Maine Department of Transportation
Highway Program

GEOTECHNICAL SERIES 100 REPORT

Baxter Boulevard
Portland, Maine

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Cumberland County PIN 17337.00 Soils Report No. 2011-111
Federal Number STP-1733(700)X TEDOCS# 1164169
December 8, 2011

Highway Program

Brad Foley, Program Manager

Memorandum

DATE: December 8, 2011

TO: Denis Lovely **DEPT:** Region 1

FROM: Scott A. Hayden **DEPT:** Highway Program

SUBJECT: 17337.00 Portland, Baxter Blvd. - Existing Pavement Thickness Estimates
100 Series Report # 2011-111

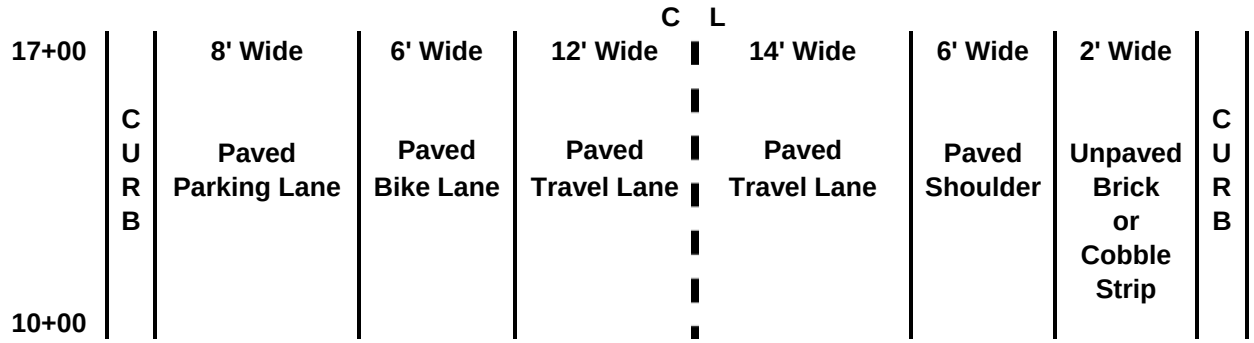
Project Description

A pavement thickness investigation has been completed for a 0.14 mile portion of Baxter Boulevard in the town of Portland. The project begins at the intersection of Forest Avenue and extends northeast to Preble Street. Project stationing was provided in the field by Region 1 personnel. All offsets are measured from the existing roadway centerline.

The purpose of the investigation is to determine the thickness of pavement from curb to curb. At the time of the request Region 1 personnel were under the impression that the pavement surface was underlain by cobblestone, curb to curb.

The roadway measures 48 feet from curb to curb. Pavement extends full width to the curb on the left side. However, the pavement surface generally ends two feet from the curb on the right side where a 2 foot wide strip consisting of brick prior to station 13+30 and cobblestone beyond station 13+30 is exposed. See figure 1 for a plan view of the area of investigation.

Figure 1: Roadway Plan View



Data Collection

Pavement coring and ground penetrating radar (GPR) was used to obtain existing pavement thickness estimates. This data has been plotted collectively in a plan view format as figure 2. Pavement core data is plotted in black and the GPR data is plotted in red (See figure 2).

Coring Data: A total of 22 pavement cores were conducted. Cores were drilled with a hand held, gas powered, coring machine using a 2" thin wall core bit. Cores were conducted transversely at stations 12+00, 14+00, and 16+00 within the left parking lane, left bike path, inner and outer wheel paths of each travel lane, and the right shoulder.

Left Parking Lane – Three pavement cores were drilled in the left parking lane. Cores encountered 1.5"- 3.5" of pavement. At station 12+00, 23' left, the pavement was underlain by 3.5 inches of brick (See Core Photo 1). At stations 14+00, 20' left and 16+00, 21.5' left the pavement was underlain by McAdam. The McAdam was cored at station 16+00 and was found to be 1.5" in thickness.

Left Bike Path – Three pavement cores were drilled in the bike path. The pavement thickness ranged between 3.5"- 4.5". The pavement was underlain by McAdam. No cobblestone or brick was encountered.

Travel Lanes – Thirteen pavement cores were drilled within the travel lanes. Cores were drilled at stations 12+00, 14+00, and 16+00. The pavement thickness was greatest at station 12+00 ranging between 4.5"- 5.0". At station 14+00 the pavement thickness was considerably thinner ranging between 2.5"- 4.0". Three pavement cores taken in the left lane (14+00) only encountered 2.5" of pavement. Of all of the cores taken in the travel lanes throughout the entire project, these cores in the left lane at station 14+00 were the thinnest (It should be noted that the GPR data indicates that the pavement is only 1.8" thick at station 17+24). At station 16+00 the pavement thickness was 3.0" in each of the travel lanes. McAdam was found directly underlying the pavement at all travel lane core locations. The McAdam layer was cored at station 12+00, 14+00 and 16+00 and was found to be 4.5", 5.0" and 6.0" thick respectively (See core photo 2). No cobblestone or brick was encountered.

Right Shoulder – Three pavement cores were drilled in the right shoulder. The thickness ranged between 1.5"- 3.5". The pavement was underlain by McAdam. No cobblestone or brick was encountered at the offsets drilled (See pavement core summary sheet).

Ground Penetrating Radar Data:

Ground penetrating radar data was collected in the right and left wheel path of the two primary travel lanes, the right paved shoulder, the left paved shoulder and the left bike lane. Data was collected at 1 foot intervals along the entire section. Pavement thickness estimates were developed using Geophysical Survey Systems Inc. (GSSI) RADAN GPR Data Processing Software. Where available, pavement thicknesses from pavement cores were used in developing the estimated GPR pavement thicknesses.

The GPR data has been consolidated to provide an average pavement thickness every 50' for testing conducted along the left parking lane, left bike path, inner and outer wheel paths in each travel lane and the right shoulder (See attached GPR estimated pavement thickness sheets). Pavement thickness obtained from the GPR generally agrees with the pavement cores. The pavement thickness estimates from the GPR have been plotted (in red) collectively with the pavement core information in a plan view format (See figure 2).

The GPR data indicates that the pavement thickness is considerably greater at the beginning of the project (4.7", 10+50 travel lane) than the thickness encountered near the end of the project (1.8", 17+24 travel lane). See Table 2.

Figure 2: Pavement Thickness Summary

X = Pavement Core Locations
Black = Pavement thickness obtained from pavement core
Red = Pavement thickness obtained from ground penetrating radar average

	8' Wide	6' Wide	12' Wide		14' Wide		8' Wide
	Left Parking	**Bike Lane**	**Travel Lane**	C L	**Travel Lane**		**Right Shoulder**
17+24			1.8"		1.8"		1.7"
17+00	1.6"	2.2	2.5"		2.5"		1.8"
16+50	1.6"	2.5"	2.8"		2.8"		1.6"
16+00	X 1.5" Pave McAdam	X 3" Pave McAdam	X 3" Pave McAdam	X 3" Pave McAdam	X 3" Pave McAdam	X 3" Pave McAdam	X 1.5" Pave McAdam
	1.5"	3.1"	2.9"		2.9"		1.8"
15+50	1.6"	3.7"	2.8"		2.8"		2.0"
15+00	3.5"	4.3"	3.1"		3.1"		2.2"
14+50	3.3"	4.1"	3.0"		3.0"		1.9"
14+00	X 3.5" Pave McAdam	X 4.0" Pave McAdam	X 2.5" Pave McAdam	X 2.5" Pave McAdam	X 2.5" Pave McAdam	X 4.0" Pave McAdam	X 3.5" Pave McAdam	X 2.5" Pave McAdam
	3.4"	4.0"	3.1"		3.1"		2.1"
13+50	3.4"	4.1"	3.0"		3.0"		1.7"
13+00	3.9"	5.2"	3.8"		3.8"		3.2"
12+50	3.4"	4.4"	4.2"		4.2"		3.1"
12+00	X 3" Pave Brick	X 4.5" Pave McAdam	X 4.0" Pave McAdam	X 5.0" Pave McAdam	X 5.0" Pave McAdam	X 4.5" Pave McAdam	X 3.5" Pave
	3.5"	4.1"	4.5"		4.5"		3.3"
11+50	4.6"	4.9"	4.5"		4.5"		2.1"
11+00	4.6"	5.0"	4.6"		4.6"		2.3"
10+50	3.1"	3.6"	4.7"		4.7"		2.4"
10+00							

Data Summary

Pavement thickness estimates are based upon limited pavement coring data and ground penetrating radar (GPR) data. Actual pavement thickness may vary.

- The average pavement thickness and range is summarized in Table 1:

Table 1: Pavement Thickness Range and Average

	Left Parking Lane	Left Bike Path	Left Travel Lane	Right Travel Lane	Right Shoulder
Pavement Thickness Range (in.)	1.5 – 4.6	2.2 – 5.2	1.8 – 5.0	1.8 – 5.0	1.6 – 3.5
Average Pavement Thickness (in.)	3.0	3.9	3.5	3.5	2.3

- The pavement thickness is considerably greater at the beginning of the project than the thickness encountered near the end of the project. Table 2 compares the pavement thickness encountered at station 10+50 verses the pavement thickness encountered at station 17+24.

Table 2: % Reduction in Pavement Thickness
Station 10+50 compared to Station 17+24

	Left Parking Lane	Left Bike Path	Left Travel Lane	Right Travel Lane	Right Shoulder
Pavement Thickness 10+50 (in.)	3.1	3.6	4.7	4.7	2.4
Pavement Thickness 17+24 (in.)	1.6	2.2	1.8	1.8	1.7
Percent Reduction in Thickness	48 %	39%	62%	62%	29%

- A two foot wide strip of exposed cobblestone and brick can be seen adjacent to the right curb. Brick was found to be exposed south of station 13+30 and cobblestone was found to be exposed north of station 13+30. It is anticipated that the exposed brick or cobblestone surface does not extend full width beneath the pavement surface. Ground penetrating radar data collected transversely (full-width) at 100 foot intervals suggests that the cobblestone or brick may only extend inward 4' from the curb (See Table 3).

- The existing pavement surface extends full-width to the left curb thus there is no cobblestone or brick exposed. However, a pavement core conducted 3' inward from the left curb at station 12+00 indicates that brick is present directly beneath the pavement. Ground penetrating radar data collected transversely (full-width) at 100 foot intervals suggests that buried cobblestone or brick beneath the pavement next to the left curb may extend inward 4' from the curb (See Table 3).

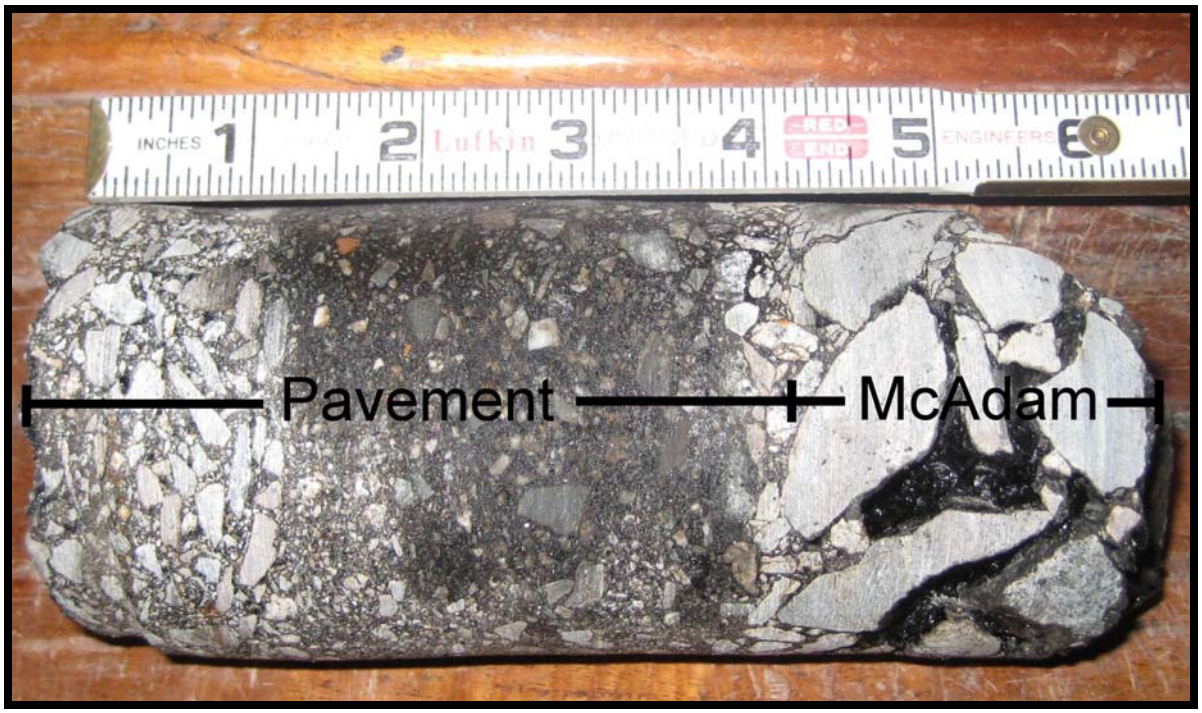
Table 3: Estimated Inward limit of cobblestone and/or brick layer from curb based upon GPR Data

Station	Inward Limit From Left Curb	Inward Limit From Right Curb
11+00	4.1’	?
12+00	4.2’	4.2’
13+00	3.8’	4.1’
14+00	3.8’	4.1’
15+00	4.1’	3.5’
16+00	?	3.8’
17+00	?	4.8’

Core Photo 1: Brick core beneath pavement surface
PC-1, Station 12+00, 23.0’ Left

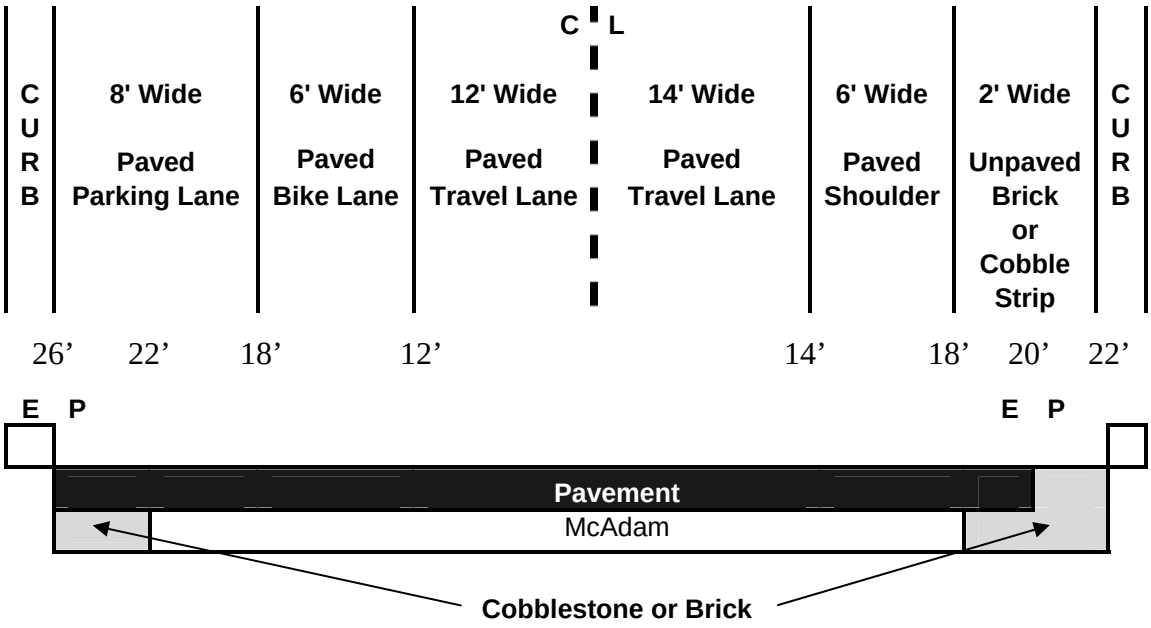
- A layer of McAdam was encountered directly beneath the existing pavement surface in 20 of the 22 pavement cores drilled. The McAdam was 5.0” – 6.0” thick under the travel lanes and 1.5” thick under the shoulder. It is anticipated that McAdam will be encountered directly beneath the pavement structure extending from centerline to 20’ – 22’ left and right. See cross section schematic depicted in Figure 3 below.

Core Photo 2: Pavement Core with underlying McAdam attached
PC-2, 14+00, 3’ Right



- Based upon the pavement core info and ground penetrating radar information the following subsurface profile is anticipated.

Figure 3: Plan and Cross Sectional View



State of Maine - Department of Transportation

Pavement Core Summary Sheet

Town(s): Portland Work Number: 17337.00

Station (Feet)	Offset (Feet)	Pavement Depth (Inches)	McAdam (Inches)	PC-Number	Saved Core	Comments / Date 12/1/2011
12+00	23.0 Lt.	3.0		1	yes	park lane, 3.5" brick
12+00	17.0 Lt.	4.0	yes			bike lane
12+00	10.0 Lt.	4.0	yes			
12+00	4.0 Lt.	5.0	yes			
12+00	3.0 Rt.	5.0	4.0			
12+00	10.0 Rt.	4.5	yes			
12+00	16.0 Rt.	3.5	yes			shoulder
14+00	20.0 Lt.	3.5	yes			park lane
14+00	14.0 Lt.	4.0	yes			bike lane
14+00	8.0 Lt.	2.5	yes			
14+00	7.0 Lt.	2.5	yes			
14+00	2.0 Lt.	2.5	yes			
14+00	3.0 Rt.	4.0	5.0	2	yes	
14+00	9.0 Rt.	3.5	yes			
14+00	17.0 Rt.	2.5	1.5			shoulder
16+00	21.5 Lt.	1.5	1.5			park lane
16+00	14.0 Lt.	3.0	yes			bike lane
16+00	8.0 Lt.	3.0	yes			
16+00	2.0 Lt.	3.0	6.0	3	yes	
16+00	3.0 Rt.	3.0	yes			
16+00	10.0 Rt.	3.0	yes			
16+00	15.0 Rt.	1.5	yes			shoulder

Logged By: B. Wilder

2" Thinwall Core

17337.00 Portland - Baxter Blvd (Left Shoulder)
Estimated Pavement Thickness
Ground Penetrating Radar (GPR)

Explanation of Ground Penetrating Radar (GPR) Data Collection and Analysis:
For Project 17337.00 (Portland), GPR data was collected in the right and left wheel path of the two primary travel lanes, the right paved shoulder, the left paved shoulder and the left bike lane. Data was collected at 1 foot intervals along the entire section. Pavement thickness estimates were developed using Geophysical Survey Systems Inc. (GSSI) RADAN GPR Data Processing Software. Where available, pavement thicknesses from pavement cores collected by MaineDOT personnel were used in developing the estimated GPR pavement thicknesses.

GPR pavement thickness averages are to be considered for estimating purposes only.
Actual pavement thickness may vary.

Analysis Distance (ft) - 50

17337.00 Portland - Baxter Blvd (Left Shoulder)

Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)
10+00	10+50	3.1									
10+50	11+00	4.6									
11+00	11+50	4.6									
11+50	12+00	3.5									
12+00	12+50	3.4									
12+50	13+00	3.9									
13+00	13+50	3.4									
13+50	14+00	3.4									
14+00	14+50	3.3									
14+50	15+00	3.5									
15+00	15+50	1.6									
15+50	16+00	1.5									
16+00	16+50	1.6									
16+50	17+00	1.6									

17337.00 Portland - Baxter Blvd (Left Bike Path)
Estimated Pavement Thickness
Ground Penetrating Radar (GPR)

Explanation of Ground Penetrating Radar (GPR) Data Collection and Analysis:
For Project 17337.00 (Portland), GPR data was collected in the right and left wheel path of the two primary travel lanes, the right paved shoulder, the left paved shoulder and the left bike lane. Data was collected at 1 foot intervals along the entire section. Pavement thickness estimates were developed using Geophysical Survey Systems Inc. (GSSI) RADAN GPR Data Processing Software. Where available, pavement thicknesses from pavement cores collected by MaineDOT personnel were used in developing the estimated GPR pavement thicknesses.

GPR pavement thickness averages are to be considered for estimating purposes only.
Actual pavement thickness may vary.

Analysis Distance (ft) - 50

17337.00 Portland - Baxter Blvd (Left Bike Path)

Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)
10+00	10+50	3.6									
10+50	11+00	5.0									
11+00	11+50	4.9									
11+50	12+00	4.1									
12+00	12+50	4.4									
12+50	13+00	5.2									
13+00	13+50	4.1									
13+50	14+00	4.0									
14+00	14+50	4.1									
14+50	15+00	4.3									
15+00	15+50	3.7									
15+50	16+00	3.1									
16+00	16+50	2.5									
16+50	17+00	2.2									

17337.00 Portland - Baxter Blvd (Travel Lanes)
Estimated Pavement Thickness
Ground Penetrating Radar (GPR)

Explanation of Ground Penetrating Radar (GPR) Data Collection and Analysis:
For Project 17337.00 (Portland), GPR data was collected in the right and left wheel path of the two primary travel lanes, the right paved shoulder, the left paved shoulder and the left bike lane. Data was collected at 1 foot intervals along the entire section. Pavement thickness estimates were developed using Geophysical Survey Systems Inc. (GSSI) RADAN GPR Data Processing Software. Where available, pavement thicknesses from pavement cores collected by MaineDOT personnel were used in developing the estimated GPR pavement thicknesses.

GPR pavement thickness averages are to be considered for estimating purposes only.
Actual pavement thickness may vary.

Analysis Distance (ft) - 50

17337.00 Portland - Baxter Blvd (Travel Lanes)

Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)
10+00	10+50	4.7									
10+50	11+00	4.6									
11+00	11+50	4.5									
11+50	12+00	4.5									
12+00	12+50	4.2									
12+50	13+00	3.8									
13+00	13+50	3.0									
13+50	14+00	3.1									
14+00	14+50	3.0									
14+50	15+00	3.1									
15+00	15+50	2.8									
15+50	16+00	2.9									
16+00	16+50	2.8									
16+50	17+00	2.5									
17+00	17+24	1.8									

17337.00 Portland - Baxter Blvd (Right Shoulder)
Estimated Pavement Thickness
Ground Penetrating Radar (GPR)

Explanation of Ground Penetrating Radar (GPR) Data Collection and Analysis:
For Project 17337.00 (Portland), GPR data was collected in the right and left wheel path of the two primary travel lanes, the right paved shoulder, the left paved shoulder and the left bike lane. Data was collected at 1 foot intervals along the entire section. Pavement thickness estimates were developed using Geophysical Survey Systems Inc. (GSSI) RADAN GPR Data Processing Software. Where available, pavement thicknesses from pavement cores collected by MaineDOT personnel were used in developing the estimated GPR pavement thicknesses.

GPR pavement thickness averages are to be considered for estimating purposes only.
Actual pavement thickness may vary.

Analysis Distance (ft) - 50

17337.00 Portland - Baxter Blvd (Right Shoulder)

Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)	Station Limits		Average Depth (in)
10+00	10+50	2.4									
10+50	11+00	2.3									
11+00	11+50	2.1									
11+50	12+00	3.3									
12+00	12+50	3.1									
12+50	13+00	3.2									
13+00	13+50	1.7									
13+50	14+00	2.1									
14+00	14+50	1.9									
14+50	15+00	2.2									
15+00	15+50	2.0									
15+50	16+00	1.8									
16+00	16+50	1.6									
16+50	17+00	1.8									
17+00	17+24	1.7									