



December 1, 2017

File No.: SH-13421-SA

Mr. Miguel Sanchez
San Benito County RMA
Public Works Division
2301 Technology Parkway
Hollister, CA 95023

PROJECT: LOVERS LANE FULL DEPTH RECLAMATION
HOLLISTER, SAN BENITO COUNTY, CALIFORNIA

SUBJECT: Geotechnical Engineering Report

Dear Mr. Sanchez:

This geotechnical engineering report was prepared for use in development of plans and specifications for the planned full depth reclamation of the section of Lovers Lane that was damaged by winter storm flooding in January 2017. We understand that full depth reclamation of the existing pavement and gravel that was placed over the roadway will be conducted using Portland cement (FDR-C), and that the roadway will be surfaced with asphalt concrete pavement.

Scope of Services

The scope of work for the geotechnical engineering investigation consisted of a general site reconnaissance, subsurface exploration, laboratory testing of soil samples, engineering evaluation of the data collected, and preparation of this report.

The report and recommendations are intended to be in accordance with common geotechnical engineering practice in this area at this time under similar conditions. The tests were performed in general conformance with the standards noted, as modified by common geotechnical practice in this area at this time under similar conditions.

Evaluation of the site geology, and analyses of the soil for permeability rates, mold or other microbial content, corrosion potential, asbestos, lead, radioisotopes, hydrocarbons, or other chemical properties are beyond the scope of this report. This report does not address issues in the domain of contractors such as, but not limited to, site safety, loss of volume due to stripping of the site, shrinkage of soils during compaction, excavatability, shoring, temporary slope angles,



and construction means and methods. Ancillary features such as LID/BMP improvements, temporary access roads, fences, light poles, signage, and nonstructural fills are not within our scope and are also not addressed.

To verify that pertinent issues have been addressed and to aid in conformance with the intent of this report, it is requested that the improvement plans be submitted to this office for review as they near completion. In the event that there are any changes in the nature, design, or locations of improvements, or if any assumptions used in the preparation of this report prove to be incorrect, the conclusions and recommendations contained herein shall not be considered valid unless the changes are reviewed and the conclusions of this report are verified or modified in writing by the geotechnical engineer. The criteria presented in this report are considered preliminary until such time as they are verified or modified in writing by the geotechnical engineer in the field during construction.

Site Setting

The storm-damaged section of Lovers Lane extends through residential parcels on the west, and farm land to the east. The effected section of roadway is partially covered with gravel, with some of the original pavement exposed. Topographically, the site is essentially flat.

Subsurface Investigation and Laboratory Testing

The subsurface exploration consisted of six borings drilled at the site on October 5, 2017. The borings were drilled using a truck-mounted Mobile Drill rig, Model B-24, equipped with a 6-inch diameter, continuous-flight, hollow-stem auger. The approximate boring locations are indicated on the attached Boring Location Map.

Soils encountered in the borings were classified and logged in general accordance with the Unified Soil Classification System (ASTM D 2488-17). Copies of the boring logs are attached. As the borings were drilled, bulk soil samples were obtained from the auger cuttings.

The sampled materials were combined and tested for grain size distribution (ASTM D 422-63/07 and D 1140-17), maximum dry density/optimum moisture content (ASTM D 1557-12, modified), and unconfined compressive strength (ASTM D 1633A-00). The unconfined compressive strength samples were mixed with 3, 4, and 5 percent Portland cement, and were sealed and cured in an



oven at 100 degrees for 7 days in accordance with the Caltrans document *Full Depth Reclamation Using Cement* (April 2013). Two R-value tests (ASTM D 2844/D 2844M) were conducted on samples of the non-treated native soils. Copies of the laboratory test results are attached.

General Subsurface Profile

The existing surface materials at the boring locations were quite variable, ranging from approximately 2 inches of asphalt concrete over 4 inches of aggregate base, to 6 inches of gravel over 36 inches of aggregate base. The underlying soils were classified as stiff to very stiff lean clays (CL) that contained varying percentages of sand. Groundwater was encountered at depths from 3 to 5 feet in some of the borings. The soils above the groundwater were very moist at the time of drilling.

Recommendations

FDR-C Pavement Sections

The following pavement sections were based on the lower of the measured R-values of 6 and 8 for the subgrade soil, and an unconfined compressive strength of 400 psi for an aggregate/soil mixture combined with 4% Portland cement. The tested unconfined strengths were reduced by the factor of safety recommended in the Caltrans document *Full Depth Reclamation Using Cement*. The sections were designed in accordance with the Caltrans Highway Design Method for assumed Traffic Indices (TIs) of 5.0 through 8.0. Determination of the appropriate TI for each area to be paved is the province of the design engineer and the jurisdiction. The FDR-C and AC thicknesses are for compacted material. Normal Caltrans construction tolerances should apply.

R-value	Traffic Index	AC Thickness	FDR-C Depth (4%)
6	5.0	2.5"	9"
6	5.5	2.5"	10"
6	6.0	3.0"	11"
6	6.5	3.0"	12"
6	7.0	3.5"	13"
6	7.5	4.0"	15"
6	8.0	4.0"	16"



1. The FDR-C material should be pulverized, mixed, and compacted to a minimum 95 percent of maximum dry density in accordance with the Caltrans document *Full Depth Reclamation Using Cement*. The FDR-C operations should be observed and tested by the geotechnical engineer.
2. To provide stability for curbs, they should be set back a minimum of 3 feet from the tops of slopes. Foundations may be provided to increase curb stability, particularly atop slopes.
3. To reduce migration of surface drainage into the subgrade, maintenance of the paved areas is critical. Any cracks that develop in the AC should be promptly sealed.

Site Drainage and Finish Improvements

1. Unpaved ground surfaces should be finish graded to direct surface runoff away from site improvements at a minimum 5 percent grade for a minimum distance of 10 feet. The site should be similarly sloped to drain away from improvements during construction. If this is not practicable due to the terrain, property lines, or other site features, swales with improved surfaces or other drainage facilities should be provided to divert runoff from those areas.
2. Runoff should discharge in a non-erosive manner away from pavement, slopes, and other improvements in accordance with the requirements of the governing jurisdictions.
3. Stabilization of surface soils, particularly those disturbed during construction, is essential to protect the site from erosion damage. Care should be taken to establish and maintain vegetation.

Closure

This report is valid for conditions as they exist at this time for the type of project described herein. Our intent was to perform the investigation in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing in the locality of this project under similar conditions. No representation, warranty, or guarantee is either expressed or implied. This report is intended for the exclusive use by the client for the subject project. Application beyond the stated intent is strictly at the user's risk.



If changes with respect to the project type or location become necessary, if items not addressed in this report are incorporated into plans, or if any of the assumptions stated in this report are not correct, Earth Systems Pacific should be notified for modifications to this report. Any items not specifically addressed in this report should comply with the California Building Code and the requirements of the governing jurisdiction.

The preliminary recommendations of this report are based upon the geotechnical conditions encountered during the investigation, and may be augmented by additional requirements of the architect/engineer, or by additional recommendations provided by the geotechnical engineer based on conditions exposed at the time of construction.

If Earth Systems Pacific is not retained to provide construction observation and testing services, it shall not be responsible for the interpretation of the information by others or any consequences arising there from.

This document, the data, conclusions, and recommendations contained herein are the property of Earth Systems Pacific. This report shall be used in its entirety, with no individual sections reproduced or used out of context. Copies may be made only by Earth Systems Pacific, the client, and his authorized agents for use exclusively on the subject project. Any other use is subject to federal copyright laws and the written approval of Earth Systems Pacific.

Thank you for this opportunity to have been of service. Please do not hesitate to contact this office if you have any questions or desire additional information.

Sincerely,

Earth Systems Pacific

George J. Barnett
Geotechnical Engineer



Attachments: Boring Location Map
Boring Logs
Laboratory Test Results

Doc. No: 1712-002.SER/ev



 B-6 Approximate boring location

Base: Google Earth (2017)



Earth Systems Pacific

Lovers Lane Full Depth Reclamation
Lovers Lane
Hollister, California

Boring Location Map

SH-13421-SA



Earth Systems Pacific

Boring No. 1

LOGGED BY: P. Penrose

PAGE 1 OF 1

DRILL RIG: Mobile B-24

JOB NO.: SH-13421-SA

AUGER TYPE: 6" Hollow Stem

DATE: 10/5/17

DEPTH (feet)	USCS CLASS	SYMBOL	Lovers Lane Full Depth Reclamation Lovers Lane Hollister, California	SAMPLE DATA						
			SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE NUMBER	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.	POCKET PEN (t.s.f)
0			2" AC, 4" AB							
-1	CL		LEAN CLAY with SAND; gray brown, very moist, stiff	0.0-1.5	Bag A	○				
-2										
-3										
-4										
-5										
-6			Bottom of boring at 5.0'							
-7			Groundwater not encountered							
-8										
-9										
-10										
-11										
-12										
-13										
-14										
-15										
-16										
-17										
-18										
-19										
-20										
-21										
-22										
-23										
-24										
-25										
-26										

LEGEND: 2.5" Mod Cal Sample Bulk Sample 2.0" Mod Cal Sample SPT Groundwater

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Earth Systems Pacific

Boring No. 2

LOGGED BY: P. Penrose

PAGE 1 OF 1

DRILL RIG: Mobile B-24

JOB NO.: SH-13421-SA

AUGER TYPE: 6" Hollow Stem

DATE: 10/5/17

DEPTH (feet)	USCS CLASS	SYMBOL	Lovers Lane Full Depth Reclamation Lovers Lane Hollister, California	SAMPLE DATA						
			SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE NUMBER	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.	POCKET PEN (t.s.f)
0			2" AC, 8" AB	0.0-1.5	Bag C	○				
1	CL		LEAN CLAY with SAND; gray brown, very moist, stiff	1.5-5.0	Bag D	○				
2										
3										
4										
5			-wet							
6			Bottom of boring at 5.0' Groundwater encountered at 5.0'							
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
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21										
22										
23										
24										
25										
26										

LEGEND: ■ 2.5" Mod Cal Sample ○ Bulk Sample □ 2.0" Mod Cal Sample ● SPT ▼ Groundwater

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Earth Systems Pacific

Boring No. 3

LOGGED BY: P. Penrose

PAGE 1 OF 1

DRILL RIG: Mobile B-24

JOB NO.: SH-13421-SA

AUGER TYPE: 6" Hollow Stem

DATE: 10/5/17

DEPTH (feet)	USCS CLASS	SYMBOL	Lovers Lane Full Depth Reclamation Lovers Lane Hollister, California	SAMPLE DATA							
			SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE NUMBER	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.	POCKET PEN (t s f)	
0			2" AC, 18" AB		0.0-1.5	Bag E	○				
1											
2	CL		SANDY LEAN CLAY; brown, very moist, stiff		1.5-5.0	Bag F	○				
3											
4			-wet								
5											
6			Bottom of boring at 5.0' Groundwater encountered at 4.0'								
7											
8											
9											
10											
11											
12											
13											
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22											
23											
24											
25											
26											

LEGEND: ■ 2.5" Mod Cal Sample ○ Bulk Sample □ 2.0" Mod Cal Sample ● SPT ▼ Groundwater

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Earth Systems Pacific

Boring No. 4

LOGGED BY: P. Penrose

PAGE 1 OF 1

DRILL RIG: Mobile B-24

JOB NO.: SH-13421-SA

AUGER TYPE: 6" Hollow Stem

DATE: 10/5/17

DEPTH (feet)	USCS CLASS	SYMBOL	Lovers Lane Full Depth Reclamation Lovers Lane Hollister, California	SAMPLE DATA							
			SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE NUMBER	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.	POCKET PEN (t s f)	
0			6" Gravel, 36" AB?		0.0-1.5	Bag G	☐				
1											
2					1.5-5.0	Bag H	☐				
3											
4	CL		SANDY LEAN CLAY; gray, moist, stiff								
5											
6			Bottom of boring at 5.0'								
7			Groundwater not encountered								
8											
9											
10											
11											
12											
13											
14											
15											
16											
17											
18											
19											
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22											
23											
24											
25											
26											

LEGEND: ■ 2.5" Mod Cal Sample ○ Bulk Sample □ 2.0" Mod Cal Sample ● SPT ▼ Groundwater

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Earth Systems Pacific

Boring No. 5

LOGGED BY: P. Penrose

PAGE 1 OF 1

DRILL RIG: Mobile B-24

JOB NO.: SH-13421-SA

AUGER TYPE: 6" Hollow Stem

DATE: 10/5/17

DEPTH (feet)	USCS CLASS	SYMBOL	Lovers Lane Full Depth Reclamation Lovers Lane Hollister, California	SAMPLE DATA						
			SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE NUMBER	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.	POCKET PEN (t.s.f)
0			2" Gravel, 24" AB?	0.0-1.5	Bag I	○				
1										
2				1.5-5.0	Bag J	○				
3	CL		SANDY LEAN CLAY; brown, very moist, stiff							
4										
5										
6			Bottom of boring at 5.0'							
7			Groundwater not encountered							
8										
9										
10										
11										
12										
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14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										

LEGEND: ■ 2.5" Mod Cal Sample ○ Bulk Sample □ 2.0" Mod Cal Sample ● SPT ▼ Groundwater

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Earth Systems Pacific

Boring No. 6

LOGGED BY: P. Penrose

PAGE 1 OF 1

DRILL RIG: Mobile B-24

JOB NO.: SH-13421-SA

AUGER TYPE: 6" Hollow Stem

DATE: 10/5/17

DEPTH (feet)	USCS CLASS	SYMBOL	Lovers Lane Full Depth Reclamation Lovers Lane Hollister, California	SAMPLE DATA						
			SOIL DESCRIPTION	INTERVAL (feet)	SAMPLE NUMBER	SAMPLE TYPE	DRY DENSITY (pcf)	MOISTURE (%)	BLOWS PER 6 IN.	POCKET PEN (t.s.f)
0			2" Gravel, 10" AB	0.0-1.5	Bag K	○				
1	CL		SANDY LEAN CLAY; brown, very moist, stiff	1.5-5.0	Bag L	○				
2										
3			-wet							
4										
5			Bottom of boring at 5.0'							
6			Groundwater encountered at 3.0'							
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										
24										
25										
26										

LEGEND: 2.5" Mod Cal Sample Bulk Sample 2.0" Mod Cal Sample SPT Groundwater

NOTE: This log of subsurface conditions is a simplification of actual conditions encountered. It applies at the location and time of drilling. Subsurface conditions may differ at other locations and times.



Lovers Lane
Full Depth Reclamation

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COMPRESSIVE STRENGTH of CEMENT TREATED SOIL ASTM D 1633A-00(mod)

November 16, 2017

CEMENT LEVEL, %	MOISTURE CONTENT, %	WET DENSITY, pcf	DRY DENSITY, pcf	MAX LOAD, lbs	COMPRESSIVE STRENGTH, psi
3	7.9	137.5	127.4	4,560	365
3	7.9	137.6	127.6	4,400	350
3	7.9	137.8	127.7	4,100	325
4	7.9	137.6	127.5	5,750	460
4	7.9	137.7	127.7	5,610	445
4	7.9	137.7	127.6	5,670	450
5	8.9	139.0	127.6	7,500	595
5	8.9	138.9	127.6	7,620	605
5	8.9	139.0	127.7	6,890	550



Lovers Lane
Full Depth Reclamation

SH-13421-SA

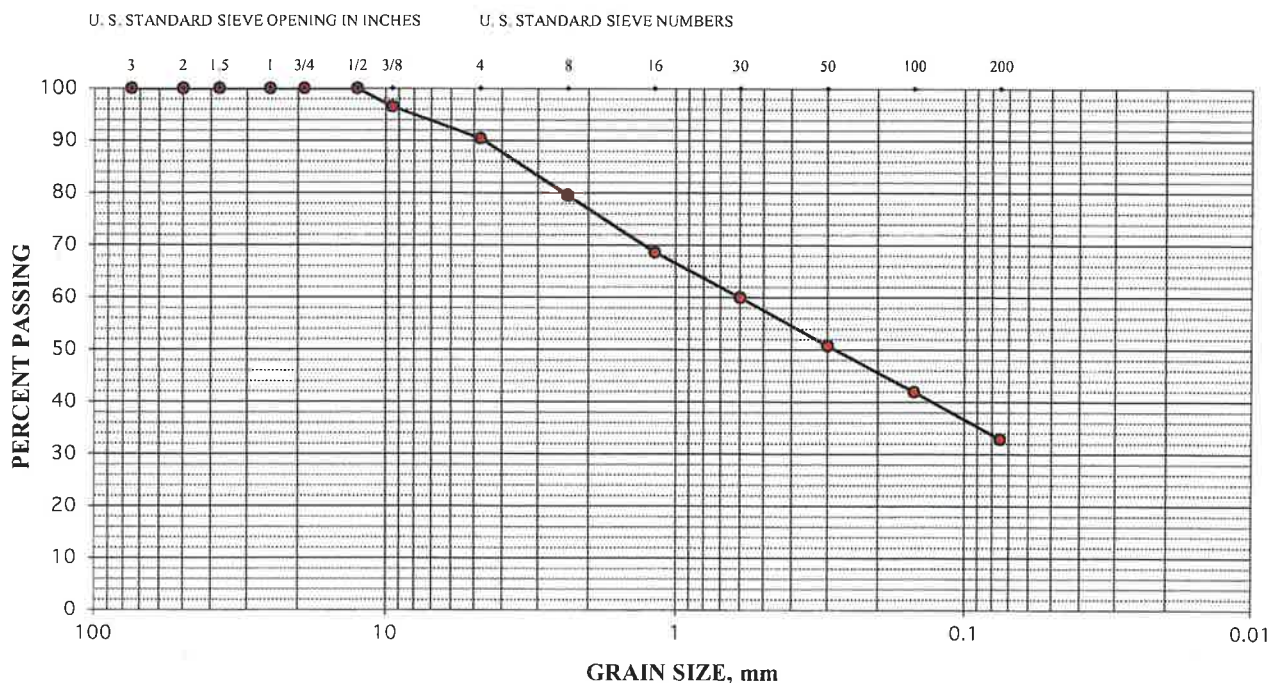
PARTICLE SIZE ANALYSIS

ASTM D 422-63/07; D 1140-17

Bulk Bag Blend @ 3% Cement
Brown Clayey Sand with Gravel (SC)

November 20th, 2017

Sieve size	% Retained	% Passing
3" (75-mm)	0	100
2" (50-mm)	0	100
1.5" (37.5-mm)	0	100
1" (25-mm)	0	100
3/4" (19-mm)	0	100
1/2" (12.5-mm)	0	100
3/8" (9.5-mm)	3	97
#4 (4.75-mm)	10	90
#8 (2.36-mm)	21	79
#16 (1.18-mm)	31	69
#30 (600-μm)	40	60
#50 (300-μm)	49	51
#100 (150-μm)	58	42
#200 (75-μm)	67	33





Lovers Lane
Full Depth Reclamation

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MOISTURE-DENSITY COMPACTION TEST

ASTM D 1557-12 (Modified)

PROCEDURE USED: B

November 6, 2017

PREPARATION METHOD: Moist

3% Cement Treated Bulk Bag Blend

RAMMER TYPE: Mechanical

Brown Clayey Sand with Gravel (SC)

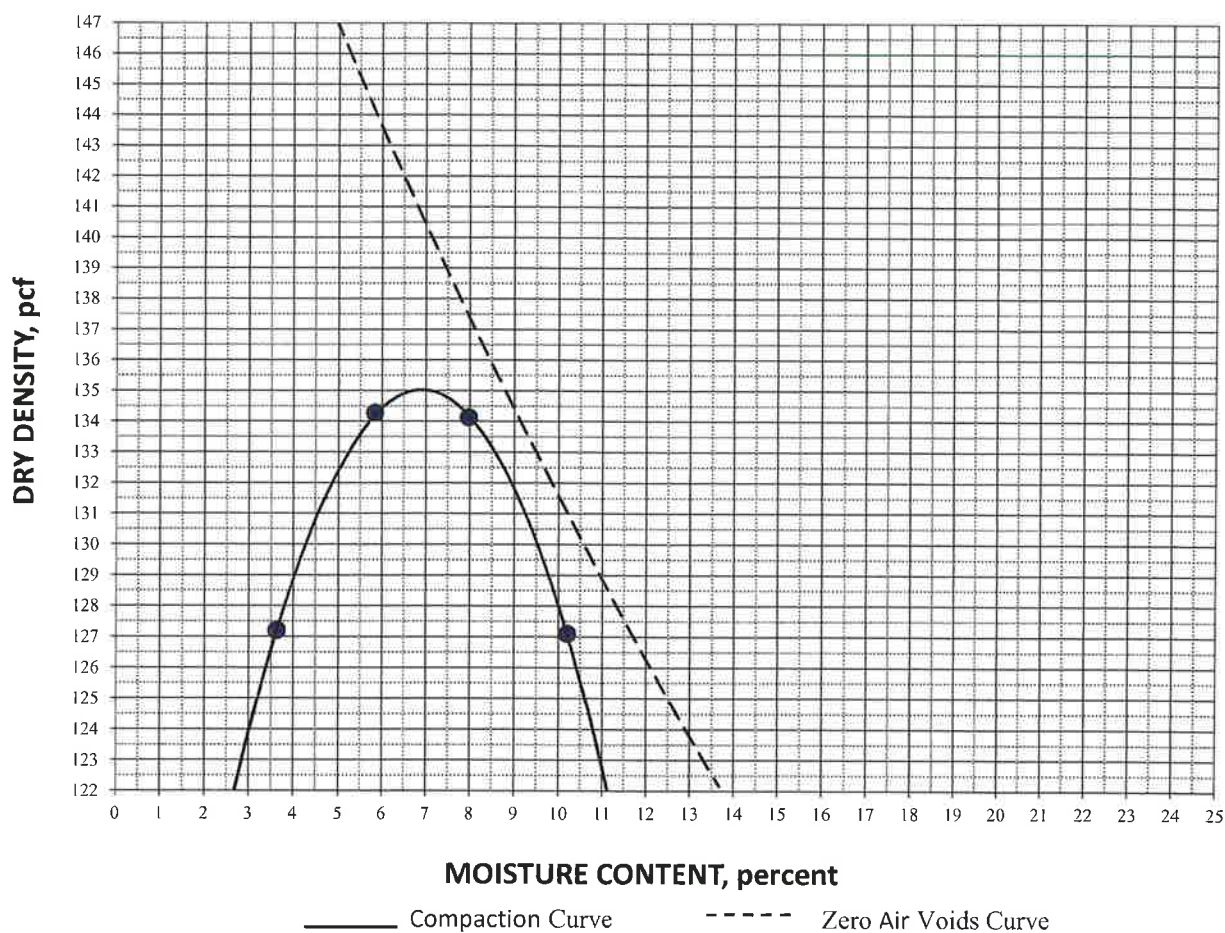
SPECIFIC GRAVITY: 2.67 (assumed)

SIEVE DATA:

Sieve Size	% Retained
3/4"	0
3/8"	3
#4	0

MAXIMUM DRY DENSITY: 135.0 pcf

OPTIMUM MOISTURE: 6.9%





Lovers Lane
Full Depth Reclamation

SH-13421-SA

RESISTANCE 'R' VALUE AND EXPANSION PRESSURE

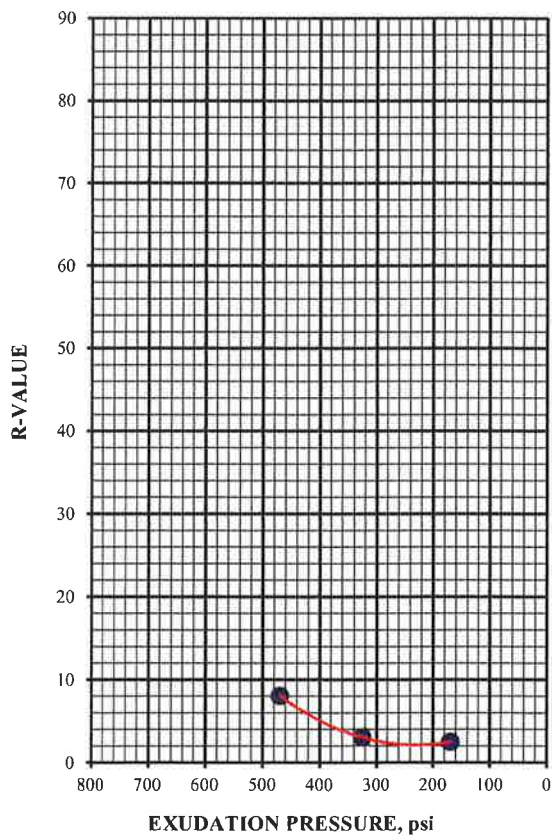
ASTM D 2844/D2844M-13

November 13, 2017

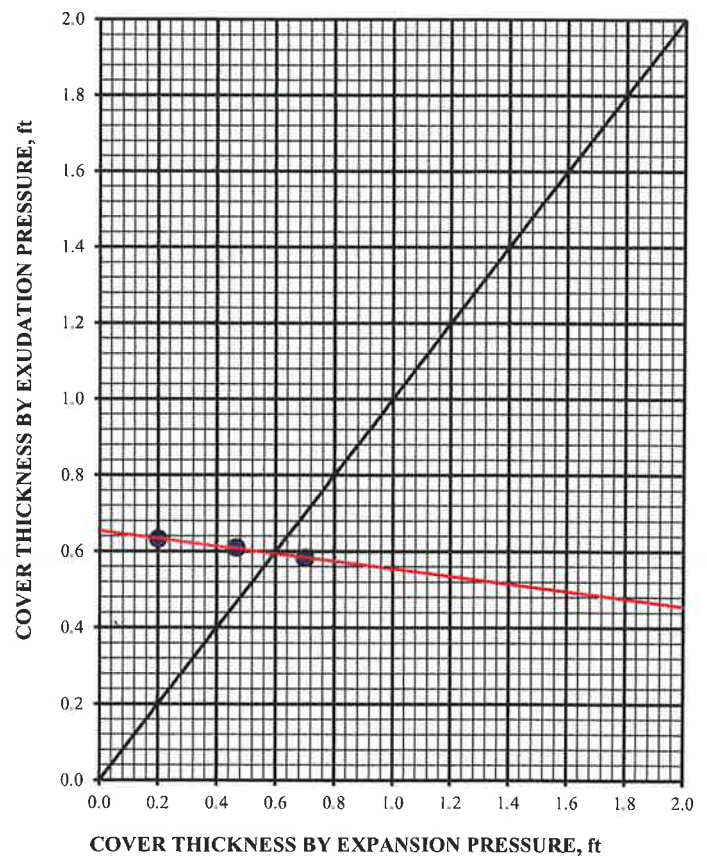
Boring #1; Bag B
Gray Brown Lean Clay with Sand (CL)
Specified Traffic Index: 5.0

Dry Density @ 300 psi Exudation Pressure: 108.4-pcf
%Moisture @ 300 psi Exudation Pressure: 18.7%
R-Value - Exudation Pressure: 3
R-Value - Expansion Pressure: 6
R-Value @ Equilibrium: 6

**EXUDATION PRESSURE
CHART**



EXPANSION PRESSURE CHART





Lovers Lane
Full Depth Reclamation

SH-13421-SA

RESISTANCE 'R' VALUE AND EXPANSION PRESSURE

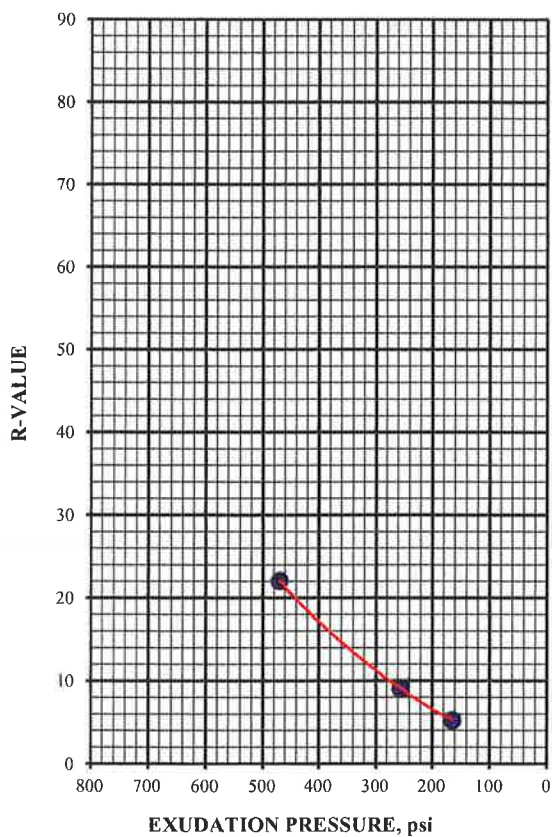
ASTM D 2844/D2844M-13

November 13, 2017

Boring #3; Bag F
Brown Sandy Lean Clay (CL)
Specified Traffic Index: 5.0

Dry Density @ 300 psi Exudation Pressure: 122.5-pcf
%Moisture @ 300 psi Exudation Pressure: 13.7%
R-Value - Exudation Pressure: 11
R-Value - Expansion Pressure: 8
R-Value @ Equilibrium: 8

**EXUDATION PRESSURE
CHART**



EXPANSION PRESSURE CHART

