

PAVEMENT EVALUATION STUDY

December 2023



Prepared for the
City of Boardman, Oregon

PAVEMENT EVALUATION STUDY

FOR

CITY OF BOARDMAN, OREGON

December 2023



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Introduction

The purpose of this Pavement Evaluation Study is to document the existing conditions of paved streets within the City of Boardman to develop recommended maintenance practices and options, and to serve as a guide for maintaining and improving street conditions. This Study includes the following sections:

- **Street Condition Inventory**

This section provides a pavement condition rating for each section of paved street within the City, defines the condition ratings, and shows a “typical” street for each rating. Identifying the current condition of each street is critical to choosing the proper repair techniques and understanding the financial requirements of maintaining the City’s streets to the desired condition.

- **Pavement Maintenance**

A critical component of this section is identifying the benefits of timely preventative maintenance versus pavement reconstruction. By identifying the recommended repairs for each pavement condition and understanding the associated costs, the City can effectively plan for future funding needs.

- **Estimated Costs for Recommended Maintenance Treatments**

This section includes estimated costs on a per-block basis of recommended maintenance treatments for typical streets of each condition rating.

- **Implementation and Recommendations**

This section outlines a ten-year maintenance schedule for repairs and to help maintain all City streets in “Good” or better condition. The maintenance schedule includes annual pavement maintenance and street reconstruction activities and outlines the funding required to meet the condition goals.

Pavement maintenance is repairing roads at the proper time to keep them in good condition. One of the most important aspects of a successful pavement maintenance plan is applying the proper repair at the proper time. Work can range from doing nothing to reconstructing an entire road. Often, it may be more cost-effective to do nothing rather than to make a repair that fails prematurely. This Study is intended to help the City understand the costs associated with repairing and maintaining the street network, and to establish an effective priority system for repairing deteriorated pavement and preserving good pavement.

Street Condition Inventory

The City’s street network includes approximately 19 miles of paved streets. The existing paved streets consist of a variety of surfaces, including asphalt concrete pavement (ACP) and layered chip seals. This Study focuses on the maintenance of the City’s paved streets, so the existing condition of gravel roads and Oregon Department of Transportation highways and county roads, including Main Street over Interstate 84, Columbia Avenue east of the Union Pacific Railroad overpass, Wilson Lane east of Main Street, and Main Street (County Road 584) south of Wilson Road, was not evaluated.

A driving tour was conducted in April 2023 to visually observe paved street conditions. Street conditions were rated on ride quality and visual observations, including surface cracking, trench settlement, and drainage issues. No structural evaluation or other testing was conducted. Each street section was given a pavement condition rating in one of four categories: "Very Good," "Good," "Fair," or "Poor." The pavement condition ratings are based on the following categories:

Very Good

- Stable with excellent ride quality.
- No cracking.
- No evidence of structural deficiencies.
- Newly constructed or has recently had significant maintenance.
- Nothing would improve the roadway at this time.

Good

- Stable with good ride quality.
- Some minor cracking is present, generally hairline and hard to detect.
- Rutting may be present but is less than 1/2 inch.
- No evidence of structural deficiencies.

Fair

- Generally stable with fair ride quality.
- Transverse, longitudinal, and some alligator cracking are present. Some trench settlement may be visible.
- Evidence of drainage problems.
- Deformation is more pronounced and easily noticed.
- Evidence of structural deficiencies.

Poor

- Areas of instability with poor ride quality.
- Extensive transverse, longitudinal, and alligator cracking are present with trench settlement and/or potholes.
- Drainage problems are evident.
- Obvious evidence of structural deficiencies.

The condition rating assigned to each section of street is a subjective observation. Examples of typical streets of each condition rating are shown in the following photographs.



Photo 1: Eagle Drive (River Ridge Drive to Dove Court) - Condition Rating "Very Good"



Photo 2: Faler Road (Mt. Hood Avenue to Mt. Adams Avenue) - Condition Rating "Good"



Photo 3: River Ridge Drive (Pheasant Court to Eagle Drive) - Condition Rating "Fair"



Photo 4: Pheasant Court (Looking West toward River Ridge Drive) - Condition Rating "Fair"



Photo 5: Columbia Avenue (Allen Court Looking West) - Condition Rating "Poor"



Photo 6: Front Street (Looking toward South Main) - Condition Rating "Poor"

The street conditions observed are identified on the Street Condition Inventory map included at the end of this Study. The most observed deficiency for pavement conditions within the City was transverse cracking of the road surface. These transverse cracks impact ride quality with varying severity, as more frequent and wider cracks create a choppy, bumpier, and less comfortable ride.

Streets listed as “Very Good” and “Good” should receive periodic observations to catch issues such as fatigue/longitudinal cracking, transverse cracking, and alligator cracking before they become severe. When these issues are observed, crack sealing should be scheduled and a resurfacing of the pavement should be considered in the form of a chip seal or slurry seal.

Many of the streets listed in this Study as “Fair” are nearing the end of their useful life and require more in-depth rehabilitation to prolong safe usability of the road surface. If these surfaces are not addressed in a timely manner, they are likely to rapidly deteriorate to a “Poor” condition rating.

Streets listed as “Poor” require the most work. These streets typically require demolition of the road surface and a full rebuild or overlay. Using the less intensive rehabilitation options for these surfaces is generally not cost effective, and structural deficiencies in the pavement will reappear quickly if not fully addressed.

Twelve percent of all paved streets were rated as “Very Good,” 14 percent were rated as “Good,” 67 percent were rated as “Fair,” and 8 percent were rated as “Poor.” Table 1 summarizes the pavement condition ratings of the 19 miles of paved streets within the City.

TABLE 1
STREET PAVEMENT CONDITION RATING SUMMARY

Pavement Condition Rating	Paved Streets	
	Percentage	Linear Feet
Very Good	12	12,110
Good	14	14,260
Fair	67	66,790
Poor	8	7,600
TOTAL		100,760

Pavement Maintenance

Like other municipal assets, paved streets have a limited service life before they must be replaced. Newly constructed ACP typically has a life expectancy of 15 to 20 years when regularly maintained. When performed at the optimal time, preventative maintenance can extend the service life of paved streets and cost significantly less than reconstructing failed streets. Alternatively, when pavement surfaces become extremely deteriorated, maintenance is generally no longer a cost-effective option. The cost to rehabilitate existing pavement increases dramatically when maintenance is delayed.

Performing maintenance before the pavement falls below 75 percent of its useful life can generally restore the pavement condition to acceptable levels. When maintenance is delayed beyond this time frame, maintenance treatments become more expensive, may be ineffective, and full reconstruction may be required. The cost of reconstruction can be as much as ten times the cost of routine pavement

maintenance. The comparative condition of providing scheduled maintenance and allowing a road surface to deteriorate as it ages is illustrated on Figure 1. Figure 1 shows that the overall condition of a road deteriorates slowly at the beginning of its useful life. Approximately year 15, the useful life of the pavement nears its end, and the road surface and structural stability of the road diminish. However, if maintenance treatments are performed early, significant cost savings can be achieved, along with an increase in the useful life of the pavement.

Numerous options are available for pavement maintenance. Recommended pavement maintenance treatments, including the applicability to each pavement condition rating, typical unit costs, and average maintenance intervals, are discussed below. The options included are proven, cost-effective maintenance treatments common in eastern Oregon.

The unit costs discussed for maintenance treatments include all material, labor, and equipment costs to complete the work. These unit costs assume the work will be performed by a contractor but do not include administration, engineering, mobilization, traffic control, or other costs typically associated with the work being performed. For reference, the applicable sections of the 2024 Oregon Standard Specifications for Construction are indicated for each maintenance treatment described below.

Crack Sealing

Crack sealing consists of cleaning and filling narrow cracks in the pavement surface with a hot-poured sealant material. The sealant forms a flexible and resilient seal that expands and contracts with fluctuating pavement temperatures. Crack sealing reduces the amount of moisture entering subsurface layers, thus preventing premature pavement deterioration and failure due to freeze-thaw cycles. Sealing cracks 1/4 inch or wider can greatly extend the pavement life.

Crack sealing is a very cost-effective method of pavement preservation for streets with a pavement condition rating of “Very Good” or “Good.” The Oregon Standard Specifications for Construction cover crack sealing in Section 00746 - Crack Sealing Flexible Pavements. The typical year 2023 unit cost for crack sealing is approximately \$2.50 per linear foot, as measured along the length of cracks.

Slurry Seal

Slurry sealing consists of a mixture of asphalt emulsion, well-graded fine aggregate (sand), and mineral filler mixed with water to produce a surfacing that is applied in a slurry consistency. Slurry seals are used to seal minor surface cracks and voids, delay surface raveling, and improve surface friction characteristics.

A curing period is necessary before allowing traffic on the slurried surface. Under warm conditions, slurry seals require one to two hours or more to cure depending on the type of emulsion used. Thus, slurry seals may not be appropriate for situations where immediate use of the road is required.

Slurry seals are not effective treatments for severely cracked pavements. For a successful slurry seal application, the existing pavement should not have large cracks that displace under traffic. The pavement should be stable with no excessive rutting or pavement deflection. If the pavement has severe weathering or raveling, a tack coat may be used to promote bonding of the slurry to the surface.

The life expectancy of slurry seals is three to five years when placed on streets with a pavement condition rating of “Good.” The slurry seal performance is affected by several factors such as existing pavement condition, quality of materials and design, construction quality, traffic loading, and environmental conditions.

The Oregon Standard Specifications for Construction cover slurry seals in Section 00706 – Emulsified Asphalt Slurry Seal Surfacing. The typical year 2023 unit cost for slurry seal treatment is approximately \$4.75 per square yard.

Chip Seal

Chip sealing consists of applying a hot emulsified asphalt binder to the existing pavement surface, then immediately spreading aggregate on the hot asphalt. A pneumatic roller is used to seat the aggregate in the asphalt layer. Excess aggregate is removed from the surface after the asphalt has cooled.

This treatment repairs minor raveling, provides a new wearing surface, and seals small cracks to prevent water from penetrating into the street base. Cracks measuring wider than 1/4 inch should be sealed prior to applying a chip seal. A single-layer chip seal treatment generally has a life expectancy of four to six years when placed on streets with a pavement condition rating of “Good” or “Fair.”

A double-layer chip seal may be used on streets with more extensive cracking but still in the “Fair” category. Double-layer chip seals consist of a second application of emulsified asphalt and aggregate over the first chip seal. When multiple chip seal layers are applied, the second layer should consist of smaller aggregate to lock into the first layer and provide a smoother wearing surface.

A street surfaced with a double-layer chip seal can generally be expected to maintain a “Good” or better condition rating for eight to ten years. An additional chip seal layer midway through this life cycle could extend the life cycle another three to five years. Double- and triple-layer chip seals can also be used to produce a wearing surface cap over existing gravel roads and should be considered for such. This technique can also be utilized on existing paved streets with chip seals in poor condition by pulverizing the existing pavement and constructing a multi-layer chip seal as described above.

The Oregon Standard Specifications for Construction cover chip seals in Section 00710 - Single Application Emulsified Asphalt Chip Seal and Section 00715 - Multiple Application Emulsified Asphalt Surface Treatment. The typical year 2023 unit cost for chip seal treatment is approximately \$7.00 per square yard per layer.

A chip seal application does not provide additional structural support for streets, nor will it correct structural deficiencies in existing pavements. However, it can prevent structural deficiencies due to water infiltration, extend the useful life of the pavement surface, provide a serviceable pavement until reconstruction occurs, and prevent structural deficiencies from worsening.

Asphalt Concrete Pavement Overlay

ACP overlays may be used on streets with existing ACP. An overlay generally consists of placing a thin asphalt concrete mat, typically 1-1/2 to 2 inches thick, over the existing ACP. Pavement patching and crack sealing are generally performed prior to placing an overlay. An ACP overlay will provide a longer life and a smoother wearing surface than a chip seal treatment but is also considerably more expensive. ACP overlays should be considered for higher traffic volume streets with existing ACP that have a condition rating of “Good” or “Fair” with no structural deficiencies.

The Oregon Standard Specifications for Construction cover ACP overlays in Section 00744 - Asphalt Concrete Pavement. The typical year 2023 unit cost for a 2-inch ACP overlay is approximately \$25 per square yard.

Remove and Replace Patching

In instances where pavement defects are too severe to address with other treatments or are localized to small areas in an otherwise acceptable section of street, it may be necessary to remove the defective pavement and replace it with an ACP patch. Significant alligator cracking, potholes, and trench settlement can be repaired with remove and replace (R&R) patching. The work consists of saw cutting and removing the full depth of existing pavement and aggregate base, placing and compacting new aggregate base, placing new ACP, and compacting the patched area flush with the existing pavement. Crack sealant is then applied to the joints of the patched area.

R&R work should be targeted at localized areas in streets with a pavement condition rating of “Fair” or better. Asphalt patching of streets with a rating of “Poor” is not recommended, as it is generally not a cost-effective treatment.

The Oregon Standard Specifications for Construction cover R&R in Section 00748 - Asphalt Concrete Pavement Repair. The typical year 2023 unit cost for full-depth asphalt patching is approximately \$75 per square yard, assuming a section consisting of 8 inches of aggregate base and 4 inches of ACP.

Asphalt Concrete Pavement Reconstruction

ACP reconstruction is required when structural failure has occurred and other maintenance treatments will not provide lasting improvements. Reconstruction consists of removing the entire pavement structure and constructing a structural aggregate base and ACP wearing surface designed for the anticipated traffic volume. Additionally, drainage and other issues should be addressed at this time. Reconstruction increases the structural capacity of the pavement to the level required for long-term performance. Full reconstruction is expensive and should be considered for streets with a pavement condition rating of “Poor.” The life expectancy of new ACP is 15 to 20 years with regular maintenance.

The Oregon Standard Specifications for Construction cover ACP reconstruction in Section 00744 - Asphalt Concrete Pavement. The typical year 2023 unit cost for full ACP reconstruction is approximately \$75 per square yard, assuming a section consisting of 8 inches of aggregate base and 4 inches of ACP.

Estimated Costs for Recommended Maintenance Treatments

When performed at regular intervals, the recommended treatments for each condition rating should improve or maintain the “Good” or “Very Good” condition of the pavement. The following section outlines the recommended maintenance treatments for pavement of each condition rating and the estimated unit cost for those treatments. The estimated unit costs shown are per block of pavement of each condition rating assuming an average pavement width of 40 feet and a block length of 400 feet.

The per-block costs shown assume that multiple blocks are maintained as part of a larger effort to achieve economies of scale. Costs would be much higher if maintenance is performed one block at a time. The unit price is based on contractor-performed work and does not include the costs of engineering, traffic control, etc. All costs shown are in 2023 dollars.

Generally, it is not recommended that extensive maintenance be performed on streets in “Poor” condition unless hazardous or unsafe conditions are present. “Poor” condition streets should be targeted for full reconstruction. It should be noted that the cost estimate shown for reconstruction is for the pavement structure only and does not include adding or reconstructing curbs, drainage systems, sidewalks, lighting, signing, or other appurtenances.

A summary of the recommended maintenance treatments and estimated costs for streets of each pavement condition rating is presented on Table 2. Costs are per block in 2023 dollars.

TABLE 2
COST PER BLOCK FOR RECOMMENDED MAINTENANCE TREATMENTS

Cost per Block	Pavement Condition Rating	Maintenance			Reconstruction
		Crack Seal	Chip Seal	R&R	ACP
\$0	Very Good				
\$5,500	Good	✓		✓	
\$24,000	Fair	✓	✓	✓	
\$133,500	Poor				✓

To estimate the cost of maintenance and reconstruction, the following assumptions were made for each street rating (all work is assumed to be performed by a contractor, as noted above):

Very Good (\$0 per Block)

- No work is performed.

Good (\$5,500 per Block)

- Crack sealing 7.5 percent of the pavement surface.
- Repairing four potholes per block.

Fair (\$24,000 per Block)

- Crack sealing 10 percent of the pavement surface.
- Repairing four potholes per block.
- Complete single-layer chip seal.

Poor (\$133,500 per Block)

- Perform a complete ACP reconstruction with an 8-inch base and 4-inch ACP surface.

Implementation and Recommendations

Preventative maintenance early in the pavement life cycle can extend its useful life for many years and is much more cost-effective than reconstructing failed pavement. The City is responsible for approximately 19 miles of paved streets. To accomplish the goal of maintaining all City streets in “Good” or better condition, this Study provides a ten-year schedule of recommended maintenance, including annual costs.

The following assumptions were used for the purposes of creating the ten-year maintenance schedule:

- Paved streets will generally have a 15- to 20-year serviceable life: years one through six in “Very Good” condition, years seven through 11 in “Good” condition, years 12 through 16 in “Fair” condition, and year 17 and beyond in “Poor” condition.
- Existing streets in “Fair” condition will not be allowed to deteriorate to “Poor” condition.
- Preventative maintenance will reduce the effective age of the street by four years for streets in “Good” condition and by five years for streets in “Fair” condition.
- ACP reconstruction of streets in “Poor” condition will return the effective pavement age to year one.
- The proposed schedule shows a recommended number of City blocks for each condition rating to receive maintenance each year. It does not identify specific streets or blocks.
- Due to the nature of work proposed, the annual costs assume the City will have contractors perform the work.
- The Study assumes an annual inflation rate of 4 percent per year for total costs. All yearly maintenance costs are in 2023 dollars. Total costs are inflated to account for the actual cost.

The proposed ten-year pavement maintenance schedule and associated costs are shown on Figure 2. The current Street Condition Inventory map shows that only 26 percent of all paved streets within the City are in “Good” or “Very Good” condition. Following the proposed maintenance schedule, this percentage rises to 81 percent by year five and 98 percent at the end of the ten-year period.

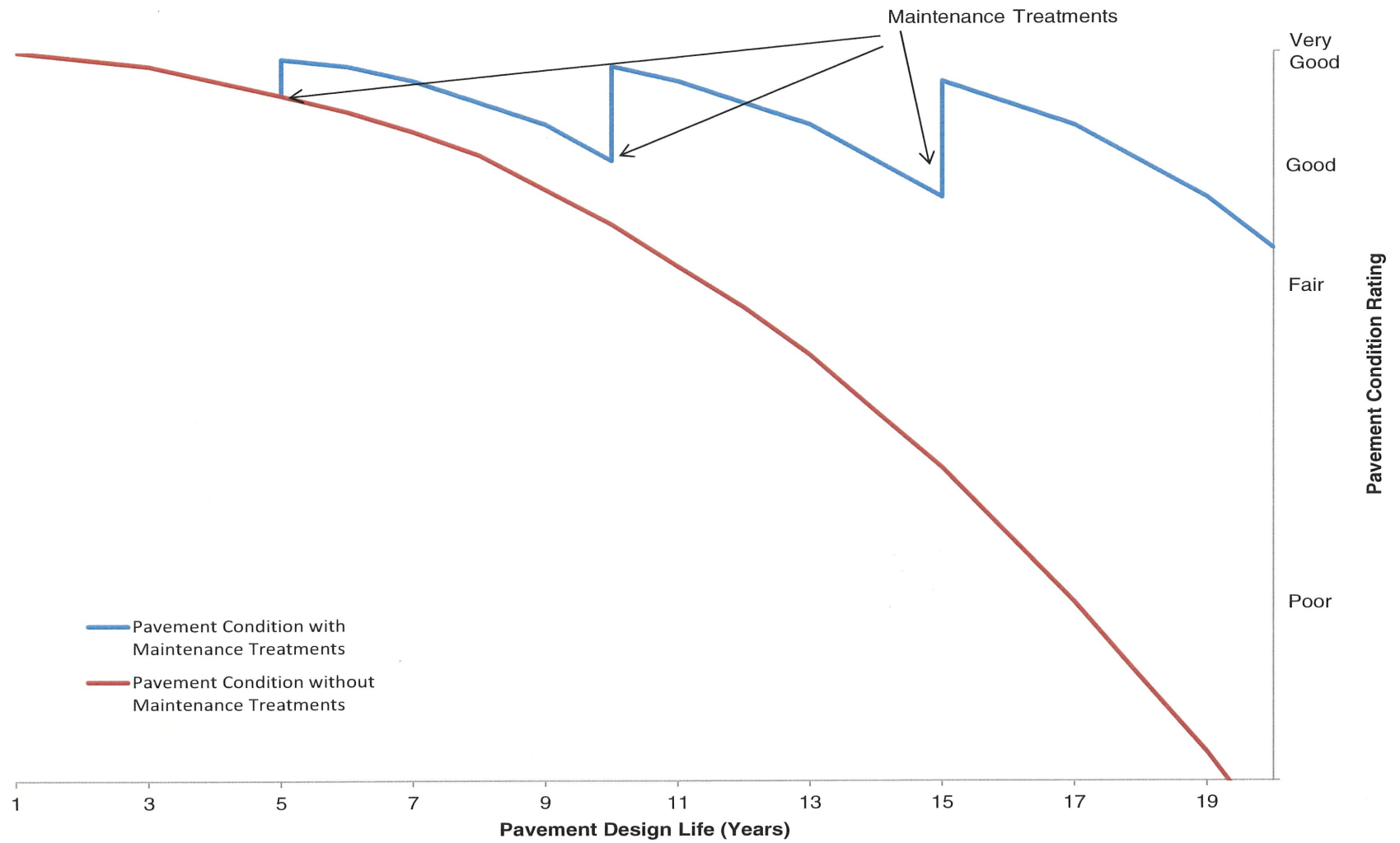
The number of street blocks to be maintained is shown in the ten-year maintenance schedule to provide an estimate of the anticipated cost. However, specific street sections have not been identified. Maintenance and reconstruction should be prioritized by the City considering location, traffic volumes,

and available funding. It is important to note that the proposed maintenance schedule is based on a “typical” pavement deterioration rate and that actual deterioration rates will vary from street to street, depending on the material quality, weather conditions, and traffic patterns. Additionally, the benefits gained from maintenance treatments will vary according to the quality of construction, weather conditions, and traffic patterns. The proposed maintenance schedule, if implemented, should be reviewed annually to account for these factors.

It is recommended that the streets receiving the highest volumes of traffic be given priority for maintenance funding, as these streets are the backbone of the City’s system. Sixty-seven percent of the streets are in “Fair” condition. These streets should be aggressively targeted for the recommended maintenance treatments to prevent further deterioration into the “Poor” category. City staff should review and update the Street Condition Inventory map annually to select specific street sections from the “Fair” category to receive maintenance each year.

Without adequate planning and funding, streets will receive limited maintenance and continue to deteriorate. Implementation of the pavement maintenance recommendations outlined in this Study will help to provide the City of Boardman with a high-quality, reliable street network that will meet the City’s needs for many years to come.

Figures

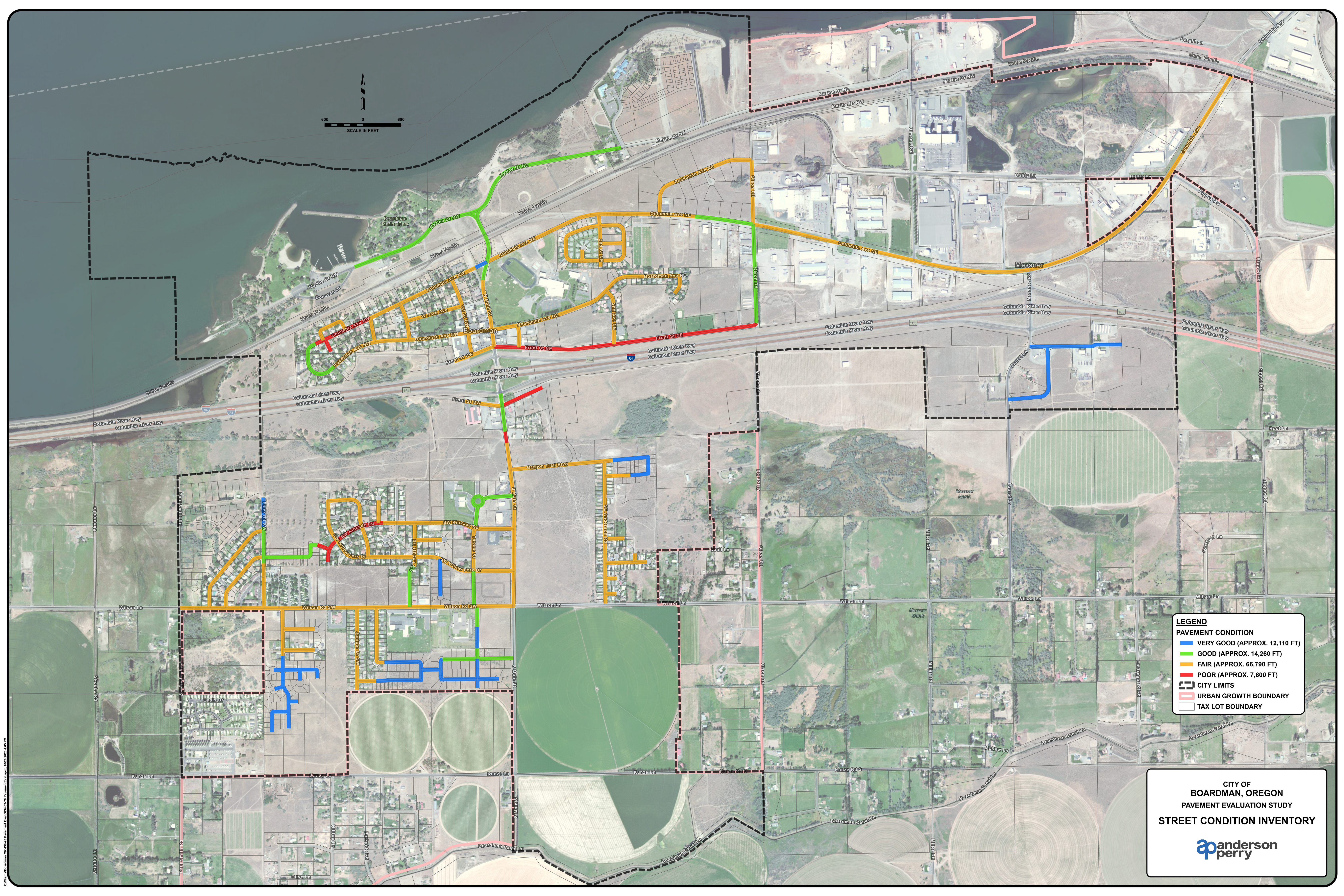


CITY OF BOARDMAN, OREGON
PAVEMENT EVALUATION STUDY
TEN-YEAR PAVEMENT MAINTENANCE SCHEDULE

Pavement Condition Rating	Pavement Effective Age (Year)	2023		2024		2025		2026		2027		2028		2029		2030		2031		2032	
		No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained	No. of Blocks in Inventory	No. of Blocks Maintained
Very Good	1	5		0		0		0		0		0		4		4		4		4	
	2	5		5		0		0		0		0		0		4		4		4	
	3	5		5		5		0		0		0		0		0		4		4	
	4	5		5		5		5		0		0		0		0		0		4	
	5	5		5		5		5		5		0		0		0		0		0	
	6	5		5		5		5		5		5		0		0		0		0	
Good	7	7		12		46		46		46		45		50		46		46		46	
	8	7		7		12		46		46		46		45		50		46		46	
	9	7		7		7		12		46		46		46		45		50		46	
	10	7		14		13		12		17		46		46		46		45		50	
	11	7	7	41	41	41	41	41	41	40	40	45	45	46	46	46	46	46	46	45	45
	12	33		0		0		0		0		0		0		0		0		0	
Fair	13	33		33		0		0		0		0		0		0		0		0	
	14	34		33		33		0		0		0		0		0		0		0	
	15	34	7	34	6	33	5	33	5	0		0		0		0		0		0	
	16	34	34	27	27	28	28	28	28	28	28	0		0		0		0		0	
Poor	17+	20		20		20		20		20		20	4	16	4	12	4	8	4	4	4
Total No. of Blocks		253	48	253	74	253	74	253	74	253	68	253	49	253	50	253	50	253	50	253	49
Percentage of Streets Rated "Good" or "Very Good"		26%		42%		55%		68%		81%		92%		94%		95%		97%		98%	
Annual Maintenance Cost (Year 2023)		\$1,022,500.00		\$1,017,500.00		\$1,017,500.00		\$1,017,500.00		\$892,000.00		\$781,500.00		\$787,000.00		\$787,000.00		\$787,000.00		\$781,500.00	
Annual Maintenance Cost (Year of Construction)		\$1,022,500.00		\$1,058,200.00		\$1,100,528.00		\$1,144,549.12		\$1,043,513.84		\$950,814.24		\$995,806.07		\$1,035,638.31		\$1,077,063.84		\$1,112,318.18	

- Assumptions:**
- Recommended maintenance will reduce effective age by four years for pavement in "Good" condition.
 - Recommended maintenance will reduce effective age by five years for pavement in "Fair" condition.
 - Streets in "Poor" condition that receive asphalt concrete pavement reconstruction are considered new and have an effective pavement age of year one.
 - City staff will review and update the Street Condition Inventory Map annually to select the specific street sections to receive maintenance.
 - Inflation is assumed to occur at 4 percent per year.
 - Annual costs are based on the following 2023 per-block costs:
 - "Very Good" No Maintenance
 - "Good" \$5,500 per block
 - "Fair" \$24,000 per block
 - "Poor" \$133,500 per block
 - Costs assume a contractor will perform the maintenance but do not include administration, engineering, mobilization, traffic control, or other costs typically associated with the work.

Street Condition Inventory Map



LEGEND

PAVEMENT CONDITION

- VERY GOOD (APPROX. 12,110 FT)
- GOOD (APPROX. 14,260 FT)
- FAIR (APPROX. 66,790 FT)
- POOR (APPROX. 7,600 FT)

CITY LIMITS

URBAN GROWTH BOUNDARY

TAX LOT BOUNDARY

CITY OF
BOARDMAN, OREGON
PAVEMENT EVALUATION STUDY
STREET CONDITION INVENTORY

apanderson
perry