Montana Department of Transportation
Research Programs
April 2013

EXPERIMENTAL PROJECT

EVALUATION OF HOT-LAID THERMOPLASTIC PAVEMENT MARKINGS PREPARATIONS PRIOR TO A SEAL COAT (SC) APPLICATION

Installation-Annual Inspection & Analysis Final Report

Location:	Various: Avon – Elliston – Deer Lodge
Project name:	Thermoplastic Pavement Markings Evaluation
Project Number:	N/A
Type of Project:	Experimental trial in trying other treatments with existing hot-laid thermoplastic in an effort to promote a solid mechanical bond with a seal and cover
Principal Investigator:	Craig Abernathy: Experimental Program Manager (ExPM)
Date Constructed:	September 2008/2009
Evaluation Date:	2009-2013

Objective

The intent of this experiment is to identify a less costly method of preparing plant mix surfaces having hot in-laid thermoplastic pavement markings (TPM) for use prior to seal coat (chip seal) application. Current information has stated that a SC will bond poorly to a TPM. Presently MDT has utilized two options in areas having in-laid thermoplastic pavement markings:

1. When markings are found to be in acceptable condition and location, the markings are perpetuated by covering them prior to seal coat app.

2. If not in an acceptable condition or location, the markings must be removed via full depth grinding and the resultant trenches patched with plant mix materials prior to seal coat application.

Both options are labor intense and expensive.

Experimental Design

Thermoplastic pavement markings will be scarified using mechanical means thus providing a roughened surface for seal coat material to adhere to. Other sections of thermoplastic pavement marking will not be treated (scarified). The seal and cover will be applied and monitored for bonding performance to TPM. Numerous sites have been chosen for this analysis. Due to constraints on Research staff was limited to documentation at three sites; Elliston at the intersection of Highway 12 and Cemetery road, and at Avon at the intersection of Highway 12 and Highway 141 (both sites with TPM in poor condition); and a location in Deer Lodge at the intersection of Main and College with the TPM in good condition.

Analysis

Documentation of the three sites of the specific treatment prior to seal and cover will be by visual documentation. The following images, taken September 2008, represent the procedure conducted at the Avon, Elliston, with the Deer Lodge site installed in 2009. This report will document performance and condition of the sites in 2009, 2010, 2011, 2012 and 2013. Page 35 of this report details the accumulated performance of each site.

ELLISTON: INTERSECTION OF HIGHWAY 12 & CEMETERY ROAD – September 2008

↑ Condition of eastbound stop bar prior to scarification.

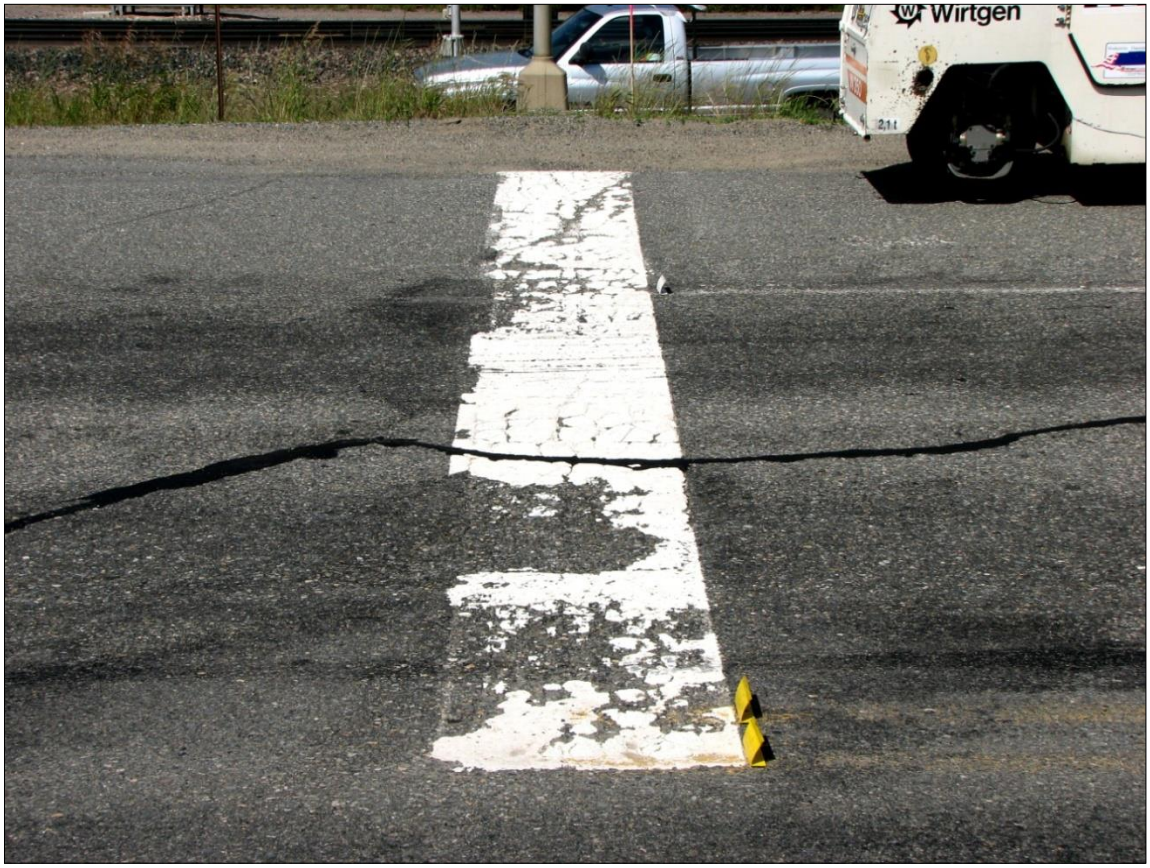
↑ Scarification complete on west side of intersection.

↑ Close-up of scarification.

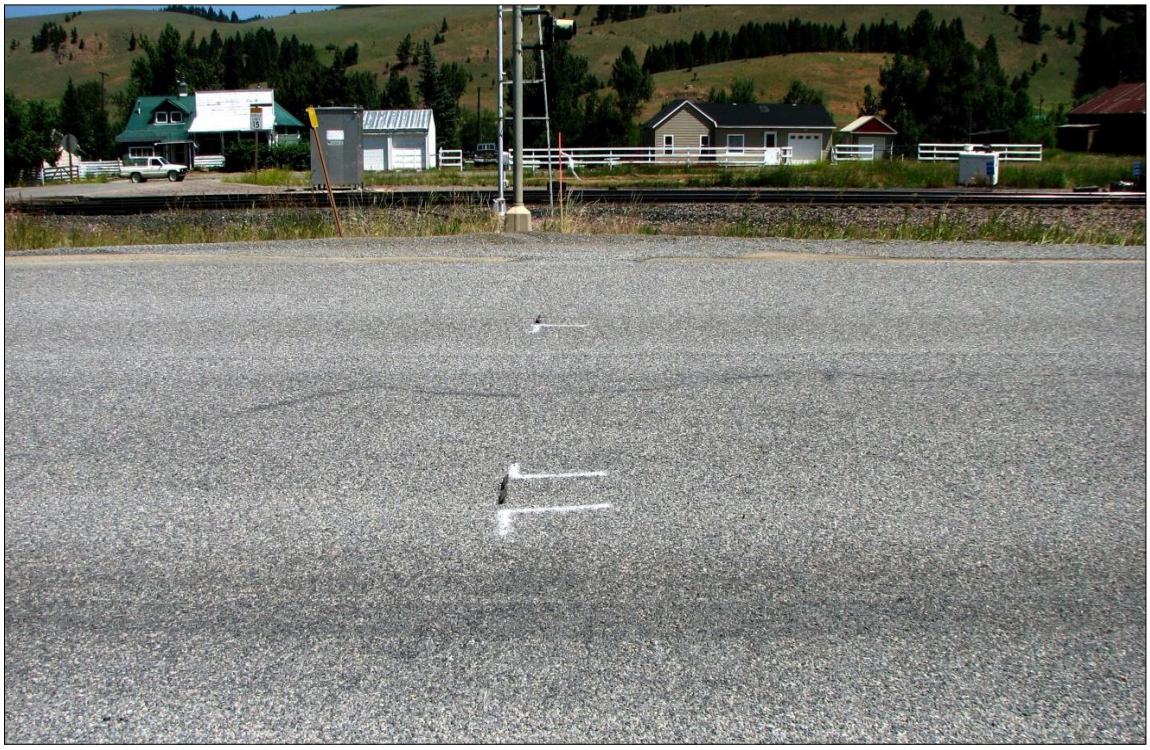
↑ Completed seal and cover (view east).

↑ Completed re-marking of west side of intersection.

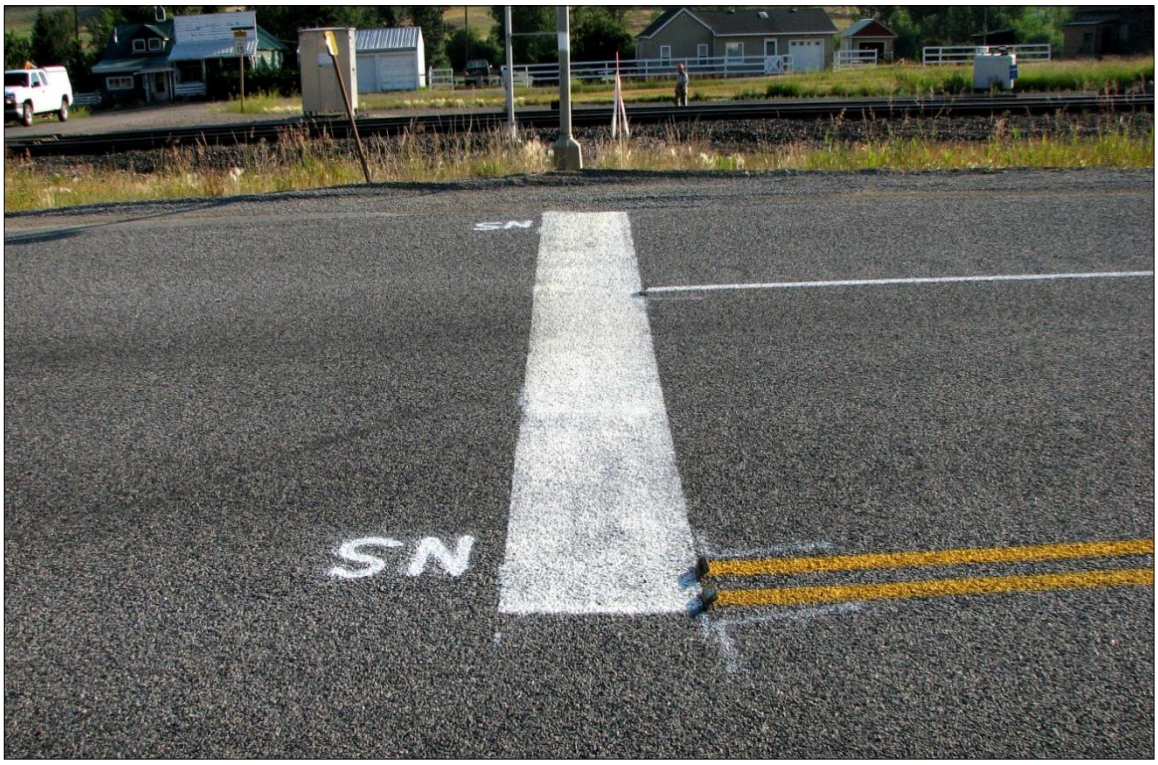
Note: This side marked with an ‘S’ to denote it was scarified.



↑ Stop bar at westbound lane (east side of intersection). This was not scarified prior to the seal and cover.



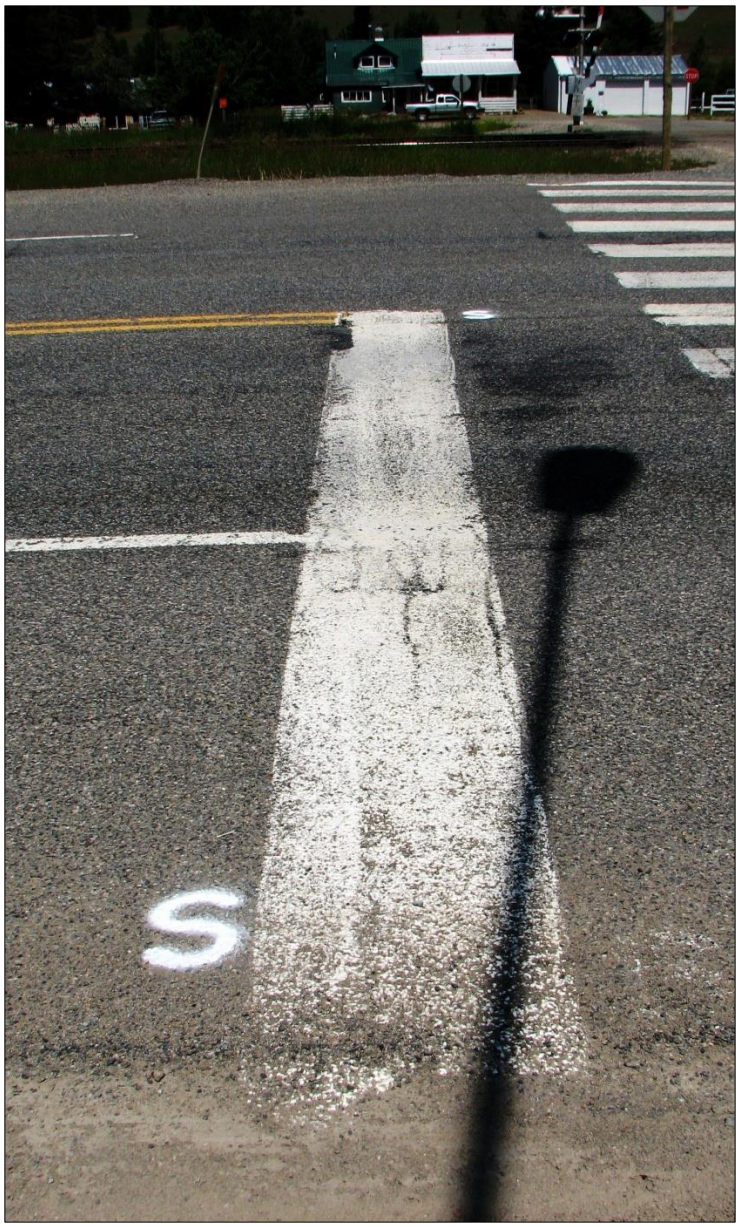
↑ Seal and cover prior to reapplying stop bar.



↑ Reapplied stop bar, the 'NS' denotes no scarification.

ELLISTON: INTERSECTION OF HIGHWAY 12 & CEMETERY ROAD – July 2009

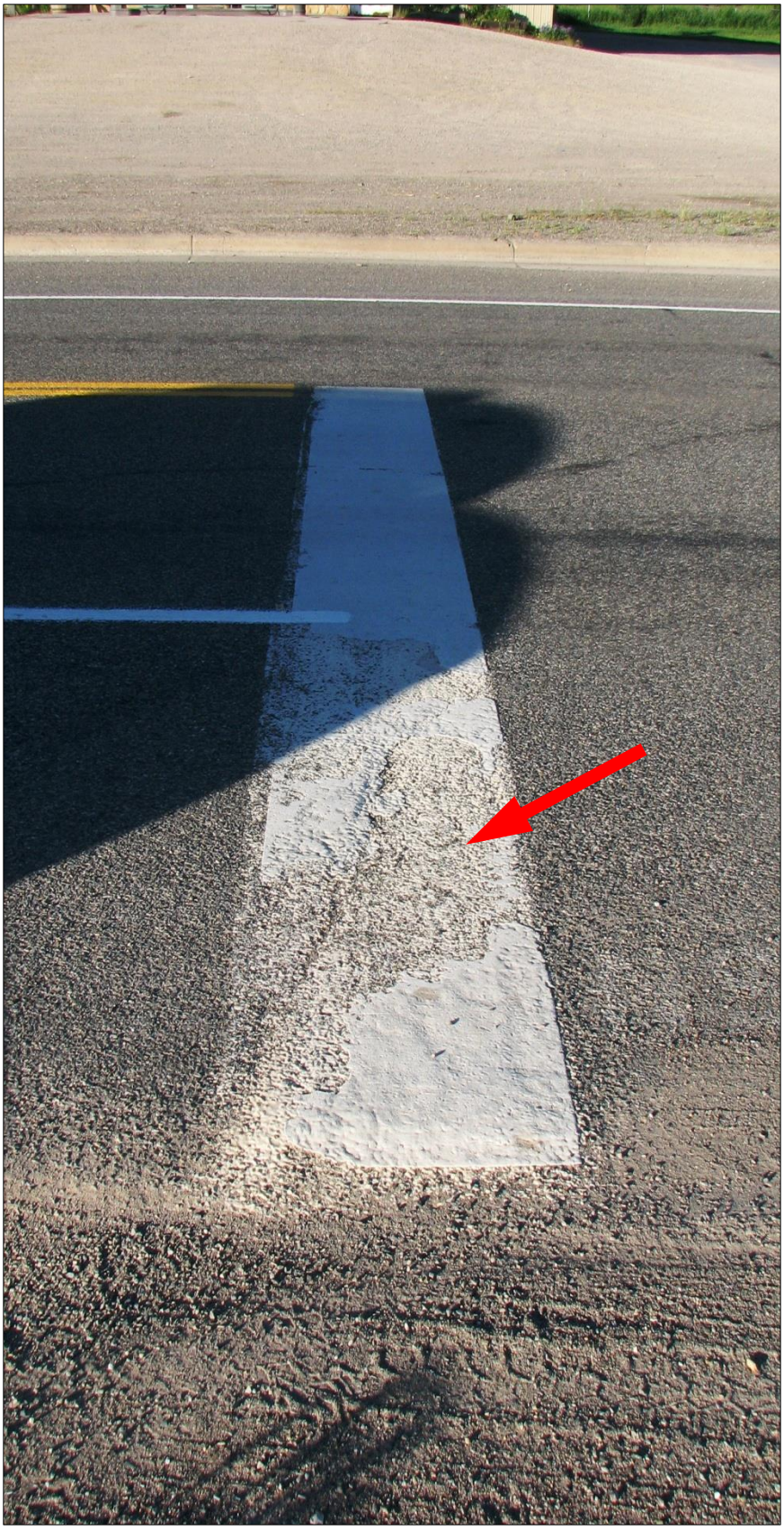
Both images show the condition of the non-scarified (westbound lanes) stop bar in 2009. Seal and cover is still intact, no evidence of debonding from chip seal to thermoplastic is apparent to date. Pavement marking is in fair condition.



Overview and close-up of the eastbound (scarified) stop bar treatment in 2009. Seal and cover is still intact. Pavement marking in fair to poor condition.

The next site inspection will be in 2010.

ELLISTON: INTERSECTION OF HIGHWAY 12 & CEMETERY ROAD – June 2010

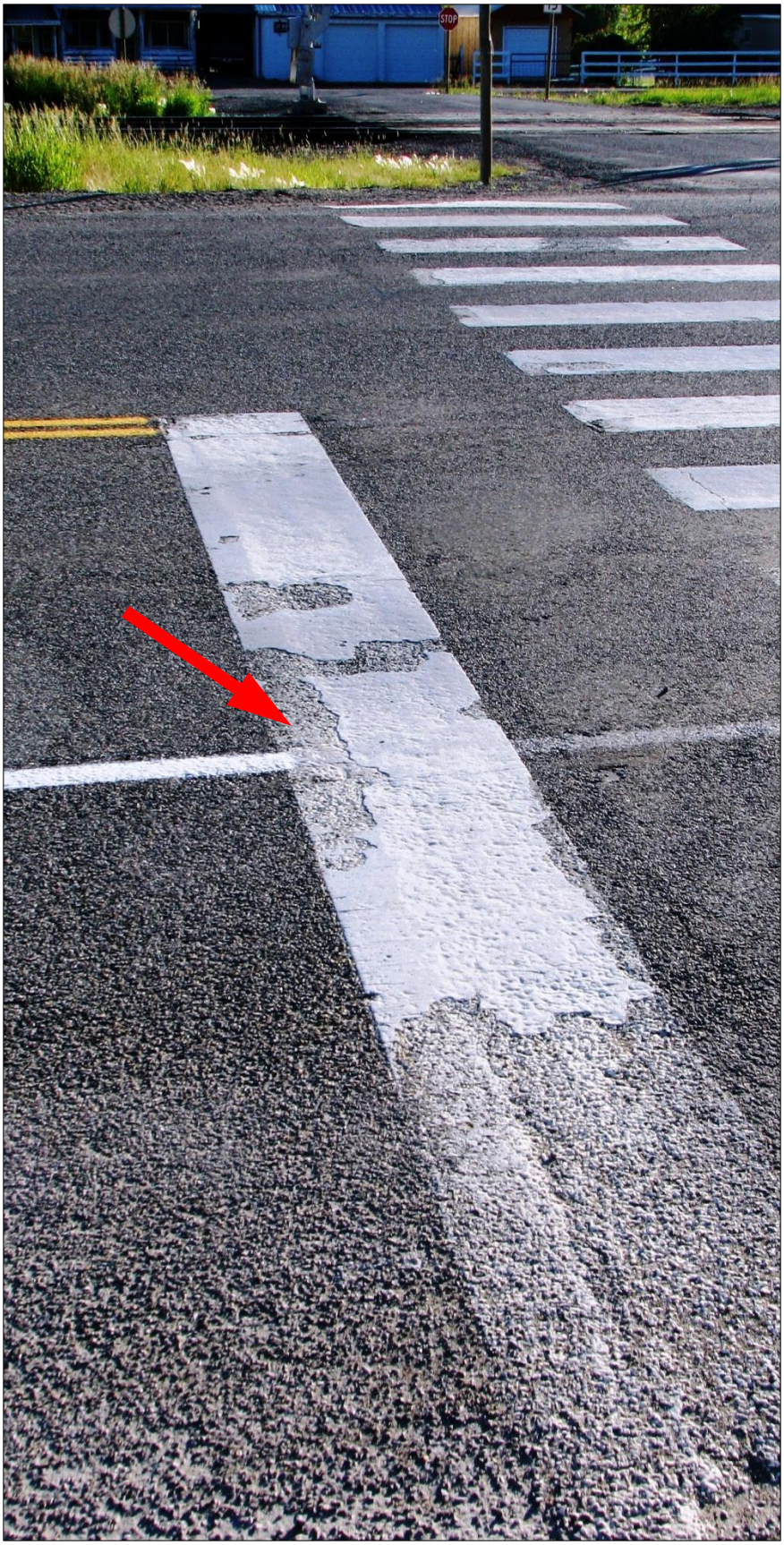


🡐 Overview of westbound stop bar. Note that a type of thermoplastic sheet-style pavement marking was applied after the 2009 site visit. This type of marking is laid over the existing pattern and heat is used to adhere the product in place.

Notice that portions of the heat-applied marking are beginning to be removed (red arrow) most likely from plow passes.

Normally this type of pavement marking would be recessed to prevent this; however since it is applied atop the existing stop bar marker that is already over the existing thermoplastic has raised this sufficiently for passing plows to continue this condition.

Also note the seal and cover is still intact with no debonding noticeable.



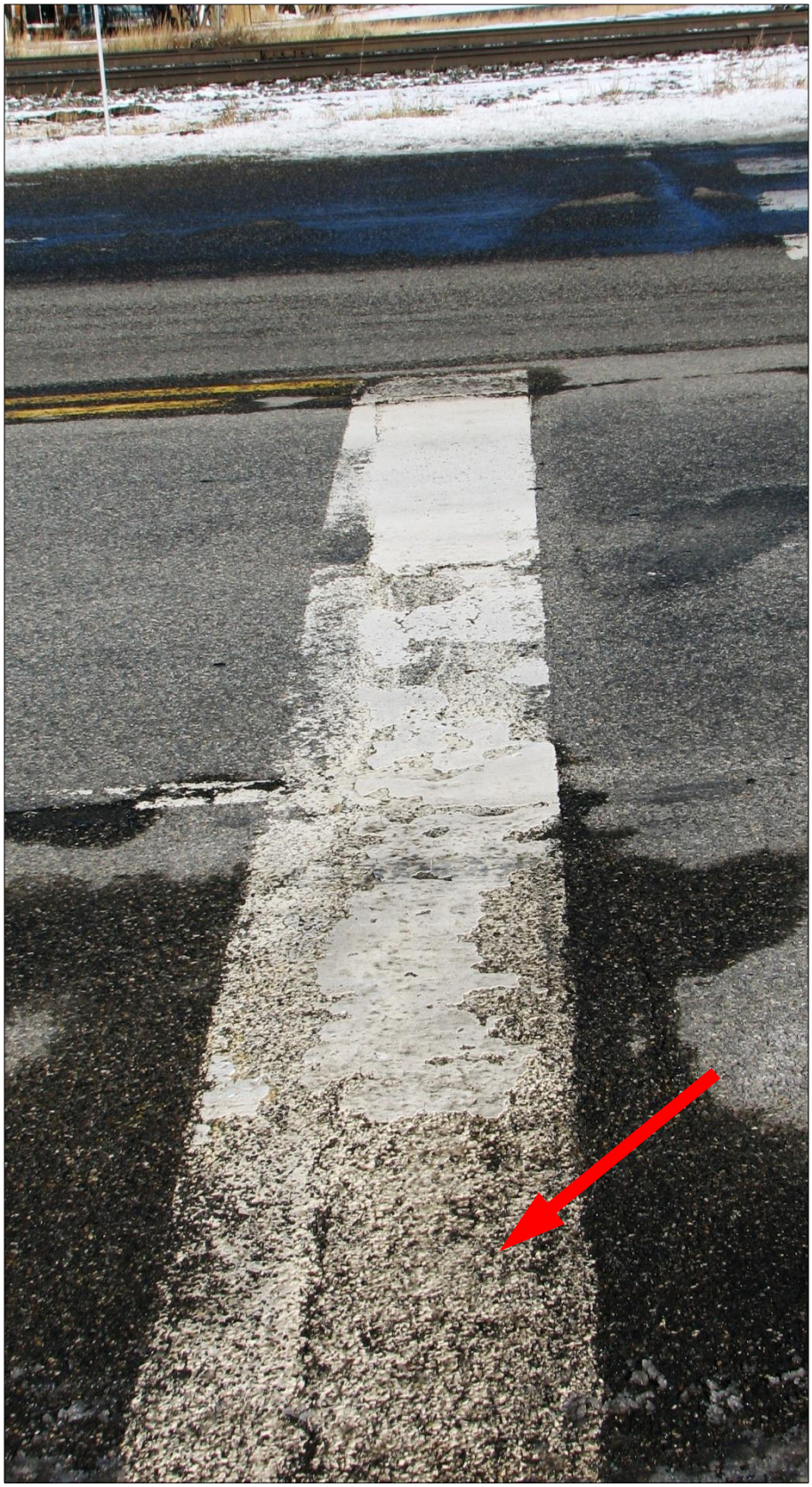
🡸 East bound stop bar, west side of intersection.

As depicted in the west bound stop bar image, the same marking condition is seen here.

The top application of thermoplastic is being stripped presumably by plow action (Red arrow). The seal and cover is still intact

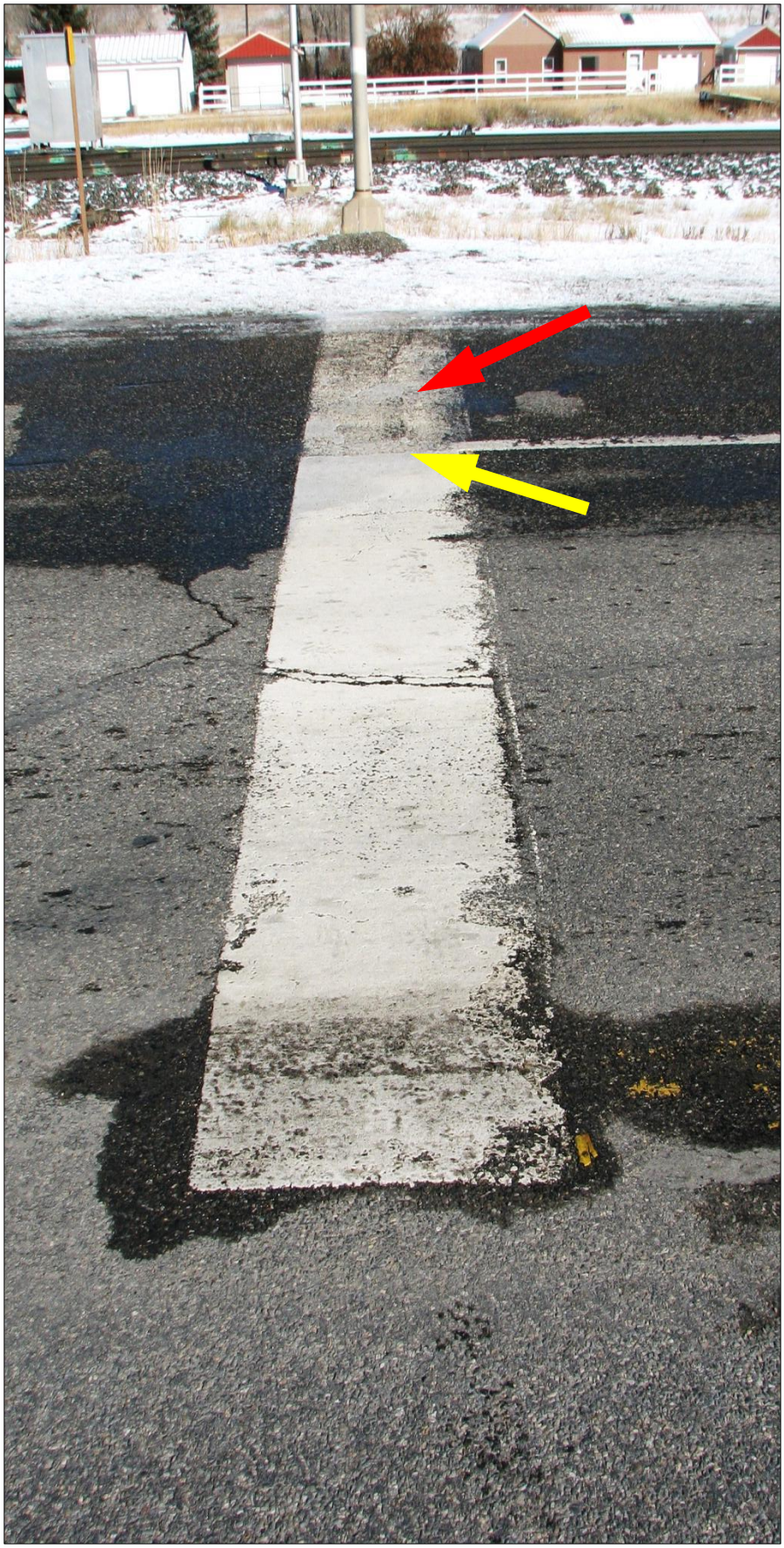
🡅 Westbound view of eastbound intersection. The zebra walk displays less delamination of the heat-applied thermoplastic than the stop bars.

ELLISTON: INTERSECTION OF HIGHWAY 12 & CEMETERY ROAD – November 2011



🡸 East bound lane, west side of intersection stop bar. This was a scarified in 2008.

As reported during the 2010 site visit, the pavement marking was reapplied using a heat-applied thermoplastic after the 2009 inspection. In the image you can see the original pavement marking coating over the chip seal applied in 2008 (red arrow).

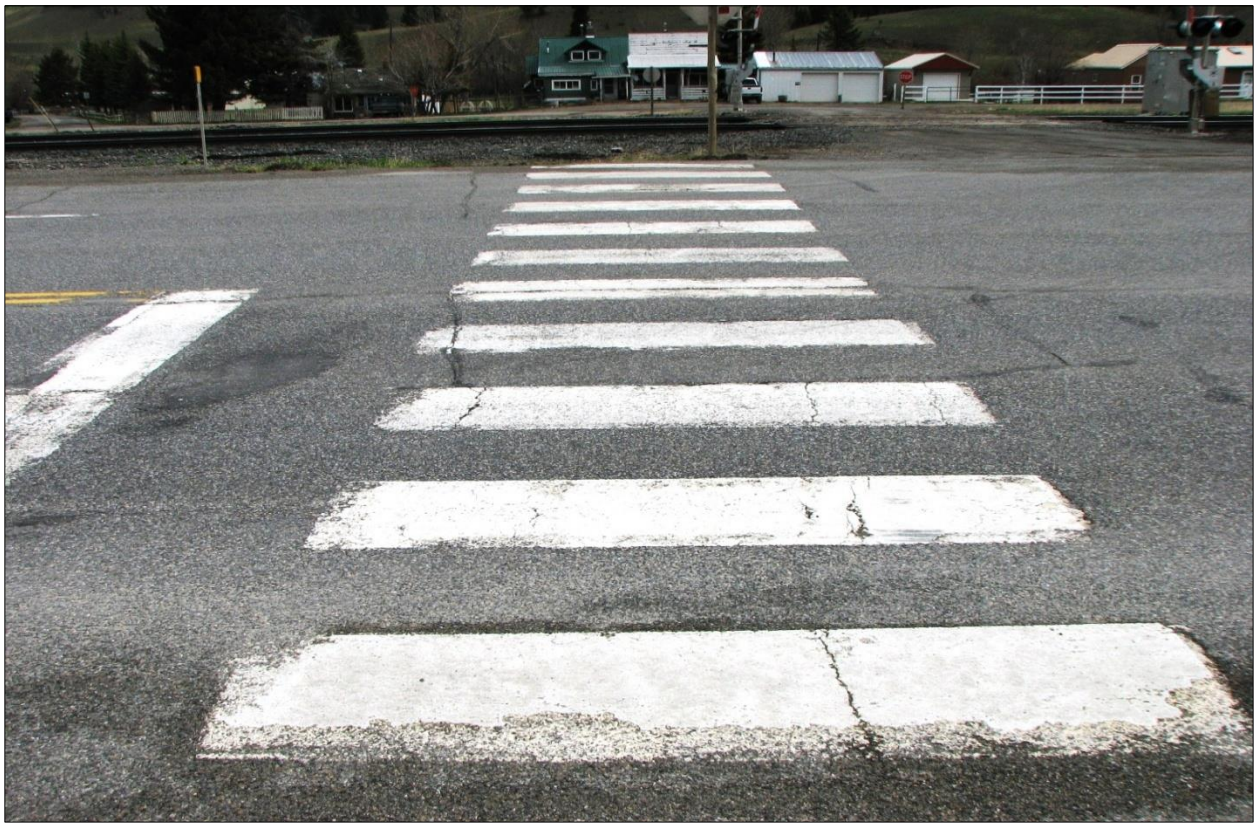


🡸 West bound lane, east side of intersection stop bar. This did not receive a scarification.

In the image you can see a section of the seal and cover as applied in 2008 over the existing thermoplastic (red arrow). This section is completely sheared off. Since the line of delineation (yellow arrow) is precise at the shear off, it is assumed this was a separate sheet of heat-applied thermoplastic.

🡅 Intersection crosswalk at Highway 12, west side. As in the previous images you can see the pavement markings applied over the existing thermoplastic in 2008 and the reapplied marking sometime after July 2009. The crosswalk received a scarification treatment.

ELLISTON: INTERSECTION OF HIGHWAY 12 & CEMETERY ROAD – June 2012



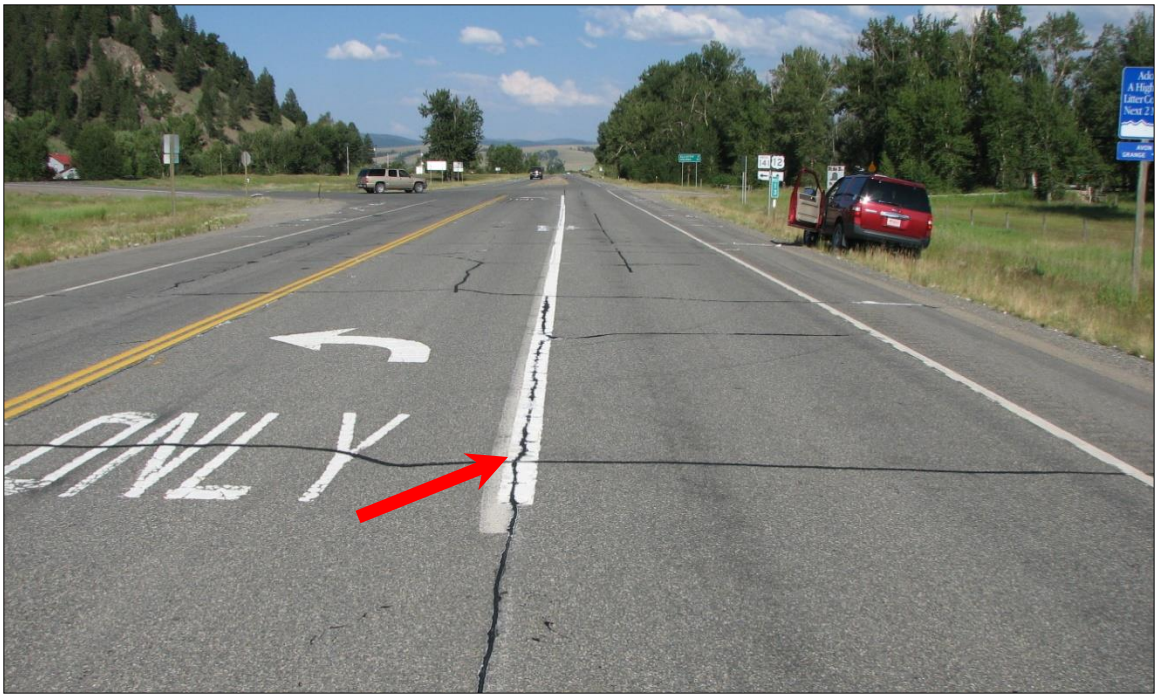
🡅 The condition of the cross walk is the same as documented in 2011. The chip seal over the existing thermoplastic is intact. The additional layer of sheet-applied thermoplastic applied in 2010 continues to be worn off in areas.

🡅 Close-up of stop bar. Yellow arrow shows area and condition of the pavement marking as applied on the chip seal over existing thermoplastic in 2008.

ELLISTON: INTERSECTION OF HIGHWAY 12 & CEMETERY ROAD – April 2013

🡅🡇 The condition of the pavement markings is the same as documented in 2012. The chip seal over the existing thermoplastic is intact over both scar and non-scar treatments. The additional layer of sheet-applied thermoplastic applied in 2010 continues to be worn off in areas.

AVON: INTERSECTION OF HIGHWAY 12 & HIGHWAY 141 – August 2008



↑ View east. The six-inch solid white line separating the east-bound through lane and left-turn lane is the object of the experiment (red arrow).

↑ Close-up shot of average condition of the thermoplastic.

↑ The solid lane divider was split approximately 50/50 for a section that will receive scarification (east half) and a section (west half) that will receive none.

↑ View looking west. Image of test sections after east half of thermoplastic marking was scarified.

↑ Close-up of scarified thermoplastic after sweeping.

↑ Application of seal and cover (view north). Painted white block is separation of the scar – no scar of the lane divider.

↑ Reapplied pavement marking with delineation of the scarified and non-scarified sections (view west).

AVON: INTERSECTION OF HIGHWAY 12 & HIGHWAY 141 – August 2009

↑ Overview of lane divider as of August 2009 (view west). Pavement marking in good condition. No apparent debonding of the seal and cover to the thermoplastic on either the non-scarified of scarified sections.

↑ Close-up of the east half scarified section.

↑ Close-up of the west half non-scarified section.

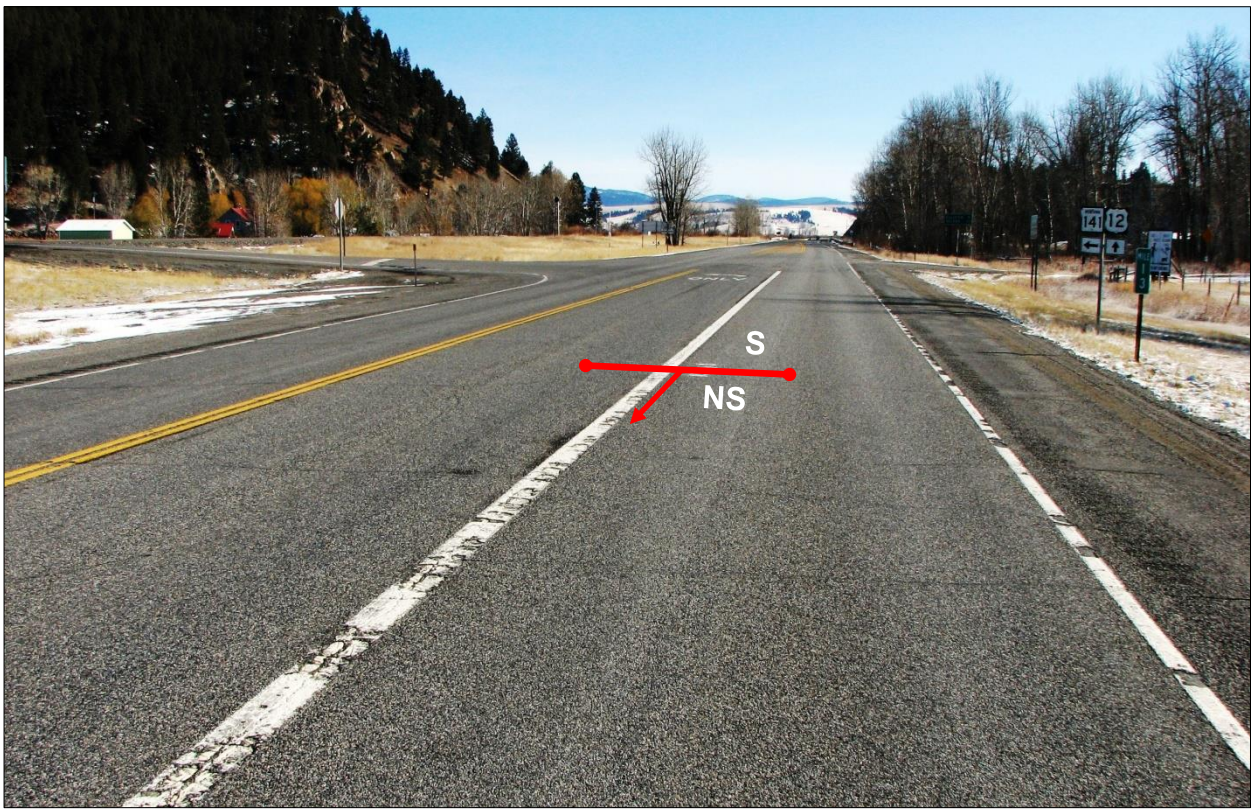
AVON: INTERSECTION OF HIGHWAY 12 & HIGHWAY 141 – July 2010

↑ Overview of lane divider stripe (view west). Visually the pavement marking was in very good condition, better than it was in the 2009 documentation. It appears this has been restriped. The mechanical bond between the seal and cover (chip seal) and underlying thermoplastic is intact.

↑ Close-up image of scarified section of lane divider pavement marking.

↑ Close-up image of non-scarified section of lane divider pavement marking.

AVON: INTERSECTION OF HIGHWAY 12 & HIGHWAY 141 – November 2011



🡅 View east. The non-scarified section (NS) is exhibiting debonding of the seal and cover (applied in 2008) from the existing thermoplastic on the longitudinal lane divider. The scarified portion of the lane divider (east half) is still intact.

🡄 Close-up of seal and cover debonding of the non-scarified marking exposing the underlying thermoplastic (red arrow).

🡄 Close-up of the average condition of the scarified portion of the longitudinal lane divider.

AVON: INTERSECTION OF HIGHWAY 12 & HIGHWAY 141 – June 2012

🡅 The above image shows the condition of the scarified and non-scarified lane divider marking as it appeared in 2011.

🡸 Debonding of the seal & cover is still progressing on the non-scarified section of the lane divider.

🡸The scarified section of the lane divider is in good shape with no debonding of the seal & cover to the underlying thermoplastic to date.

AVON: INTERSECTION OF HIGHWAY 12 & HIGHWAY 141 – April 2013

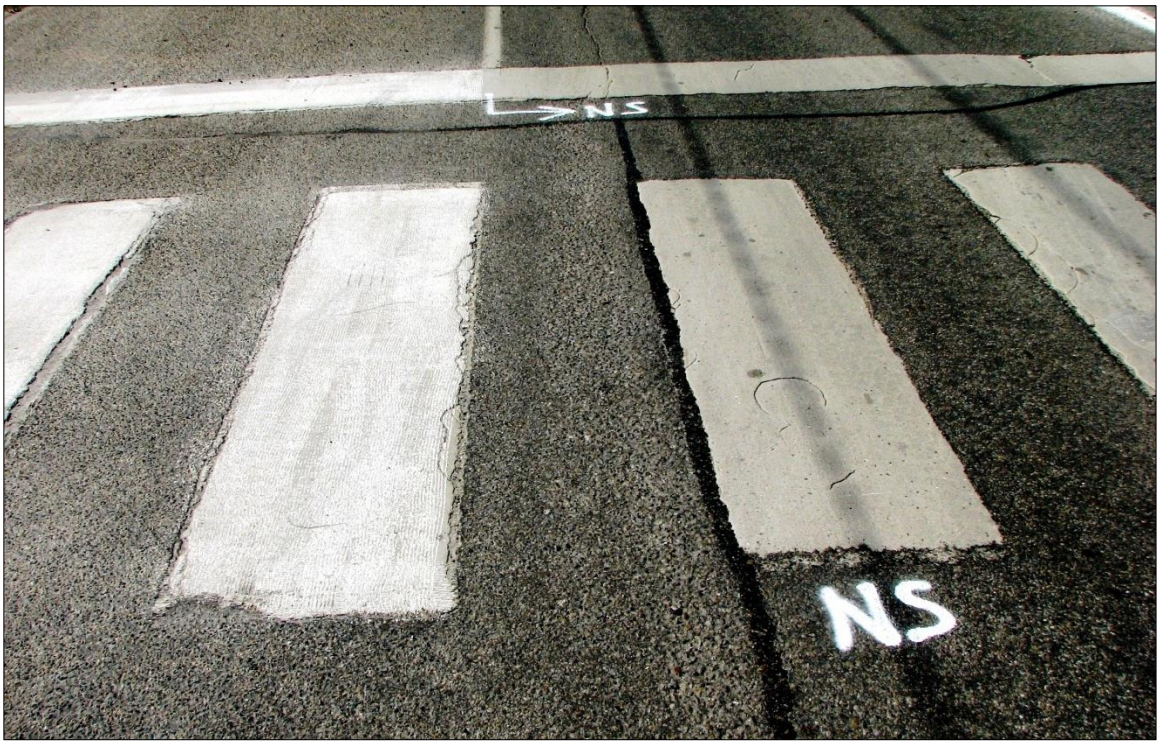
🡅🡇 Above sample image of the non-scarified longitudinal line showing areas of debonded chip seal to thermoplastic, below sample image is the scarified section of the marking. Condition is near to the same as documented in 2012.

DEER LODGE: INTERSECTION OF MAIN & COLLEGE ST. – August 2009

This location encompasses a four-lane configuration with stop bars and a zebra style pedestrian cross-walk. The southbound lane existing thermoplastic markings will receive the scarification treatment with the northbound lanes receiving no treatment prior to seal and cover.

↑ View of intersection looking east. Although difficult to see, the northbound lanes have been marked as 'NS' denoting that the thermoplastic is not to receive scarification. The southbound lanes crosswalk will receive a scar treatment. The yellow arrow denotes the separation of the treatments.

↑ Overview of intersection looking west.



↑ Representative image of scarified section of thermoplastic and non-scarified thermoplastic (view north).

↑ Close-up texture of scarified thermoplastic.

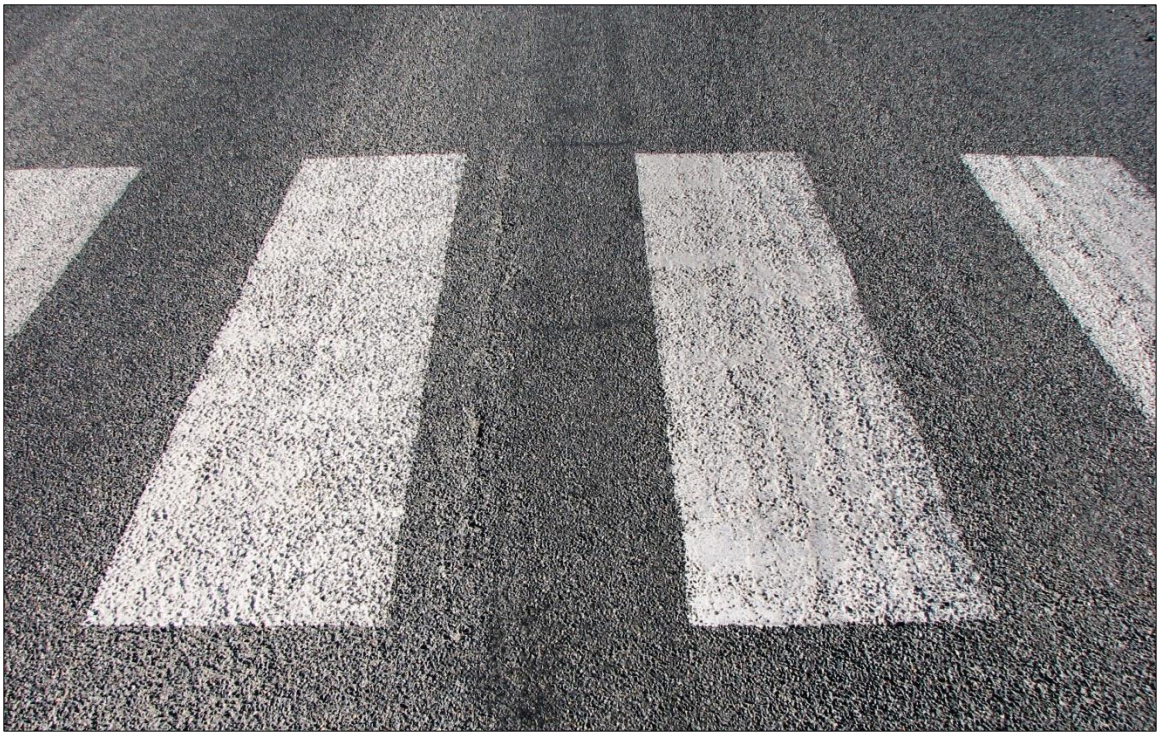
DEER LODGE: INTERSECTION OF MAIN & COLLEGE ST. – October 2009

↑ View of southbound lanes after seal & cover and reapplied pavement markings

↑ View of northbound lanes after seal & cover and reapplied pavement markings. Note that the first three crossing bars and adjacent stop line (yellow arrow) did receive a scar treatment. It was determined only the bars and stop line in the traffic lanes could determine level of mechanical bond due to the effect of moving vehicles over the non-scar treatments.

DEER LODGE: INTERSECTION OF MAIN & COLLEGE ST. – July 2010

↑ Overview of intersection (view west). To date no evidence of lack of bond between the seal and cover and thermoplastic. Next inspection will be in the summer of 2011.



↑ Example image (July 2010) of northbound lane non-scarified treated thermoplastic with seal & cover. No debonding noted to date.

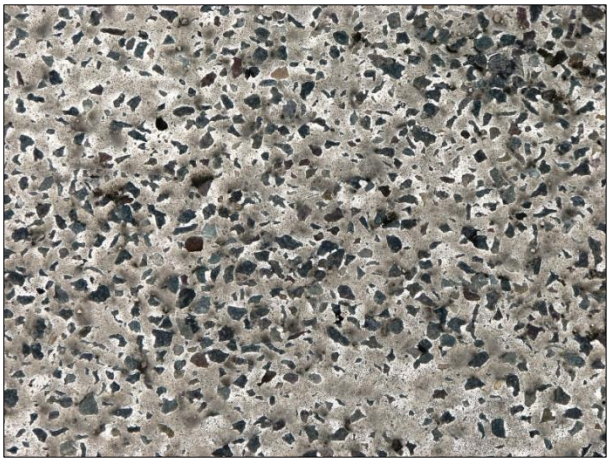
↑ Example image (July 2010) of southbound lane scarified treated thermoplastic with seal & cover. No debonding noted to date.

DEER LODGE: INTERSECTION OF MAIN & COLLEGE ST. – November 2011

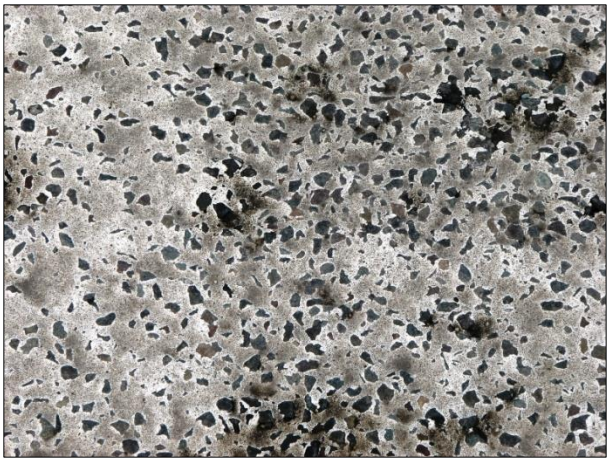
🡅 The overall condition of the seal and cover to the existing thermoplastic was intact. No discernible difference between the scarified (southbound) and non-scarified (northbound) sections were noticed. Appearance of the current pavement markers relatively remained unchanged since the inspection of 2010.

DEER LODGE: INTERSECTION OF MAIN & COLLEGE ST. – June 2012

🡅 The overall condition of the seal and cover to the existing thermoplastic was intact. No discernible difference between the scarified (southbound) and non-scarified (northbound) sections were noticed. Appearance of the current pavement markers relatively remained unchanged since the inspection of 2011 (view west).



🡅 Surface close-up of seal & cover over non-scarified thermoplastic cross walk section.



🡅 Surface close-up of seal & cover over scarified thermoplastic cross walk section.

Supplemental: DEER LODGE-INTERSECTION OF MAIN & COLLEGE ST. – June 2012

🡅 Research was informed by the District the crosswalk had been restriped in late June 2012.

DEER LODGE: INTERSECTION OF MAIN & COLLEGE ST. – April 2013

🡅 Overview of intersection. Bothe scarified and non-scarified treatments are performing equally well. No evidence of chip seal to thermoplastic debonding was evident.

Analysis to date

Elliston Site:

The original application of seal and cover (2008) over the existing (scarified and non-scarified) sections of the thermoplastic are intact and to date display no signs of debonding. Sometime after the July 2009 site visit, a heat-applied thermoplastic sheet was installed over the existing pavement markings. This layer of thermoplastic has steadily deteriorated over time and as stated above the seal and cover is still intact as of April 2013.

Avon Site:

The non-scarified section of the longitudinal lane divider (seal and cover applied in 2008) has exhibited debonding of the seal coating to the existing thermoplastic. Approximately 40% of the original thermoplastic is exposed, presumably from snow plowing. The scarified section is still intact as of April 2013.

Deer lodge:

Both sections of the intersection (scarified and non-scarified) seal and cover (applied in 2009) to date show no indication of debonding on any of the treatments.

This report and other project information may be found at:

http://www.mdt.mt.gov/research/projects/thermo_various.shtml