APPROVED

By: RCR Date: 5-16-16

City of Fort Collins
City of Fort Collins
Engineering Department

SOILOGIC

May 5, 2016

Hall Irwin Corporation
301 Centennial Drive
Milliken, Colorado 80543

Attn: Mr. Andy Laycock

Re: Geotechnical Subsurface Exploration and Pavement Section Design
Mail Creek Phase 2 - Pavements
Fort Collins, Colorado
Soilogic Project # 16-2016P

Mr. Laycock:

Soilogic, Inc. (Soilogic) personnel have completed the geotechnical subsurface exploration and pavement section design you requested for the Mail Creek Phase 2 interior roadways in Fort Collins, Colorado. April 28, 2015

Soilogic, Inc. (Soilogic) personnel have completed the geotechnical subsurface exploration and pavement section design you requested for the on-site roadways to be constructed as part of the Mail Creek Phase 2 development in Fort Collins, Colorado. The results of our subsurface exploration and pertinent geotechnical engineering recommendations are included with this report. Structural pavement section designs are also included.

The purpose of our exploration was to describe the subsurface conditions encountered in the completed site borings and develop the test data necessary to provide recommendations concerning development of the roadway subgrade soils and pavement section design options for the interior site roadways. The conclusions and recommendations outlined in this report are based on results of the completed field and laboratory testing and our experience with subsurface conditions in this area.

Phase 2 of the Mail Creek development is located northeast of the intersection of Tilden Street and Zephyr Road in Fort Collins, Colorado. At the time of our site exploration, the water and sewer utilities had been installed and the roadways developed to approximate finish grade. In general, the site was relatively level with a gentle overall slope

downward to the south and a maximum difference in ground surface elevation across the site estimated to be less than five (5) feet.

FIELD EXPLORATION

To develop subsurface information for use in the pavement design, five (5) test areas were evaluated. One (1) boring was advanced over the utility trench area to a depth of approximately five (5) feet below roadway subgrade level and one (1) boring advanced outside the utility trench area to a depth of approximately 10 feet. The test areas were established at approximate 500 foot intervals along the roadway alignments in accordance with the Larimer County Urban Area Street Standards (LCUASS). The boring locations were established in the field by Soilogic personnel by pacing and estimating angles and distances from identifiable site references. The boring locations should be considered accurate only to the degree implied by the methods used to make the field measurements. A diagram indicating the approximate boring locations is included with this report. A graphic log of each of the auger borings is also included.

The test holes were advanced using 4-inch diameter continuous-flight auger powered by a truck-mounted Diedrich D50 drill rig. Samples of the subsurface materials were obtained at regular intervals using California barrel sampling procedures in general accordance with ASTM specification D-1586. As part of the D-1586 sampling procedure, standard sampling barrels are driven into the substrata using a 140-pound hammer falling a distance of 30 inches. The number of blows required to advance the samplers a distance of 12 inches is recorded and helpful in estimating the consistency or relative density of the soils encountered. In the California barrel sampling procedure, lesser disturbed samples are obtained in removable brass liners. Samples of the subsurface materials obtained in the field were sealed and returned to the laboratory for further evaluation, classification and testing.

LABORATORY TESTING

The samples collected were tested in the laboratory to measure natural moisture content and visually and/or manually classified in accordance with the Unified Soil Classification

System (USCS). The USCS group symbols are indicated on the attached boring logs. An outline of the USCS classification system is included with this report.

As part of the laboratory testing, a calibrated hand penetrometer (CHP) was used to estimate the unconfined compressive strength of essentially cohesive specimens. The CHP also provides a more reliable estimate of soil consistency than tactual observation alone. Dry density, Atterberg limits, -200 wash and swell/consolidation tests were completed on selected samples to help establish specific soil characteristics. Atterberg limits tests are used to determine soil plasticity. The percent passing the #200 size sieve (-200 wash test) is used to determine the percentage of fine grained materials (clay and silt) in a sample. Swell/consolidation tests are performed to evaluate soil volume change potential with variation in moisture content. Swell/consolidation tests completed on samples obtained at a depth of approximately 2 feet below ground surface were inundated with water at a 150 psf confining pressure while samples obtained at a depth of approximately 4 feet below ground surface were inundated at a 500 psf confining pressure. The results of the completed laboratory tests are outlined on the attached boring logs and swell/consolidation summary sheets.

SUBSURFACE CONDITIONS

The subsurface materials encountered in the completed site borings can be summarized as follows. Light to dark brown/grey/olive/rust lean clay with varying amounts of silt and sand were encountered at the surface at the boring locations. A portion of the near-surface lean clay appeared to be overlot fill and/or utility backfill and contained varying amounts of bedrock fragments and scattered gravel. We understand the site fill and utility backfill soils were tested for moisture and density at the time of placement and compaction by Earth Engineering Consultants Inc. (EEC) personnel and results of the completed moisture/density tests met project requirements. The lean clay varied from medium stiff to very stiff in terms of consistency, exhibited no to low swell potential when inundated with water at in-situ moisture and density conditions and extended to the bottom of all borings at depths ranging from approximately 5 to 10 feet below present site grades.

The stratigraphy indicated on the included boring logs represents the approximate location of changes in soil types. Actual changes may be more gradual than those indicated.

Groundwater was not encountered in any of the completed site borings at the time of drilling. Groundwater levels will vary seasonally and over time based on weather conditions, site development, irrigation practices and other hydrologic conditions. Perched and/or trapped groundwater conditions may also be encountered at times throughout the year. Perched water is commonly encountered in soils overlying less permeable soil layers and/or bedrock. Trapped water is typically encountered within more permeable zones of layered soil and bedrock systems. The location and amount of perched and/or trapped water can also vary over time.

ANALYSIS AND RECOMMENDATIONS

Roadway Subgrade Development

The lean clay subgrade soils encountered in the completed site borings exhibited low swell potential at in-situ moisture and density conditions, and in our opinion, could be used for support of the roadway pavements. At this time, we understand the subgrade soils with be stabilized with class C fly ash prior to surfacing. For fly ash stabilization, we recommend the addition of 12% class 'C' fly ash based on component dry unit weights. A 12-inch thick stabilized zone should be constructed by thoroughly blending the fly ash with the in-place subgrade soils. Some "fluffing" of the finish subgrade level should be expected with the stabilization procedures. The blended materials should be adjusted to within ±2% of standard Proctor optimum moisture content and compacted to at least 95% of the material's standard Proctor maximum dry density within two (2) hours of fly ash addition. Care should be taken to avoid disturbing the developed subgrade soils prior to paving.

Proof-rolling of the roadway subgrade soils should be completed prior to paving to help identify any areas of soft/unstable soils. Those areas identified as unstable would need to be mended prior to paving.

Pavement Design

Site pavement could be supported directly on the fly ash treated and stable subgrade soils developed as outlined above. The site lean clay soils would be subject to low remolded strength. An R-value of 10 was determined for the subgrade soils in Phase 1 by EEC personnel. Similar subgrade soils were encountered in Phase 2, such that it is our opinion an R-value of 10 and corresponding resilient modulus value of 3562 could be used in design of the Phase 2 pavements. Equivalent 18-kip single axle loads (ESAL's) were provided by the City of Fort Collins Engineering Department. Serviceability loss and reliability were obtained from current LCUASS design criteria for local residential and minor collector roadways. Alternative pavement section designs could be considered and we would be happy to discuss any design alternatives at your request.

TABLE 1 – PAVEMENT SECTION DESIGN

Roadways	Sand Creek, Owl Creek and Yellow Creek Drives	Spruce Creek Drive
Classification	Local Residential	Minor Collector
ESAL's	73,000	146,000
Reliability	75%	75
% Loss	2.5%	2.2%
Resilient Modulus (Mr)	3562	3562
Design Structural Number	(2.61)	(2.93)
Option A – Composite on Stabilized Subgrade		
Surface Asphalt (Grading S or SX)	*4" (0.44/inch)	*4" (0.44/inch)
Aggregate Base (Class 5 or 6)	*6" (0.11/inch)	*6" (0.11/inch)
Fly Ash Treated Subgrade	12" (.05/inch @ 10")	12" (.05/inch @ 10")
(Structural Number)	(2.92)	(2.92)

* Minimum Section Required by the City of Fort Collins

Asphaltic concrete should consist of a bituminous plant mix composed of a mixture of aggregate, filler, binders and additives if required meeting the design requirements of the City of Fort Collins (LCUASS). Aggregate used in the asphaltic concrete for local

residential roadways should meet specific gradation requirements for Colorado Department of Transportation (CDOT) grading S (3/4 inch minus) or SX (1/2 inch minus) mixes. We expect grading S mixes will be required for Spruce Creek Drive. Hot mix asphalt designed using "Superpave" criteria should be compacted to within 92 to 96% of the materials Maximum Theoretical Density. Aggregate base should be consistent with CDOT requirements for Class 5 or 6 aggregate base, placed in loose lifts not to exceed 9 inches thick and compacted to at least 95% of the materials standard Proctor maximum dry density.

The proposed pavement section design does not include an allowance for excessive loading conditions imposed by heavy construction vehicles or equipment. The recommended pavement sections are minimums and periodic maintenance efforts should be expected. A preventative maintenance program can help increase the service life of the roadway pavement.

Drainage

Positive drainage is imperative for long term performance of the roadway pavements. Water which is allowed to pond adjacent to site pavements can result in a loss of subgrade support and premature failure of the overlying pavement section.

LIMITATIONS

This report was prepared based upon the data obtained from the completed site exploration, laboratory testing, engineering analysis and any other information discussed. The completed borings provide an indication of subsurface conditions at the boring locations only. Variations in subsurface conditions can occur in relatively short distances away from the borings. This report does not reflect any variations which may occur across the site or away from the borings. If variations in the subsurface conditions anticipated become evident, the geotechnical engineer should be notified immediately so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any biological or environmental assessment of the site or identification or

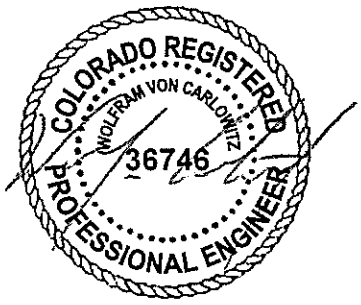
prevention of pollutants or hazardous materials or conditions. Other studies should be completed if concerns over the potential of such contamination or pollution exist.

The geotechnical engineer should be retained to review the plans and specifications so that comments can be made regarding the interpretation and implementation of our geotechnical recommendations in the design and specifications. The geotechnical engineer should also be retained to provide testing and observation services during construction to help determine that the design requirements are fulfilled.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with the generally accepted standard of care for the profession. No warranties express or implied, are made. The conclusions and recommendations contained in this report should not be considered valid in the event that any changes in the nature, design or location of the project as outlined in this report are planned, unless those changes are reviewed and the conclusions of this report modified and verified in writing by the geotechnical engineer.

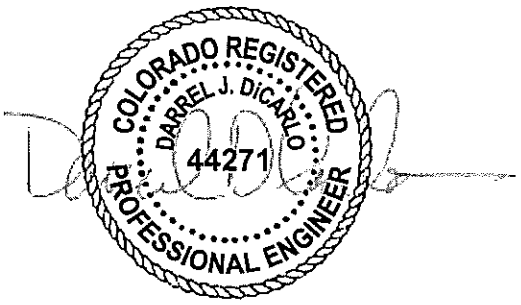
We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the enclosed information or if we can be of further assistance to you in any way, please do not hesitate to contact us.

Very Truly Yours,
Soilogic, Inc.



Wolf von Carlowitz, P.E.
Principal Engineer

Reviewed by:

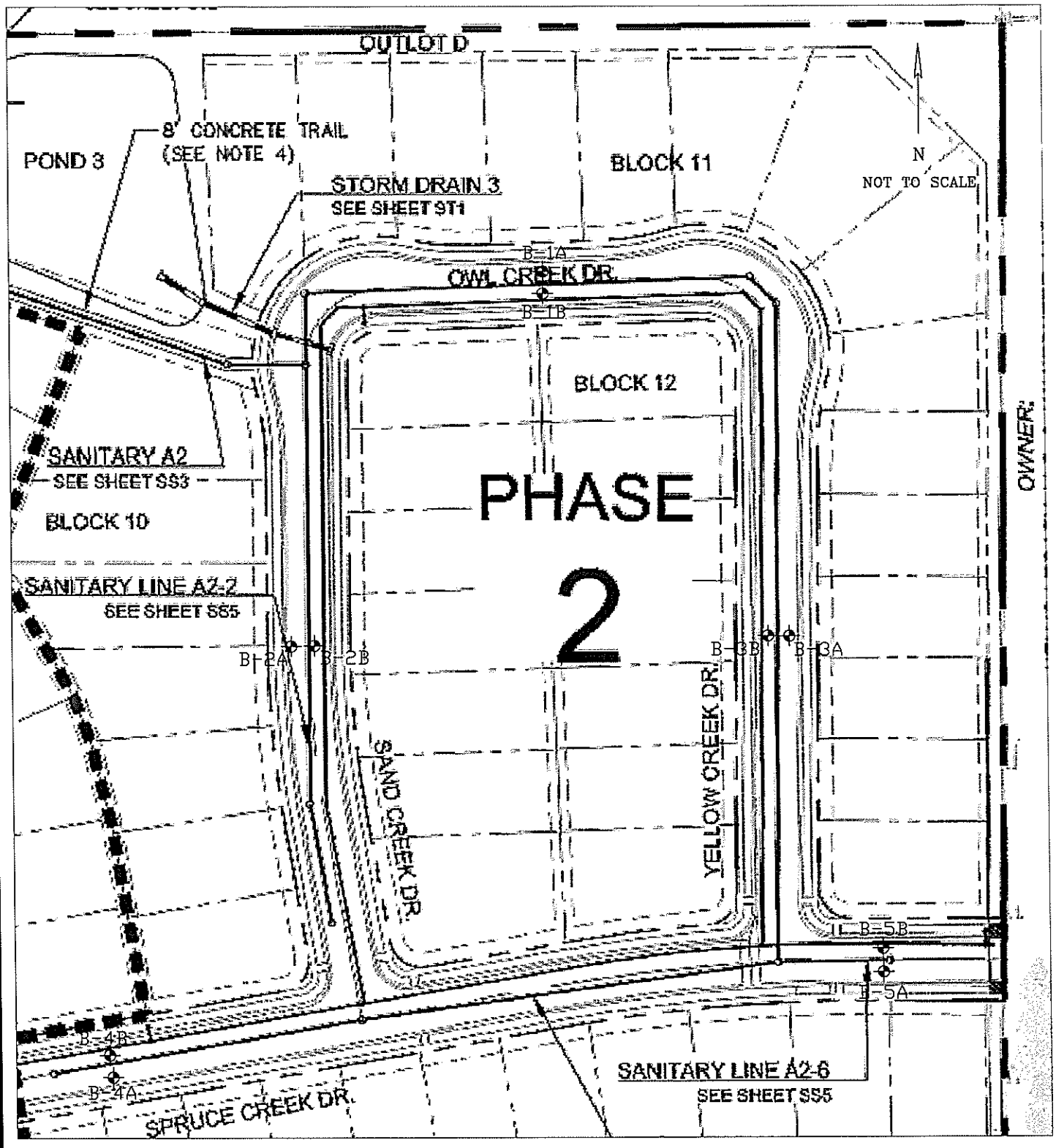


Darrel DiCarlo, P.E.
Senior Project Engineer

MAY 2016
PROJECT #16-2016P

BORING LOCATION DIAGRAM

SOLOGIC



MAIL CREEK PHASE 2 - PAVEMENTS
FORT COLLINS, COLORADO

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
Project # 16-2016P
May 2016

SOLOGIC

LOG OF BORING B-1A

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
CL	FILL - SANDY LEAN CLAY dark brown/rust very stiff	3	CS	23	18.4	108.8	9000+	0.6% @ 0.15k	700	-	-	-
		5	CS	19	17.6	111.8	8500	0.5% @ 0.5k	1100	37	21	81.7%
CL	SANDY LEAN CLAY light brown/rust stiff	10	CS	14	20.1	110.2	5000	-	-	-	-	-
	BOTTOM OF BORING @ 10.0'											

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
Project # 16-2016P
May 2016

LOG OF BORING B-1B

SOLOGIC

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
	0-4" VEGETATION AND TOPSOIL	-										
		1										
	FILL - SANDY LEAN CLAY	-										
	light to dark brown/rust	2										
	stiff to very stiff	-										
		3	CS	15	19.4	106.6	9000+	-	-	-	-	-
		-										
		4										
		-										
		5	CS	27	19.6	107.6	8000	1.3% @ 0.5k	1900	-	-	-
	BOTTOM OF BORING @ 5.0'	-										
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MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
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May 2016

LOG OF BORING B-2A

SOLOGIC

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
CL	SANDY LEAN CLAY rust/olive/brown medium stiff to stiff	3	CS	12	17.3	110.2	7000	0.8% @ 0.15k	700	-	-	-
		5	CS	13	19.7	102.4	7000	-	-	-	-	-
	Light Brown with Depth	10	CS	10	19.9	102.0	2500	-	-	-	-	-
	BOTTOM OF BORING @ 10.0'											

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
Project # 16-2016P
May 2016

LOG OF BORING B-2B

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
	0-4" VEGETATION AND TOPSOIL	-										
	FILL - SANDY LEAN CLAY brown/olive/rust/grey stiff to very stiff	1										
		-										
		2										
		-										
		3	CS	11	22.2	95.5	4000	-	-	-	-	-
		-										
		4										
		-										
		5	CS	19	24.8	98.0	9000+	0.6% @ 0.5k	1100	-	-	-
	BOTTOM OF BORING @ 5.0'	-										
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MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
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May 2016

LOG OF BORING B-3A

SOLOGIC

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
CL	SANDY LEAN CLAY brown/rust/olive stiff to very stiff	3	CS	21	17.9	106.8	9000+	1.1% @ 0.15k	1100	-	-	-
		5	CS	28	18.4	98.7	7000	None @ 0.5k	<500	35	16	70.1%
		10	CS	11	25.3	91.6	3000	-	-	-	-	-
	BOTTOM OF BORING @ 10.0'											

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
Project # 16-2016P
May 2016

LOG OF BORING B-3B

SOLOGIC

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
	0-4" VEGETATION AND TOPSOIL	-										
	FILL - SANDY LEAN CLAY light to dark brown/olive/rust stiff to very stiff	1 - 2 - 3	CS	14	18.7	109.8	9000+	-	-	-	-	-
		4 - 5	CS	25	17.6	103.5	7000	None @ 0.5k	<500	-	-	-
	BOTTOM OF BORING @ 5.0'	6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25										

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
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May 2016

LOG OF BORING B-4A

SOLOGIC

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
CL	SANDY LEAN CLAY light to dark brown/rust/olive stiff	3	CS	15	18.4	108.0	5000	None @ 0.15k	<150	-	-	-
	Scattered Gravel from 4 - 6 Feet	5	CS	12	19.3	102.5	4500	-	-	-	-	-
		10	CS	16	21.4	101.8	5000	-	-	-	-	-
	BOTTOM OF BORING @ 10.0'											

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
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May 2016

LOG OF BORING B-4B

SOILOGIC

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
	0-4" VEGETATION AND TOPSOIL	-										
	FILL - SANDY LEAN CLAY light to dark brown/olive/rust/grey stiff With Bedrock Fragments	1 - 2 - 3	CS	16	18.1	102.3	6500	0.2% @ 0.15k	700	-	-	-
		- 4 -										
		5	CS	15	16.5	98.4	6500	-	-	-	-	-
	BOTTOM OF BORING @ 5.0'	- 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25										

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
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May 2016

LOG OF BORING B-5A

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
CL	SANDY LEAN CLAY light brown/rust stiff to very stiff	3	CS	26	19.1	102.0	5500	0.2% @ 0.15k	900	-	-	-
		5	CS	15	20.9	103.8	6000	-	-	-	-	-
		10	CS	17	10.7	108.3	9000+	-	-	-	-	-
	BOTTOM OF BORING @ 10.0'											

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO
Project # 16-2016P
May 2016

LOG OF BORING B-5B

Sheet	1/1	Drilling Rig:	Diedrich D50	Water Depth Information	
Start Date	4/27/2016	Auger Type:	4" CFA	During Drilling	None
Finish Date	4/27/2016	Hammer Type:	Manual	After Drilling	None
Surface Elev.	-	Field Personnel:	BMc	7 Days After Drilling	-

USCS	SOIL DESCRIPTION	Depth (ft)	Sampler	"N"	MC (%)	DD (pcf)	Estimated q_u (psf)	% Swell @ 150&500 psf	Swell Pressure (psf)	Atterberg Limits LL	Atterberg Limits PI	% Passing # 200 Sieve (%)
	0-4" VEGETATION AND TOPSOIL	-										
	FILL - SANDY LEAN CLAY brown/rust stiff to very stiff	1 - 2 -										
		3	CS	14	16.3	109.4	9000	-	-	-	-	-
		- 4 -										
		5	CS	23	22.7	102.0	5000	None @ 0.5k	<500	-	-	-
	BOTTOM OF BORING @ 5.0'	- 6 - 7 - 8 - 9 - 10 - 11 - 12 - 13 - 14 - 15 - 16 - 17 - 18 - 19 - 20 - 21 - 22 - 23 - 24 - 25										

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

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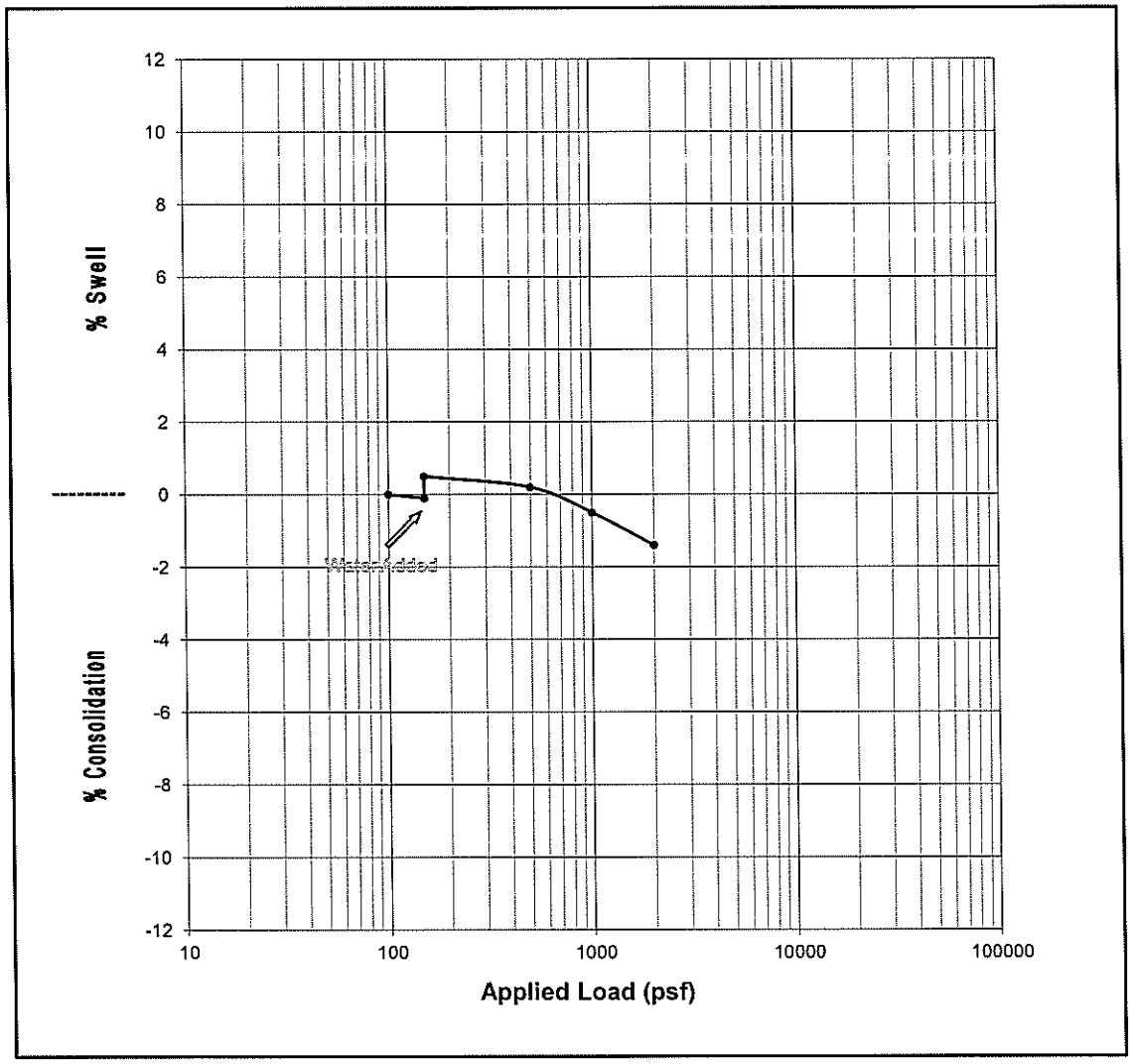
May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-1A @ 2'

Sample Description: Fill - Rust Brown to Dark Brown Sandy Lean Clay (CL)

Initial Moisture	18.4%	Liquid Limit	-
Final Moisture	20.5%	Plasticity Index	-
% Swell @ 150 psf	0.6%	% Passing #200	-
Swell Pressure	700 psf	Dry Density	108.8 pcf

SOILOGIC

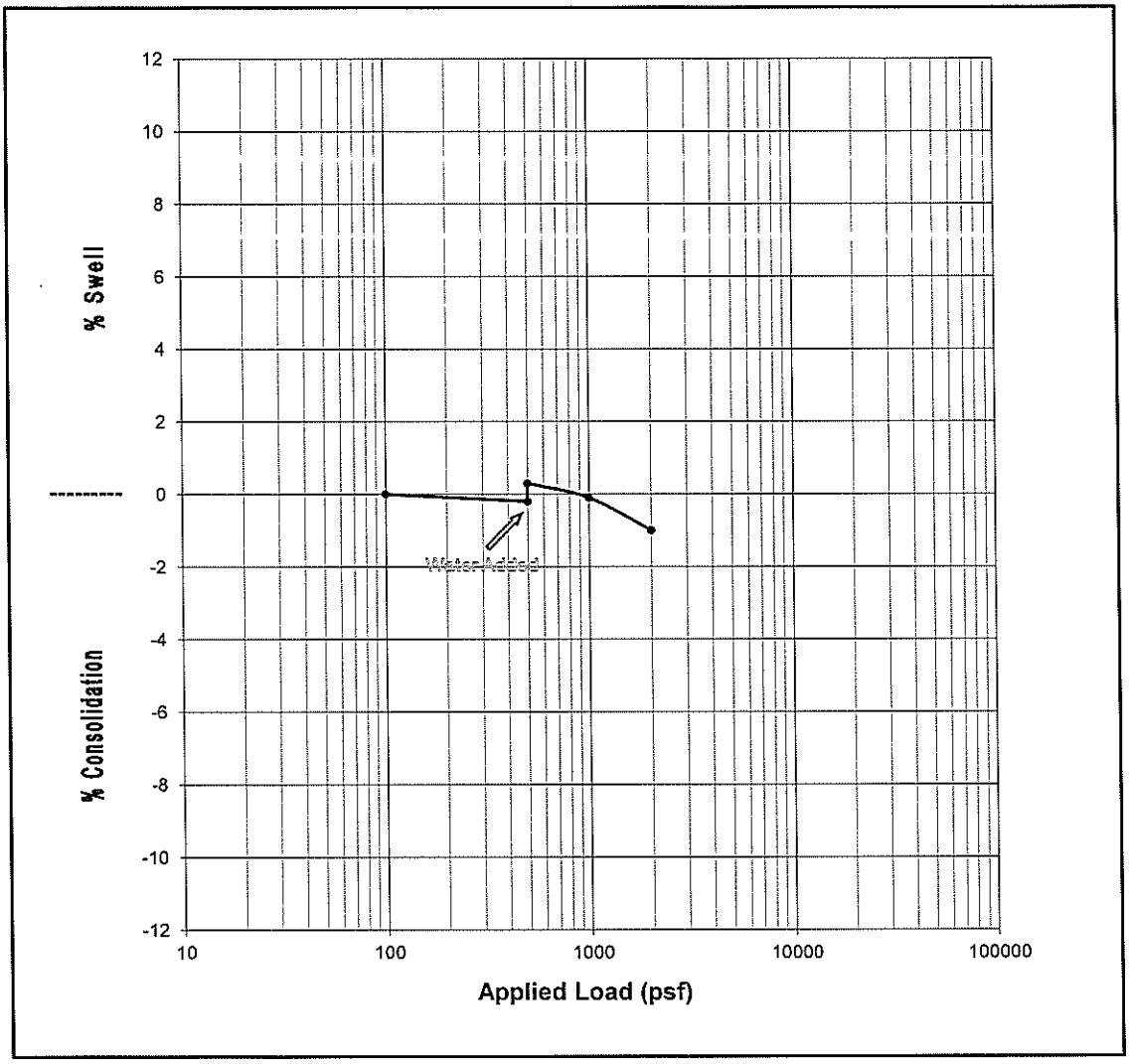
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-1A @ 4'

Sample Description: Fill - Rust Brown to Dark Brown Lean Clay with Sand (CL)

Initial Moisture	17.6%	Liquid Limit	37
Final Moisture	18.7%	Plasticity Index	21
% Swell @ 500 psf	0.5%	% Passing #200	81.7%
Swell Pressure	1100 psf	Dry Density	111.8 pcf

SOILOGIC

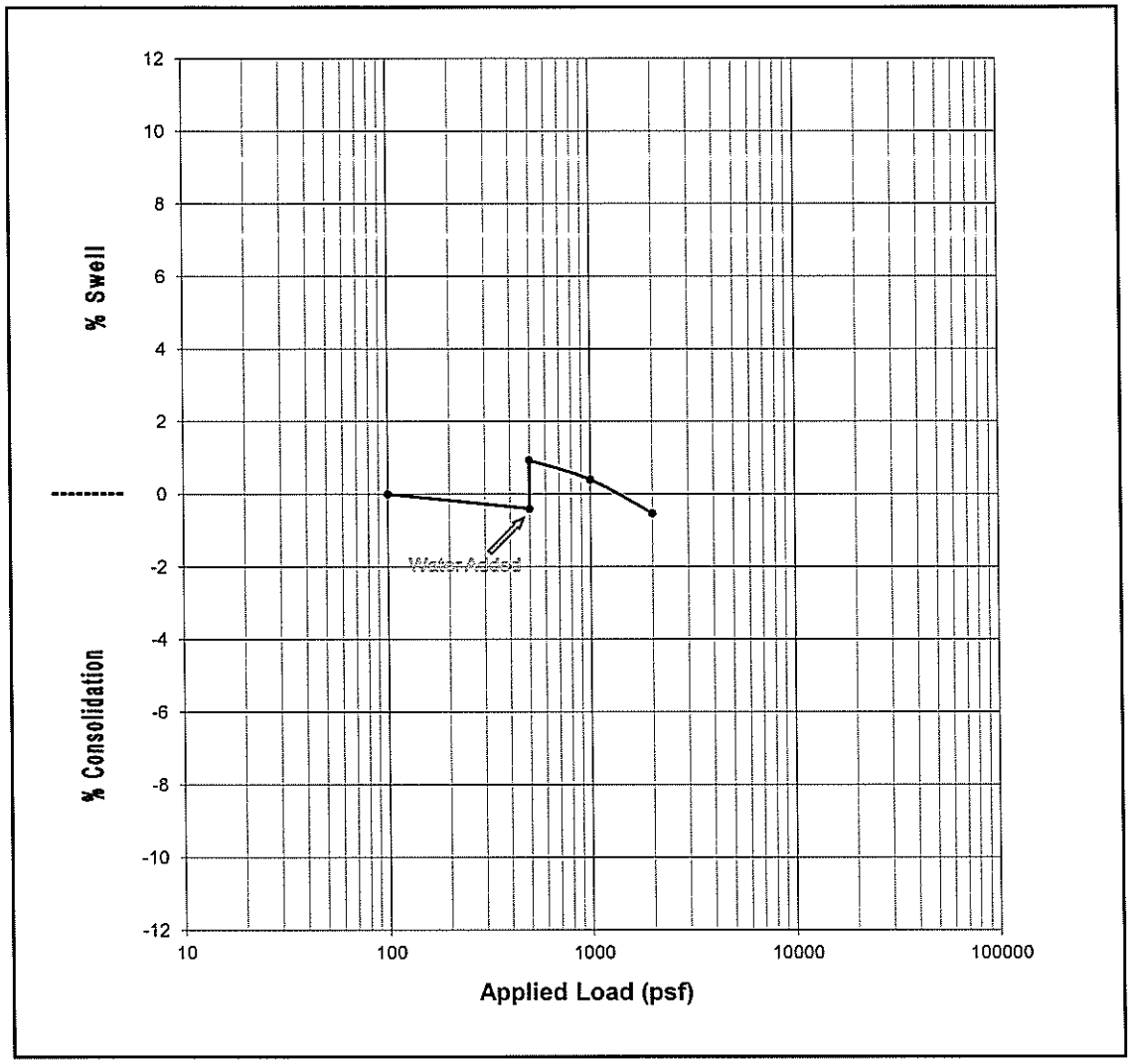
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-1B @ 4'

Sample Description: Fill - Light to Dark Brown/Rust Sandy Lean Clay (CL)

Initial Moisture	19.6%	Liquid Limit	-
Final Moisture	21.3%	Plasticity Index	-
% Swell @ 500 psf	1.3%	% Passing #200	-
Swell Pressure	1900 psf	Dry Density	107.6 pcf

SOLOGIC

MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

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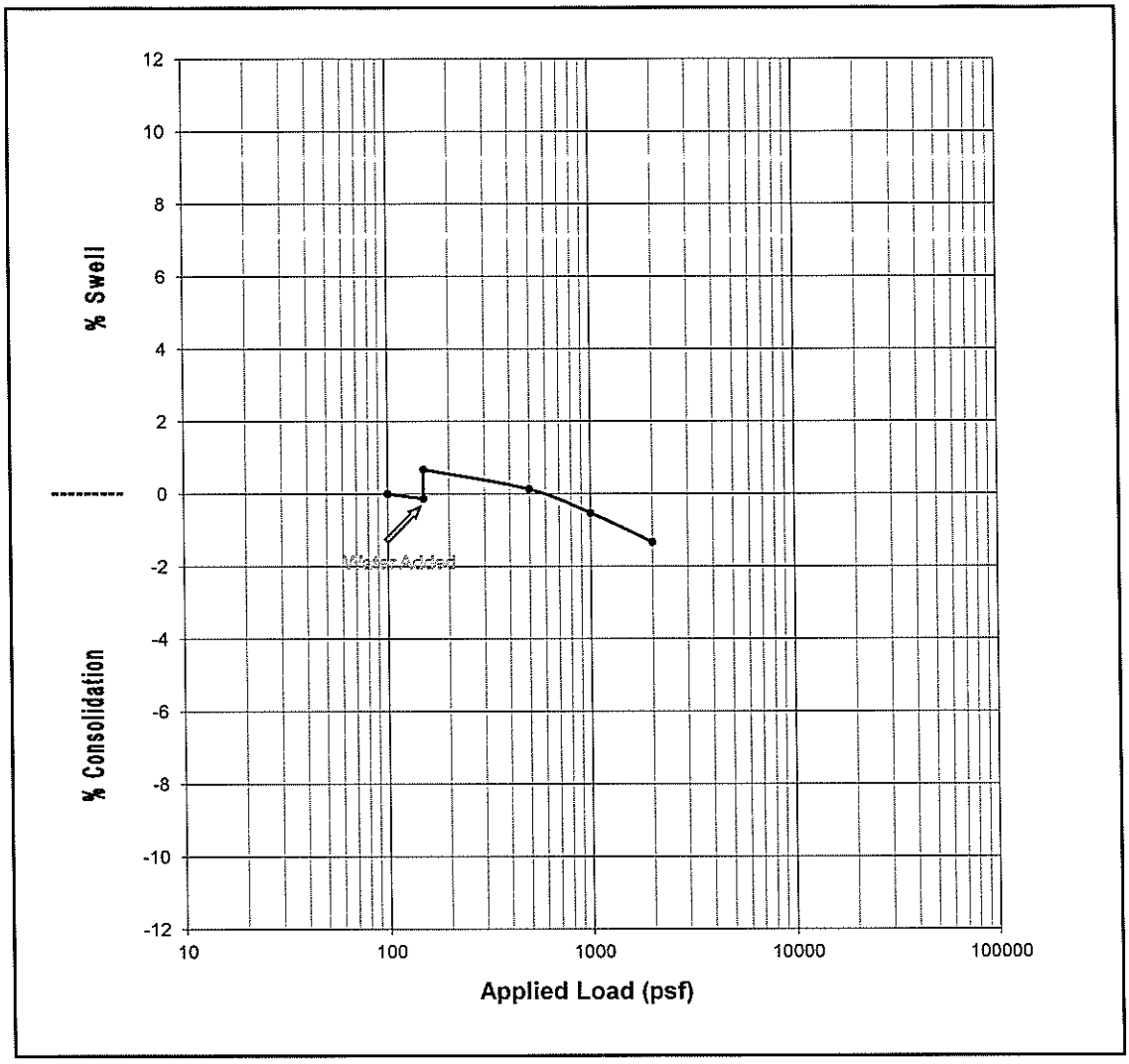
May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-2A @ 2'

Sample Description: Rust/Olive/Brown Sandy Lean Clay (CL)

Initial Moisture	17.3%	Liquid Limit	-
Final Moisture	19.5%	Plasticity Index	-
% Swell @ 150 psf	0.8%	% Passing #200	-
Swell Pressure	700 psf	Dry Density	110.2 pcf

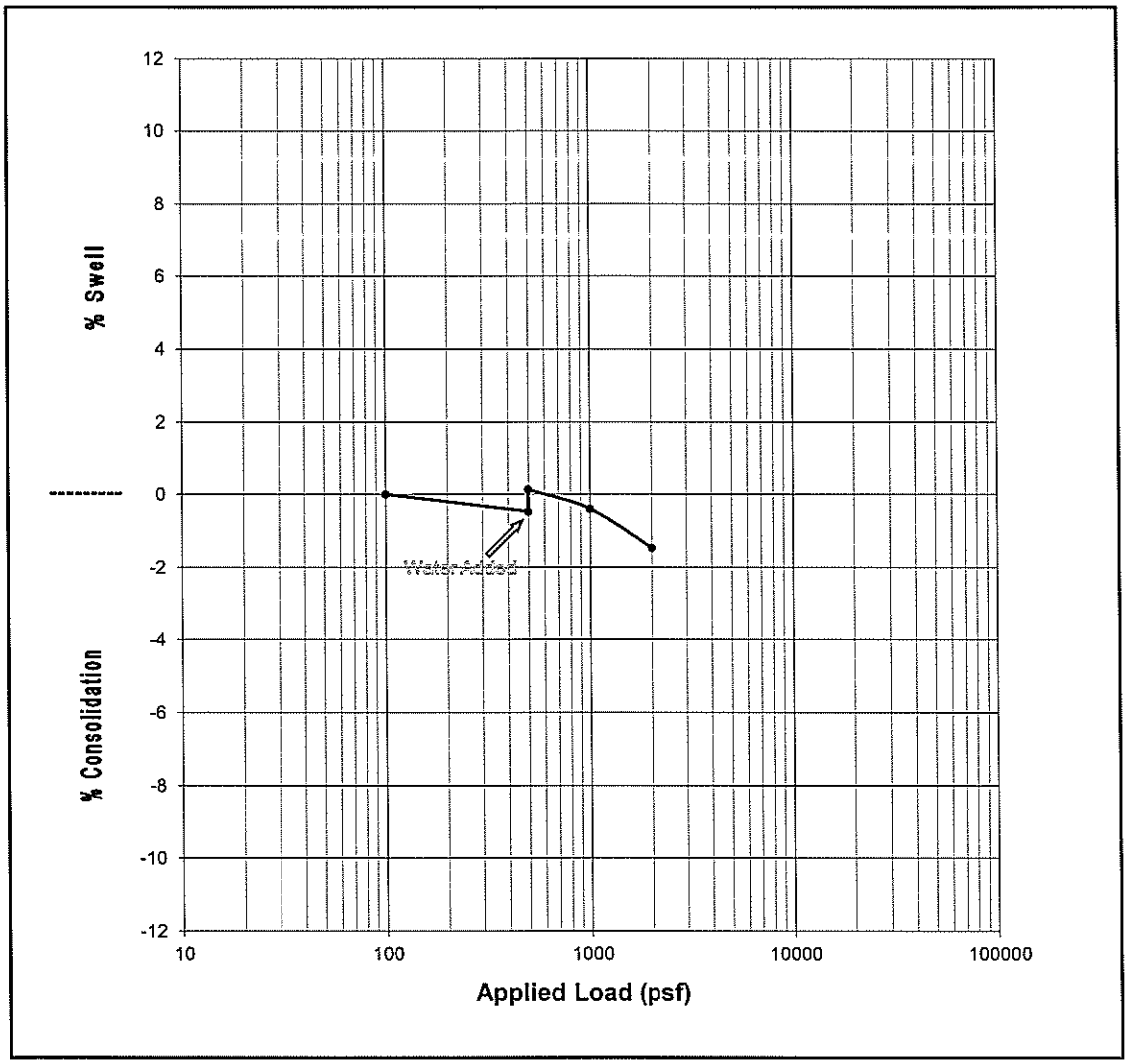
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-2B @ 4'

Sample Description: Fill - Grey/Rust/Olive/Brown Sandy Lean Clay (CL)

Initial Moisture	24.8%	Liquid Limit	-
Final Moisture	25.8%	Plasticity Index	-
% Swell @ 500 psf	0.6%	% Passing #200	-
Swell Pressure	1100 psf	Dry Density	98.0 pcf

SOILOGIC

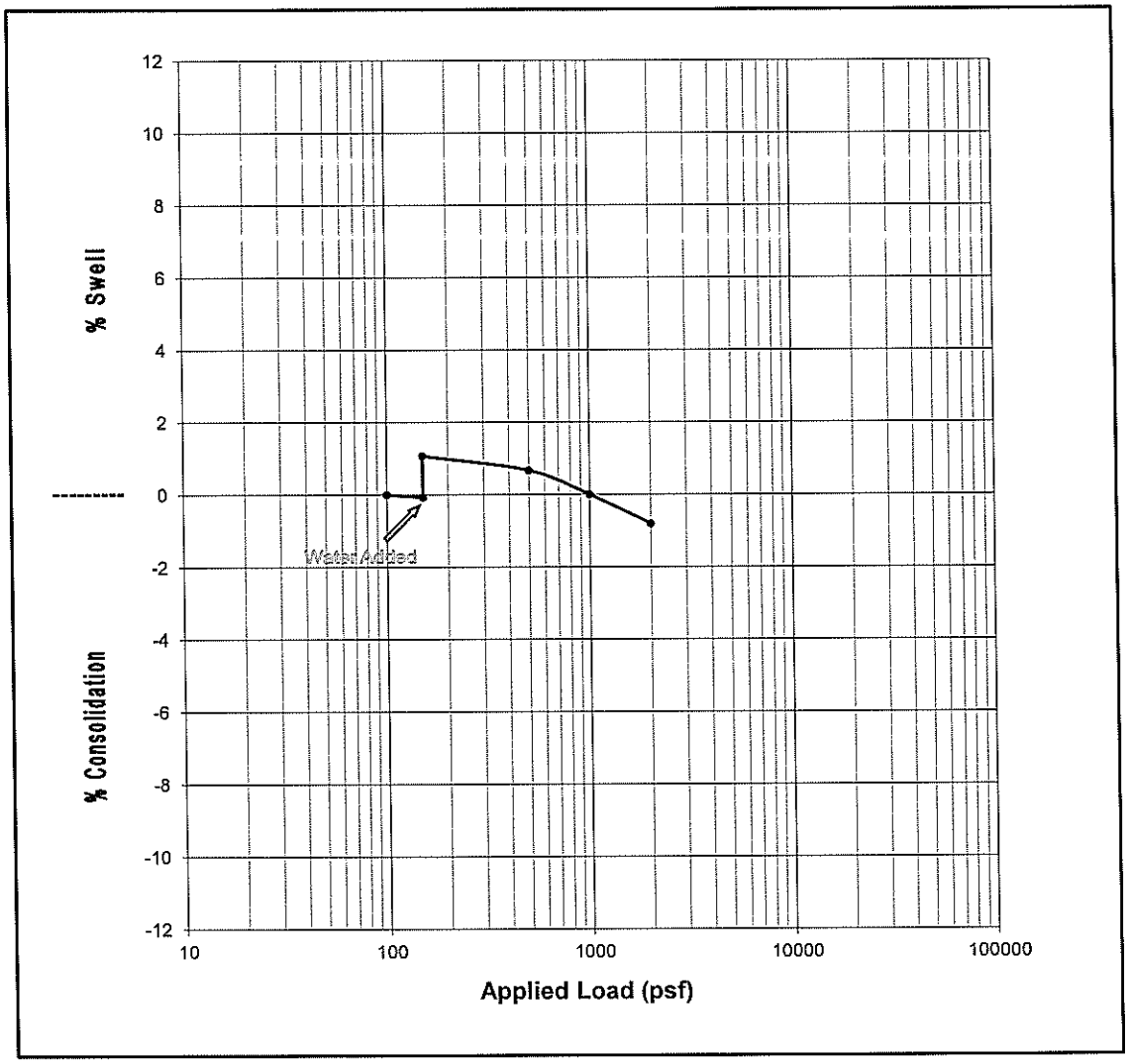
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-3A @ 2'

Sample Description: Olive/Brown/Rust Sandy Lean Clay (CL)

Initial Moisture	17.9%	Liquid Limit	-
Final Moisture	20.9%	Plasticity Index	-
% Swell @ 150 psf	1.1%	% Passing #200	-
Swell Pressure	1100 psf	Dry Density	106.8 pcf

SOLOGIC

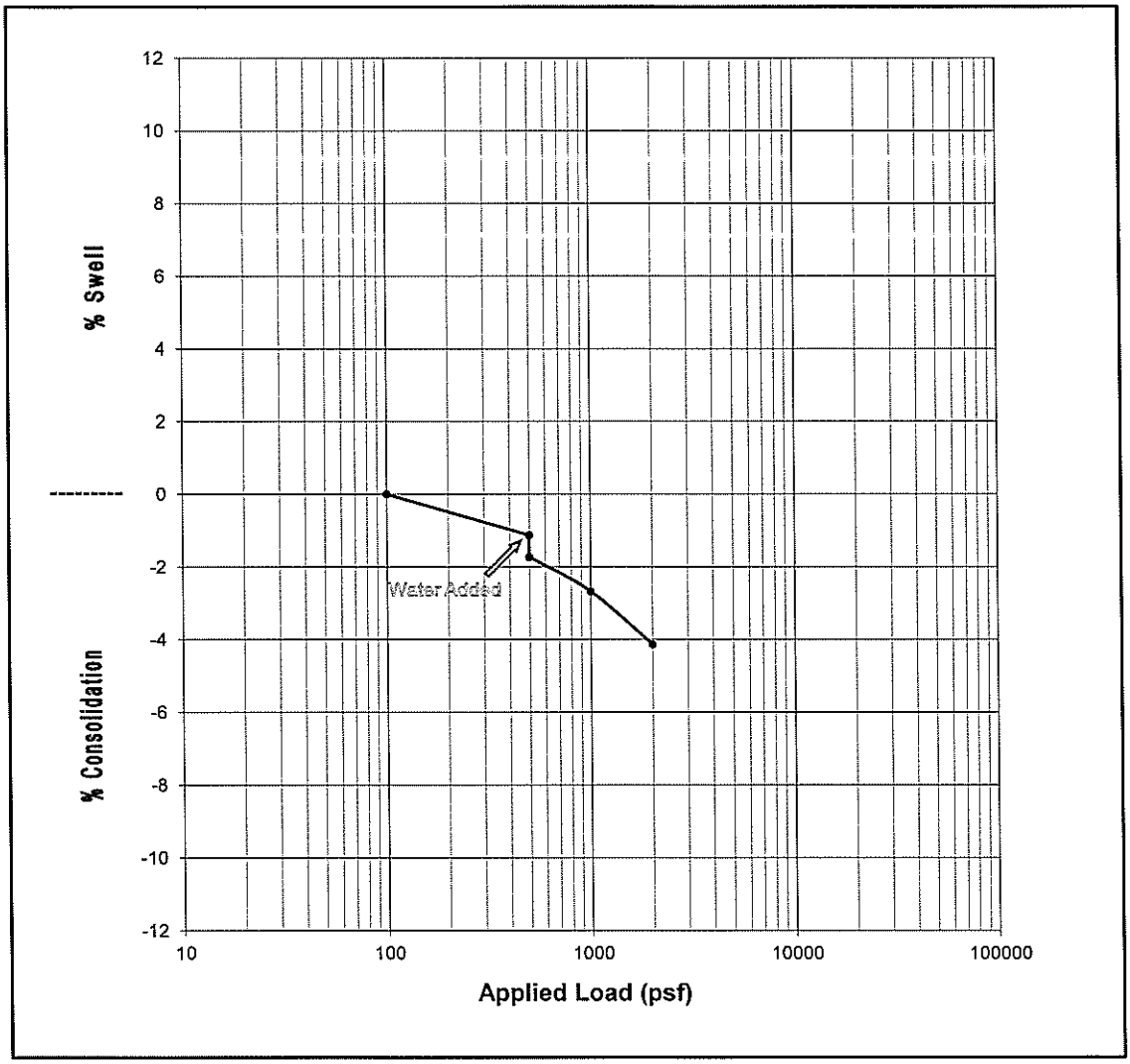
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-3A @ 4'

Sample Description: Rust Brown Lean Clay with Sand (CL)

(disturbed sample)

Initial Moisture	18.4%	Liquid Limit	35
Final Moisture	22.7%	Plasticity Index	16
% Swell @ 500 psf	None	% Passing #200	70.1%
Swell Pressure	<500 psf	Dry Density	98.7 pcf

SOLOGIC

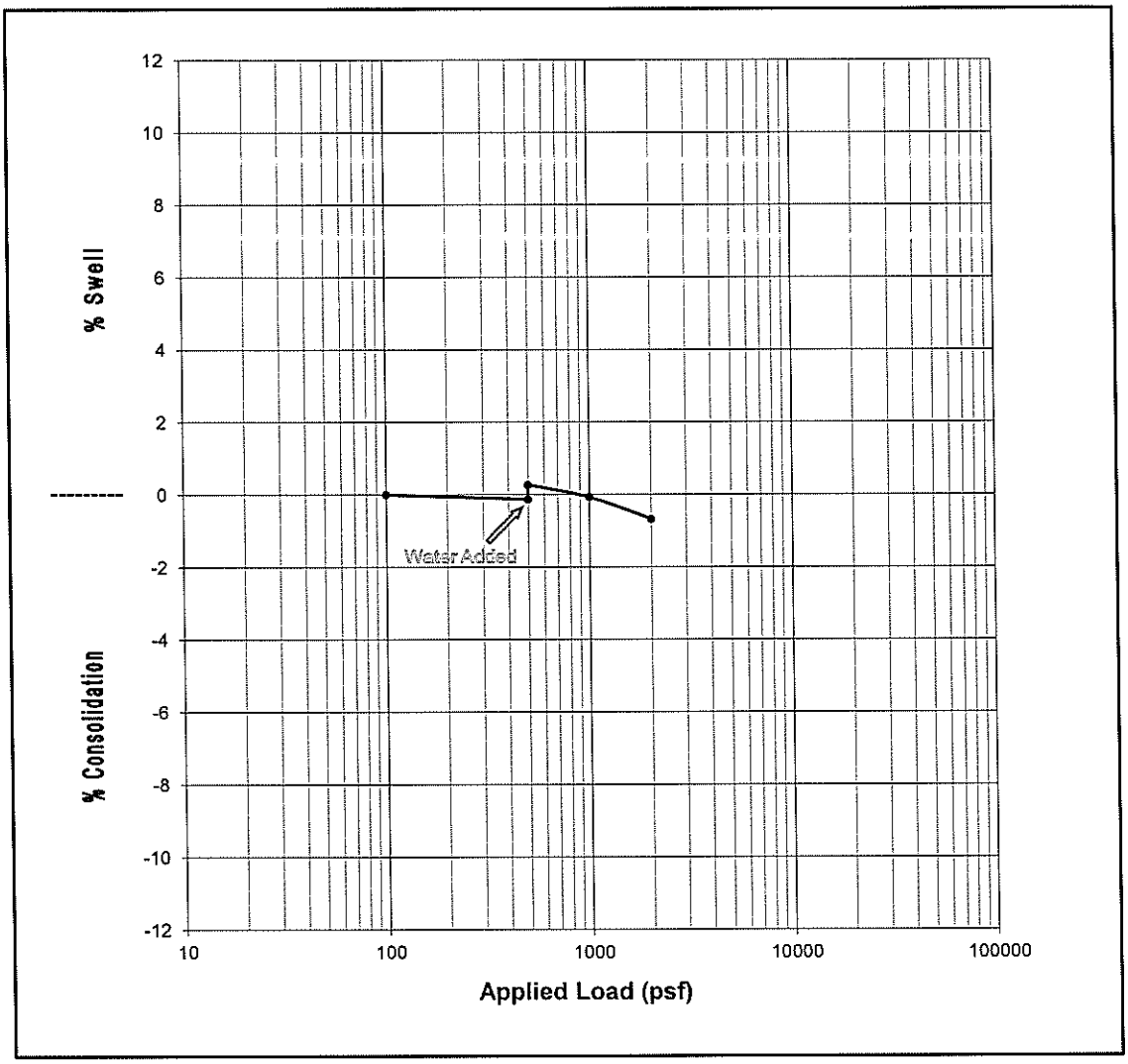
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-3B @ 4'

Sample Description: Fill - Rust/Olive/Brown Sandy Lean Clay (CL)

Initial Moisture	17.6%	Liquid Limit	-
Final Moisture	20.3%	Plasticity Index	-
% Swell @ 500 psf	None	% Passing #200	-
Swell Pressure	<500 psf	Dry Density	103.5 pcf

SOILOGIC

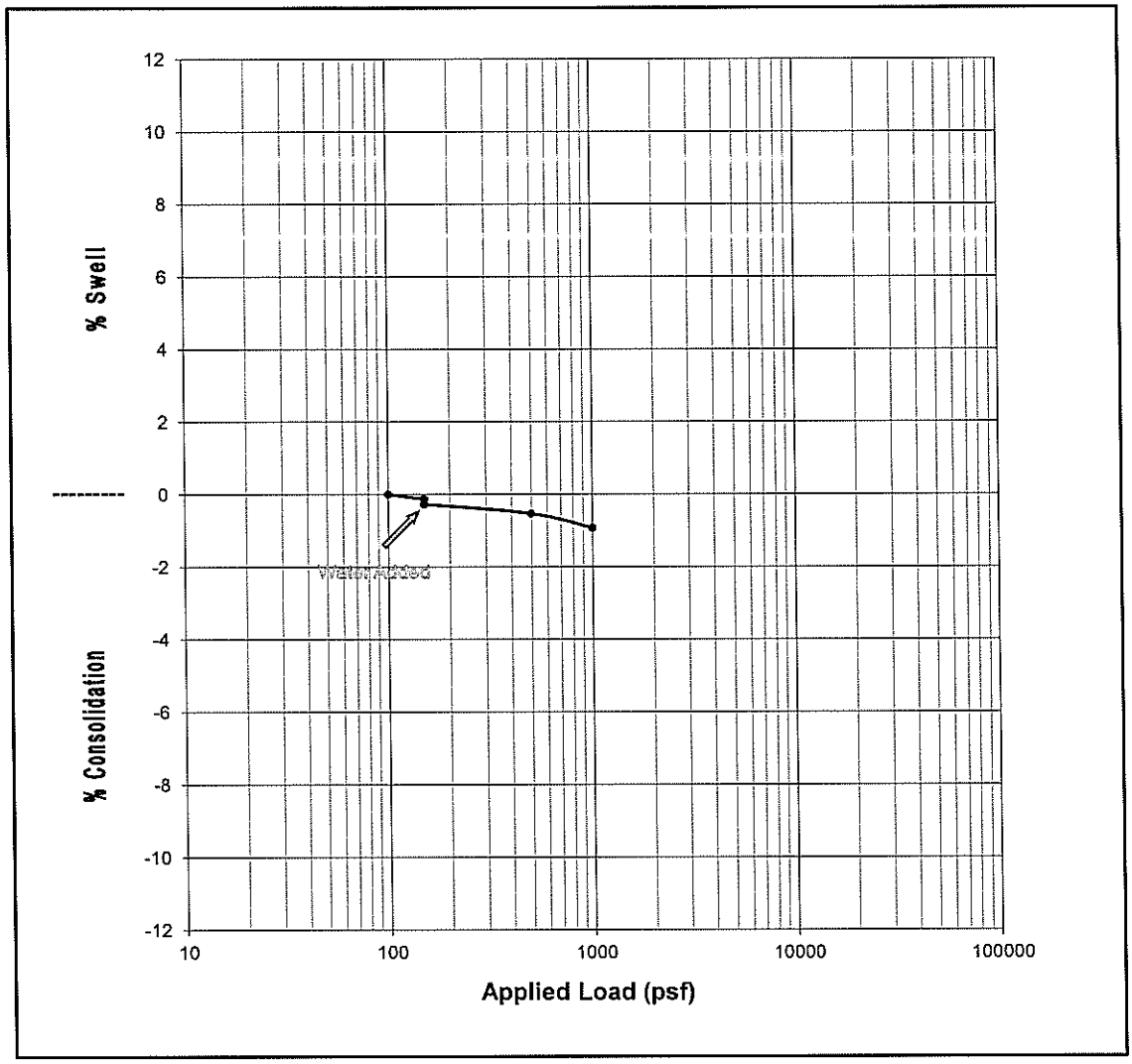
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-4A @ 2'

Sample Description: Brown/Rust Sandy Lean Clay (CL)

Initial Moisture	18.4%	Liquid Limit	-
Final Moisture	19.6%	Plasticity Index	-
% Swell @ 150 psf	None	% Passing #200	-
Swell Pressure	<150 psf	Dry Density	108.0 pcf

SOILOGIC

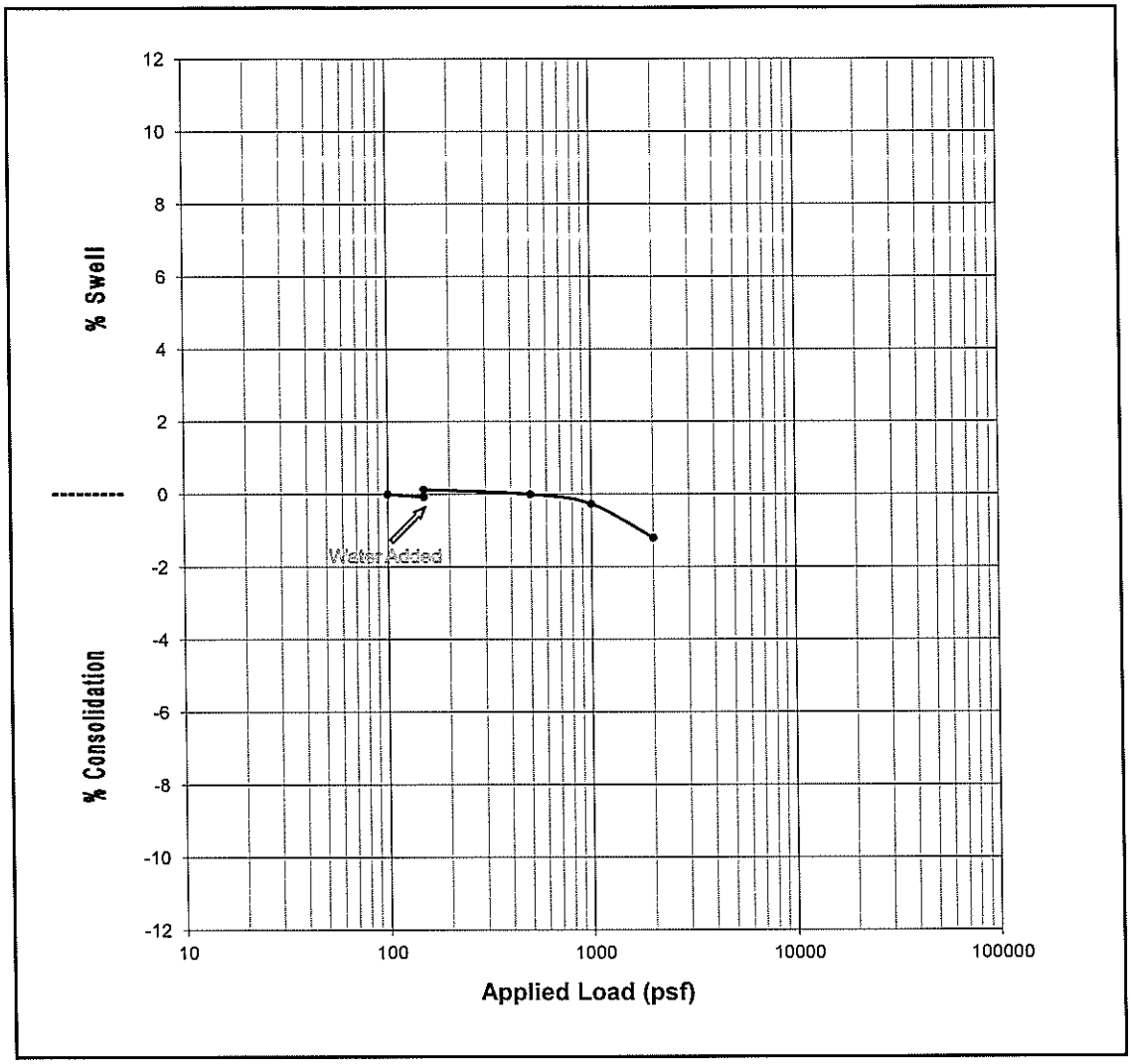
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-4B @ 2'

Sample Description: Fill - Light Brown to Brown/Olive/Rust Sandy Lean Clay (CL)

Initial Moisture	18.1%	Liquid Limit	-
Final Moisture	21.2%	Plasticity Index	-
% Swell @ 150 psf	0.2%	% Passing #200	-
Swell Pressure	700 psf	Dry Density	102.3 pcf

SOILOGIC

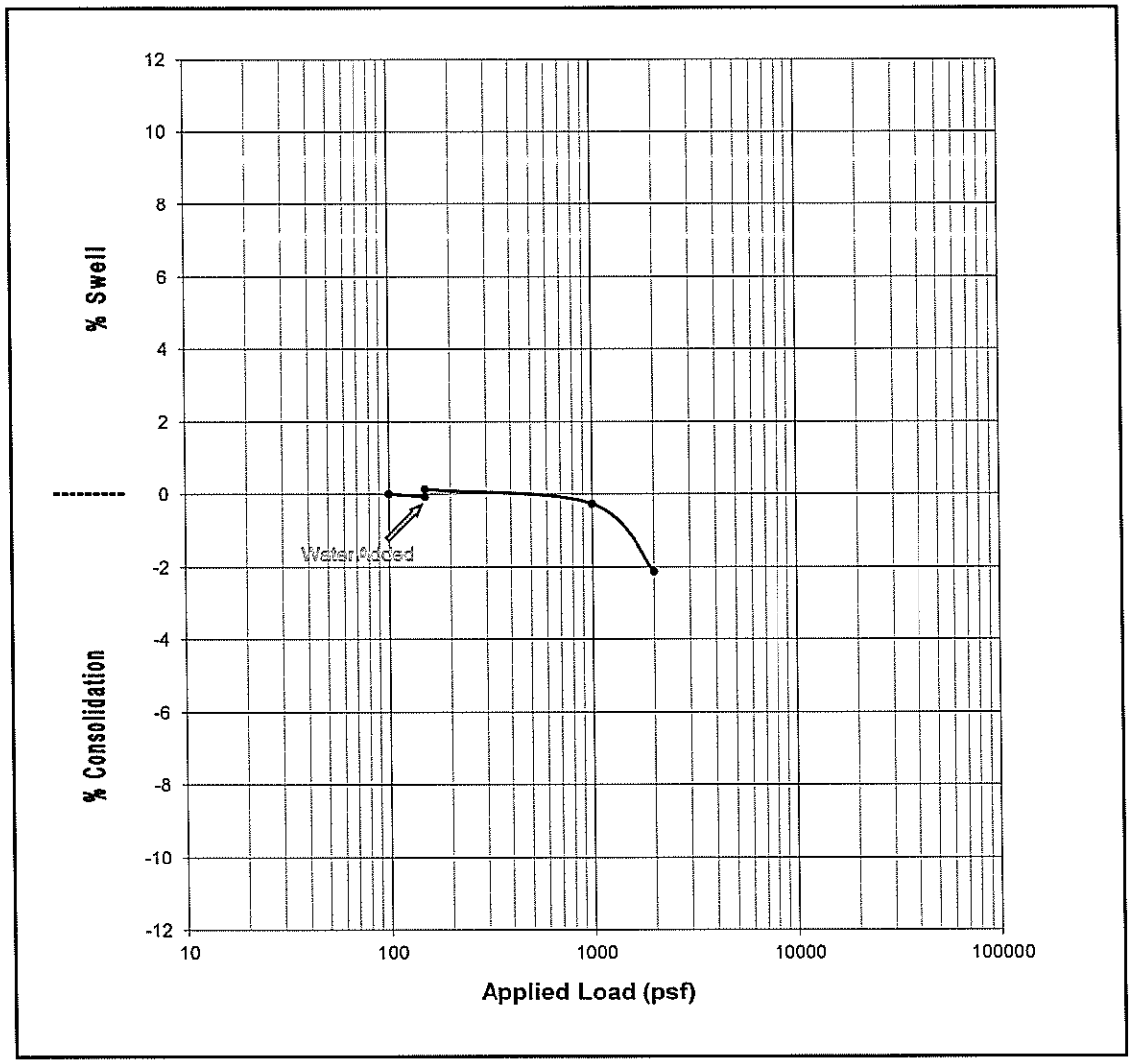
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-5A @ 2'

Sample Description: Rust Brown Sandy Lean Clay (CL)

Initial Moisture	19.1%	Liquid Limit	-
Final Moisture	21.7%	Plasticity Index	-
% Swell @ 150 psf	0.2%	% Passing #200	-
Swell Pressure	900 psf	Dry Density	102.0 pcf

SOLOGIC

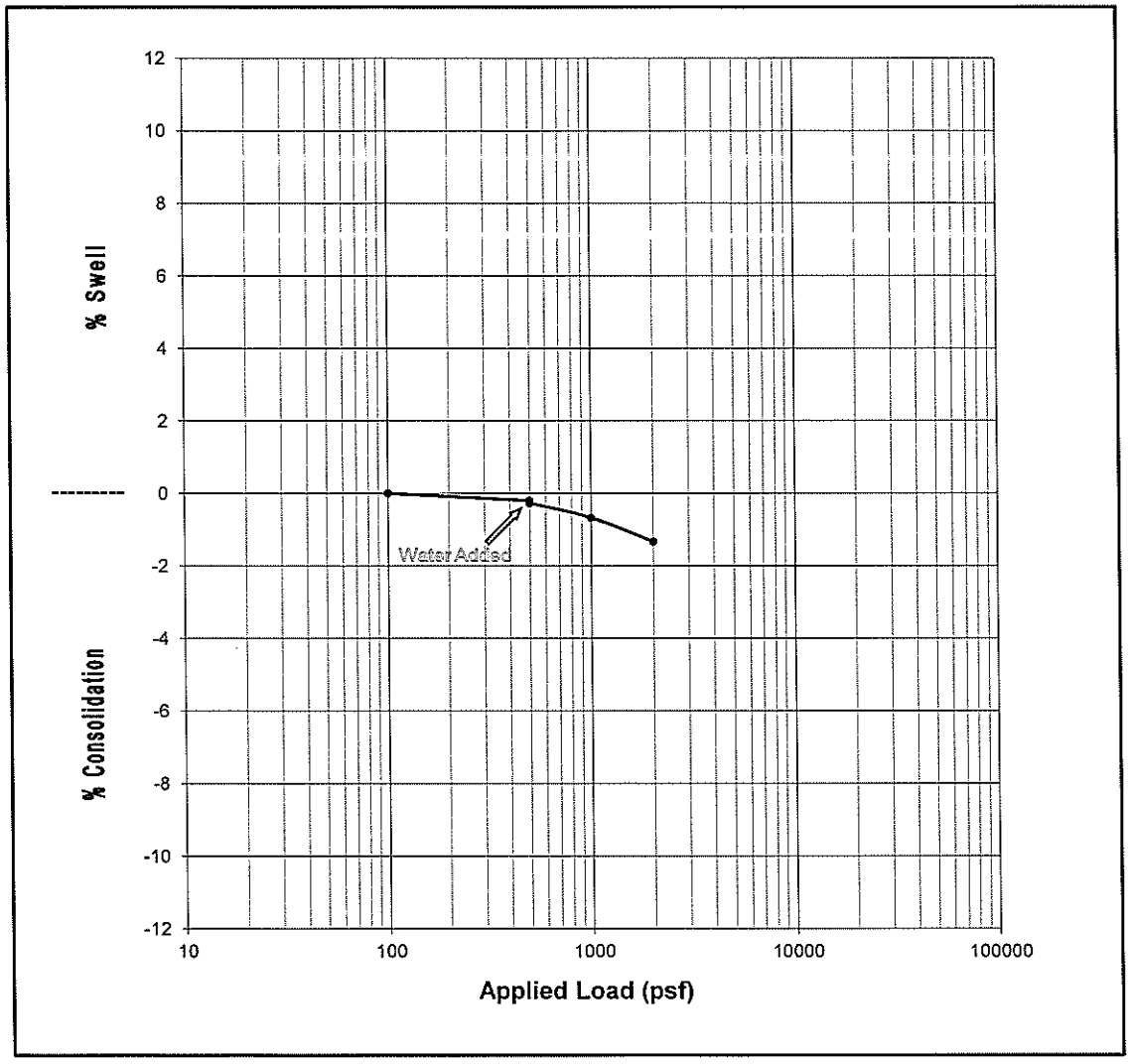
MAIL CREEK PHASE 2 - PAVEMENTS

FORT COLLINS, COLORADO

Project # 16-2016P

May 2016

SWELL/CONSOLIDATION TEST SUMMARY



Sample ID: B-5B @ 4'

Sample Description: Fill - Dark Brown/Rust Sandy Lean Clay (CL)

Initial Moisture	22.7%	Liquid Limit	-
Final Moisture	23.6%	Plasticity Index	-
% Swell @ 500 psf	None	% Passing #200	-
Swell Pressure	<500 psf	Dry Density	102.0 pcf

SOILOGIC

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]					Soil Classification	
					Group Symbol	Group Name[B]
Coarse Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]		GW	Well graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]		GP	Poorly graded gravel[F]
		Gravels with Fines More than 12% fines[C]	Fines classify as ML or MH		GM	Silty gravel[F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]		SW	Well graded sand[I]
			$Cu < 6$ and/or $1 > Cc > 3$[E]		SP	Poorly graded sand[I]
		Sands with Fines More than 12% fines[D]	Fines classify as ML or MH		SM	Silty sand[G,H,I]
			Fines classify as CL or CH		SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	Inorganic	PI > 7 and plots on or above "A" line[J]		CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]		ML	Silt[K,L,M]
		Organic	Liquid limit - oven dried / Liquid limit - not dried	< 0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	Inorganic	PI plots on or above "A" line		CH	Fat clay[K,L,M]
			PI plots below "A" line		MH	Elastic silt[K,L,M]
		Organic	Liquid limit - oven dried	< 0.75	OH	Organic clay[K,L,M,P]
			Liquid limit - not dried			Organic silt[K,L,M,Q]
Highly organic soils	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well graded gravel with silt, GW-GC well graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well graded sand with silt, SW-SC well graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

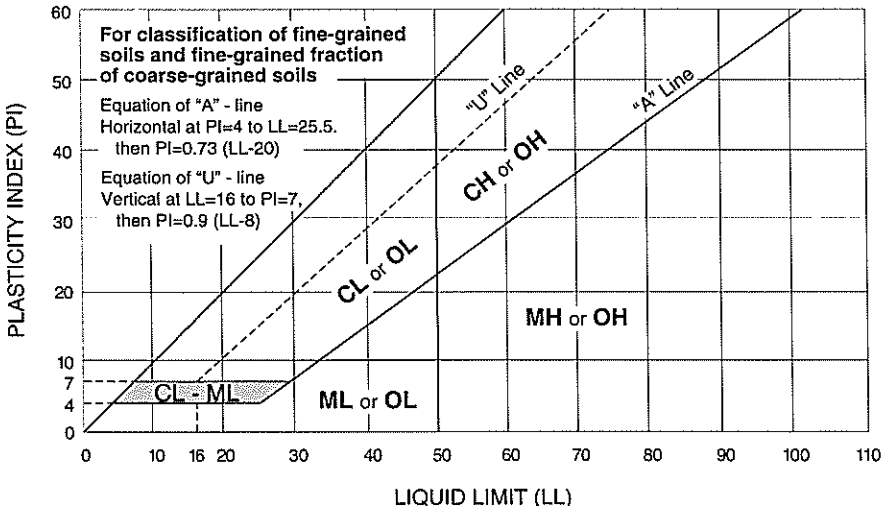
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS:	Split Spoon - 1⅜" I.D., 2" O.D., unless otherwise noted	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2.5" O.D., unless otherwise noted	PA:	Power Auger
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
CS:	California Barrel - 1.92" I.D., 2.5" O.D., unless otherwise noted	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	WB:	Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value". For 2.5" O.D. California Barrel samplers (CB) the penetration value is reported as the number of blows required to advance the sampler 12 inches using a 140-pound hammer falling 30 inches, reported as "blows per inch," and is not considered equivalent to the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL:	Water Level	WS:	While Sampling
WCI:	Wet Cave in	WD:	While Drilling
DCI:	Dry Cave in	BCR:	Before Casing Removal
AB:	After Boring	ACR:	After Casing Removal

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

FINE-GRAINED SOILS			COARSE-GRAINED SOILS			BEDROCK		
(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency	(CB) Blows/Ft.	(SS) Blows/Ft.	Relative Density	(CB) Blows/Ft.	(SS) Blows/Ft.	Consistency
< 3	0-2	Very Soft	0-5	< 3	Very Loose	< 24	< 20	Weathered
3-5	3-4	Soft	6-14	4-9	Loose	24-35	20-29	Firm
6-10	5-8	Medium Stiff	15-46	10-29	Medium Dense	36-60	30-49	Medium Hard
11-18	9-15	Stiff	47-79	30-50	Dense	61-96	50-79	Hard
19-36	16-30	Very Stiff	> 79	> 50	Very Dense	> 96	> 79	Very Hard
> 36	> 30	Hard						

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75 mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Terms of Other Constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifiers	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	30+

SOILOGIC