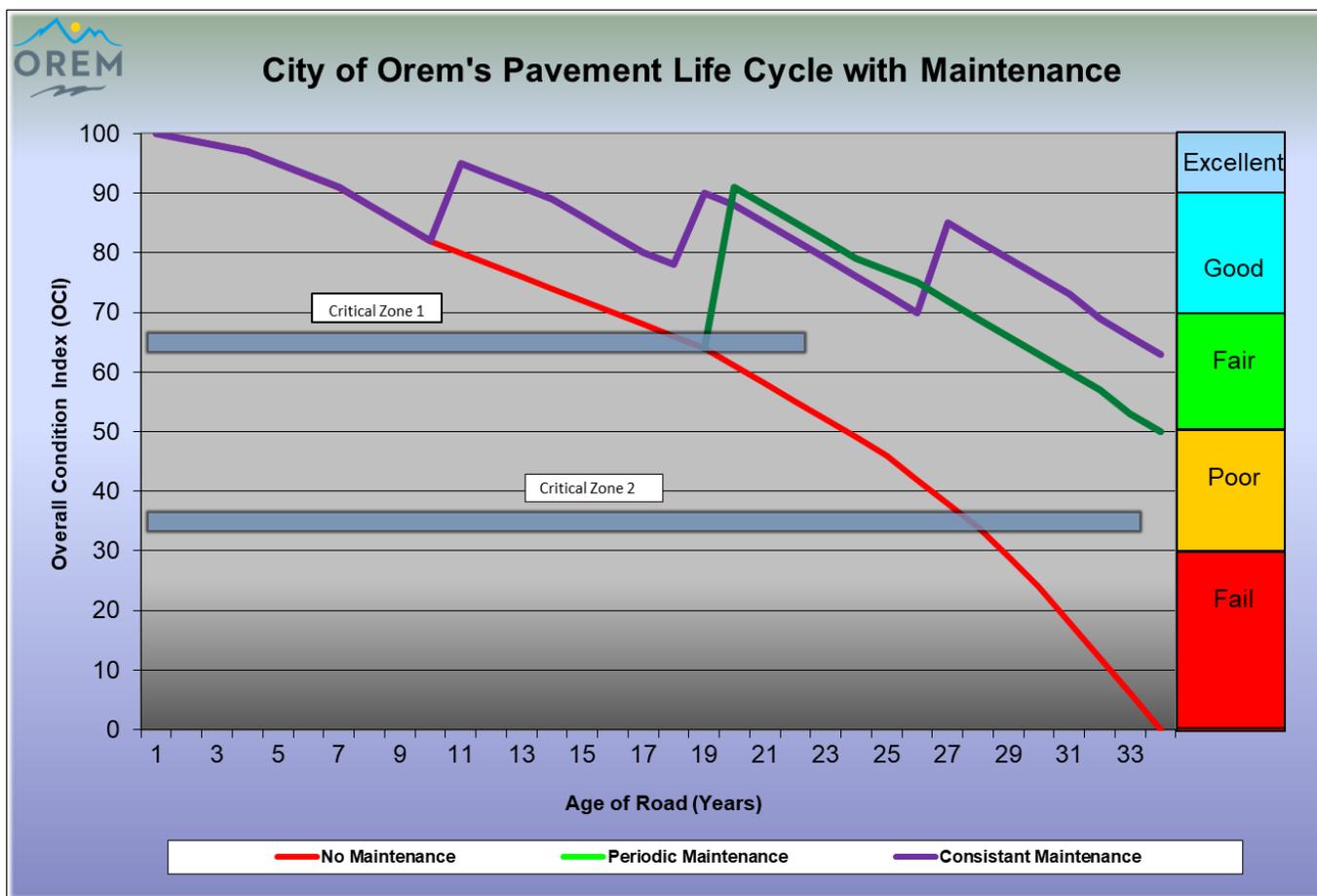
**Figure 3.** Life cycle of Local, Collector and Arterial streets, passing through Critical Zones without any maintenance performed.

Maintenance performed before critical zone one is approximately **\$0.30** sf.

Maintenance performed between critical zones one and two is approximately **\$1.50** sf.

Maintenance performed after zone two is approximately **\$4.25** sf. Performing the right treatment, on the right road, at the right time, can reduce costs significantly.

Figure 4 illustrates the basic life cycle of a Local (RED) street in Orem when maintenance is not performed. The PURPLE line represents the consistent use of regular and routine preventive maintenance and clearly shows the service life gained. The GREEN line represents postponing maintenance until major deterioration has occurred.



## Preventive Maintenance and Rehabilitation

### CRACK SEAL:

Crack seal is used to fill and seal cracks in pavement and next to curb and gutter. This treatment is used on all pavement to help minimize the penetration of water to the base and sub grade which can cause structural breakdown. It also slows crack deterioration. Crack sealing is done before streets receive a slurry seal, micro-surface or asphalt overlay treatment. On average, six to seven tons of crack seal has been used for each centerline street mile at an approximate cost of \$13,000 per mile. Crack seal has a service life of 3+ years.



### SEAL COATS:

There are several types of seal coats and spray seals with varying attributes. Seal coats are primarily used as a surface sealant and protector. Many have rejuvenating properties and fine aggregate can be added to help with wearing surface performance. They are commonly applied to newer Local and selected Collector and Arterial roads that have minimal surface distress, where a smooth surface is desired. Seal coats vary significantly in cost depending on type and design, but can range from \$0.10 - \$0.20 sf. Seal coats have an approximate service life of 3+ years.

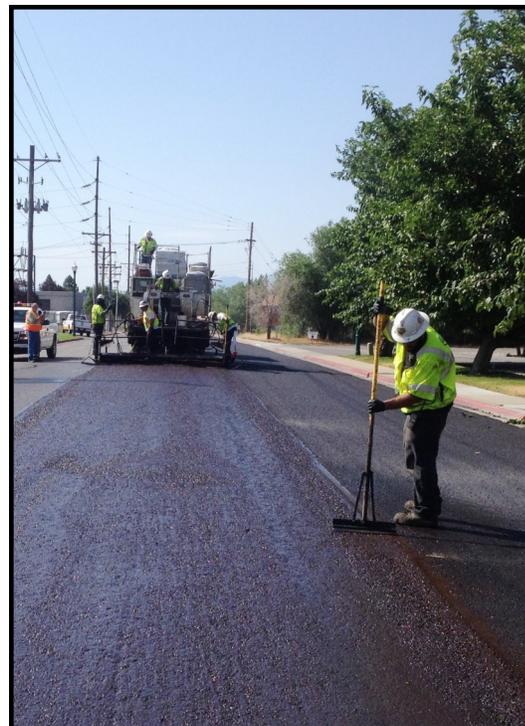
**SLURRY SEAL:**

Slurry seal is used as an asphalt sealant, rejuvenator, protector and surface course for all Local and some Collector streets. Slurry consists of an asphalt emulsion, aggregate, fillers and polymers. Type II Slurry is approximately 1/4" thick and is generally placed on Local streets at an approximate cost of \$22,500 per mile. Slurry Seal may add an additional 5+ years of street service life.

**MICROSURFACING:**

Microsurfacing, like slurry seal, is used as an asphalt sealant, protector and surface course.

Microsurfacing can be applied to Local streets but is best used for Collector and Arterial street maintenance. Microsurface consists of polymer modified emulsion, water, cement and additives, applied approximately 3/8" thick. The benefits of micro-surfacing include: continuous lay down, some leveling capabilities, higher poundage per square yard than slurry which can enhance the durability, quick traffic return, and can be applied at night. Approximate cost if applied to Collector and Arterial roads is \$110,000 per mile. Microsurface may add an additional 5+ years of road service life.



**BONDED WEARING COURSE:**

A Bonded Wearing Course (BWC) is a gap or open graded, thin hot-mix asphalt mixture, applied over a thick polymer modified asphalt emulsion membrane. It can be placed, 5/8" to 1.5" thick, over structurally sound pavements as a maintenance treatment, and may also be used in new construction and rehabilitation projects as the final wearing course. The City is looking to include this treatment on future projects. Overall benefits versus costs are being determined. The cost to apply a BWC is approximately \$150,000 per mile. The service life is generally 7 to 12 years.

**OVERLAY:**

Overlays are the placement of 1”+ of asphalt over existing asphalt. Overlays are used when the pavement has deteriorated to a point that a slurry seal will not bring the pavement back to an acceptable level, due to loss of structural and pavement properties. The existing asphalt is generally milled down 1” to 2” prior to the overlay to increase profile functionality. Costs for a 2” overlay is approximately \$210,000 per mile on an average 34’ wide Local street, and \$340,000 per mile on an average 52’ wide Collector or Arterial street. Overlays may have a service life of 12+ years.

**RECONSTRUCT:**

A reconstruct consists of removing the existing asphalt and replacing with new asphalt. In many cases, base and sub grade material will be removed and replaced. Reconstructs are performed when the asphalt has lost its structural properties and/or base and sub grade material has failed. Reconstruction of Local streets (4” asphalt over 8” base) is approximately \$700,000 per centerline mile. Reconstructing Arterial and Collector streets (5+” asphalt over 8” base) increases to approximately \$1,375,000 per mile. Reconstructs generally have a service life of 20+ years.



**CITY CREW MAINTENANCE AND PREPARATION WORK:**

City crews are an important component of the City’s street maintenance program. Their knowledge and abilities are a valuable asset to the City. They are responsible for multiple maintenance activities, including preparation work for contracted slurry seals, micro-surfacing, and asphalt overlays. Other activities they perform include patching utility trenches, removing and replacing failed sections of streets, leveling depressions for improved ride and safety, pothole patching, and smaller overlay and reconstruction projects.

Since 2005, City crews have placed over 58,000 tons of asphalt on City roads. This amount of asphalt equates to approximately 26 miles of 2” thick asphalt. Through the work performed by City crews, street condition and service life is increased and the total cost of contracted work is reduced.



## Maintenance Comparisons

### Local Roads:

Local streets may be maintained and increase service life through cost effective treatments. This maintenance includes the replacement of localized failure, leveling, crack seal, slurry seal, and asphalt overlays.

**Both a crack seal and slurry seal can be performed for less than 20% of the cost of a 2" asphalt overlay.**

**Table 1.** Slurry seal and asphalt overlay cost and service life comparison per centerline mile.

TREATMENT	APPLICATIONS	TOTAL COST	SERVICE LIFE
Crack and Slurry Seal	3 applications	\$99,000	15+ years
Crack Seal and Asphalt Overlay	1 application	\$220,000	15 years

### Collector and Arterial Roads:

Arterial and Collector streets may be efficiently maintained and increase service life through the application of crack seal, micro-surface, and asphalt overlays.

**Reconstruction costs can be almost 3 times more than an overlay and microsurface, for nearly the same total service life.**

**Table 2.** Asphalt overlay and micro-surface compared to full asphalt reconstruction per centerline mile.

TREATMENT	APPLICATIONS	TOTAL COST	SERVICE LIFE
2" Overlay/Micro-Surface	1 Each	\$435,000	15+ years
5" Asphalt Reconstruct	1	\$1,250,000	20+ years

## Maintenance Guideline

Figure 5 is a Maintenance Guideline that was created using the Decision Matrix, City of Orem’s Pavement Lifecycle, proven maintenance treatments, past performance, and current observations. It is designed to help identify when and what possible treatments are recommended after initial road construction.

If all City roads were simply reconstructed after their initial 20-25 year design life, approximately **\$9-\$10 million** would be needed annually to complete. A consistent preventive maintenance program can reduce costs and increase service life.

Maintenance Guideline			
Local		Collector/Arterial	
Year	Treatment	Year	Treatment
0	Initial Construction	0	Initial Construction
2-4	Crack Seal, Spray Seal	2-4	Crack Seal
6-8	Crack Seal, Slurry Seal	7-8	Crack Seal, Micro-Surface
14-16	Crack Seal, Slurry Seal	15-16	Crack Seal, Micro-Surface
22-24	Crack Seal, Slurry Seal	23-24	Crack Seal, 2" Asphalt Overlay/Recon
30-32	Crack Seal, 2" Asphalt Overlay/Recon	30-31	Crack Seal, Micro-Surface
38-39	Crack Seal, Slurry Seal		

**Figure 5.** Maintenance Timing Guideline with recommended maintenance after initial construction.

*"Apply the right treatment, to the right road, at the right time, while remaining fiscally responsible."*

### Budget and OCI Relationship:

Table 4 lists the annual maintenance budget and corresponding OCI average, from 2005 to 2020. Road Bond funding enabled the City to contract much needed rehabilitation, increasing the overall OCI. With limited funding after the Bond, needed annual maintenance was unable to be fully completed, resulting in a downward trend of the OCI. With some additional one time funding we were able to maintain near the OCI average from 2018-2020.

OCI Comparison - 2005 through 2020																
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Budget (millions) with Road Bond.	\$3.65	\$3.65	\$3.65	\$3.65	\$3.20											
Budget (millions) without Road Bond						\$1.2	\$2.4	\$1.2	\$1.7	\$1.4	\$1.5	\$2.6	\$1.8	\$2.2	\$3.5	\$2.4
Overall OCI (244 Centerline Miles)	79.1	80.3	81.9	83.4	84.1	83.4	82.8	81.5	81.2	80.8	80.5	80.4	80.2	80.1	80.1	80

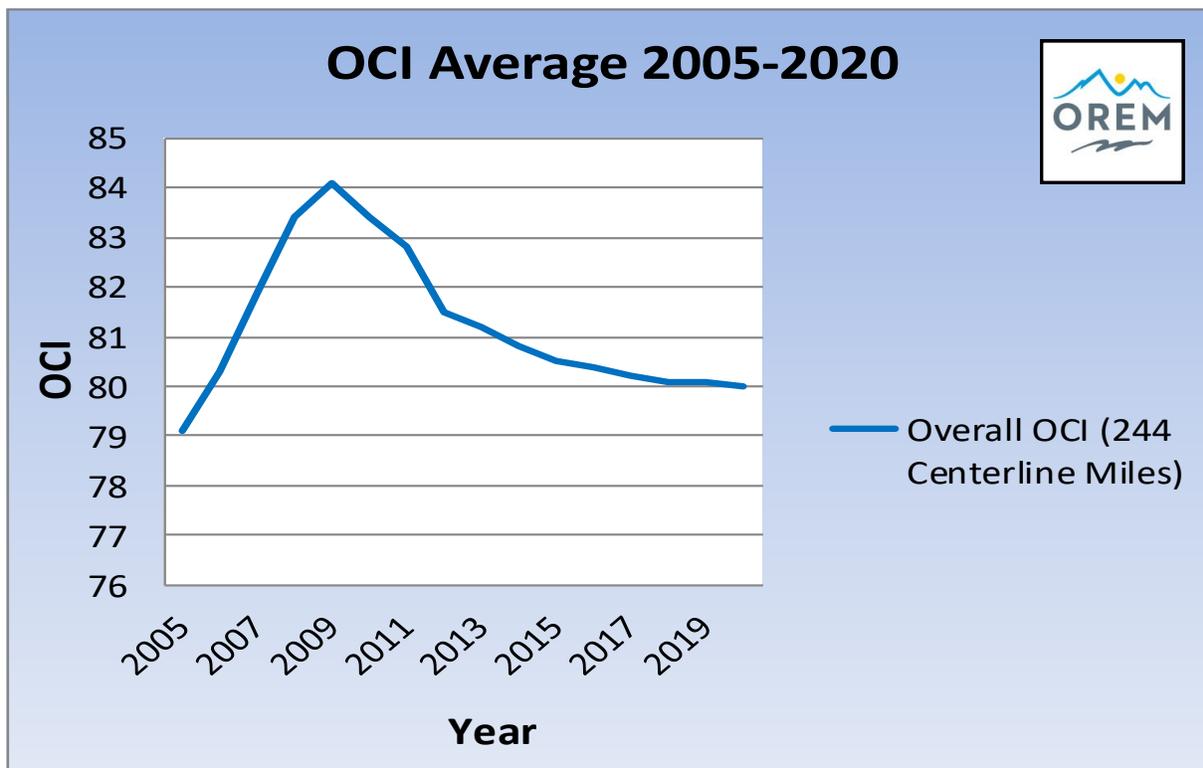


Table 4. Annual Budget and corresponding OCI from 2005-2019

Figure 7. OCI average from 2005-2020

## Budget

### Current Budget and Allocation:

Additional transportation funding was received through the passing of the county sales tax in 2018. This increase allowed for a over a 60% increase in street surfacing and maintenance. The following table indicates the current annual allocation.

Type	Recommended Allocation
Crack Seal All - 8 Year Rotation	\$350,000
Slurry Seal Local - 8 Year Rotation (Excluding Overlay Year)	\$450,000
Overlay All Local - 40 Year Rotation	\$675,000 - (\$1,000,000 in 2024)
Overlay All Collector/Arterial - 24 Year Rotation	\$750,000
Reconstruct Collector/Arterial, - 5% over a 24 Year Period	\$150,000
Micro-Surface All Arterial/Collector - 2 Times Before Overlay	\$400,000
<b>Total Budget</b>	<b>\$2,775,000</b>

**Table 3.** Current Budget

Current funding enables the City to perform a crack seal and slurry seal every eight years on Local streets, and a 2" asphalt overlay every 40 years.

Arterial and Collector streets can receive crack seal three times and micro-surfacing two times before receiving an asphalt overlay at 24 years.

**Current funding will now enable the City to remain near or slightly below the current OCI.**

## Recommended Budget and Allocation:

**Table 5.** Recommended Budget

Type	Recommended Allocation
Crack Seal All - 8 Year Rotation	\$350,000
Slurry Seal Local - 8 Year Rotation (Excluding Overlay Year)	\$450,000
Overlay All Local - 32-36 Year Rotation	\$1,125,000
Reconstruct Local - 5% of Roads over a 32 Year Period	\$150,000
Overlay All Collector/Arterial - 24 Year Rotation	\$750,000
Reconstruct Collector/Arterial, - 5% over a 24 Year Period	\$125,000
Micro-Surface All Arterial/Collector - 2 Times Before Overlay	\$400,000
Total Budget	<b>3,350,000</b>

Current funding can help up stay at or near the current OCI. Recommended funding could help us maintain and slowly increase the OCI of the City streets.

All Local roads could receive a crack seal and slurry seal every eight years with an asphalt overlay every 32-36 years. Approximately 5% of the Local roads could be reconstructed within the 32 year period.

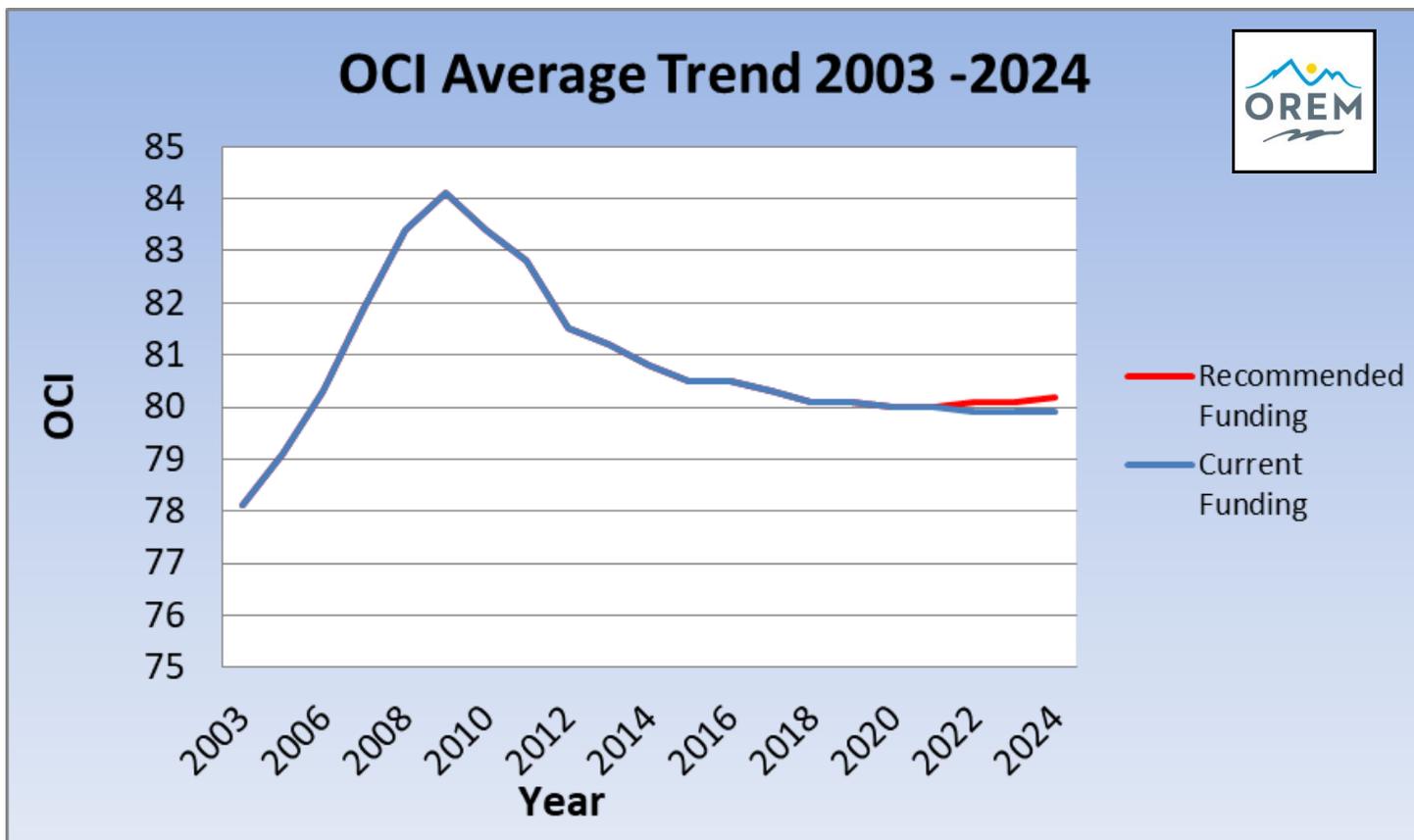
Arterial and Collector roads could receive an overlay every 24 years with a crack seal every six years and a micro-surface application every eight years. 5% of the roads could also be reconstructed within the 24 year period.

**The work performed with the Recommended Budget could enable the City to maintain and slowly increase the current OCI.**

### Current vs Recommended Budget - OCI Forecast:

Figure 8 illustrates the likely OCI trend of Orem City streets according to the Current and Recommended funding:

1. **Current Budget (\$2.775 million)**
2. **Recommended Budget (\$3.35 million)**



**Figure 8.** OCI forecast related to funding levels.

With the Current Budget, the OCI will most likely remain at or trend slightly lower than the current OCI. The Recommended Budget will likely result in an OCI at or above the current.

## Challenges and Improvements

There are several challenges, changes, and variables when constructing, rehabilitating and maintaining roads. These can increase costs, cause delays or change design. Required infrastructure, population and business growth, utility failure, utility replacement, and street network re-design are just a few examples. The following items are processes that have been or will be implemented into the pavement management system to help increase quality, mitigate risk, and reduce overall costs.

### Asphalt, Base and Sub-Base Testing:

- Pre-design base and sub-base testing.
- Construction base, sub-base and asphalt testing.

### Seam Construction and Placement:

- Seam placement out of wheel paths.
- Seam compaction testing.

### Utilities and Infrastructure Relationship:

- Pre-construction utility placement.
- Required sidewalk, gutter, ADA ramps, stormwater upgrades, etc.
- Road Widening.

### Surface Preparation and Maintenance:

- Use of crack seal, tack coat, fabric, geogrid, milling and leveling.
- Initial surface treatment over perpetual pavement
- Valve and manhole construction and maintenance.

## Summary and Recommendations

Due to the rehabilitation and maintenance activities performed since 2005, approximately 95% of the City street network rates as “Good” or “Excellent.” Performing preventive maintenance has proven effective. Continuing these processes, while increasing funding to match yearly service life loss, can help the City maintain quality streets and prevent higher costs in the future.

The Pavement Management Staff recommends the City maintain an **80** or above OCI average on all street classifications, with **NO** failed roads in the City.

Table 6 outlines the annual projected costs to maintain or increase the recommended levels through the next 5+ years.

**Table 6.** Pavement Management Recommendation

Type	Recommended Budget and Allocation
Crack Seal - 8 Year Rotation	\$350,000
Slurry Seal Local - 8 Year Rotation (Excluding Overlay Year)	\$450,000
Overlay All Local, 32-36 Year Rotation	\$1,125,000
Reconstruct Local, 5% of Roads over 32 Years	\$150,000
Overlay All Collector/Arterial - 24 Year Rotation	\$750,000
Reconstruct Collector/Arterial - 5% over 24 Years	\$125,000
Micro-Surface All Arterial/Collector - 2 Times Before Overlay	\$400,000
Total Budget	<b>3,350,000</b>

A great investment has been made in the City street network. The Pavement Management Staff and Street Section are committed to doing all they can to help be responsible stewards of this valuable asset.