EcoPave Engineering Study
Santa Ynez Private Roads

Geotechnical Investigation
July 2019

1.0 Introduction

Midwest's EcoPave stabilization system was installed to a depth of 4" in a California Private Road in the fall of 2018. Dynamic Cone Penetrometer testing was conducted the week of July 29th, 2019 on a California Private Road. Testing was conducted as a quality control measure to ensure that heavy rains the road experienced over the winter of 2018 had not compromised the EcoPave stabilization. Additionally, there were some areas that experienced damage after the EcoPave installation in the fall of 2018. These areas were repaired and were also tested to insure they were achieving the same strengths as the original EcoPave stabilization sections.

2.0 Geotechnical Investigation

As part of the geotechnical investigation, Midwest conducted a site visit on 7-31-2019 which included visual assessments and Dynamic Cone Penetrometer (DCP) testing. The site visit and testing were conducted by Jim Phillips. The objective of the site visit was to determine and confirm the depth of stabilization. This was achieved by performing DCP testing to assess and illustrate the California Bearing Ratio (CBR) values at different depths in the roadway. The stabilized layer will yield significantly higher CBR values than the underlying untreated material.

2.1 DCP Overview

The Dynamic Cone Penetrometer is a portable, hand-held device used to measure the strength, and thickness of soil layers. The DCP is used worldwide in geotechnical investigations as it is a user-friendly and quick method for evaluating soil and pavement layers. The DCP consists of two 5/8" diameter shafts (upper and lower shaft) that are coupled near the midpoint. The lower shaft has a pointed tip that is driven into the soil by dropping a sliding hammer located on the upper shaft. The soil strength is determined by measuring the penetration of the lower shaft into the soil after each hammer drop. This value is recorded in millimeters per blow and is easily converted to a CBR value. Midwest utilizes the SmartDCP equipment which uses a laser to precisely measure the depth of penetration for each drop and is automatically stored on a mobile device. The SmartDCP automatically converts each drop to a corresponding CBR value and plots the CBR vs depth on a graph to identify the strength and thickness of different pavement layers.

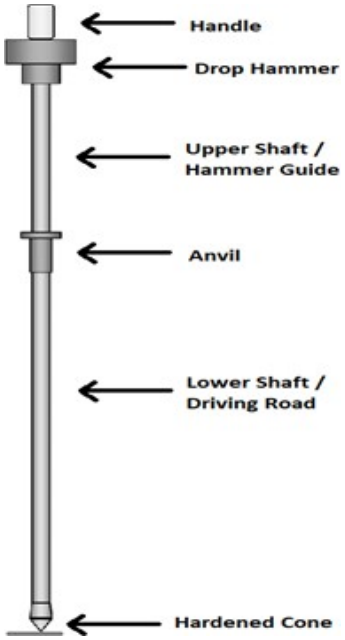

Figure 1: Dynamic Cone Penetrometer setup

Midwest Industrial Supply, Inc.
1101 3rd Street Southeast
Canton, Ohio 44707
www.midwestind.com

Tel 330.456.3121
Fax 330.456.3247
Toll Free 1.800.321.0699

2.2 DCP Testing

All DCP testing is performed in accordance with ASTM D 6951-03 “Standard Test Method for Use of the Dynamic Cone Penetrometer in Shallow Pavement Applications”. On July 31, 2019, Jim Phillips performed DCP testing at 17 different locations on site. Of the 17 total test locations, 14 of them were in areas where the pavement had been stabilized with EcoPave. The other 3 locations were on untreated material; 2 with base material added and 1 without base material. Testing was conducted to a depth of 200mm (approx. 8”) below the surface. Figure 2 illustrates the locations of the DCP readings.

Figure 2: DCP test locations

As illustrated in the chart below, the average CBR value at 0-4” (Stabilized Layer) below the surface for all treated test locations is 80. The average CBR value at 4-6” (Transition Layer) below the surface for all treated test locations is 55. The average CBR value at 6-8” (Untreated Layer) below the surface for all treated test locations is 26. These results indicate that an average increase of over 200% in CBR value was achieved through stabilization with EcoPave.

2.3 DCP Results

The results of the DCP testing were plotted versus depth to identify the transition between he stabilized pavement layer and the underlying untreated soil. Based on the readings obtained, the stabilized surface layer appears to be 4-6” thick. Midwest can confidently identify 3 different layers of pavement based on the DCP testing conducted on July 31, 2019. They are as follows:

0-4” = Stabilized Layer

4-6” = Transition between stabilized soil layer and underlying untreated soil

6-8” = Untreated soil

Average CBR Reading By Location and Depth - Treated Locations			
Location of DCP Testing	**Stabilized Layer (0-4")**	**Transition Layer (4-6")**	**Untreated Layer (6-8")**
North Road 1000' from West Road Corner	71	35	19
North Road 2000' from West Corner	67	38	17
North Road West Road Corner	88	54	22
Pipeline Road North Road Intersection	80	56	25
Pipeline Road 1000' from North Road Intersection	87	63	35
Pump Road 200ft form South Road Intersection	87	49	22
Pump Road 830ft from North Road Intersection	70	39	22
South Bottom Road 1-2 Between Pipeline and Tractor Lot - Southside	77	48	25
South Bottom Road First Oak - Southside	97	91	39
South Bottom Road West Corner	53	44	26
South Road Pump Intersection - Southside	81	59	35
West Road 1000' from South Road Corner	96	74	32
West Road 2000' from South Road Corner	95	75	29
West Road South Road Corner	64	42	16
Average CBR Reading	**80**	**55**	**26**

Figure 3: Average CBR reading by location and depth for all treated locations.

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The testing performed at untreated locations (shown below) confirms that the 6-8” DCP readings collected from treated

Average CBR Reading By Location and Depth - Untreated Locations			
Location of DCP Testing	**(0-4")**	**(4-6")**	**(6-8")**
Untreated - Installed Base	11	17	18
Untreated - No Base	30	21	22
Untreated - Base Road 500' East Corner of Shop Pad	35	23	16
AVERAGE CBR Reading	**25**	**20**	**19**

Figure 4: Average CBR reading by location and depth for all untreated locations.

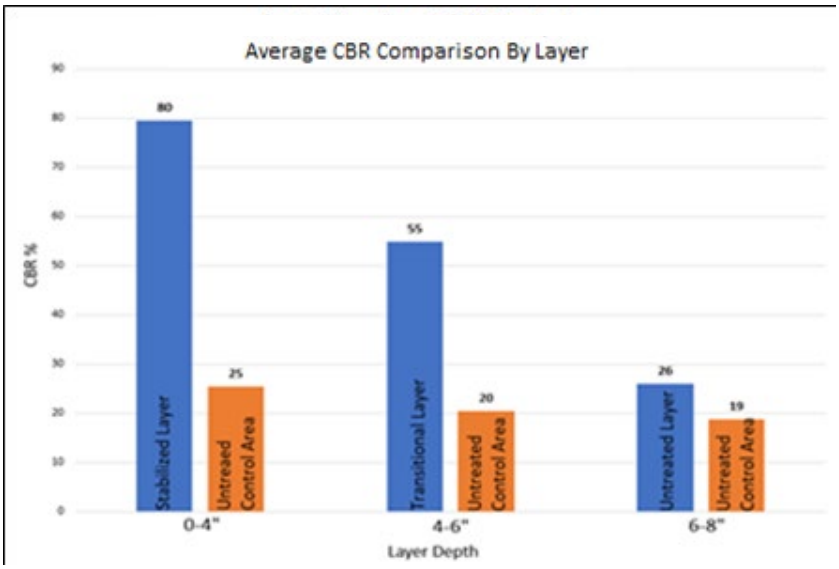
3.0 Conclusion

Based on the DCP testing conducted by Jim Phillips on July 31, 2019, Midwest can confidently conclude that the depth of stabilization was a minimum of 4”. The testing shows 3 distinct pavement layers that Midwest has identified as:

-4” = Stabilized Layer Average CBR of 80

4-6” = Transitional Layer Average CBR of 55

6-8” = Untreated Layer Average CBR of 26



Along with identifying the 3 distinct pavement layers, Midwest is also able to quantify the increase in CBR for the “Stabilized Layer” relative to the “Untreated Layer” as shown in the chart below.

Average CBR Increase Achieved Through Stabilization			
Location of DCP Testing	**Stabilized Layer (0-4")**	**Untreated Layer (6-8")**	**% Increase in CBR**
North Road 1000' from West Road Corner	71	19	274%
North Road 2000' from West Corner	67	17	294%
North Road West Road Corner	88	22	300%
Pipeline Road North Road Intersection	80	25	220%
Pipeline Road 1000' from North Road Intersection	87	35	149%
Pump Road 200ft form South Road Intersection	87	22	295%
Pump Road 830ft from North Road Intersection	70	22	218%
South Bottom Road 1-2 Between Pipeline and Tractor Lot - Southside	77	25	208%
South Bottom Road First Oak - Southside	97	39	149%
South Bottom Road West Corner	53	26	104%
South Road Pump Intersection - Southside	81	35	131%
West Road 1000' from South Road Corner	96	32	200%
West Road 2000' from South Road Corner	95	29	228%
West Road South Road Corner	64	16	300%
Average CBR Reading	**80**	**26**	**219%**

Figure 5: Average CBR increase achieved through stabilization

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4.0 Site Photographs

DCP testing

DCP Testing on repaired area

East Road- main drive

East Road – surface

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1101 3rd Street Southeast
Canton, Ohio 44707
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Tel 330.456.3121
Fax 330.456.3247
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MIDWEST

North Road

North Road- repair area

North Road- repair area

North Road- repair area

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Pump Road

Pump Road

West Road

West Road

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