

PREVENTATIVE MAINTENANCE

- The Free Dictionary = The care and servicing by personnel for the purpose of maintaining equipment and facilities in satisfactory operating condition by providing for systematic inspection, detection, and correction of incipient failures either before they occur or before they develop into major defects.
- Answers.com = (*engineering*) A procedure of inspecting, testing, and reconditioning a system at regular intervals according to specific instructions, intended to prevent failures in service or to retard deterioration.
- Wisconsin Department of Transportation definition: Pavement preventive maintenance efforts are typically lower in cost than full fledged improvements and are intended to:
 - Slow pavement deterioration
 - Maintain a highway's functional condition
 - Extend pavement life
- AASHTO (American Association of State Highway and Transportation Officials) definition. Preventative Maintenance activities include work that:
 - Prevents intrusion of water to the pavement structure (sealcoat, fog seals, micro-surfaces, crackfills, thin overlays)
 - Provides for the removal of water from the pavement structure (restoring ditch drainage, underdrain repairs, storm sewer repairs)
 - Provides/improves pavement rideability (thin overlays, profiling and milling)
 - Prevents deterioration of bridges (painting, deck cleaning, scour protection, deck repairs)

Iowa County Infra-structure value – GASB report 2011

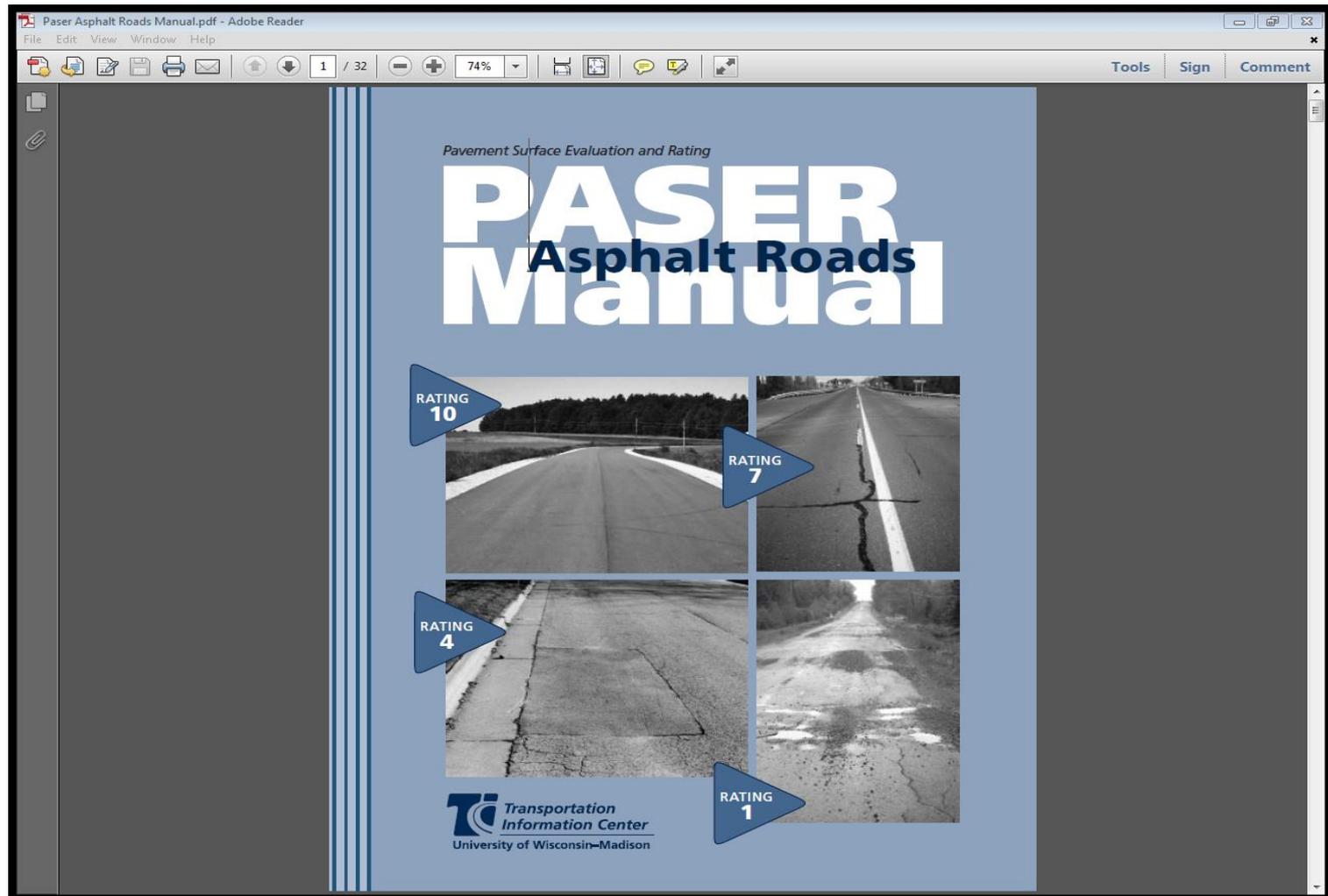
SUMMARY OF INFRASTRUCTURE

2011

Type of Asset	Original Cost	2011 Additions	Prior Yrs. Deprec.	2011 Deprec.	Book Value 12/31/2011
Bridges	7,237,637.40	27,528.83	2,387,242.19	135,267.43	4,742,656.61
Culverts	2,649,441.00	-	1,498,185.00	47,379.00	1,103,877.00
Right-of Way- 3251.55 acres	808,385.00	-	-	-	808,385.00
Roads	94,117,854.94	873,988.48	53,704,843.82	1,940,575.30	39,346,424.30
Total Infrastructure	\$104,813,318.34		\$57,590,271.01	\$2,123,221.73	\$46,001,342.91

*A copy of the detail for all of the above may be obtained at the highway office upon request.

Wisconsin adopted method of measuring pavement distresses through numerical ratings
PASER = Measuring tool



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Tools Sign Comment

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Rating pavement surface condition 15

Rating system

Surface rating	Visible distress*	General condition/ treatment measures
10 Excellent	None.	New construction.
9 Excellent	None.	Recent overlay. Like new.
8 Very Good	No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced (40' or greater). All cracks sealed or tight (open less than 1/4").	Recent sealcoat or new cold mix. Little or no maintenance required.
7 Good	Very slight or no raveling, surface shows some traffic wear. Longitudinal cracks (open 1/4" - 1/2") due to reflection or paving joints. Transverse cracks (open 1/4") spaced 10' or more apart, little or slight crack raveling. No patching or very few patches in excellent condition.	First signs of aging. Maintain with routine crack filling.
6 Good	Slight raveling (loss of fines) and traffic wear. Longitudinal cracks (open 1/4" - 1/2"), some spaced less than 10'. First sign of block cracking. Slight to moderate flushing or polishing. Occasional patching in good condition.	Shows signs of aging. Sound structural condition. Could extend life with sealcoat.
5 Fair	Moderate to severe raveling (loss of fine and coarse aggregate). Longitudinal and transverse cracks (open 1/2") show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking up to 50% of surface. Extensive to severe flushing or polishing. Some patching or edge wedging in good condition.	Surface aging. Sound structural condition. Needs sealcoat or thin non-structural overlay (less than 2")
4 Fair	Severe surface raveling. Multiple longitudinal and transverse cracking with slight raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (1/2" deep or less).	Significant aging and first signs of need for strengthening. Would benefit from a structural overlay (2" or more).
3 Poor	Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25% of surface). Patches in fair to poor condition. Moderate rutting or distortion (1" or 2" deep). Occasional potholes.	Needs patching and repair prior to major overlay. Milling and removal of deterioration extends the life of overlay.
2 Very Poor	Alligator cracking (over 25% of surface). Severe distortions (over 2" deep). Extensive patching in poor condition. Potholes.	Severe deterioration. Needs reconstruction with extensive base repair. Pulverization of old pavement is effective.
1 Failed	Severe distress with extensive loss of surface integrity.	Failed. Needs total reconstruction.

* Individual pavements will not have all of the types of distress listed for any particular rating. They may have only one or two types.

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Tools Sign Comment

PAVEMENT CONDITION

RATING 10
Excellent

RATING 6
Good

RATING 4
Fair

RATING 2
Poor

PAVEMENT AGE →

In addition to indicating the surface condition of a road, a given rating also includes a recommendation for needed maintenance or repair. This feature of the rating system facilitates its use and enhances its value as a tool in ongoing road maintenance.

RATINGS ARE RELATED TO NEEDED MAINTENANCE OR REPAIR

Rating 9 & 10	No maintenance required
Rating 8	Little or no maintenance
Rating 7	Routine maintenance, cracksealing and minor patching
Rating 5 & 6	Preservative treatments (sealcoating)
Rating 3 & 4	Structural improvement and leveling (overlay or recycling)
Rating 1 & 2	Reconstruction

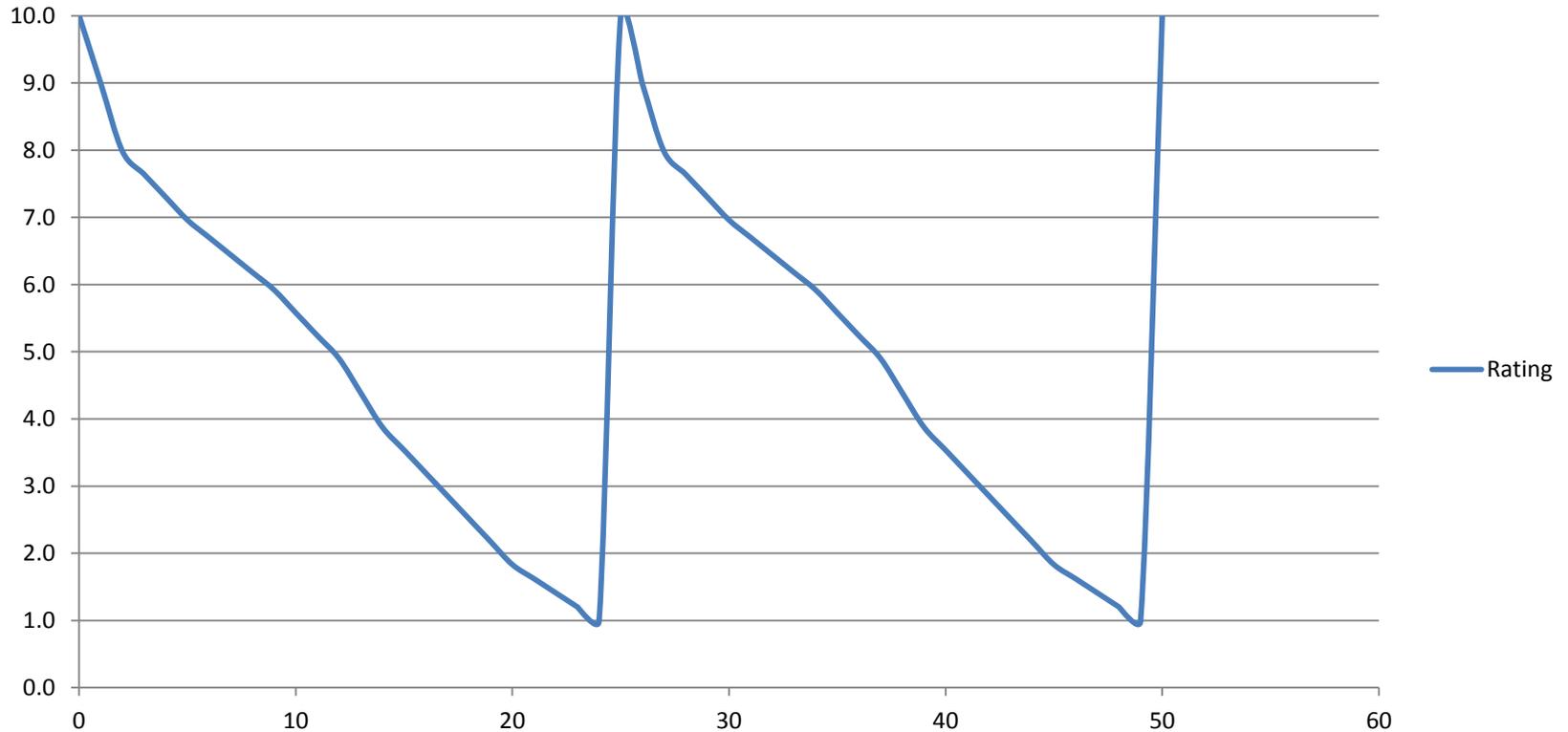
UW-TIC University of Wisconsin Transportation Information Center

PASER road rating mathematical procedure and assumptions based solely on asphalt pavement oil age and weathering deterioration

Serviceable road is considered a 4 or 5 rating and above.				
Paser Rating	Loss/Year	Years/Paser loss	Years	Treatment Recommendation
10	1.01	0.99	0	
9	1.01	0.99	0.99	
8	0.34	2.93	1.98	
7	0.26	3.85	4.91	Crackfill
6	0.341	2.93	8.76	Sealcoat
5	0.51	1.96	11.69	Seal and spot wedge restoration
4	<u>0.341</u>	<u>2.93</u>	<u>13.65</u>	<u>Sealcoat and other deterioration repairs</u>
3	0.341	2.93	16.58	Asphalt Pavement Resurface or Structural Overlay
2	0.21	4.76	19.51	Pavement & Subgrade Recondition or Rehabilitation
1	0.21	4.76	24.27	Complete Roadbed Reconstruction
0			29.03	Impassable – Closed to traffic

LIFE CYCLE OF AN ASPHALT PAVEMENT (Do Nothing Approach – Age Deterioration only)

PASER Rating Vs Time (years)



Types of pavement distress

An understanding of the types of distresses created and treated on the highway system needs to be discussed to fully understand the various maintenance procedures summarized above. There are 8 different types of typical asphalt pavement distresses identified by the PASER program, as well as the asphalt industry in general. They are described as:

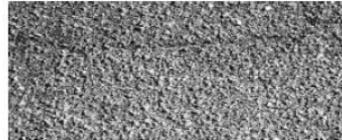
- **Raveling** – loss of pavement material from the top down due to loss of the bituminous film (coating) on aggregates; asphalt hardening due to aging, poor compaction, or insufficient asphalt content during production; or other fine or coarse aggregate loss within the pavement materials. Corrective actions would include all treatments from a sealcoat to an HMA non-structural overlay, dependent on the need for a wearing surface or additional material. **Repairs performed via targeted preventative maintenance treatments.**
- **Flushing** – excess asphalt on the surface caused by a poor initial mix design, by an overlay, or sealcoat of a flushed surface. Corrective action would include blotting with sand or lime to absorb the excess asphaltic material at the surface, or by an HMA non-structural overlay designed to the proper parameters. **Repairs via Reactive maintenance.**
- **Polishing** – the presence of a smooth slippery surface caused by traffic wearing off the surface of the aggregates. **Repairs via preventative maintenance treatments.**
- **Rutting** – the displacement of pavement material creating channels in the wheel path caused by the traffic compaction or displacement of unstable sub-grade or pavement materials. Severe rutting in excess of 2" thick is typically a result of sub-grade or base failures. Corrective action of micro-surfacing, double sealcoat, paver placed thin overlay, HMA wedge, or ultra-thin HMA overlays can repair ruts up to 2" in depth as long as the application exceeds the depth of the rut. Localized areas or ruts of small diameter (less than half the roadway width) can be repaired by sand-patching with cold mix patch. Ruts of 2" and greater in depth require reconstruction of the pavement and base system to repair the distress. **Routine maintenance for pothole patching, Reactive maintenance for larger surface treatments.**
- **Distortion** – is the shoving or rippling of material crossways to the direction of the traffic pattern. The distress can escalate to wash-boarding of the pavement if the mixture is unstable due to improper asphalt production mixing, poor aggregate quality, or an improper mix design. Corrective action would be to perform a mill to the bottom of the distortion and overlay with a non-structural overlay. Severe distortions due to frost/heave may require reconstruction. **Corrective actions include routine maintenance spot repairs, Reactive maintenance for larger repairs.**
- **Potholes** – the loss of pavement materials creating a hole in the surface of the pavement system due to traffic loading, fatigue, or inadequate strength, usually associated with poor drainage. Corrective actions include sand-patching or localized removal and repair of the sub-grade and pavement surface. **Corrective actions are performed as routine maintenance spot repairs.**
- **Patching** – the repair of the original asphalt pavement surface with a new and different asphalt material, typically indicates a pavement defect repair or utility excavation. Corrective actions include crackfilling, sand-patching, and spot repairs. **Corrective actions are performed as a part of Routine maintenance.**
- **Cracking** – described as an opening in the surface of the asphalt pavement caused by a variety of reasons related to age, strength, load, deformation, expansion, contraction, weather, or other distress issues. It is recommended to seal all cracks with an opening of ¼ inch or more to prevent further deterioration.

4 EVALUATION — Surface Defects

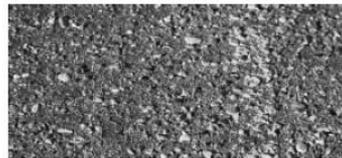
SURFACE DEFECTS

Raveling

Raveling is progressive loss of pavement material from the surface downward, caused by: stripping of the bituminous film from the aggregate, asphalt hardening due to aging, poor compaction especially in cold weather construction, or insufficient asphalt content. Slight to moderate raveling has loss of fines. Severe raveling has loss of coarse aggregate. Raveling in the wheelpaths can be accelerated by traffic. Protect pavement surfaces from the environment with a sealcoat or a thin overlay if additional strength is required.



◀ Slight raveling. Small aggregate particles have worn away exposing tops of large aggregate.



◀ Moderate to severe raveling. Erosion further exposes large aggregate.

Flushing

Flushing is excess asphalt on the surface caused by a poor initial asphalt mix design or by paving or sealcoating over a flushed surface. Repair by blotting with sand or by overlaying with properly designed asphalt mix.



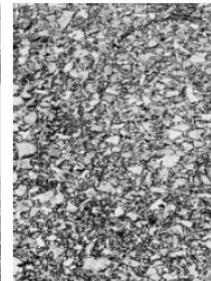
◀ Severe raveling and loss of surface material.

Polishing

Polishing is a smooth slippery surface caused by traffic wearing off sharp edges of aggregates. Repair with sealcoat or thin bituminous overlay using skid-resistant aggregate.

Polished, worn aggregate needs repair. ▼

▶ Flushing. Dark patches show where asphalt has worked to surface.



SURFACE DEFORMATION

Rutting

Rutting is displacement of material, creating channels in wheelpaths. It is caused by traffic compaction or displacement of unstable material. Severe rutting (over 2") may be caused by base or subgrade consolidation. Repair minor rutting with overlays. Severe rutting requires milling the old surface or reconstructing the roadbed before resurfacing.



◀ Even slight rutting is evident after a rain.



◀ Severe rutting over 2" caused by poor mix design.



◀ Severe rutting caused by poor base or subgrade.

6 EVALUATION — Surface Deformation

Distortion

Showing or rippling is surfacing material displaced crossways to the direction of traffic. It can develop into washboarding when the asphalt mixture is unstable because of poor quality aggregate or improper mix design. Repair by milling smooth and overlaying with stable asphalt mix.

Other pavement distortions may be caused by settling, frost heave, etc. Patching may provide temporary repair. Permanent correction usually involves removal of unsuitable subgrade material and reconstruction.

▼ Heavy traffic has shoved pavement into washboard ripples and bumps.



► Severe settling from utility trench.



► Frost heave damage from spring break-up.

Types of cracking in asphalt pavements

- **Transverse** – a random crack at an approximate right angle to the travelling direction, typically at regular intervals. The primary cause is by temperature fluctuations and the hardening of the asphalt materials with aging. Transverse cracks will half life on a 3 to 5 year cycle over the life of an asphalt pavement. Initial cracks develop at intervals greater than 50 feet, usually in the 120 to 150 feet range. Over a 35 year life expectancy of a road, crack spacing would halve until they reached 2-4 feet or less on center or block cracking by the end of life. Initial treatment is by Rout & Seal crackfilling until no longer cost effective to do so. Typically, transverse crack spacing of 12 feet or less on center is no longer economical to perform Rout and Seal, in addition; loss of pavement life can be expedited by routing cracks in close proximity to each other. Late in service life Overband crackfilling of cracks $> \frac{1}{4}$ " in width can serve as an economical solution to deter water filtration. **Corrective actions performed as a part of Preventative maintenance.**
- **Reflection** – random cracking in overlays or surface treatments reflective of the pavement and sub-grade system underneath them. The cracks are impossible to prevent without performing thick structural overlays. Typically indicative of the pavement structure being treated. Corrective actions would include Rout & seal crackfilling or Overband crackfilling dependent on the crack spacing. **Corrective actions performed as a part of Preventative maintenance.**
- **Slippage** – crescent or rounded cracking patterns in the surface of a pavement caused by the slippage of materials between overlays; an overlay and an underlying pavement; a surface treatment and an underlying pavement; or a pavement and a recycled base course. Distress is usually found in stop and go traffic locations or turning movement locations. Corrective action is to remove the surface materials and re-apply using a tack product to bind the two together as a spot repair. **Corrective actions performed as a part of Routine maintenance.**
- **Longitudinal** – random cracks in the direction of the traffic pattern. Caused by inadequate bonding of pavement layers during construction; fatigue failure from heavy vehicle loads within the wheel path; or edge cracks due to insufficient shoulder support, poor drainage, or frost/heave action. Cracks grow in width with age and if not treated will result in more severe distress such as raveling, potholes, patching, or other issues. Corrective actions include Overband crackfilling or Rout and Seal crackfilling dependent on the width, length, and proximity of the cracks. **Corrective actions are performed as a part of Preventative maintenance.**
- **Block** – interconnected cracks intersecting at nearly right angles to create large (10 feet or more) or small (down to 6") block shapes. The closer spacing or block sizing indicates advancement of aging caused by shrinking and hardening of the asphalt materials. Corrective actions include Overband or Rout and seal crackfilling dependent on the size of the blocks, blocks smaller than 10 feet should be Overband or not crackfilled dependent on the width of the openings. Other corrective actions include Chip sealcoating, Double sealcoat, wedge & Sealcoat, or HMA overlay in early deterioration stages, block cracks of 10 feet or more or blocks less than 10 feet if no other distress is evident. Block cracking less than 10 feet on center is an indication of approaching end of service life for a pavement surface, and planning for a capital improvement should occur. **Corrective actions are performed as a part of Preventative maintenance or capital improvement dependent on crack distribution severity and pavement age.**
- **Alligator** – interconnected cracks forming small pieces or shapes of any size ranging from 1" to 6". The cracks are caused by failure of the surface due to fatigue strength loading due to aging, inadequate sub-grade support, inadequate base for the loads, water infiltration, or other issues. Corrective actions require restoration of the sub-grade and pavement system by patching, potholing, or reconstruction. **Corrective actions are performed as a part of Routine or Reactive maintenance for localized areas or Capital Improvement for larger areas.**

▼ Widely spaced, well-sealed cracks.



CRACKS

Transverse cracks

A crack at approximately right angles to the center line is a transverse crack. They are often regularly spaced. The cause is movement due to temperature changes and hardening of the asphalt with aging.

Transverse cracks will initially be widely spaced (over 50'). Additional cracking will occur with aging until they are closely spaced (within several feet). These usually begin as hairline or very narrow cracks; with aging they widen. If not properly sealed and maintained, secondary or multiple cracks develop parallel to the initial crack. The crack edges can further deteriorate by raveling and eroding the adjacent pavement.

Prevent water intrusion and damage by sealing cracks which are more than 1/4" wide.

▲ Sealed cracks, a few feet apart.



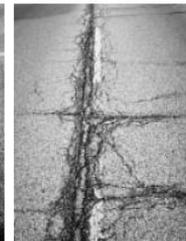
▲ Tight cracks less than 1/4" in width.



▲ Open crack — 1/2" or more in width.



▲ Water enters unsealed cracks softening pavement and causing secondary cracks.



▲ Pavement ravel and erodes along open cracks causing deterioration.

8 EVALUATION — Cracks

Reflection cracks

Cracks in overlays reflect the crack pattern in the pavement underneath. They are difficult to prevent and correct. Thick overlays or reconstruction is usually required.



► Concrete joints reflected through bituminous overlay.

Slippage cracks

Crescent or rounded cracks in the direction of traffic, caused by slippage between an overlay and an underlying pavement. Slippage is most likely to occur at intersections where traffic is stopping and starting. Repair by removing the top surface and resurfacing using a tack coat.

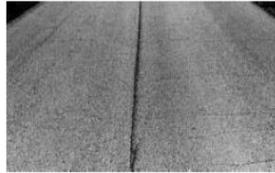


► Crescent-shaped cracks characteristic of slippage.

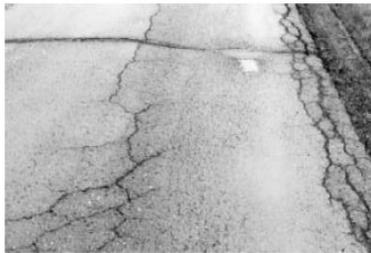


► Loss of bond between pavement layers allows traffic to break loose pieces of surface.

Centerline crack (still tight).



Edge cracking from weakened subbase and traffic loads.



First stage of wheelpath cracking caused by heavy traffic loads.



Load-related cracks in wheel path plus centerline cracking.



Longitudinal cracks

Cracks running in the direction of traffic are longitudinal cracks. Center line or lane cracks are caused by inadequate bonding during construction or reflect cracks in underlying pavement. Longitudinal cracks in the wheel path indicate fatigue failure from heavy vehicle loads. Cracks within one foot of the edge are caused by insufficient shoulder support, poor drainage, or frost action. Cracks usually start as hairline or vary narrow and widen and erode with age.

Without crack filling, they can ravel, develop multiple cracks, and become wide enough to require patching.

Filling and sealing cracks will reduce moisture penetration and prevent further subgrade weakening. Multiple longitudinal cracks in the wheel path or pavement edge indicate a need for strengthening with an overlay or reconstruction.

Multiple open cracks at center line, wheelpaths and lane center.



10 EVALUATION — Cracks

Block cracks

Block cracking is interconnected cracks forming large blocks. Cracks usually intersect at nearly right angles. Blocks may range from one foot to approximately 10' or more across. The closer spacing indicates more advanced aging caused by shrinking and hardening of the asphalt over time. Repair with sealcoating during early stages to reduce weathering of the asphalt. Overlay or reconstruction required in the advanced stages.



▶ Large blocks, approximately 10' across.



▶ Intermediate-size block cracking, 1'-5' across with open cracks.



▶ Extensive block cracking in an irregular pattern.



▶ Severe block cracking - 1' or smaller blocks. Tight cracks with no raveling.

Alligator cracks

Interconnected cracks forming small pieces ranging in size from about 1" to 6". This is caused by failure of the surfacing due to traffic loading (fatigue) and very often also due to inadequate base or subgrade support. Repair by excavating localized areas and replacing base and surface. Large areas require reconstruction. Improvements in drainage may often be required.



◀ Alligator crack pattern. Tight cracks and one patch.



◀ Characteristic "chicken wire" crack pattern shows smaller pavement pieces and patching.



◀ Open raveled alligator cracking with settlement along lane edge most likely due to very soft subgrade.

12 EVALUATION — Patches and Potholes

PATCHES AND POTHOLES

Patches

Original surface repaired with new asphalt patch material. This indicates a pavement defect or utility excavation which has been repaired. Patches with cracking, settlement or distortions indicate underlying causes still remain. Recycling or reconstruction are required when extensive patching shows distress.



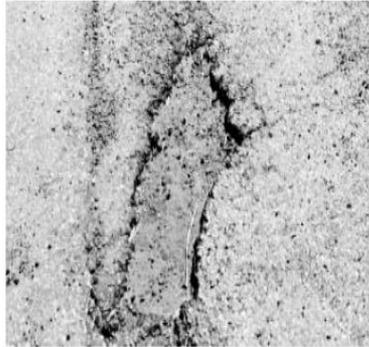
▶ Typical repair of utility excavation. Patch in fair to good condition.



▶ Edge wedging. Pavement edges strengthened with wedges of asphalt. Patch is in very good condition.



▶ Extensive patching in very poor condition.



Potholes

Holes and loss of pavement material caused by traffic loading, fatigue and inadequate strength. Often combined with poor drainage. Repair by excavating or rebuilding localized potholes. Reconstruction required for extensive defects.

◀ Small pothole where top course has broken away.



◀ Multiple potholes show pavement failure, probably due to poor subgrade soils, frost heave, and bad drainage.



◀ Large, isolated pothole, extends through base. Note adjacent alligator cracks which commonly deteriorate into potholes.

10 = CTH DD



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PASER 9 – CTH G





05/30/2014

PASER 8 – CTH Q



PASER 6 = CTH B



PASER 5 = CTH B





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PASER 4 = CTH D





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PASER 3 = CTH N



PASER 1 = CTH F OR T (BIRCH LK)



PASER 1 THRU 3 DEPENDING ON

- FREQUENCY OF BLOCK CRACK SPACING (Size of Blocks or Alligators)
- SEVERITY OF PAVEMENT DEFORMATION (Amount of rutting)
- SUBGRADE CONDITION (Pumping of pavement and soils)
- TRAFFIC VOLUME AND TYPE (Functional capacity can contribute to structural deficiency due to load and frequency)



Types of Preventative Maintenance

(Bold = Historical process of Iowa County prior to 2009)

- The following listing is types of maintenance typically performed on rural asphalt pavement roads, it is not intended to be an all inclusive listing:
 - Overband Crackfilling – Crack cleaning and filling treatment of the pavement surface longitudinal and some transverse joints.
 - **Crackfill** – Crack rout, cleaning, and filling treatment of transverse and some longitudinal joints.
 - Fog Sealing – Oil treatment of the pavement surface.
 - Micro-surfacing – single or multiple layers of thin aggregate (< ¼”) overlays.
 - **Chip seal** – single or double layers of aggregate (1/4” to 3/8”).
 - **HMA Shoulder Ribbon** – asphalt shoulder placement for drainage or load widening.
 - **Ultra-thin HMA Overlay** – overlays of 1” thickness or less.
 - **HMA Wedge and Sealcoat** – HMA pavement placement in deficiency areas then a sealcoat surface.
 - Paver placed Surface Seal – ultrathin overlay with emulsifier sealant.
 - **Non-structural HMA Overlay** – overlays of less than 2” thickness.

Thus is the methodology behind a **Preventative Maintenance** program, to extend the original 20-year design pavement system life by applying specific treatments at specified intervals for the reduction of age, environment, structural, load, and other related distresses. The following table establishes a listing of industry wide standard life expectancies for various preventative maintenance treatments. Some of the treatments listed, although utilized in urban settings for a number of years; are fairly new to rural applications. Therefore, the actual life expectancy of the treatment may be more or less as determined through time and study (related to Fog sealing, micro-surfacing, ultra-thin HMA overlay, and a paver placed surface seal) :

- **Overband crackfill** – 1 to 3 years, say 2 years.
- **Rout & Seal crackfill** – 3 years.
- Fog seal – 1 to 2 years say 2 years.
- Micro-surface – 4 to 8 years, say 6 years.
- **Chip sealcoat** – 3 to 7 years, say 5 years.
- **HMA wedge and sealcoat** – 7 to 10 years, say 9 years.
- **Double Chip sealcoat** – 6 to 10 years, say 8 years.
- **HMA shoulder ribbon** – equivalent to that of the pavement adjacent to it based on thickness
- **Ultra-thin HMA overlay** – 5 to 8 years, say 7 years
- Paver placed surface seal - 4 to 6 years? Acknowledges a new process without a lot of data available
- **Non-structural HMA overlay (<2")** – 5 to 10 years, say 7 years. Note the life can be extended by performance of other maintenance activities.

Source Minnesota sealcoat manual, AASHTO Pavement Preservation & Maintenance Guide, and Basic Asphalt Recycling Manual

Overband – CTH D





Rout N Seal – CTH D





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Overband (Left) versus Rout-N-Seal (Right) Crackfill example – CTH D



Chip Seal (Sealcoat) – CTH Q



HMA Shoulder Ribbon – CTH H







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HMA Wedge and Sealcoat



Non-structural Overlay





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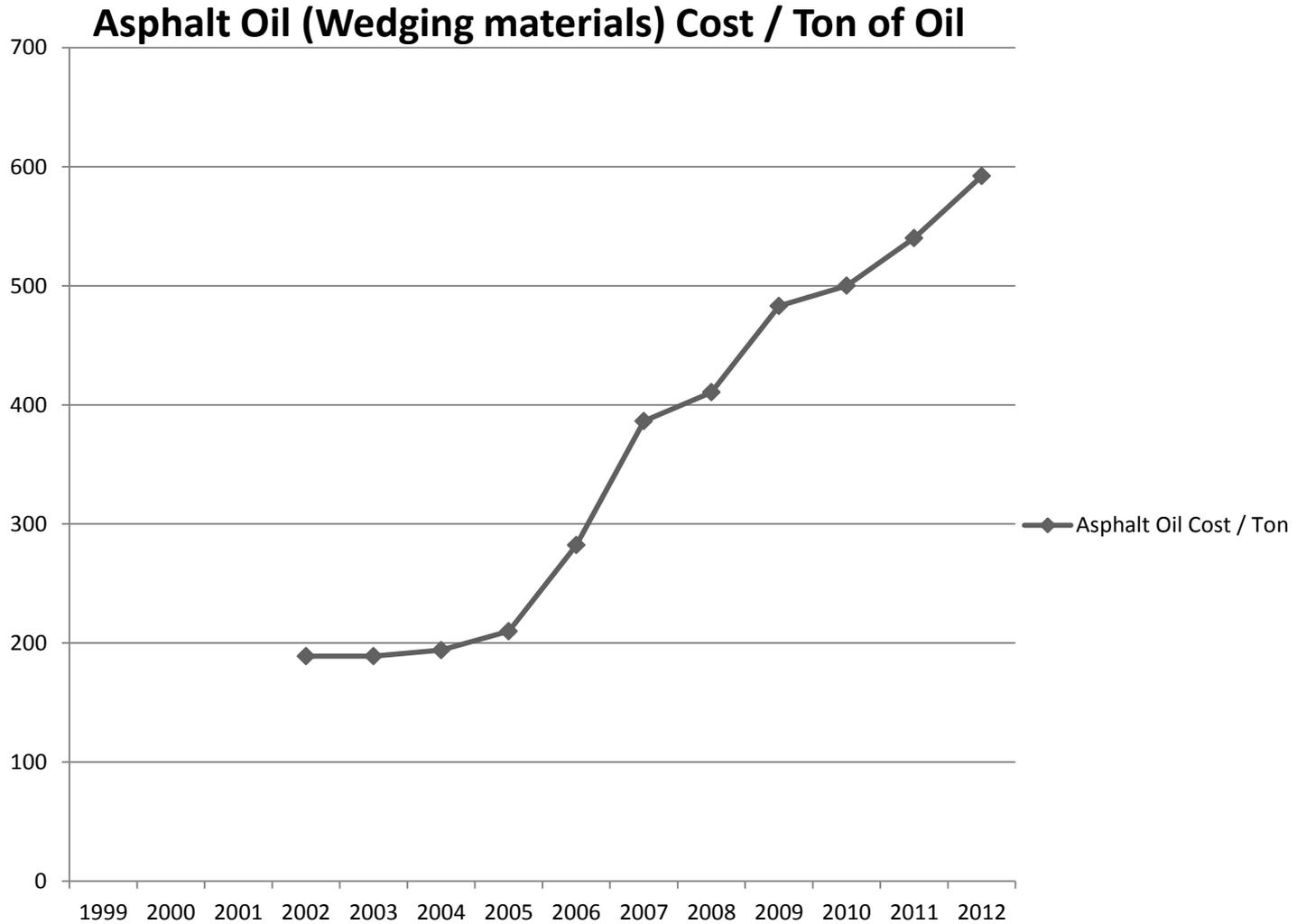


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- **With a regularly scheduled preventative maintenance program, the only amount of mileage beyond 10 years should be the mileage being improved or surfaced for the next cycle.**
 - Preventative Maintenance (Wearing surface or asphalt surface seal - Sealcoat) - 365.7 mi / 10 year cycle = 36.57 mi / yr.
 - Construction (Pavement and/or subgrade) Improvement – 365.7 mi / 50 yr. life = 7.31 mi / yr.
 - Preventative Surface Treatment over 10 years = 7.31 + 36.57 = 43.88 miles (the next year's improvements).
 - **System Needs = 114.78 miles – 43.88 mi = 70.9 miles are being neglected and not maintained on a regular schedule and the number grows biennially (every 2 years) by 10 to 15 miles.**
- **Result will be a growing cost of routine and preventative maintenance expenses due to not performing the right treatments within the correct timeframe, which leads to increased deterioration (maintenance \$) to correct the deficiencies.**
- **Cost Examples (2012 Dollars on a per mile basis):**
 - 1st round sealcoat (during years 7 to 10) = 2 crackfill cycles and a sealcoat \$500 * 2 + \$13,868 = **\$14,868.**
 - 2nd Round sealcoat (during years 15 to 20) = 1 crackfill cycle, distress (load, age, moisture) wedging @ 70T/mi, and sealcoat = \$1900 + \$14,800 + \$4500 = **\$21,200.**
 - 3rd round sealcoat (during years 25 to 30) = crackfill, distress (load, age, moisture) wedging @ 166T/Mi, and sealcoat = \$4300 + \$14,800 + \$7,800 = **\$26,900.**
 - 4th round sealcoat (during years 35 to 40) = crackfill (Rout and overband), distress (load and age) wedging @ 350T/mi. and sealcoat = \$7500 + \$14,800 + \$22,750 = **\$45,050.**
 - 5th round sealcoat (beyond year 40) = crackfill (rout & overband), distress (load and age) wedging @ 600T/mi., and sealcoat = \$8500 + \$14,800 + \$39,000 = **\$62,300.**
 - 1-inch non-structural overlay @ 742T/Mi. (22 foot pavement) = **\$48,200 / mile**
 - 2-inch overlay (structural for pavement only) @ 1484T/Mi. (22 foot pavement) = **\$89,000 / mile.**

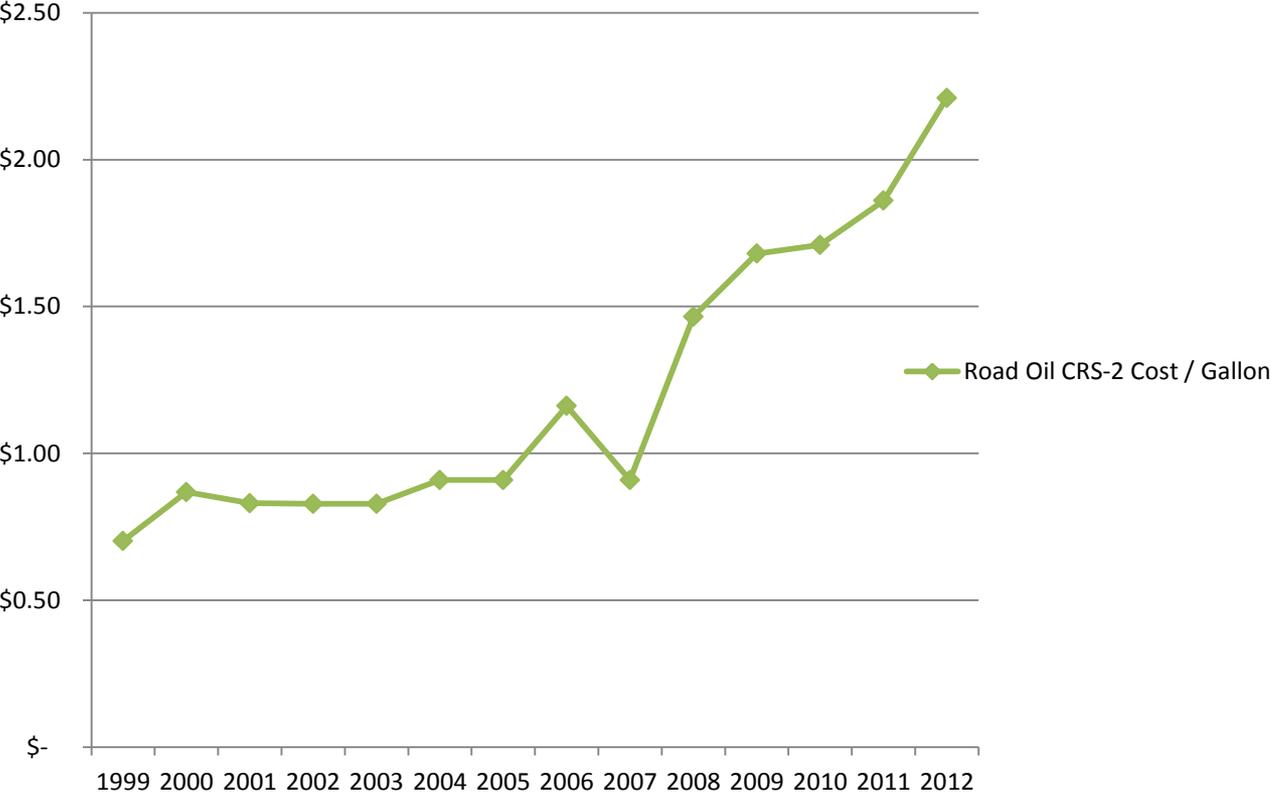
If a cycle is missed, the expenses increase as well due to the amount of deterioration due to weathering, age, moisture infiltration, and load distresses not addressed when first noticed.

In 1999 wedging costs were \$27.00/ton; in 2012 costs were \$43.00/ton

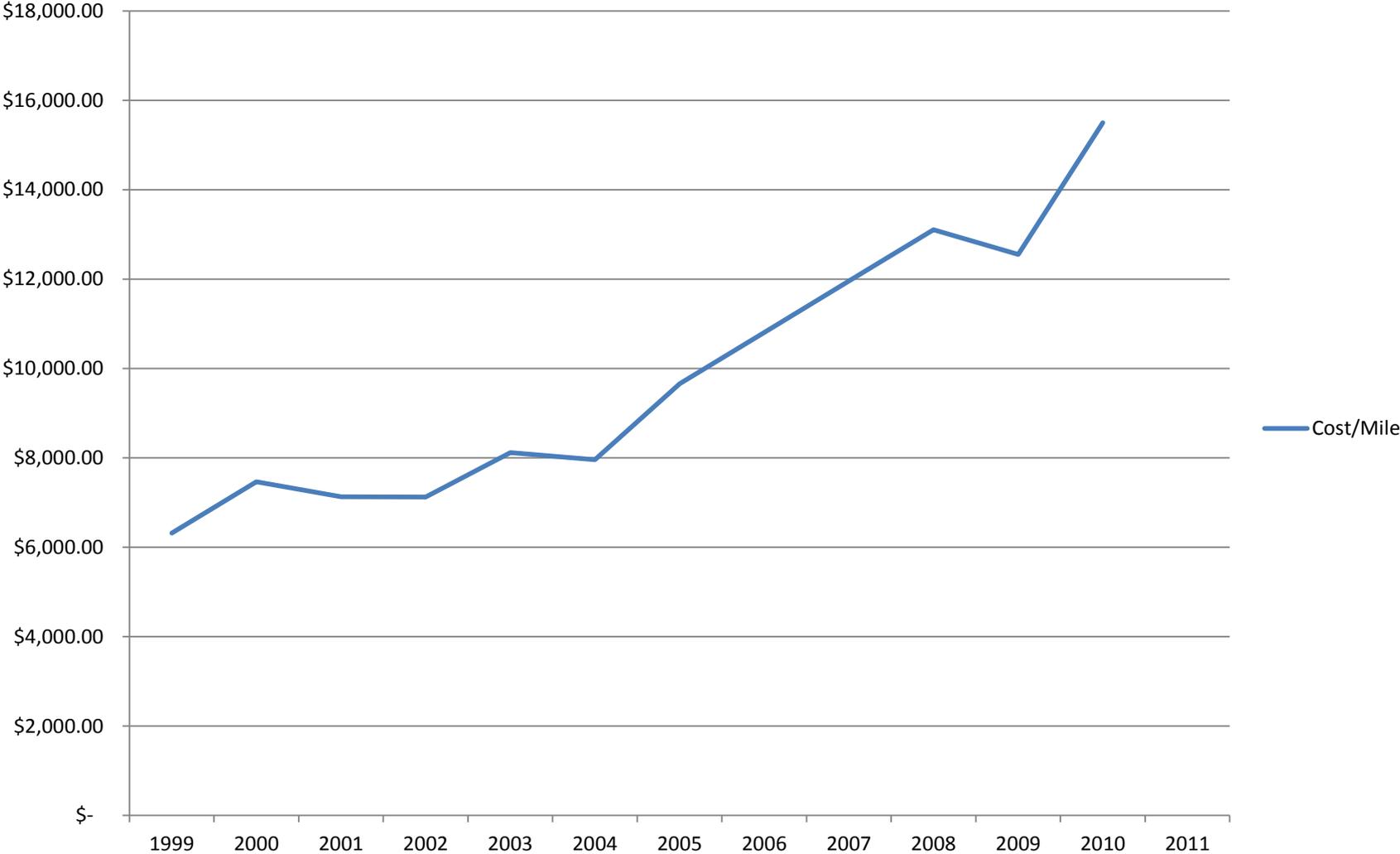


In 1999 a sealcoat was \$6,314/mile; 2012 a sealcoat was \$13,868/mile

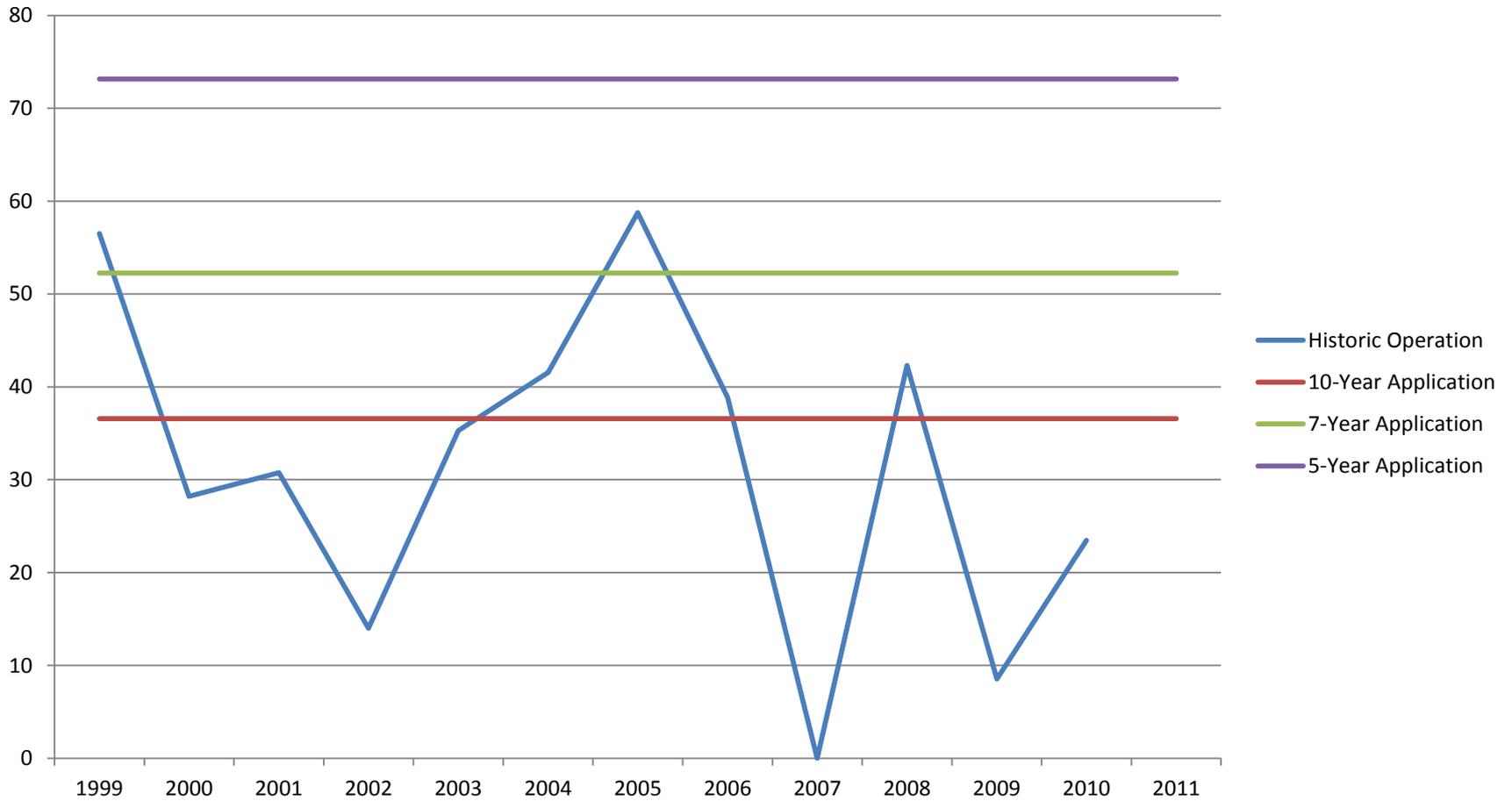
Road Oil (Sealcoat oils) CRS-2 Cost / Gallon



Sealcoat surface treatment Cost/Mile



Sealcoat Application History (1999-2010)



Preventative Maintenance Cost / system with the following assumptions:

Pavement Life = 20 to 25 Years (Do nothing approach)

Pavement Life = 50 Years with a timely preventative maintenance program

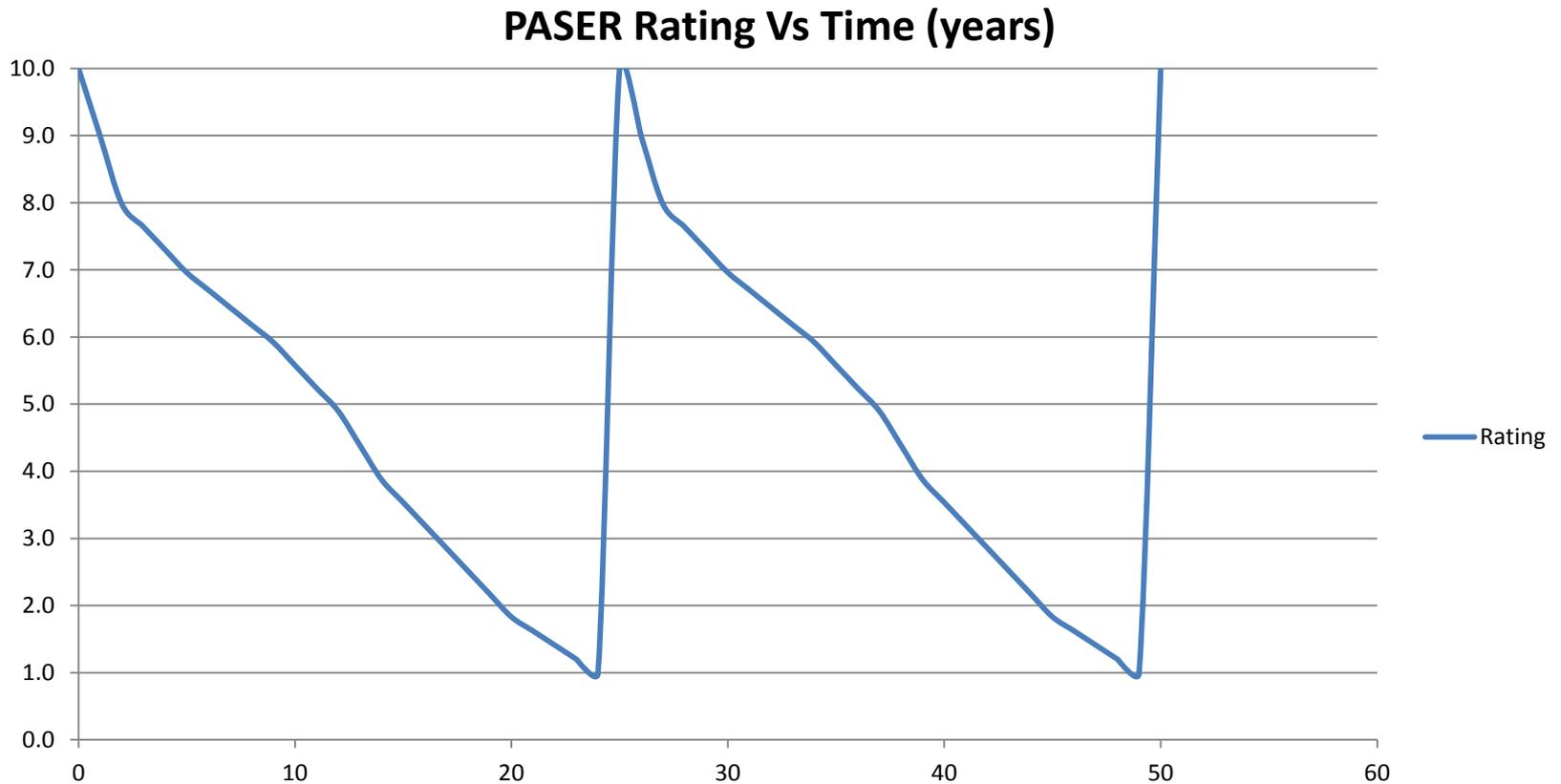
1/50th of the system receives a capital improvement in any given year (7.31 mi.)

Life of a wearing surface (sealcoat) is presumed to be 10 years.

$(365.7 - 7.31) = 358.39 \text{ mi} / 10 = 35.84 \text{ miles to treat annually.}$

Sealcoat	35.84 miles @ \$14800/mile	\$ 530,432.00	
Crackfill	35.84 miles @ \$5320/mile	\$ 190,669.00	
Wedge	35.84 miles (180T/mile) \$11700	\$ 419,328.00	
	35.84 miles (350T/mile) \$22620	\$ 810,701.00	
	Range (180T / Mile)	\$ 1,140,429.00	
	Range (360T / Mile)	\$ <u>1,531,802.00</u>	
<u>ANNUAL PROGRAM ESTIMATE (2012 \$).</u>		<u>\$ 1,336,116.00</u>	
<u>2014 BUDGETED AMOUNT</u>		<u>\$ 987,962.00</u>	(\$697,400 – 2013 BUDGET)

LIFE CYCLE OF AN ASPHALT PAVEMENT (Do Nothing Approach)



PASER surface improvement (replaced asphalt pavement) history

TARGET = 365.7 mi/50 yrs = 7.31 mi/yr * 10 yrs = 73.14 mi / 365.7 mi = **19.5 % / Decade**

HISTORY = 0 + 2 + 3.7 + 2.1 + 2.5 = 10.3 % / Decade

(0 + 7.46 + 13.69 + 7.82 + 9.3 = 38.27 Mi. in 10 Yrs.)

Difference = 9.2% or 33.64 mi (backlog in Construction Improvement Program as of 2012 ratings)
and growing at a rate of 3.8 miles/year every decade

327.43 Mi. (over 10 Yrs) – (7.31 Mi * 40 Yrs.) = 34.87 Mi. backlog

Paserware 2.5 - [Based on Last Improvement Year]

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Based on Last Improvement Year
Iowa County Hwy Dept.
PAVED Surfaces

Years Since Last Treatment	Miles	Percent(%)
0 to 2	0.000	0.0
3 to 4	7.460	2.0
5 to 6	13.690	3.7
7 to 8	7.820	2.1
9 to 10	9.300	2.5
Over 10	327.430	89.5
TOTAL:	365.700	

UNPAVED Surfaces

Years Since Last Treatment	Miles	Percent(%)
0 to 2	0.000	0.0
3 to 4	0.000	0.0
5 to 6	0.000	0.0
7 to 8	0.000	0.0

Page: 1 Paserware 2.5 - MAIN MENU

- **Need to increase the Preventative Maintenance budget by \$1,336,000 - 987,000 = \$349,000** (above 2014 budgeted amount) just to keep pace with the needs of the infrastructure, assuming we perform the program annually.
- Problem is we have assumed we replace a percentage of asphalt pavements based on a 50-year maintenance cycle (365.7 mi / 50 yrs. = 7.31 Mi / yr). **In actuality, the department has performed 3.83 mi/yr over the last 10 years.**
- From the PASER rating and deterioration formulas, preventative maintenance costs increase with the age of the surface being maintained. Hence as pavement surfaces age and aren't replaced; **the preventative maintenance costs to maintain them, in serviceable condition will increase on a cost / mile basis = deteriorating road conditions without an increase in funding.**

- Need to increase the Construction Improvement budget by 7.31 miles – 3.8 miles (10 year average) = **3.51 miles** or almost double.
- Annual road construction Improvement program was \$525,000/2013 fiscal year. for an estimated increase of \$525,000 / 3.8 = \$138,158/mile * 3.51 mi. = **\$484,934**
- **Program budget should be \$1,009,934 / year.** For the 2014 budget, the construction improvement budget for roadway improvements is \$123,000 for design of CTH E and F improvements, the balance was placed into Preventative Maintenance.
- For 2014 capital improvement program = 0 miles, 2013 was 2.57 miles, 2012 was 5.25 miles (CTH T south debate) for a 3 year total of 7.82 miles. System needs based on a 50-year pavement structure service life = 7.31*3 = 21.93 miles. Amount of construction improvement mileage deferred to increased routine and preventative maintenance in the last three years alone is 14.11 miles (4.71 miles / year which is slightly above the 10-year average of 3.81 miles/year). **Increased maintenance costs are also increasing the amount of construction projects deferred to reliability on continued routine and preventative maintenance to maintain serviceability.**