Montana Department of Transportation
Research Program
November 2007

EXPERIMENTAL EVALUATION FINAL REPORT

Emulsified Asphalt Treated Aggregate (EATA)

Location:	Deer Lodge and Silver Bow Counties; Butte District Highway 43: P-46, C000046 Approximate Milepost 51-58; Project is located in the Bighole River Valley, beginning at the Sportsman's Campground east to Dickie Bridge
Project No.:	Sportsman's Campground – East STPP 46-5(2)51; CN 2137
ADT:	2001 ADT=350; 7.3% Trucks 2021 ADT=460
FHWA No.	Experimental Project No.: MT 00-14
Description:	The Sportsman's Campground project is a reconstruct that included grading, gravel, plant mix surfacing, seal/cover, and two bridges. This project was determined a good candidate to incorporate EATA as an 'improved' winter driving surface and enhanced road surface dust suppression.
Dates of Evaluation:	September 2006 through May 2007
Date Constructed:	Fall 2006
Principal Investigator:	Craig Abernathy Experimental Project Manager

Acknowledgements

Research would like to thank Mike Arvish, EPM and Bill Shegina, Butte District Construction, for their help in the coordination of the experimental effort and assistance in the analysis of the treatments. We would also like to thank Bob Weber, Construction Review, in his assistance with site visits. And to Bill Fogarty in his overall support with the experimental portion of this project. Their teamwork in this project added value to the overall analysis.

Purpose

EATA is a crushed aggregate course (CAC) material blended with an emulsified asphalt. With this project the CAC was pug mill blended with CSS-1H emulsified asphalt. The intended benefit of using of EATA is to reduce chemical dust control products and provide an improved, temporary riding surface on highway projects, particularly during winter shut down. EATA was originally intended to improve the construction process by increasing the serviceability of the gravel sections and reduce the amount of dust control products that are currently being used on highway projects.

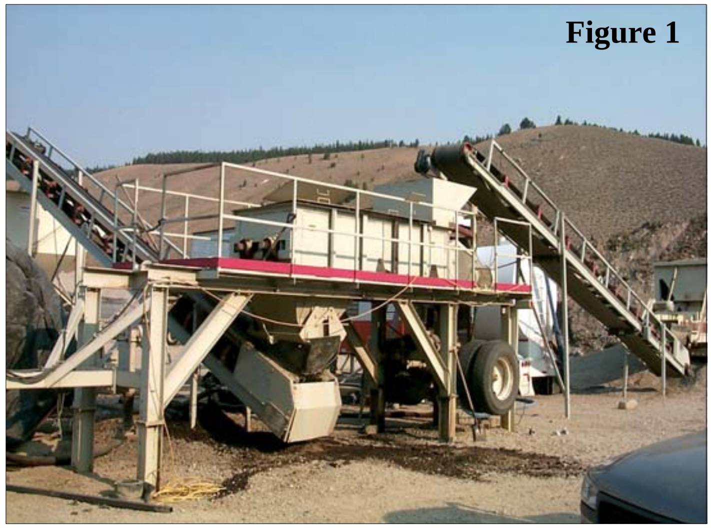


Figure 1

The goals and objectives of EATA:

-Reduce road dust, and reduce the need for chemical dust control products.
-Provide a smoother improved temporary riding surface.
-Reducing winter and construction maintenance.
-Provide a firm, stable, and smooth platform to pave on.

The intent of this report is to document the activities during construction and to record and comment on the performance of the sections during the 2006-2007 winter season prior to the paving phase.

<u>Test Section Layout</u>

Six sites of various percentages of CSS-1H, at approximated depths of 100 & 200mm, were delineated for analysis with the first section beginning at the west end of the project ending with section seven at the east end of the project. An untreated gravel section (6) was included for a control.

Note: The percentages of EATA used in this project (1.5, 2.0, and 2.5% respectively) represent the incorporation of emulsified asphalt with the CAC. This represents approximate residual asphalt content (RAC) of fifty percent (50%): Example; 2.0% EATA=1.0% RAC after cure.

The following are the test and control section locations:

- Section 1: Sta. 0+00 to 23+50 1.5% EATA @ 100mm depth (0.75% RAC)
- Section 2: Sta. 26+85 to 43+60 2.0% EATA @ 100mm depth (1.0% RAC)
- Section 3: Sta. 47+00 to 51+00 2.0% EATA @ 200mm depth (1.0% RAC)
- Section 4: Sta. 51+00 to 55+30 2.5% EATA @ 100mm depth (1.25% RAC)
- Section 5: Sta. 55+30 to 76+30 2.0% EATA @ 100mm depth (1.0% RAC)
- Section 6: Sta. 76+30 to 85+00 No Treatment - Gravel control
- Section 7: Sta. 85+00 to 95+55 2.0% EATA @ 100mm depth (1.0% RAC; shaded and super elevated roadway)

Construction

The contractor used a double-screw-type pug mill to incorporate the CSS-1H with the CAC as seen in figure 1. The blended EATA was then sent to a holding bin and subsequently loaded by conveyor belt to waiting trucks. The contractor explained that this method of pug milling allowed the CSS-1H product to coat the aggregate at each stage of the process including the loading of the truck (figure 2).

Figure 2

Figure 3a

Figure 3b

Figure 4

It was observed on several occasions during the loading of the trucks, based on visual inspection only, the blended CAC had the appearance of an even coating of product.

The EATA was transported using belly dump and rear-end dump trucks. This observer saw the belly dump used more frequent. The material was bladed to grade with GPS machine control using a finish blade with serrated cutting teeth (figures 3a & b).

Once graded the EATA was compacted using steel drum rollers (figure 4). With the installation of the first test section (1.5% EATA at 100mm depth) did exhibit segregation (or raveling) at the surface predominately between the wheel paths and shoulders (figure 5). Over time as the treatment cured and as the loose aggregate was displaced or compacted by traffic the section began to display a more uniform appearance. All the test sections (with the exception of the gravel control) developed a more uniform appearance after a short cure time. The EATA sections had good workability and compacted easily. Once placement was finished, traffic and construction equipment had no visual effect on the material. The product did not track onto vehicle body or tires. The amount of moisture on the surface did not add to any tracking issues.

Figure 5

The following report section is the test sites and control as documented through post-construction and the 2006-2007 winter season.

Note: In each test section there were areas of raveling, and unconsolidated material; some more prevalent from one section to another. A close-up shot of each surface treatment is included in each section. The close-up image is meant to represent the norm of surface condition for that treatment during the duration of the inspections. Unless otherwise stated, all views are looking East.

Section 1: 1.5% EATA, 100mm

Section 1 - Continued

March 2, 2007

March 20, 2007

Section 1 – Continued

<u>Section 2: 2.0% EATA, 100mm</u>

October 27, 2006

December 21, 2006

Section 2 – Continued

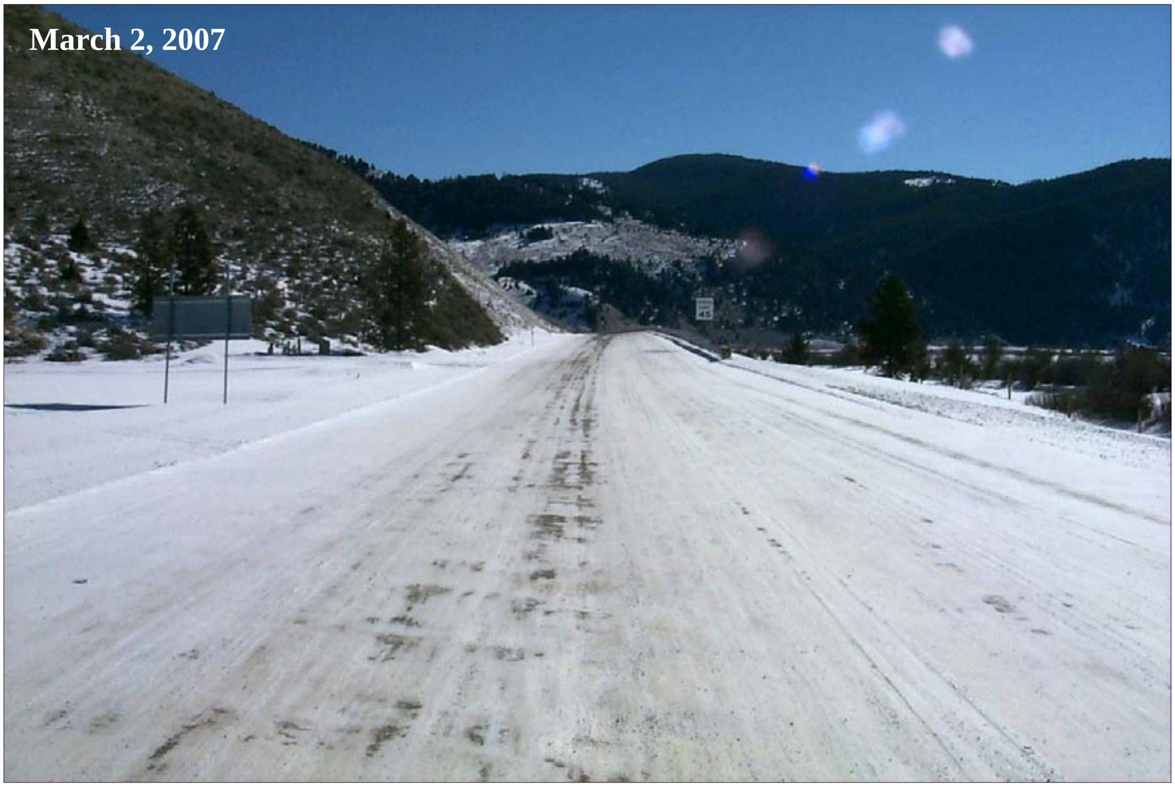

March 2, 2007


March 20, 2007

Section 2 – Continued

Section 3: 2.0% EATA, 200mm

Section 3 – Continued



March 2, 2007

March 20, 2007

Section 3 – Continued


April 13, 2007

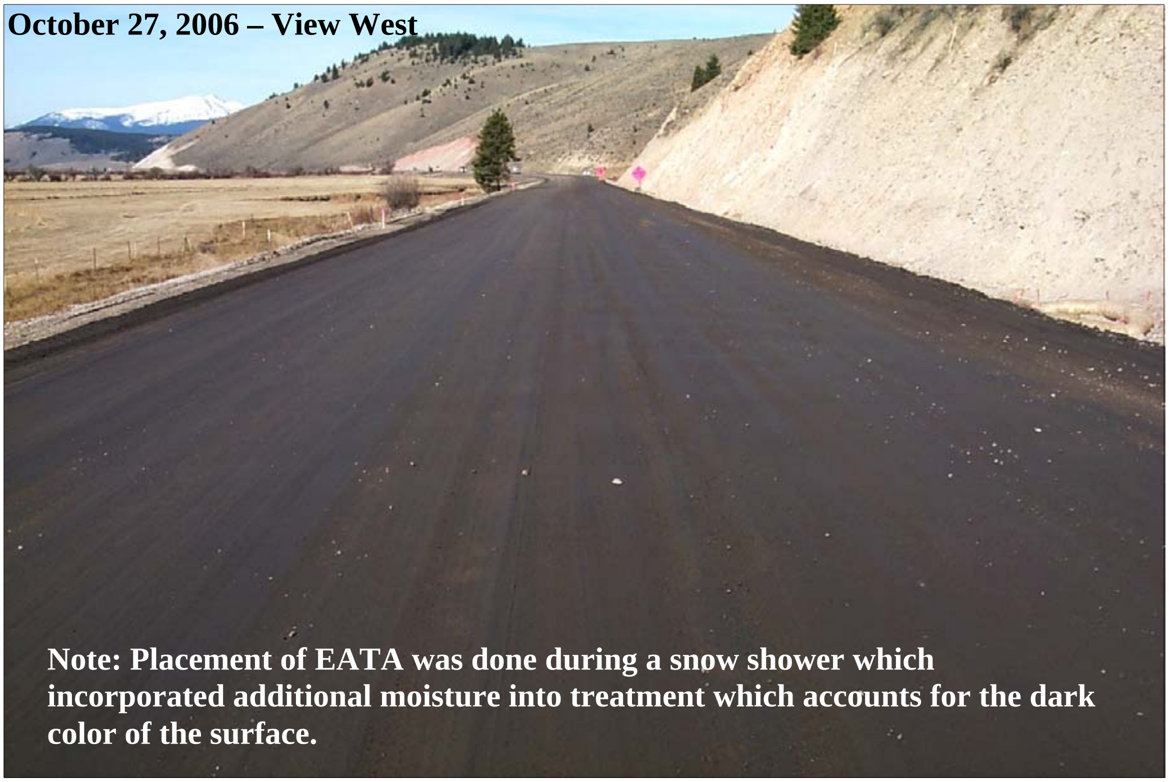

Close-up

Section 4: 2.5% EATA, 100mm

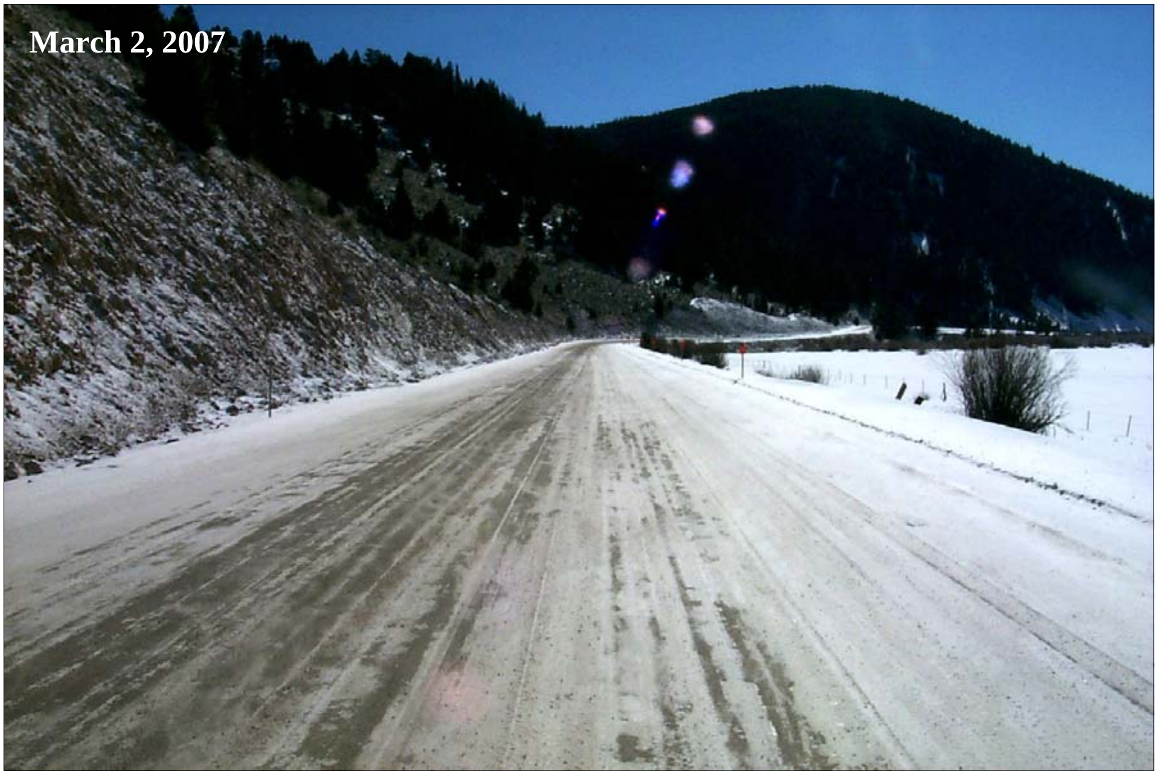
Section 4 – Continued

Section 4 – Continued

Test Section 5: 2.0% EATA, 100mm



Test Section 5 – Continued



Test Section 5 – Continued

Section 6: Gravel Control

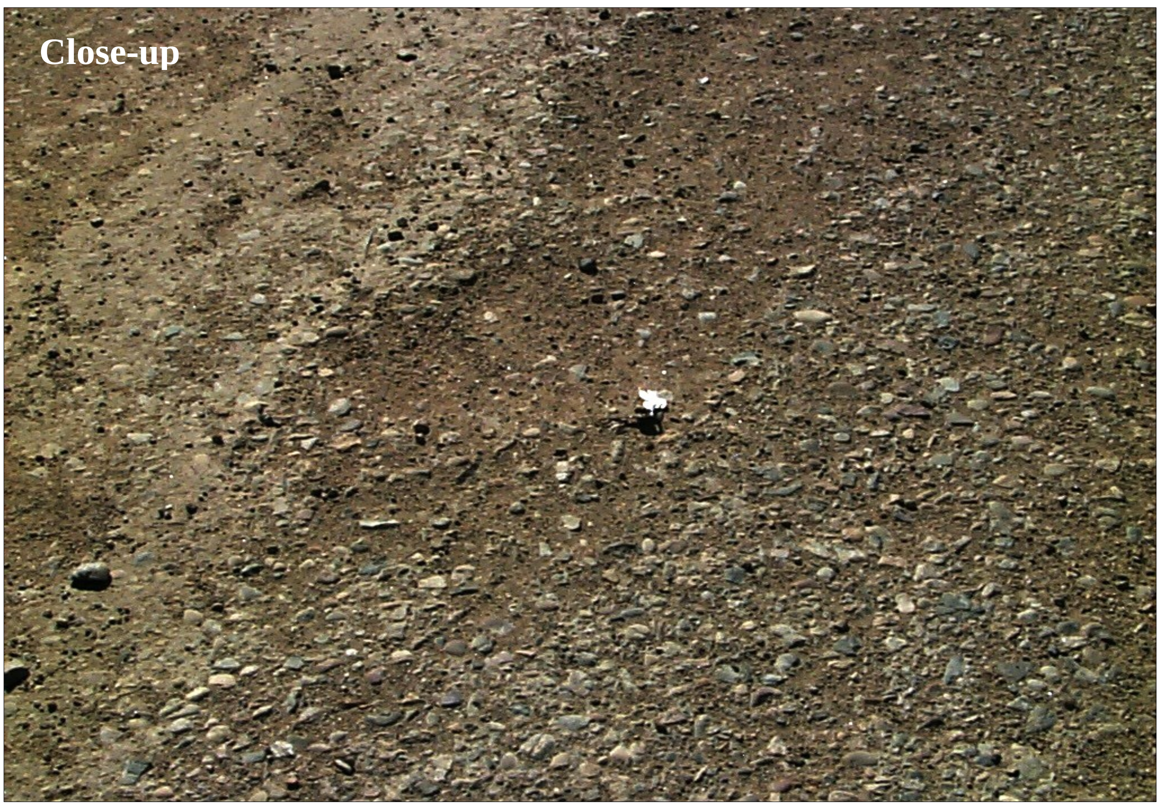
October 27, 2006 – View West

December 21, 2006

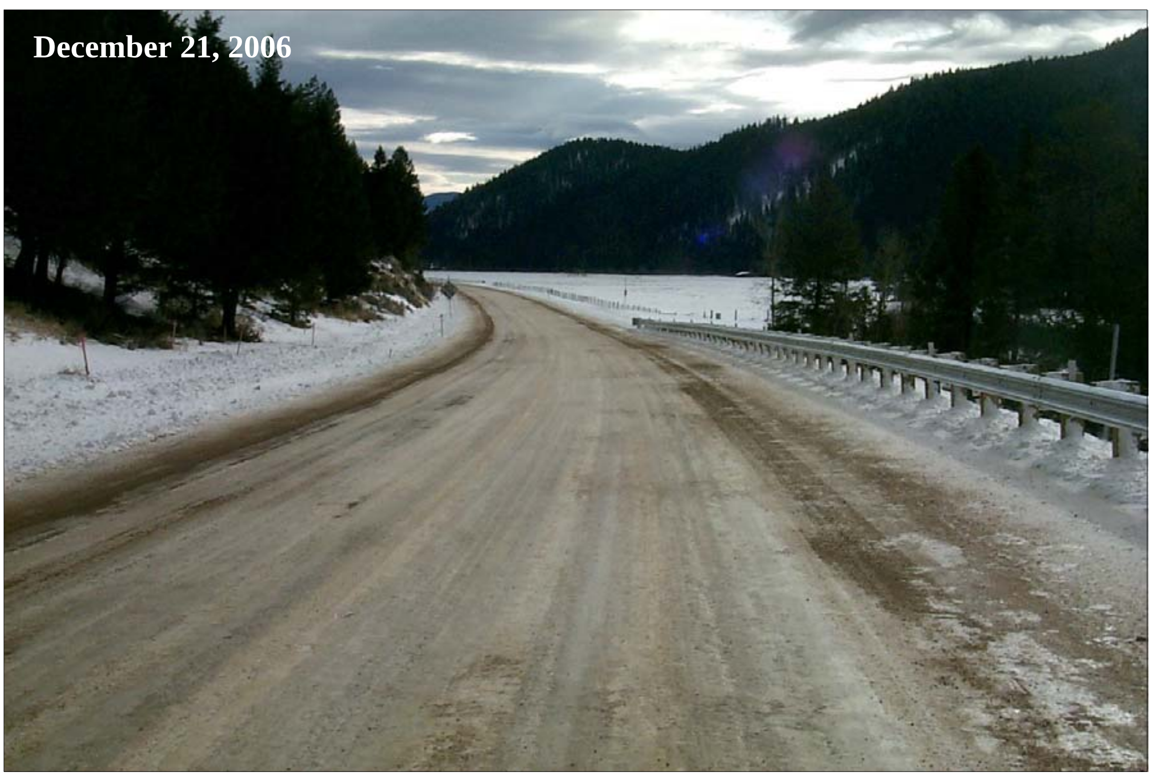
Section 6 - Continued

Section 6 - Continued


April 13, 2007


Close-up

Test Section 7: 2.0% EATA, 100mm



Test Section 7 – Continued


March 2, 2007


March 20, 2007

Test Section 7 – Continued

April 13, 2007

Close-up

EATA Core Samples

On May 18, 2007, the Butte District took core samples of the EATA test sites to see how the CSS-1H emulsion had incorporated into the aggregate. Cores were drilled approximately 100mm in depth. As predicted, due to the low emulsion content, most core samples fell apart during drilling. Section 1 (1.5% EATA at 100mm) did produce a nominal core which showed good cohesion of the aggregate (figure 6).

Figure 7 shows partially the interior of the core wall after the core was removed. Figure 8 shows another image of the condition of the core side walls. Notice the evidence of asphalt released during the coring. The side walls of these cores were relatively smooth and hard.

Note: Cores drilled without water held together better than those drilled with water.

Figure 6

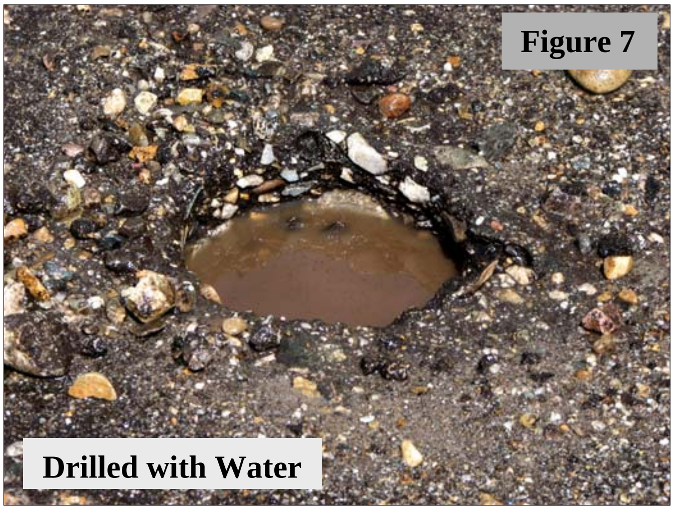


Figure 7

Drilled with Water

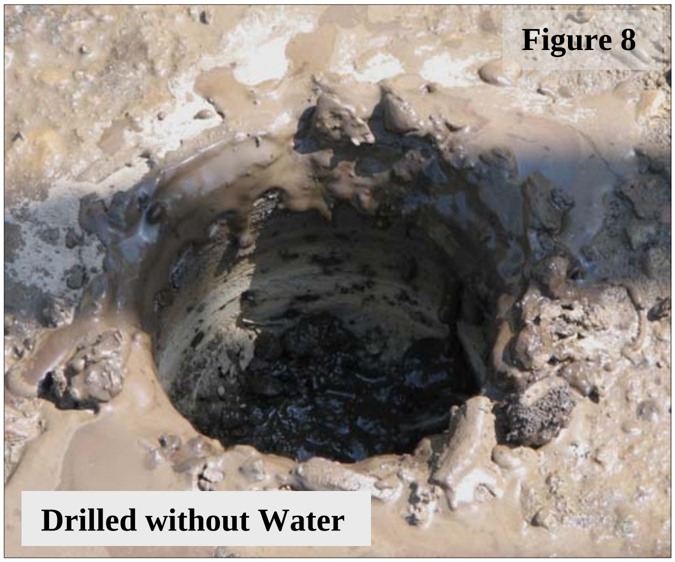


Figure 8

Drilled without Water

Conclusion

By consensus of MDT staff that participated in the review and analysis of the experimental features; all test sections performed better than anticipated. Those sections with a higher percentage of Emulsified Asphalt Treated Base (EATA) exhibited better qualities of aggregate cohesion, dust suppression, and overall ride. Throughout the inspection(s) for the period of construction, through the winter and into spring there was a noticeable improvement in the lower level of dust throughout the project. What dust was observed during the winter was most likely attributable to sanding material. The road surface was of a quality that allowed the travelling public a comfort factor to exceed the posted 45mph.

The 1.5%, 100mm (section 1) displayed the most in raveling and traffic dust during the mild months. Pertaining to section 1, the crushed aggregate course (CAC) used in this project contained a high level of fines which would be difficult for a homogeneous coating of emulsion during the pug milling process. The lower the percentage of emulsion may attribute to more segregation and raveling with the higher percentage level of emulsion (or the higher amount of residual asphalt content after cure) functioning better. The 2.5% treatment (section 4) did achieve performance over the other test sites but it should be noted that the 2.0% sections performed almost as well as the 2.5% site. There was no discernable difference in function over the 100mm and 200mm depths. The gravel control section performed as expected, described as having the poorest ride quality based on severity of potholes, raveling, washboard and dust. The control section required routine surface maintenance due to conditions previously noted.

Water usage for dust suppression was lower than would be in a conventional project. Based on anecdotal information from construction staff, with section 4 (2.5%), it was stated that only one pass of water was needed on a daily basis.

In reviewing all test sections during the timeframe of this analysis, we attempted to look at each section at areas that displayed the optimum performance for that treatment. In any new procedure, there are anomalies in practice, which may slant performance based on the inconsistency of application, or the variables in daily construction routine that may have contributed to less than satisfactory results on any given section. The 2.5% EATA did perform the best; however, the 2.0% sections functioned almost as well. With the rising cost of oil, a 2.0% EATA may be a more cost effective application.

At the time of this writing the project is completed with all paving finished. Mike Arvish; EPM, stated that paving went very well which may be contributed to the EATA base. Rollout was not a problem on the first lift of PMS and compaction.

It may be beneficial to perform this procedure in other areas of the state that have problems with base preparation such as ease of consolidation, rollout, raveling and any other constructability concerns are involved. The incorporation of CSS-1H in a base preparation was one of the elements in a proposed experimental project feature on the Angela N&S project (Glendive District) but was removed due to financial constraints.