State Study 173--Evaluation Of Preventive Maintenance Treatments

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September 2009 (Updated April 2012)

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1.Report No. FHWA/DOT-RD-12-173	2. **Government Accession No.**	**3. Recipient's Catalog No.**
4. Title and Subtitle Evaluation of Preventive Maintenance Treatments		**5. Report Date** September 2009 (updated 4/2012)
		6. Performing Organization Code
7. Author(s) MDOT Research Division		**8. Performing Organization Report No.**
9. Performing Organization Name and Address MDOT Research Division PO Box 1850 Jackson, MS 39215-1850		**10. Work Unit No. (TRAIS)**
		11. Contract or Grant No. N/A
12. Sponsoring Agency Name and Address MDOT Research Division PO Box 1850 Jackson, MS 39215-1850		**13. Type Report and Period Covered**
		14. Sponsoring Agency Code
15. Supplementary Notes		

16. Abstract

Scrub seals were placed in 2007 in Tallahatchie, Marshall, Carroll and Grenada Counties to evaluate their effectiveness and feasibility as preventive maintenance treatments. Condition data was collected and evaluated on the project sections.

17. Key Words Preventive Maintenance, Pavement Preservation, Scrub Seal, Emulsion		**18. Distribution Statement** Unclassified	
19. Security Classif. (of this report) Unclassified	**20. Security Classif. (of this page)** Unclassified	**21. No. of Pages** 22	**22. Price**

Acknowledgments

The author wishes to thank Jordan Whittington, Jeff Wages, Marta Charria, Robbie Vance, and Alan Hatch for their diligence on monitoring the project, data collection and analysis, and compilation of this report. Thanks also to Mitch Turner, Tommy McCain, and Dean Kidd of District 2 for providing photos and information.

Introduction

Scrub seal is a long-term pavement preservation technique where a polymerized asphalt surface sealer (PASS) is applied and then scrubbed using a broom apparatus to fill cracks with the asphalt emulsion before an aggregate is distributed. The advantage of a scrub seal technique over a chip seal technique is that cracks up to 0.5 inches can be filled, whereas with other methods, a crack seal would have to be applied first.

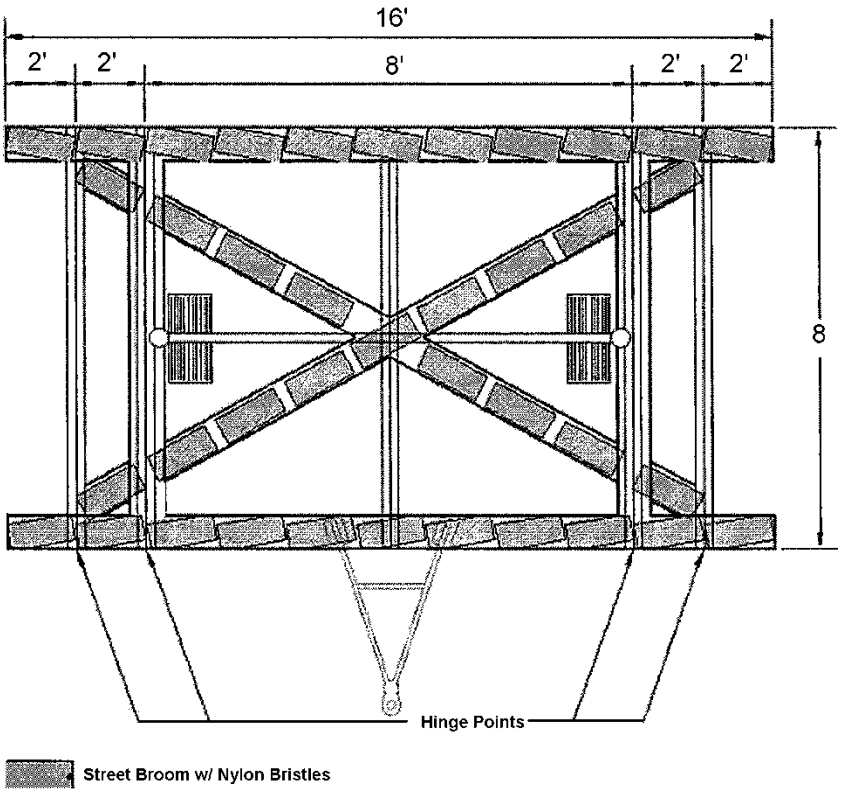
Application

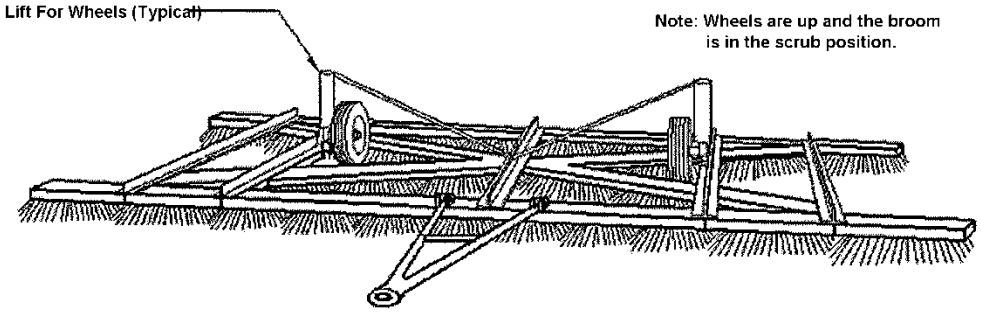
A mile of scrubs seal was placed on Highway 35 in Tallahatchie County, Mississippi, in 2005 as an initial demonstration project. District 2 and MDOT's central office agreed to place more and evaluate them, and the remaining sections were placed in 2007. What follows is a narrative of the application procedures.

The following pictures were taken on Highway 35 in Charleston, Mississippi, on March 25, 2005. The initial emulsion application rate was .30 gal/yd^2, and the aggregate was applied at 16 lbs/yd^2 while not using the broom apparatus behind the emulsion application vehicle. When the broom was later added the initial emotion application rate remained the same, but the aggregate application rate was reduced to 14 lbs/yd^2. During the first emulsion pass, the cracks were not wide enough to allow the full amount of emulsion (.30 gal/yd^2) to absorb into the pavement fast enough at brooming, resulting in the broom pushing half the emulsion off the road. To combat this two passes of 0.15 gal/yd^2 were made, which solved the problem. In the picture below the asphalt emulsion was sprayed and then scrubbed with the broom apparatus:

The broom above was used in the 1-mile demo project. However, between the demo project in 2005 and the district-wide project in 2007, MDOT decided to use a larger broom design, called for in the PASS scrub seal specifications below:

> The scrub broom frame shall be constructed of metal. The scrub broom shall be attached to and pulled by the distributor truck. The scrub broom must be equipped with a means of raising and lowering the scrub broom at desired points. It shall be towable in the elevated position to the next area of construction. The weight of the broom assembly shall be such that it does not squeegee the emulsion off the roadway surface.
>
> The main body of the scrub broom shall have a minimum frame size of 6.5 feet wide and 10 feet long. The maximum transverse rigid frame width at any point shall not exceed 6.75 feet. The nearest and furthest members, paralleling the back of the spreader truck, and diagonal members shall be equipped with street brooms. The leading member and the trailing member shall have broom heads angled at 10 to 15 degrees off the centerline of the supporting member. The diagonal members shall have broom heads attached in line with the centerline of the supporting member. Each individual street broom attached to the scrub broom assembly shall be 3.5 inches wide x 6.5 inches high x 16 inches long and have stiff nylon bristles. Bristle height is to be maintained at a minimum of five inches (5”). The scrub broom shall be equipped with hinged wing assemblies attached to the main body not to exceed 4.5 feet per side, with diagonals and equipped with street brooms. The purpose of the maximum rigid frame width and the hinged wing extensions is not only for maximum width of 16 feet but to maintain the scrubbing process evenly as contours and cross-sections change across the existing road surface.


16'
2'
2'
8'
2'
2'
8
Hinge Points
Street Broom w/ Nylon Bristles


Lift For Wheels (Typical)
Note: Wheels are up and the broom is in the scrub position.

Scrub Broom

The photograph below shows the emulsion filling the cracks in the asphalt.

Two passes were made to prevent asphalt emulsion runoff:

In the photos below the aggregate is being applied to emulsion after the second pass.

The pneumatic tire roller is shown compacting the lane once the aggregate was applied in the two photos below:

This is the seal 4 days after the application:

The following photos illustrate the transition from the scrub seal section to the pavement.

The photo below shows the aggregate coming up in the wheel path. This issue occurred during the 1-mile demo but was rectified before the 2007 District-wide project.

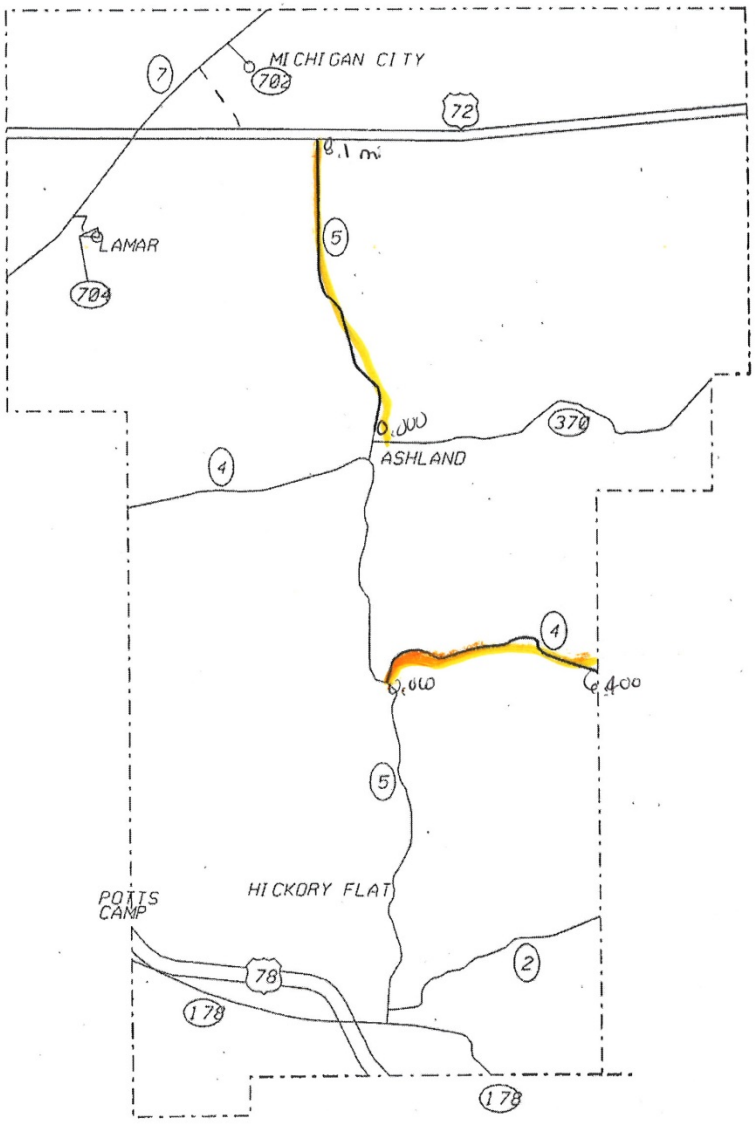
A picture of the aggregate and the emulsion after rolling:

Locations

Below are the routes included in the data for this report. There were 6 test sections in 5 counties:

1. Approximately 6.4 miles of SR4 in Benton Co.
2. Approximately 8.1 miles of SR5 in Benton Co.
3. Approximately 7.5 miles of SR17 in Carroll Co. (approximately 1 mile was sealed not broomed because of recent maintenance overlay)
4. Approximately 6.4 miles of SR35 in Grenada Co. (N/B only)
5. Approximately 11.0 miles of SR35 in Tallahatchie Co.
6. Approximately 12.7 miles of SR311 in Marshall Co.

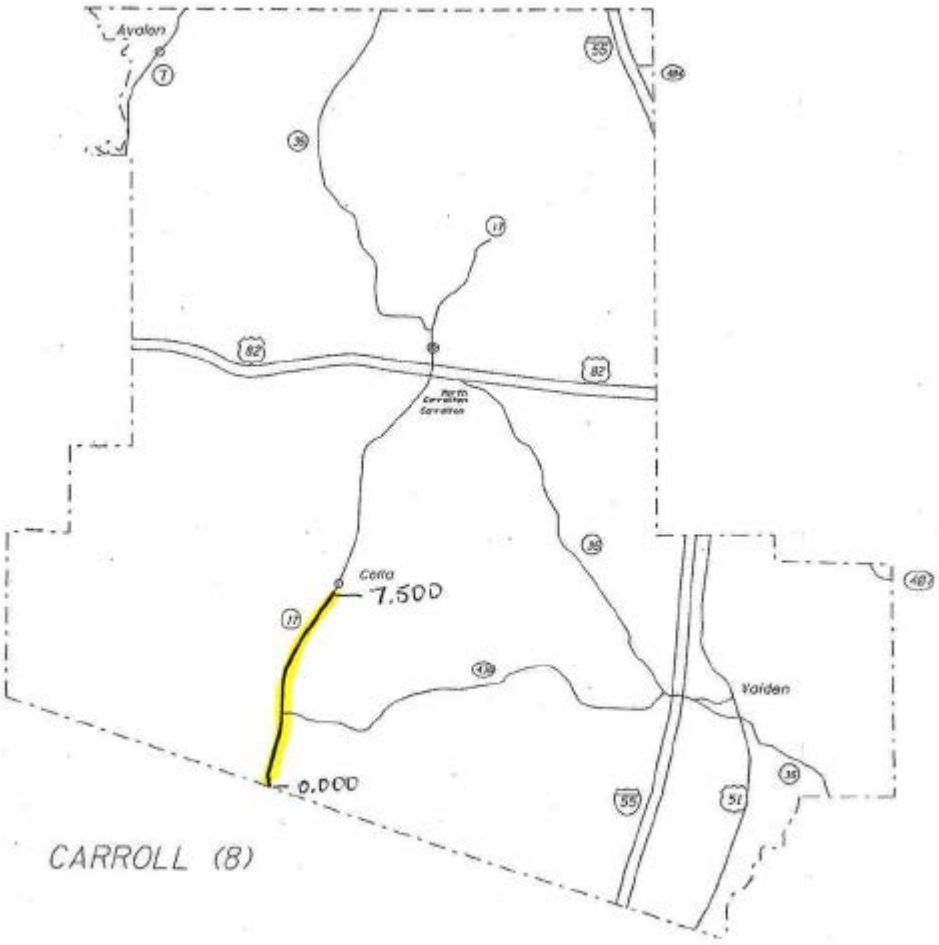
The following picture shows the locations in Benton Co. on SR4 and SR5:



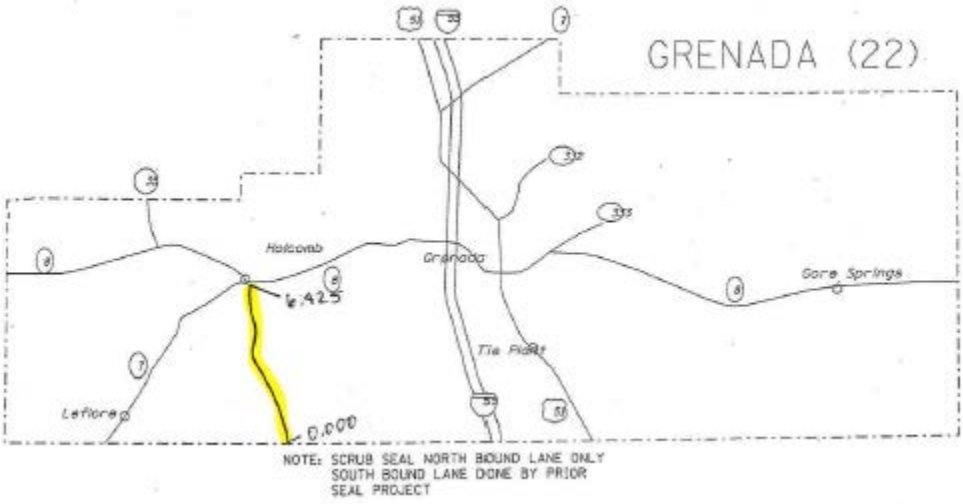
BENTON (5)

35

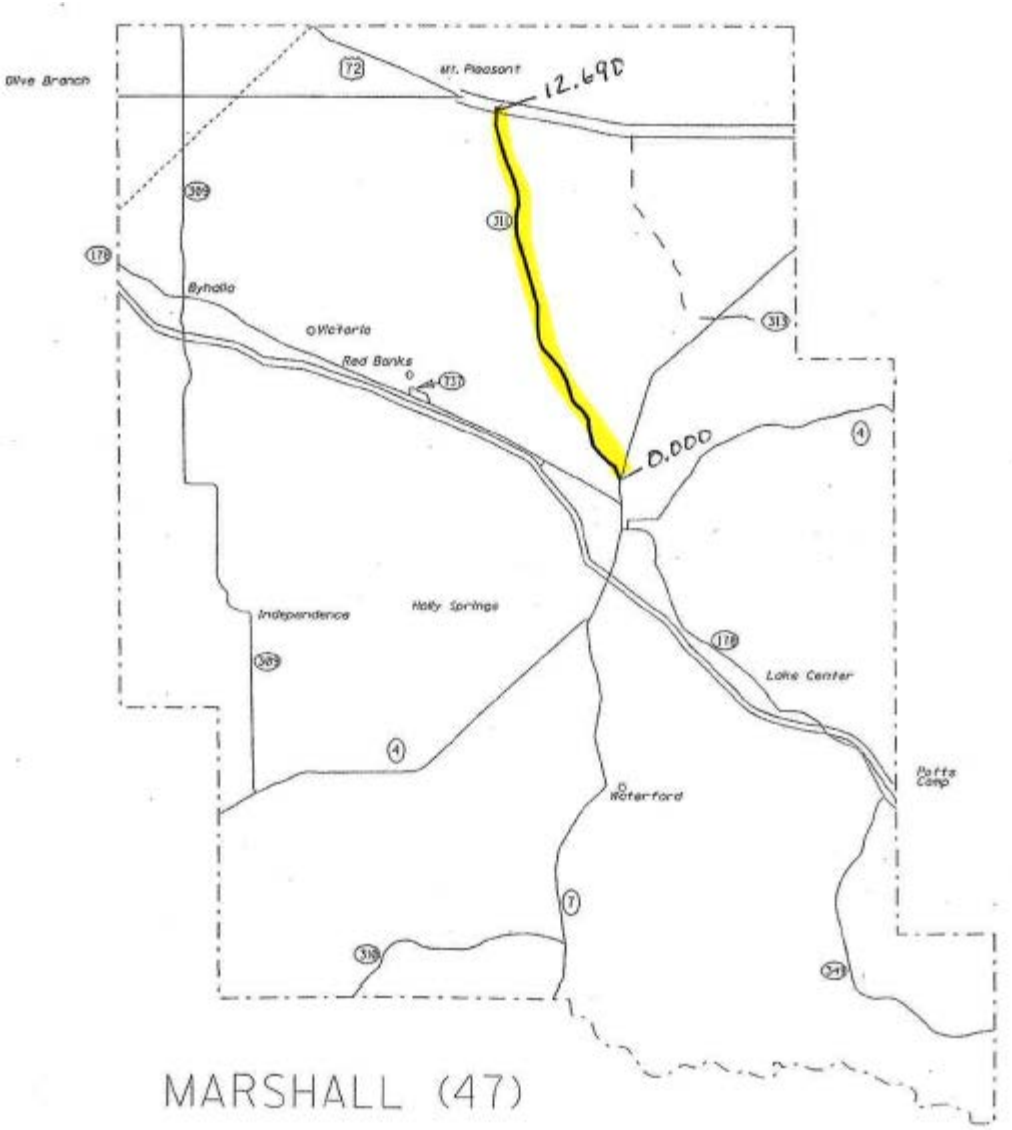
In Carroll County there were Approximately 7.5 miles of Highway 17 from the Holmes County line. Approximately one mile was sealed but not broomed due to a recent maintenance overlay:



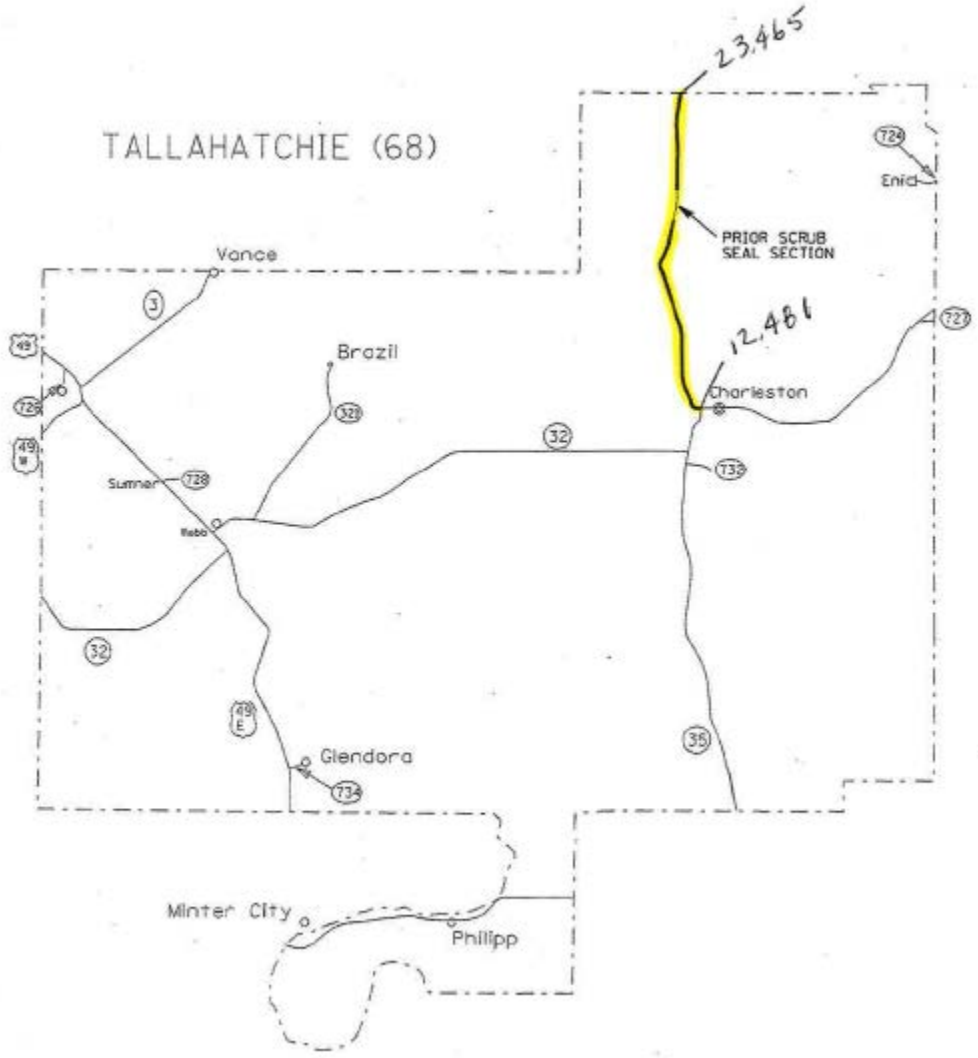
In Grenada County, approximately 6.4 miles of Highway 35 were included in the northbound lane only:



In Marshall County, there were approximately 12.7 miles of Highway 311 included:



In Tallahatchie County there were approximately 11 miles of Highway 35 included in this study:



Data Collection/Methodology

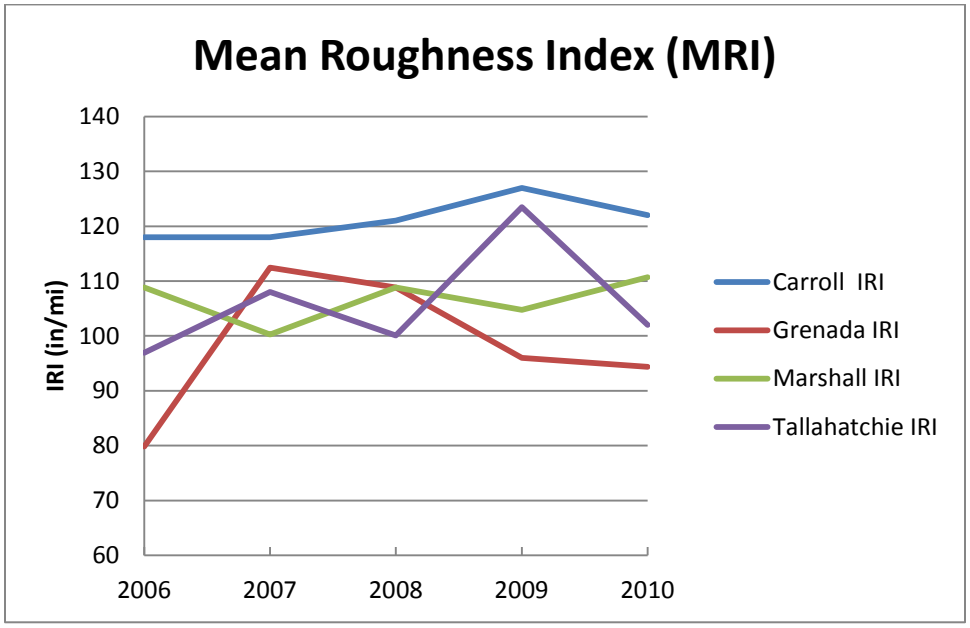
Data for this report was collected on the four test sections over a five-year period. The data was collected using different test equipment as well as different researchers, which due to the subjective nature of some of the test factors makes trends in the data difficult to discern. Roughness, rutting, and pavement condition rating (PCR) are discussed in this section.

Mean Roughness Index (MRI)

The Mean Roughness Index (MRI) summarizes the roughness qualities that impact vehicle response, and is most appropriate when a roughness measurement is desired that relates to: overall vehicle

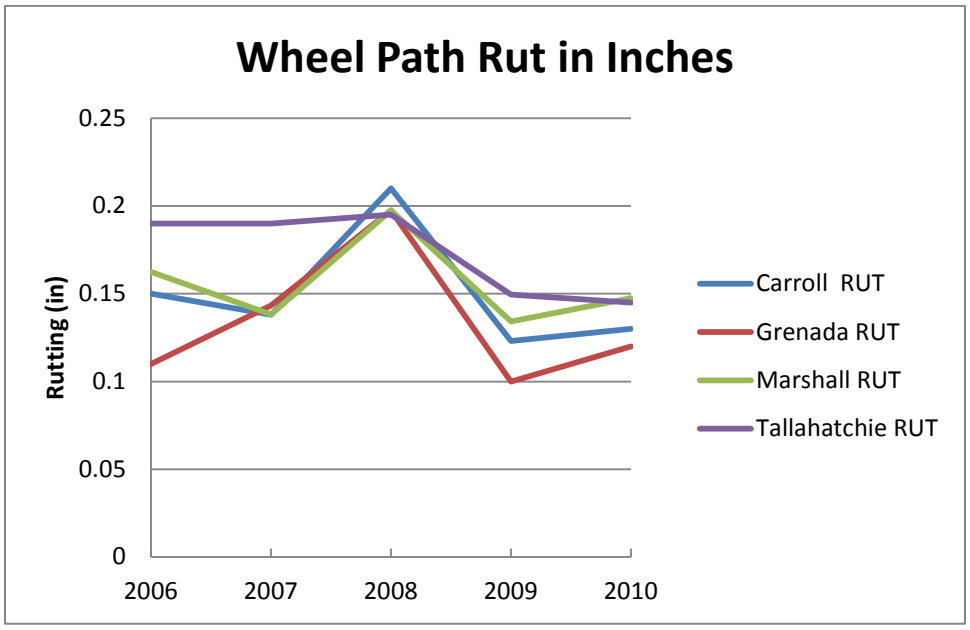
operating costs, overall ride quality, dynamic wheel loads (that is, damage to the road from heavy trucks and braking and cornering safety limits available to passenger cars), and overall surface condition (*The Little Book of Profiling*, September 1998). A new smooth pavement might have an MRI of 50-60 inches/mile. The roughness is more on these routes are they are low-volume, older and had cracking.

The graph below shows the MRI values for the test sections over a five-year period.



Rutting

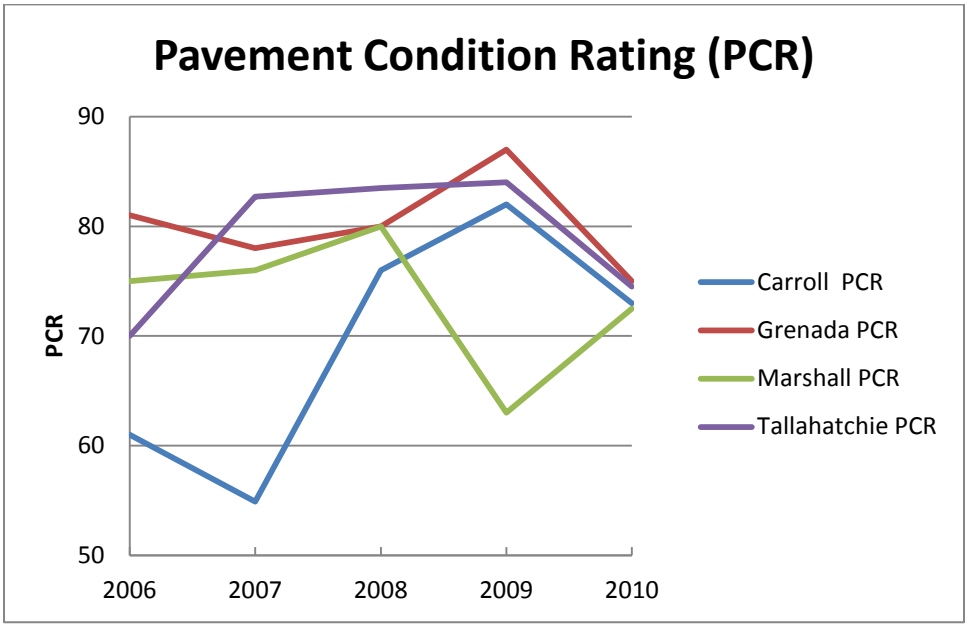
The graph below shows the depth of ruts in the wheel path.



The rutting values were all in a good-to-fair range (from 1/10" to slightly more than 2/10" in Carroll County. Rut data collection changed drastically in 2008, when our condition survey data collection contractor began collecting rutting data with scanning lasers, which are much more sensitive than the conventional 3-point laser, which was used in 2009 when the data was collected in-house. Beginning in 2010 the condition survey was collected on 100% of the roadway as opposed to the previous 20% sampling due to imaging technology improvements and affordability. The use of different vehicles and data collection methods makes trends hard to see; however, the pavements in these projects stayed within acceptable rutting ranges.

Pavement Condition Rating (PCR)

PCR is an important pavement management index calculated using the distress evaluation (cracking, rutting, and roughness are combined into a composite value using an algorithm developed by MDOT and the University of Mississippi). PCR is on a 0-100 scale with 100 being perfect. Below are the PCRs for the four test sections over a five-year period. PCR values were also affected by the newer rutting and 100% automated data collection methods, so trends are difficult to see with PCR, as with rutting and roughness. However, it can be seen from the graph below that the pavements in the projects increased to or stayed within the fair-to-good range.



Conclusions

The roughness (IRI), rutting, and pavement condition rating (PCR) data show much variability due to differing collection techniques, technologies, and vehicles. This and the small sample size make conclusions difficult to draw. Since scrub seals are preventive treatments, one would necessarily not expect dramatic improvements in condition, but rather that the sections of roadway on which these projects were done would maintain their condition for a few years. The PCRs do show a slight increase after 2007 on the Grenada, Marshall, and Tallahatchie projects, and a dramatic increase on the Carroll Co. project. Also, pavement preservation treatments are best done on pavements which are in good condition, and most of these were in either fair or poor condition; therefore, they may not have been ideal candidates. As mentioned above, the increase in rutting in 2008 on all projects was due to a more sensitive scanning laser rut collection method (measuring approximately 1,280 points across the roadway) becoming available, which read higher rut vales than the previous 3-sensor collection method, which measured only 3 points: the right and left wheel paths and the center.

Despite the variability in data and some of the sections being in less than optimal condition for a pavement preservation treatment, these seals have performed well overall and met expectations. Scrub seals are potentially a cost-effective, feasible pavement preservation treatment for Mississippi's low-volume roads. MDOT personnel generally viewed them as good return on investment, or "bang for the buck." Challenges to further implementation of scrub seals are partially financial in nature. Interstates and four-lane routes usually receive a higher priority due to the higher amounts of traffic they carry. MDOT's ability to dedicate funding to needed pavement preservation activities such as scrub seals on its lower traffic volume routes will be determined by future federal and state funding levels for transportation.

References

The Little Book of Profiling (1998: Sayers, Michael W. and Karamihas, Steven M.), University of Michigan; http://www.umtri.umich.edu/content/LittleBook98R.pdf