Pavement Design Report
US 6 Bridge over Garrison Street
Lakewood, Colorado
CDOT Project No. FBR 0063-046 (19478)
RockSol Project No. 321.01
April 7, 2014

Prepared for:

Colorado Dept. of Transportation, Region 1

Prepared by:

RockSol Consulting Group, Inc.

Sub-consultant to:

CH2MHILL

9193 South Jamaica Street
Englewood, Colorado 80112

RockSol
Consulting Group, Inc.

April 7, 2014

CH2M HILL
9193 South Jamaica Street
Englewood, Colorado 80112

Attention: Mr. Aaron Swafford, P.E.

Subject: Pavement Design Report, US 6 over Garrison Street Bridge Replacement Project, Lakewood, Colorado, Colorado Department of Transportation Project No. FBR 0063-046 (19478), RockSol Project Number 321.01

Dear Mr. Swafford:

RockSol Consulting Group, Inc. (RockSol) has performed a geotechnical investigation for the US 6 over Garrison Street Bridge Replacement Project.

This Pavement Design Report presents a brief discussion of the subsurface conditions encountered, a summary of the lab testing performed on recovered soil and bedrock samples, and pavement design recommendations to assist with design of pavements for the subject project.

Surface and groundwater hydrology, hydraulic engineering, and environmental studies including contaminant characterization were not included in RockSol's scope of work.

Project Description

The existing three-span bridge structure, identified as the US 6 over Garrison Bridge (Structure No. F-16-ER) is proposed to be replaced by a new single-span bridge over Garrison Street. The new structure may be slightly wider to accommodate wider shoulders within US 6 and lengthened to an approximate span length of 85 feet to allow for new 8-foot wide sidewalks and 4-foot wide bike lanes along northbound and southbound Garrison Street. Planned improvements will also include correcting the vertical curve deficiency on US 6 by raising the grade for US 6 to the east and west of Garrison Street and lowering the bridge over Garrison Street. The existing connection ramp configurations and tie in grades to US 6 are proposed to generally remain the same. The grade of the eastbound US 6 off-ramp to Garrison Street will be raised slightly for a portion of its length.

Proposed construction phasing will include the construction of a temporary bridge over Garrison Street to the south of the existing bridge structure and the construction of temporary retaining wall systems at the southwest and southeast quadrants of the overpass to allow westbound (WB) traffic to shift into the existing eastbound (EB) US 6 lanes while the WB bridge section is removed and replaced. During bridge construction the EB US 6 traffic will be shifted to the temporary bridge alignment. New pavement construction will be required for EB and WB US 6 within the project limits. Temporary (detour) pavement will also be required for EB US 6 as part of the construction phasing.

Project Site Conditions

The existing US 6 bridge over Garrison Street is a three span structure consisting of continuous welded girder center spans supported by two sets of six-concrete column piers. The existing bridge carries three lanes of traffic in each direction over Garrison Street and is approximately

90 feet in width. US 6 is presently surfaced with flexible pavement. The existing US 6 approach embankments (fill placement) are approximately 20 feet in height at the bridge abutments. Concrete slope paving (approximate 2H:1V slope) is present at each abutment with embankment side slopes of approximately 3H:1V to 4H:1V.

A mix of commercial and residential development borders the project area. Topography at the site generally consists of flat to mild slopes with a general trend of decreasing elevation to the north and east.

Subsurface Investigation

In August and September 2013, RockSol drilled 13 boreholes to evaluate the subsurface conditions for the US 6 over Garrison Bridge Replacement project. The borehole locations are identified as BR-1 through BR-6, RW-1 through RW-5 and PV-1 through PV-2, as shown on Figure 2, Borehole Location Plan. Boreholes BR-1 through BR-6 were drilled at the approximate location of the proposed bridge structure, Boreholes RW-1 through RW-5 were drilled to assist with retaining wall foundation recommendations, and Boreholes PV-1 and PV-2 were drilled to assist with pavement thickness recommendations. The boreholes were located by field survey provided by the project surveyor (HKS). Horizontal and vertical locations were then provided to RockSol for inclusion on the Borehole Location Plan and on the borehole logs. Pavement cores were obtained at Boreholes BR-1, BR-2, BR-5, RW-1, RW-2, RW-4, PV-1 and PV-2.

Truck mounted CME-45 and CME-55 drill rigs were used for drilling and sampling. The boreholes were advanced using 4-inch outside diameter solid stem augers and 8 inch outside diameter hollow stem augers to maximum depths ranging from approximately 10 feet to 80 feet below existing grades. The boreholes were logged in the field by a representative of RockSol with the depth to groundwater noted at the time of drilling. A monitoring well was drilled and installed near Borehole BR-4 for the project environmental team (Pinyon Environmental). Except for the monitoring well, the boreholes were backfilled at the completion of drilling and groundwater level checks. Boreholes drilled within existing pavement were patched with concrete and/or asphalt patch mixes.

Subsurface materials were sampled and resistance of the soil to penetration of the sampler was performed using modified California barrel and standard split spoon samplers. The modified California barrel sampler has an outside diameter of approximately 2.5 inches and an inside diameter of 2 inches. The standard split spoon sampler used had an outside diameter of 2 inches and an inside diameter of 1⅜-inches. Brass tube liners are used with the modified California barrel sampler to retain samples for density, swell, and unconfined compressive strength testing. Sample retaining liners are not used with the standard split spoon sampler.

Penetration Tests were performed at selected intervals using both a standard rope-cathead lift system and an automatic lift system. Both hammer lift systems used a hammer weighing 140 pounds and falling 30 inches. The standard split spoon sampling method is the Standard Penetration Test (SPT) described by ASTM Method D-1586. Penetration Tests were performed using the modified California barrel sampler with a standard hammer weighing 140 pounds falling 30 inches per ASTM D3550. The modified California Barrel sampling method is similar to the SPT test with the difference being the sampler dimensions and the number of 6-inch intervals driven with the hammer. Correlation of blow counts obtained from a modified California sampler to blow counts obtained from a standard split spoon sampler is not available. However, it is RockSol's experience that blow counts obtained with the modified California sampler tend to be slightly greater than a standard split spoon sampler. Penetration resistance

values (blow counts) were recorded for each sampling event. Blow counts, when properly evaluated, indicate the relative density or consistency of the soils. Depths at which the samples were taken, the type of sampler used, and the blow counts that were obtained are shown on the Boring Logs for each borehole. Individual Borehole Logs are included in Appendix A. Engineering Geology Sheets for the project are included in Figures 2A through 2D.

Subsurface Conditions

Roadway Pavement

Flexible pavement (asphalt) was encountered at the ground surface at eight borehole locations. Where flexible roadway pavement was encountered on US 6, the thickness generally ranged from 6.0 inches to 9.5 inches. At Boreholes BR-1, BR-2, BR-5, PV-1, and RW-2 approximately 4.0 inches to 8.5 inches of flexible asphalt pavement was noted overlying 7.5 inches to 10.5 inches of rigid pavement. Aggregate base course material was not noted below the pavement sections. A summary of the pavement section thicknesses encountered is presented in Table 1.

Table 1 – Existing Pavement Sections

Borehole	Location	HMA Thickness (inches)	PCCP Thickness (inches)	Total Pavement Thickness (inches)
BR-1	WB US 6 Shoulder	5	10¼	15¼
BR-2	EB US 6 Lane 1	7½	9½	17
BR-5	EB US 6 Lane 1	11½ (total) [2 distinct layers encountered]	8½	20
PV-1	WB US 6 Shoulder	7¼	7⅛	14⅜
PV-2	EB US 6 Shoulder	7½	Not Encountered	7½
RW-1	WB US 6 Shoulder	9¼	Not Encountered	9¼
RW-2	WB US 6 Shoulder	4	7½	11½
RW-4	EB US 6 Shoulder	7¾	Not Encountered	7¾
RW-5	US 6 Frontage Road (SE)	6	Not Encountered	6

The pavement section noted at Borehole RW-5 is based on field measurements made by RockSol during drilling operations. A pavement core was not recovered at Borehole RW-5. The pavement core recovered at Borehole BR-5 included a layer of asphalt pavement, 8¼ inches in thickness, over 8½ inches rigid pavement, which was over a layer of asphalt pavement approximately 3¼ inches in thickness. A summary of the recovered pavement cores is presented in Appendix B, Pavement Core Log Summary. Included in the core log summary are photographs of the recovered core sections and RockSol's general assessment of the condition of each core.

Topsoil

Topsoil was encountered at the ground surface at four borehole locations. The topsoil encountered was lightly organic sandy silt which supported a sparse covering of grasses and weeds. A topsoil thickness of approximately 3 inches to 6 inches was estimated based on field observations.

Fill Material

Beneath the pavement and topsoil, subsurface conditions encountered generally consisted of fill material to approximate depths ranging from 3 feet to 24 feet below existing grades and appears to be associated with the roadway embankment for US 6 over Garrison and the entrance and exit ramps for US 6. Fill material was not noted in Borehole BR-3. The fill material encountered generally consisted of medium stiff to very stiff sandy clay with gravel in parts. In Boreholes BR-2, BR-6, PV-1, and PV-2, fill material consisting of silty to clayey sand with gravel was encountered. Based on laboratory test results, the fill material encountered predominantly classified as A-6 soils by the American Association of State Highway and Transportation Officials (AASHTO) soil classification system. A-7-6 soils were also encountered. A summary of laboratory test results with soil classifications is presented in Appendix C.

Native Soils

Native soils encountered below the fill material or ground surface included stiff to hard sandy clay and medium dense to dense silty to clayey sand with gravel in parts. Sandy silt and gravelly sand were encountered at depths greater than 15 feet.

Bedrock

Sedimentary bedrock was encountered beneath the native soils in Boreholes BR-1 through BR-6 and RW-5 at elevations ranging from 5,455 feet to 5,461 feet during drilling operations. The bedrock generally consisted of very hard claystone. Very hard clayey sandstone and siltstone bedrock layers were also noted in Boreholes BR-1 through BR-6. Bedrock was not noted to the maximum depths drilled (approximately 10 feet to 50 feet) at Boreholes PV-1, PV-2 and RW-1 through RW-4.

Groundwater

Groundwater was encountered in 11 boreholes at elevations ranging from 5,479 feet to 5,493 feet (approximate depths ranging from 14 feet to 37 feet below existing grades) during drilling operations. Groundwater was not encountered to the maximum depths drilled (approximately 10 feet below existing grades) at Boreholes PV-1 and PV-2.

A summary of the bedrock and groundwater elevations encountered is presented in Table 2. The approximate groundwater and bedrock elevations are rounded to the nearest one-half foot and are based on the depth to groundwater and bedrock noted during drilling and sampling operations and the ground surface elevations provided by the project surveyor.

Based on the groundwater elevations presented in Table 2, there appears to be a decreasing gradient predominately to the east. Based on the bedrock elevations presented in Table 2, the bedrock surface elevation appears to be decreasing in the northeast direction.

Table 2 – Approximate Groundwater and Bedrock Elevations

Borehole	Ground Elevation (feet)	Groundwater Elevation (feet)	Bedrock Elevation (feet) Note 1
BR-1	5,520.8	5,487	5,459
BR-2	5,521.3	5,486	5,458
BR-3	5,501.2	5,485	5,458
BR-4	5497.8	5,483.5	5,455
BR-5	5,520.4	5,483	5,455
BR-6	5,501.1	5,483	5,460
RW-1	5,514.0	5,493	Not Encountered
RW-2	5,518.9	5,490	Not Encountered
RW-3	5,504.8	5,491	Not Encountered
RW-4	5,516.4	5,479	Not Encountered
RW-5	5,499.5	5,479.5	5,461

Expansive Soil Discussion

Swell potential in the subgrade soils obtained within the upper 5 feet below existing and proposed pavement grades ranged from 0.0 percent (swell) to 1.8 percent (swell), when tested with a 200 pound per square foot (psf) surcharge, with the average swell less than 1 percent.

Swell potentials ranging from -1.0 percent (consolidation) to 3.0 percent (swell) were obtained in subgrade soils deeper than 5 feet in the boreholes used for pavement recommendations and in Boreholes in areas where no new pavement is anticipated. For pavement recommendations swell potentials from tests in the upper 5 feet below existing and proposed pavement grades where new pavement is anticipated were used.

Based on the swell test data, the pavement subgrade soils appear to possess a low swell potential and low consolidation potential. Special earthwork requirements for mitigation of expansive soils are not considered necessary for this project. New embankment material placed for this project shall meet requirements of Section 203 (Excavation and Embankment) of the CDOT Standard Specifications for Road and Bridge Construction, dated 2011, with a minimum R-Value of 5 and a swell percentage less than 1 percent when tested with a 200-psf surcharge.

A summary of laboratory test results is presented in Appendix C.

Sulfate Exposure Category

Cementitious material requirements for concrete in contact with site soils or groundwater are based on the percentage of water soluble sulfate in either soil or groundwater that will be in contact with concrete constructed for this project. Mix design requirements for concrete exposed to water soluble sulfates in soils or water is considered by Colorado Department of Transportation (CDOT) as shown in Table 3 and in the Standard Specifications for Road and Bridge Construction, dated 2011 (CDOT Table 601-2).

Table 3
Requirements to Protect Against Damage to Concrete by Sulfate Attack from External Sources of Sulfate

Severity of sulfate exposure	Water-soluble sulfate (SO_4), in dry soil, percent	Sulfate (SO_4), in water, ppm	Water Cementitious Ratio, maximum	Cementitious Material Requirements
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1,500	0.45	Class 1
Class 2	0.21 to 2.0	1,500 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

The concentration of water soluble sulfates measured in 21 soil samples obtained from RockSol's exploratory boreholes was less than 0.1 percent by weight. Based on the results of the water soluble sulfate testing, Exposure Class 0 is considered appropriate for concrete in contact with subgrade materials for the project.

Subgrade Support Testing

R-Value tests were performed on a sample of A-7-6 soil from Borehole PV-1 and on a sample of A-6 soil from Borehole PV-2. A summary of the R-Value test results is shown in Table 4. All samples tested were obtained within the upper 10 feet of the existing ground surface.

Table 4
Subgrade Soil R-Value Test Summary

Borehole	Approximate Location	AASHTO Classification	R-Value
PV-1	WB US 6, Station 104+30, Lane 3	A-7-6 (8)	5
PV-2	EB US 6, Station 118+45, Outside Shoulder	A-6 (19)	4

Based on the results of the R-Value testing and subgrade soil classification testing, RockSol considers a subgrade support R-Value of 5 appropriate for pavement design purposes.

Pavement Thickness Recommendations (New Construction – 20/30 Year Design Life)

18 Kip equivalent single axle loads (ESALs) for US 6 within the project limits and US 6 Eastbound off-ramp at Garrison Street were provided to RockSol by CH2M HILL. The average daily traffic for mainline US 6 was taken from the CDOT OTIS system and included 2012 (current) data, forecast data for the year 2035, and data for the year 2045 estimated by linear extrapolation. Percent trucks accounted for approximately 3.1 percent to 3.2 percent of the traffic volume with single unit trucks accounting for approximately 1.7 percent to 1.9 percent and combination trucks accounting for approximately 1.4 percent and 1.3 percent respectively. A summary of the traffic data used to develop the design life ESAL's for this project is included in Appendix D.

Design life ESAL's are based on a project completion year of 2015. For new construction a design life of twenty years was used for flexible pavement. A design life of thirty years was used for rigid pavement.

Pavement thicknesses were calculated using the AASHTO Pavement Design and Analysis System (DARWin) and the NCHRP rigid pavement design supplemental spreadsheet software, based on the 1998 AASHTO Supplemental Guide for rigid pavement. Structural coefficients of 0.15 and 0.44 were used for CDOT Class 6 aggregate base course and HMA, respectively, when developing flexible pavement thickness recommendations. Elastic modulus values of 25,000 psi and 3,400,000 psi were used for CDOT Class 6 aggregate base course and PCC,

respectively, when developing rigid pavement thickness recommendations. A Reliability Level of 95 percent was used.

All permanent (20/30 year design life) pavement thicknesses presented are to be placed on top of 6 inches of CDOT Class 6 Aggregate Base Course (ABC) since the design life ESAL values are greater than 500,000.

Pavement thickness recommendations for mainline US 6 and the Eastbound US 6 off-ramp at Garrison Street are presented in Table 5A.

Table 5A – Pavement Thickness Recommendations (New Construction)

Roadway	Pavement Type	Design Life (years)	Structural Number (in)	Design Lane 18k ESALs	Recommended Pavement Thickness (Note 1)
					Subgrade R-Value = 5
US 6 West of Garrison Street	Flexible	20	6.13	5,900,000	12.0 inches HMA over 6.0 inches ABC
	Rigid	30	-	13,500,000	11.0 inches PCC over 6.0 inches ABC
US 6 East of Garrison Street	Flexible	20	6.06	5,400,000	12.0 inches HMA over 6.0 inches ABC
	Rigid	30	-	12,400,000	10.5 inches PCC over 6.0 inches ABC
Eastbound Off-Ramp at Garrison Street	Flexible	20	5.11	1,500,000	10.0 inches HMA over 6.0 inches ABC
	Rigid	30	-	3,300,000	9.0 inches PCC over 6.0 inches ABC

Note 1) HMA = Hot Mix Asphalt, ABC = Aggregate Base Course, PCC = Portland Cement Concrete

The recommended flexible pavement thickness values presented in Table 5A are rounded up to the nearest ½-inch, per CDOT methodology. Recommended pavement thickness values for rigid pavement shown in Table 5A include a ¼-inch thickness added to the calculated thickness and then rounded up to the nearest ½-inch, per CDOT methodology. Pavement thickness calculation sheets for the pavement sections shown in Table 5A are included in Appendix E.

All flexible pavements will be Hot Mix Asphalt (HMA) using CDOT approved mix designs. RockSol recommends using Grade SX or SMA mix for the surface layer and Grade S mix for the lower (intermediate and base) layers. A gyratory design revolution (Ndes) of 100 is recommended. Performance Grade Binder of PG 76-28 is recommended for the surface layer (Grade SX or SMA mix). Performance Grade Binder of PG 64-22 is recommended for the intermediate and base layers (Grade S mix). A summary of the recommended pavement lift sections is presented in Tables 5B and 5C. Pavement design parameter sheets and LTPPBind output sheets summarizing the PG binder selection are included in Appendix F.

Table 5B – Recommended Flexible Pavement Lift Summary (US 6 EB and WB)

Lift Description	Lift Thickness (inches)	Grading	Binder
Top Lift	2	SX or SMA	PG 76-28
Intermediate Lift 3	2.25	S	PG 64-22
Intermediate Lift 2	2.25	S	PG 64-22
Intermediate Lift 1	2.5	S	PG 64-22
Bottom Lift	3.0	S	PG 64-22

Table 5C – Recommended Flexible Pavement Lift Summary (US 6 EB Off-Ramp)

Lift Description	Lift Thickness (inches)	Grading	Binder
Top Lift	2	SX or SMA	PG 76-28
Intermediate Lift 2	2.5	S	PG 64-22
Intermediate Lift 1	2.5	S	PG 64-22
Bottom Lift	3.0	S	PG 64-22

The contractor may choose alternative layer thicknesses to those shown in Tables 5B and 5C, however, the layer thicknesses must conform to the minimum and maximum layer thickness requirements presented in Table 3.7 of the 2014 CDOT Pavement Design Manual, or the Manual designated at the time of bidding.

US 6 Detour Pavement Section Thickness Recommendations

Temporary detours will be required for Eastbound US 6 traffic while the bridge structure over Garrison is constructed. RockSol understands that the detours may be required for 6 months to 18 months and that flexible pavement will be used. ESAL values for 6, 9, 12, and 18 month detours were used to determine required pavement thicknesses for those time frames, based on 2012 ADT data obtained for US 6 from the CDOT OTIS site and projected to the year 2015. The 2012 ADT values for the section of US 6 within the project limits were 100,000 vehicles per day (both directions with 1.7 percent single unit trucks and 1.4 percent combination trucks.

Detour pavements were calculated utilizing a subgrade with an effective R-value of 5 for the existing condition. A summary of the recommended flexible pavement sections for detours of 6, 9, 12, and 18 months are presented in Table 6.

Table 6 – Minimum Detour Pavement Thickness

Roadway	Pavement Type	Design Life (months)	Design Lane 18k ESALs	Structural Number (in)	Minimum Pavement Thickness (Note 1) Subgrade R-Value = 5
Temporary Pavement US 6 EB Lanes	Flexible	6	160,000		6.5 inches HMA over 6.0 inches ABC
		9	250,000		7 inches HMA over 6.0 inches ABC
		12	325,000		7.5 inches HMA over 6.0 inches ABC
		18	485,000		8 inches HMA over 6.0 inches ABC
		6	160,000	3.71	7.25 inches HMA over 4.0 inches ABC
		9	250,000	3.96	7.75 inches HMA over 4.0 inches ABC
		12	325,000	4.12	8.0 inches HMA over 4.0 inches ABC
		18	485,000	4.37	8.75 inches HMA over 4.0 inches ABC

Note 1) HMA = Hot Mix Asphalt, ABC = Aggregate Base Course, PCC = Portland Cement Concrete

Pavement thickness calculation sheets for the detour pavement sections shown in Table 6 are presented in Appendix E. Pavement design parameter sheets for the detour pavement sections are included in Appendix F.

Subgrade Preparation (New Pavement)

For all new pavement areas, proof rolling with pneumatic tire equipment shall be performed using a minimum axle load of 18 kips per axle after specified subgrade compaction has been obtained. Areas found to be weak and those areas which exhibit soft spots, non-uniform deflection or excessive deflection as determined by the project engineer shall be ripped, scarified, wetted or dried if necessary, and re-compacted to the requirements for density and moisture. Complete coverage of the proof roller will be required.

All pavement subgrade preparation, pavement materials, and pavement construction shall conform to CDOT Standard Specifications for Road and Bridge Construction (2011). At a minimum, subgrade moisture conditioning and compaction should meet the compaction specifications outlined in Table 7.

Table 7 –Compaction Specifications

AASHTO Classification	Minimum Relative Compaction (Percentage of MDD), %	Moisture Content (Deviation from OMC)
A-1, A-2-4, A-2-5, A-3,	95% of AASHTO T99	-2 to +2
A-2-6, A-2-7, A-4, A-5 A-6 and A-7	95% of AASHTO T99	0 to +3

Based on swell test data, it is RockSol's opinion that moisture conditioning to a depth of 6 inches is appropriate for this project.

Limitations

This geotechnical investigation was conducted in general accordance with the scope of work. This report has been prepared for use by CH2M HILL and the Colorado Department of Transportation (CDOT) exclusively for the project described in this report. The report is based on information provided by CDOT, RockSol's observations, and exploratory boreholes and does not take into account variations in the subsurface conditions that may exist between boreholes. Additional investigation is required to address such variation. The nature and extent of subsurface variations across the project site may not become evident until the construction phase of the project and when excavations are performed.

The conclusions and recommendations submitted in this report are based upon the data obtained from the boreholes drilled at the locations indicated on the boring location sheets and our understanding of the proposed type of construction. If the proposed construction is different than described in this report, RockSol should be notified to re-evaluate, or supplement, the recommendations contained in this report. RockSol is not responsible for liability associated with interpretation of subsurface data by others.

Prepared by RockSol Consulting Group, Inc.:

COLORADO REGISTERED DONALD GORDON HUNT 4-7-14 35249 PROFESSIONAL ENGINEER

Jacob Biller, P.E.
Geotechnical Engineer

Donald G. Hunt, P.E.
Senior Geotechnical Engineer

Attachments:

Figure 1 - Site Vicinity Map
Figure 2 - Borehole Location Plan
Figures 2A – 2D: Engineering Geology Sheets

Appendix A – Legend and Individual Borehole Logs
Appendix B – Pavement Core Log Summary
Appendix C – Laboratory Test Results
Appendix D – Equivalent Single Axle Load Calculations (From CH2M HILL)
Appendix E – Flexible and Rigid Pavement Calculation Sheets (DARWin/AASHTO 98)
Appendix F – Pavement Design Parameter Sheets (New Construction and Detour) and LTPPBind PG Binder Selection Reports

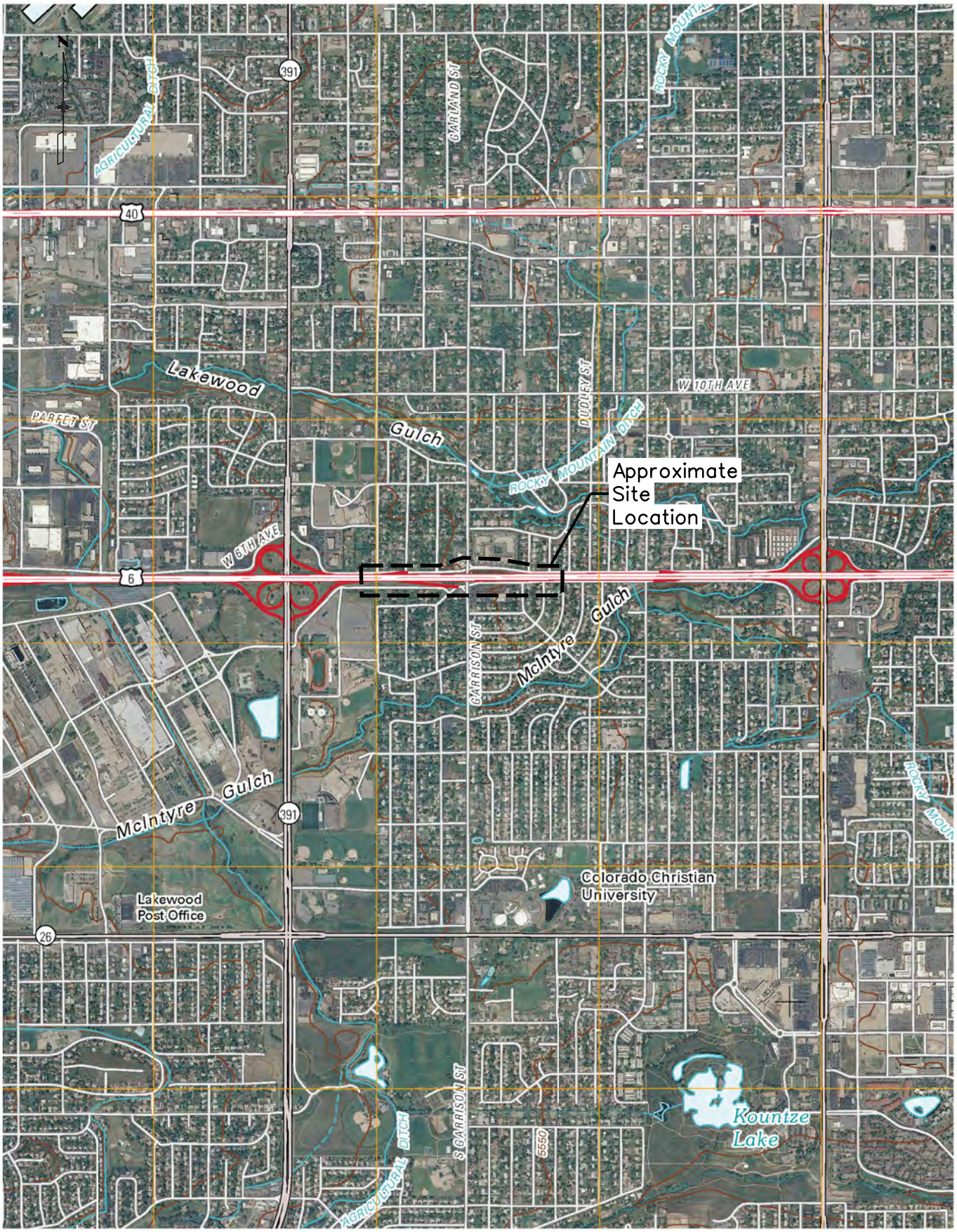

IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY, JUNE 2009, FORT LOGAN, COLORADO QUADRANGLE, 2011

Print Date: 1/6/2014	US 6 OVER GARRISON STREET SITE VICINITY MAP	Project No./Code
File Name: 19478_Site_Vicinity.dgn		19478
Horiz. Scale: AS NOTED		
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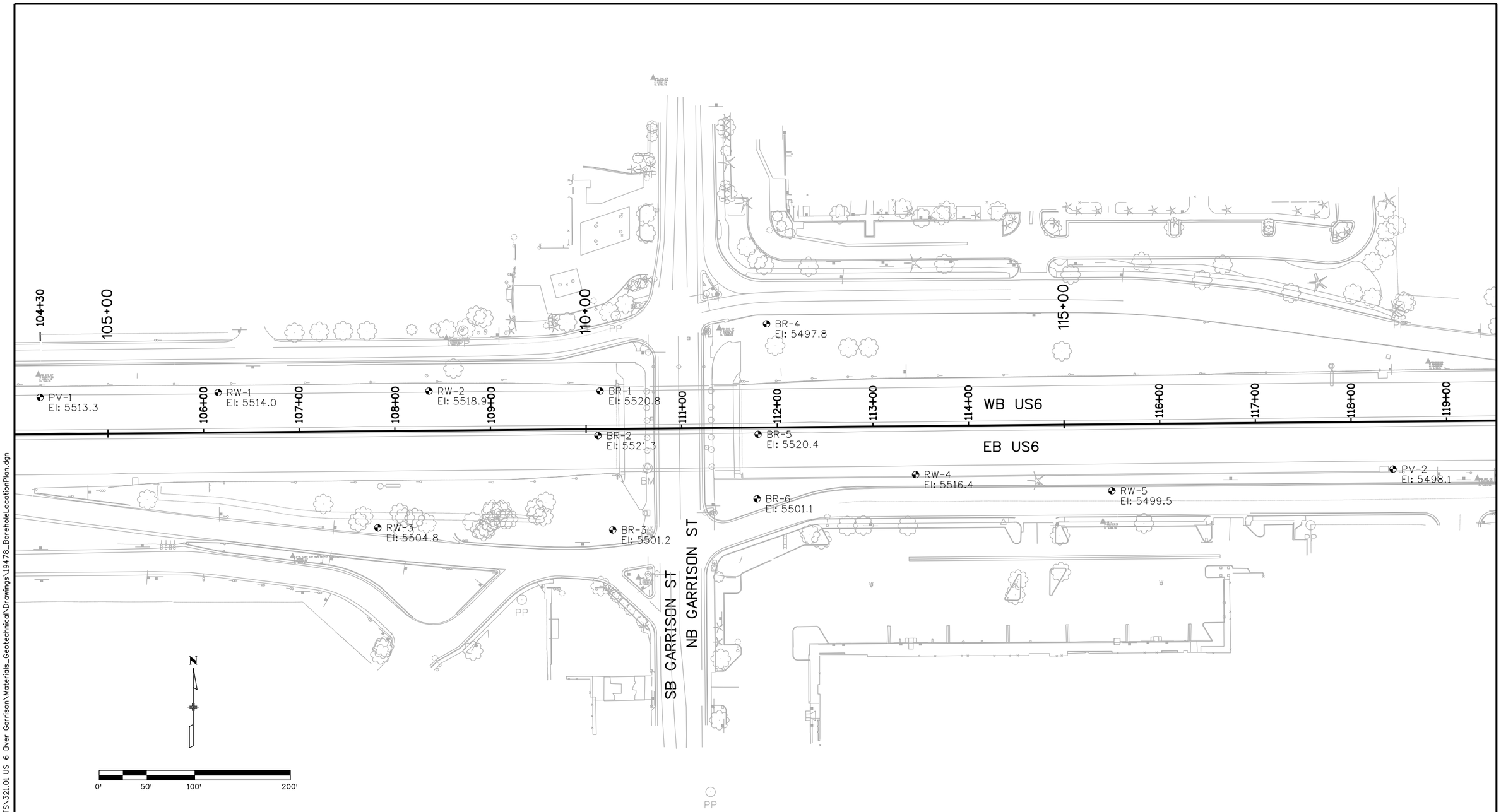
		Figure 1



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Print Date: 12/16/2013			
File Name: 19478_BoreholeLocationPlan.dgn			
Horiz. Scale: As Noted	Vert. Scale: As Noted		
RockSol Project No. 321.01	Unit Leader _		

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R-X

Sheet Revisions		
Date:	Comments	Init.

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Region 1 KPB

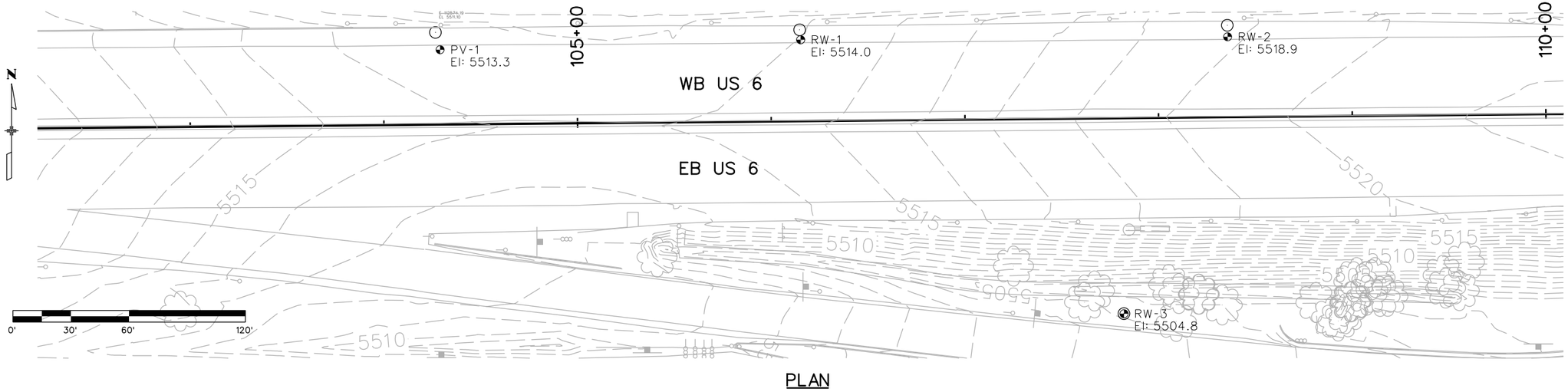
As Constructed
No Revisions:
Revised:
Void:

US 6 OVER GARRISON STREET
BOREHOLE LOCATION PLAN

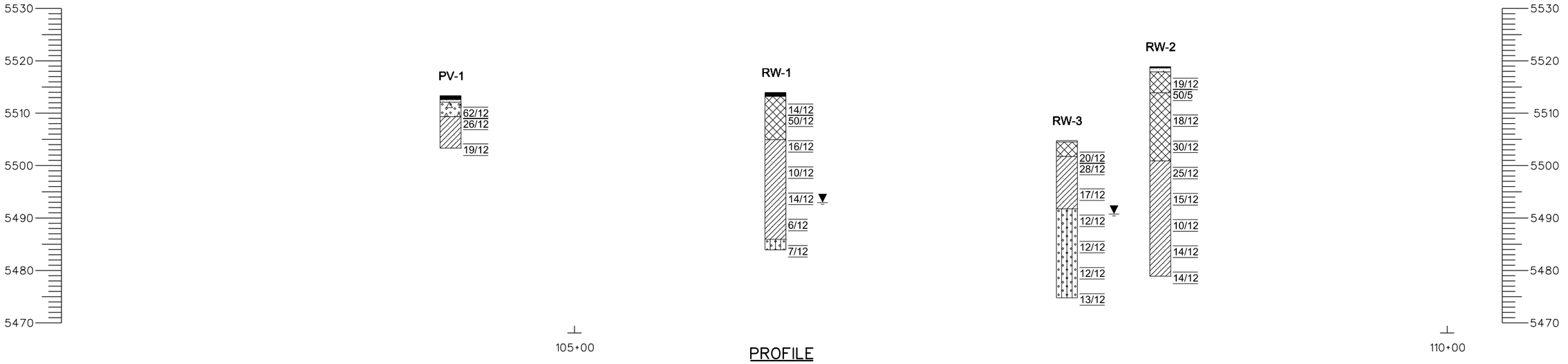
Designer: R. LEPRO
Detailer: S. MCKANNA-KOON
Sheet Subset:
Structure Numbers
Subset Sheets: of

Project No./Code
19478
Figure 2

WORK IN PROGRESS



PLAN



PROFILE

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)	Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)	Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
PV-1	1,25-10	46	24	48	SC	A-7-6 (8)			0,00	RW-2	14						14,5	111,9	0.01										
PV-1	2						6.0	119.9		RW-2	19	47	27	76	CL	A-7-6 (20)	20.4	105.4											
PV-1	4						22.4	99.5		RW-2	24						17,9	105,4											
PV-1	9						30.1	89.5		RW-2	29						22.9	103.2											
RW-1	2						20,6	106,2		RW-2	39						24,6	99,7											
RW-1	4						3,0	138,1		RW-3	0-10	43	23	54	CL	A-7-6 (9)			0.00										
RW-1	9						25,4	97,7		RW-3	2	NP	NP	47	SM	A-4 (0)	10,1	117,8	0.00										
RW-1	14						26.0	96.5	0.00	RW-3	4						19,7	108,8											
RW-1	19						29,1	92,3		RW-3	9						18,7	107,2											
RW-1	24						37,4	85,1		RW-3	14	40	17	38	SC	A-6 (2)	25,9	97,7											
RW-1	29						30,2	90,3		RW-3	19						27,3	97,2											
RW-2	1-5	38	18	44	SC	A-6 (4)			0,01	RW-3	24						30,7	96,0											
RW-2	2						18,6	108,9																					
RW-2	4						17,3	110,7																					
RW-2	9	31	16	30	SC	A-2-6 (1)	11,4	111,6																					

TYPE OF MATERIAL

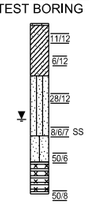
LITHOLOGY

- Asphalt Pavement
- Fill - CLAY
- Native - TOPSOIL
- Native - SAND, gravelly
- Native - CLAY
- Native - SILT, sandy
- Bedrock - Interbedded SILTSTONE/CLAYSTONE
- Concrete
- Fill - SAND
- Native - SAND, silty
- Native - SAND, clayey
- Native - CLAY, sandy
- Bedrock - CLAYSTONE
- Bedrock - SANDSTONE

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



- B — Bridge Borehole
- Ground Water Level At Time of Drilling
- 3/12 — 9 Blows for 12 Inches
- 50/3 — 50 Blows for 3 Inches
- 8/6/7 SS — Split Spoon Sampler Required 8 Blows for 6 Inches Required 6 Blows for 6 Inches Required 7 Blows for 6 Inches

BORING ID NOTED AT THE TOP OF LOG
BLOW COUNTS OBTAINED WITH SPLIT SPOON SAMPLERS ARE NOTED WITH "SS". ALL OTHER BLOW COUNTS OBTAINED WITH A MODIFIED CALIFORNIA BARREL SAMPLER
SEE INDIVIDUAL LOG SHEETS FOR MORE DETAIL

Print Date: 11/13/2013
File Name: 19478_Engineering_Geology_West_US6.dgn
Horiz. Scale: As Noted Vert. Scale: As Noted
RockSol Project No. 321.01 Unit Leader Initials

RockSol Consulting Group, Inc.
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Sheet Revisions		
Date:	Comments	Init.

Colorado Department of Transportation
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425 B Corporate Circle
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Phone: 720-497-6954 FAX: 720-497-6951
Region 1 KPB

As Constructed
No Revisions:
Revised:
Void:

US 6 OVER GARRISON STREET
ENGINEERING GEOLOGY

Designer: J. Biller
Detailer: S. McKanna-Koon
Sheet Subset:
Structure Numbers
Subset Sheets: of

Project No./Code
19478
Figure 2A

WORK IN PROGRESS

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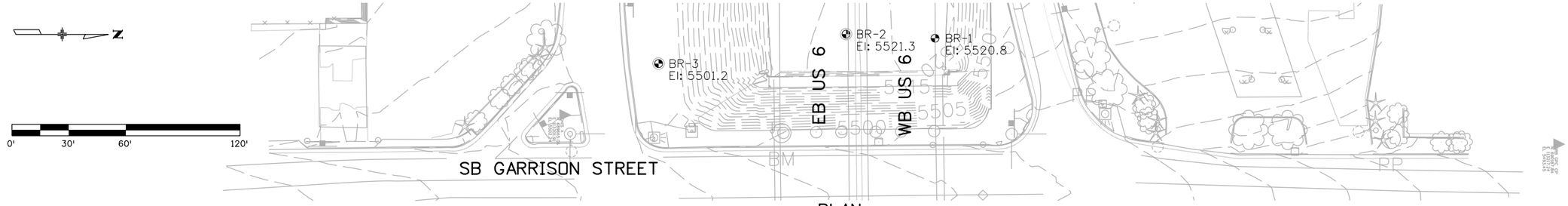

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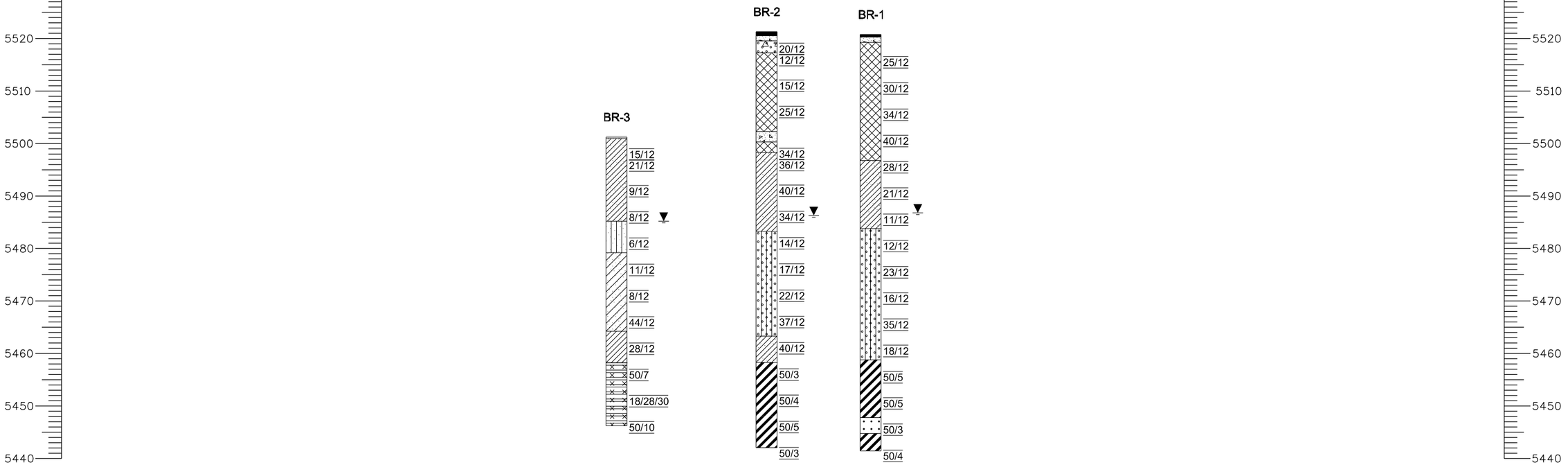


PROFILE

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR-1	4						21.4	104.8	
BR-1	9	32	17	59	CL	A-6 (7)	18.1	108.5	
BR-1	14						19.1	109.8	
BR-1	19						21.8	101.7	0.00
BR-1	24						24.1	99.9	
BR-1	29	52	28	70	CH	A-7-6 (19)	25.9	97.6	
BR-1	34						31.2	91.5	
BR-1	44						25.5	100.8	
BR-1	54						31.3	91.0	
BR-1	59						21.5	109.5	
BR-1	69						33.2	86.7	
BR-1	74						21.0	102.9	
BR-1	79						20.9	107.7	
BR-2	1.4-10	40	21	48	SC	A-6 (6)			0.02
BR-2	2						15.4	103.2	
BR-2	4						24.9	98.2	
BR-2	9						23.9	97.0	
BR-2	14						19.6	109.9	
BR-2	21						24.7	99.0	
BR-2	24						20.6	104.8	
BR-2	29						19.2	109.3	
BR-2	34	38	20	56	CL	A-6 (8)	22.3	104.9	
BR-2	39						31.3	90.0	
BR-2	44						31.8	90.6	
BR-2	49						30.7	91.9	
BR-2	54	40	18	48	SC	A-6 (5)	25.8	97.8	
BR-2	59						21.0	106.9	
BR-2	64	46	22	52	CL	A-7-6 (8)	24.6	96.6	
BR-2	69						26.2	93.8	
BR-2	79						22.7	100.4	
BR-3	1.9-14	40	15	64	CL	A-6 (8)			0.00
BR-3	2						15.3	110.3	
BR-3	4						14.6	117.2	
BR-3	9						16.4	108.4	
BR-3	14						28.6	94.2	
BR-3	19	32	3	54	ML	A-4 (0)	33.1	90.9	
BR-3	24						27.3	97.6	
BR-3	34						25.5	102.1	
BR-3	39						29.8	93.4	0.01
BR-3	44						28.1	98.1	
BR-3	49	59	22	92	MH	A-7-5 (26)	31.5		0.01
BR-3	54						25.3	97.0	

TYPE OF MATERIAL

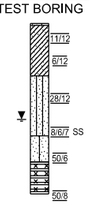
LITHOLOGY

- Asphalt Pavement
- Concrete
- Fill - CLAY
- Fill - SAND
- Native - TOPSOIL
- Native - SAND, silty
- Native - SAND, gravelly
- Native - SAND, clayey
- Native - CLAY
- Native - CLAY, sandy
- Native - SILT, sandy
- Bedrock - CLAYSTONE
- Bedrock - Interbedded SILTSTONE/CLAYSTONE
- Bedrock - SANDSTONE

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



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- Ground Water Level At Time of Drilling
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Print Date: 1/16/2014
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RockSol Project No. 321.01 Unit Leader Initials

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Sheet Revisions

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Region 1 KPB

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Revised:
Void:

US 6 OVER GARRISON STREET
ENGINEERING GEOLOGY

Designer: J. Biller
Detailer: S. McKanna-Koon
Sheet Subset:
Structure Numbers
Subset Sheets: of

Project No./Code
19478
Figure 2B

WORK IN PROGRESS

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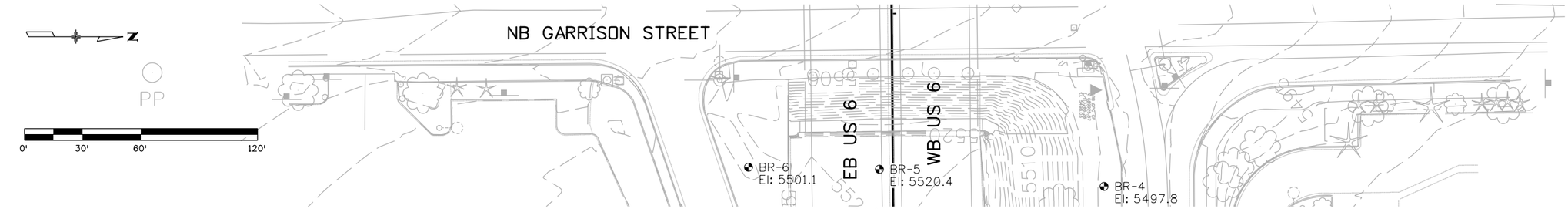

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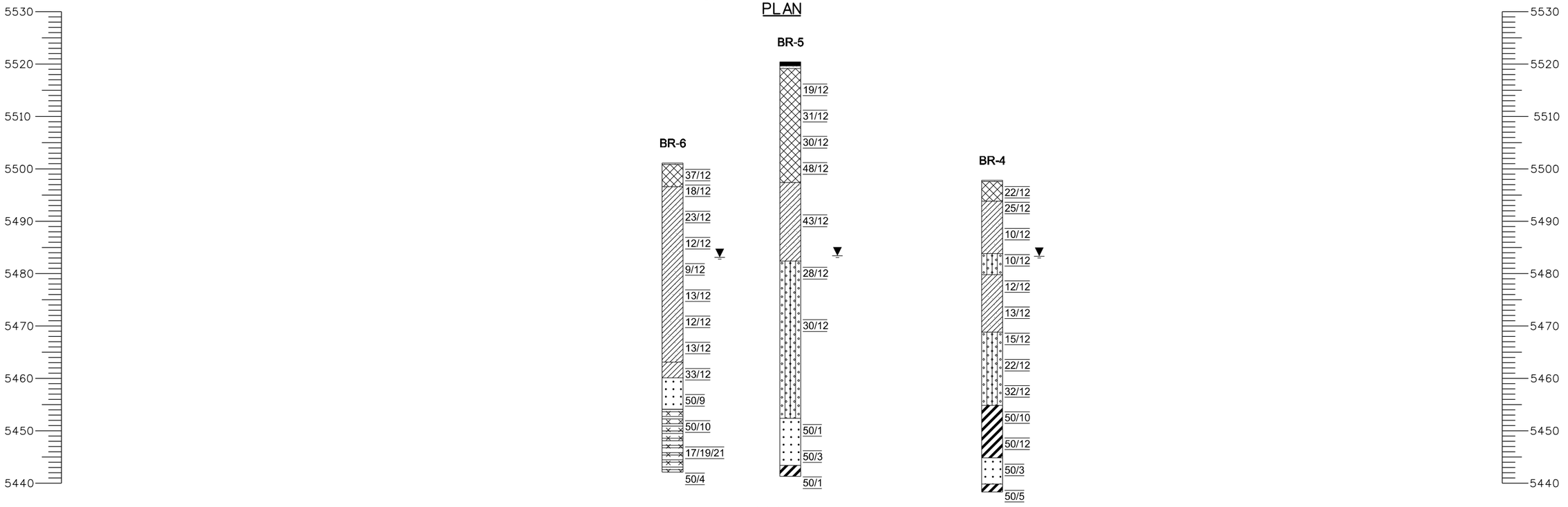


PROFILE

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
BR-4	0-10	46	24	66	CL	A-7-6 (14)			0.02
BR-4	2						13.6	91.8	
BR-4	4						19.8	108.2	0.00
BR-4	9						21.5	100.7	
BR-4	14	39	14	44	SC	A-6 (3)	30.1	98.0	
BR-4	19						29.0	96.9	
BR-4	24						35.6	88.1	
BR-4	29	41	18	47	SC	A-7-6 (5)	29.6	95.6	
BR-4	34						24.0	104.1	
BR-4	39	26	2	20	SM	A-1-b (0)	19.9	110.1	
BR-4	44						22.1	108.8	
BR-4	49	61	32	98	CH	A-7-6 (37)	30.7	92.0	0.01
BR-4	54						22.6	103.1	
BR-4	59						18.2	108.1	
BR-4	74						26.9	96.5	
BR-5	1.25-10	46	27	52	CL	A-7-6 (10)			0.01
BR-5	4						26.7	97.3	
BR-5	9						22.6	103.5	
BR-5	-20								
BR-5	10-20	52	30	60	CH	A-7-6 (16)			0.01
BR-5	14						20.0	107.2	
BR-5	19						17.8	111.1	
BR-5	29						17.0	113.7	
BR-5	49						26.3	97.2	
BR-5	74						26.9	96.5	
BR-6	2	NP		14	SM	A-1-a (0)	3.2	132.6	
BR-6	4						19.2	109.5	0.01
BR-6	9						21.7	103.8	
BR-6	14						24.8	99.8	
BR-6	19						25.1	100.9	
BR-6	24								
BR-6	29						29.8	91.7	
BR-6	34						28.4	94.9	
BR-6	39						21.0	106.0	
BR-6	44						25.4	94.0	
BR-6	49								
BR-6	54	60	21	93	MH	A-7-5 (26)	34.9		

TYPE OF MATERIAL

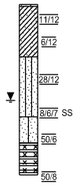
LITHOLOGY

- Asphalt Pavement
- Fill - CLAY
- Native - TOPSOIL
- Native - SAND, gravelly
- Native - CLAY
- Native - SILT, sandy
- Bedrock - Interbedded SILTSTONE/CLAYSTONE
- Concrete
- Fill - SAND
- Native - SAND, silty
- Native - SAND, clayey
- Native - CLAY, sandy
- Bedrock - CLAYSTONE
- Bedrock - SANDSTONE

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



- B — Bridge Borehole
- Ground Water Level At Time of Drilling
- 9/12 — 9 Blows for 12 Inches
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File Name: 19478_Engineering_Geology_NB_Garrison.dgn
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RockSol Project No. 321.01 Unit Leader Initials

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Sheet Revisions		
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Colorado Department of Transportation
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425 B Corporate Circle
Golden, CO 80401
Phone: 720-497-6954 FAX: 720-497-6951
Region 1 KPB

As Constructed
No Revisions:
Revised:
Void:

US 6 OVER GARRISON STREET
ENGINEERING GEOLOGY

Designer: J. Biller
Detailer: S. McKanna-Koon
Sheet Subset:
Structure Numbers
Subset Sheets: of

Project No./Code
19478
Figure 2C

WORK IN PROGRESS

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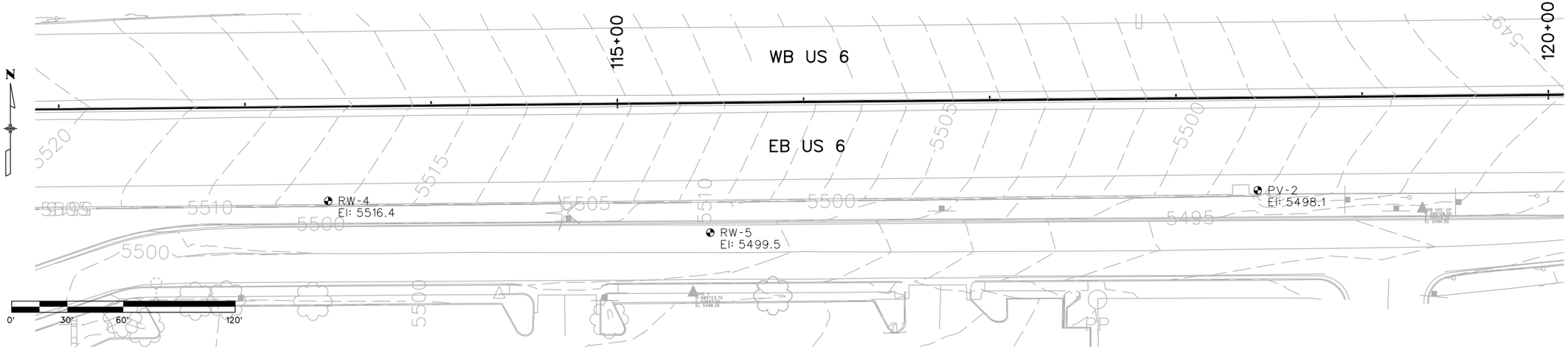

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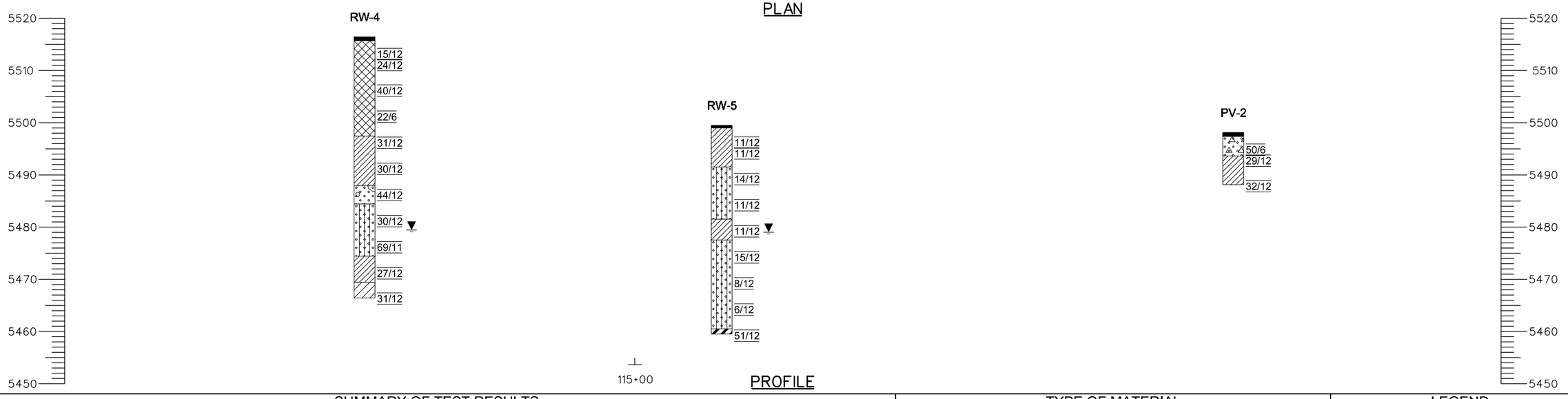


PROFILE

SUMMARY OF TEST RESULTS

Sample ID	Depth (ft)	Liquid Limit	Plasticity Index	%< #200 Sieve	Classification USCS	Classification AASHTO	Water Content (%)	Dry Density (%)	Sulfate (%)
RW-4	2						17.8	112.7	
RW-4	4	37	18	49	SC	A-6 (5)	19.6	107.5	
RW-4	9						9.4	112.6	
RW-4	14						18.6	100.7	
RW-4	19	34	9	27	SM	A-2-4 (0)	16.0	110.0	
RW-4	24						17.7	106.6	0.00
RW-4	29						7.7	116.5	
RW-4	34						28.4	95.8	
RW-4	24						17.7	106.6	0.00
RW-4	29						7.7	116.5	
RW-4	34						28.4	95.8	
RW-4	39						29.1	98.4	
RW-4	44						30.8	89.5	
RW-4	49						31.9	90.7	
RW-5	2						27.9	96.8	
RW-5	4						19.2	104.3	0.00
RW-5	9	36	8	54	ML	A-4 (3)	15.5	104.9	
RW-5	14						21.8	99.9	
RW-5	19						19.0	109.5	
RW-5	39						26.3	100.6	
PV-2	0.75-5	38	22	87	CL	A-6 (19)			0.00
PV-2	2						5.7	125.2	
PV-2	4						23.4	102.0	
PV-2	9						22.5	10.1	

TYPE OF MATERIAL

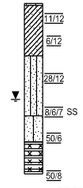
LITHOLOGY

- Asphalt Pavement
- Concrete
- Fill - CLAY
- Fill - SAND
- Native - TOPSOIL
- Native - SAND, silty
- Native - SAND, gravelly
- Native - SAND, clayey
- Native - CLAY
- Native - CLAY, sandy
- Native - SILT, sandy
- Bedrock - CLAYSTONE
- Bedrock - Interbedded SILTSTONE/CLAYSTONE
- Bedrock - SANDSTONE

SEE INDIVIDUAL LOG SHEETS FOR ADDITIONAL DESCRIPTION OF MATERIAL ENCOUNTERED

LEGEND

TEST BORING



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US 6 OVER GARRISON STREET
ENGINEERING GEOLOGY

Designer: J. Biller
Detailer: S. McKanna-Koon
Sheet Subset:
Structure Numbers
Subset Sheets: of

Project No./Code
19478
Figure 2D

WORK IN PROGRESS

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APPENDIX A

LEGEND
AND
INDIVIDUAL BOREHOLE LOGS

LEGEND

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

LITHOLOGY

- Asphalt Pavement
- Concrete Pavement
- Fill - CLAY and SAND
- Fill - SAND, sitly to clayey with gravel
- TOPSOIL
- Native - SAND, silty
- Native - SAND, gravelly
- Native - SAND, clayey
- Native - CLAY
- Native - CLAY, sandy
- Native - SILT, sandy
- Bedrock - CLAYSTONE
- Bedrock - Interbedded SILTSTONE/CLAYSTONE
- Bedrock - SANDSTONE

SAMPLE TYPE

MODIFIED CALIFORNIA SAMPLER
2.5" O.D. AND 2" I.D.
WITH BRASS LINERS INCLUDED

SPLIT SPOON SAMPLER
2" O.D. AND 1 3/8" I.D.
NO LINERS

15/12 Indicates 15 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 12 inches.

50/11 Indicates 50 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 11 inches.

5,5,5 Indicates 5 blows, 5 blows, 5 blows of a 140 pound hammer falling 30 inches was required to drive the sampler 18 inches.

▼ GROUND WATER LEVEL NOTED AT THE TIME OF DRILLING

RockSol Consulting Group, Inc.

BORING : BR-1

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/17/13 **COMPLETED** 9/17/13
GROUND ELEVATION 5520.8 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689860.5 **EAST** 113161.6
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: US6 WB Outside Shoulder West of Garrison
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH 34.0 ft on 9/17/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5521	0		Asphalt Pavement, approximately 5"										
			Concrete Pavement, approximately 10.25"										
			(Fill) CLAY, sandy with gravel in parts, moist, grey and brown, very stiff to hard										
5516	5		(US 6 Embankment)	MC	25/12	1.8		104.8	21.4				
5511	10			MC	30/12			108.5	18.1	32	15	17	59.2
5506	15			MC	34/12			109.8	19.1				
5501	20			MC	40/12		0.00	101.7	21.8				
5496	25		(Native) CLAY, sandy, very moist to wet, light brown, very stiff to stiff	MC	28/12			99.9	24.1				
5491	30			MC	21/12			97.6	25.9	52	24	28	70.2
5486	35			MC	11/12			91.5	31.2				

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5486	35		(Native) CLAY, sandy, very moist to wet, light brown, very stiff to stiff *(continued)*										
			(Native) SAND, silty to slightly clayey, wet, light brown, medium dense										
5481	40			MC	12/12								
5476	45			MC	23/12			100.8	25.5				
5471	50			MC	16/12								
5466	55			MC	35/12			91.0	31.3				
5461	60			MC	18/12			109.5	21.5				
			(Bedrock) CLAYSTONE, silty, slightly moist, brown and grey, very hard										
5456	65			MC	50/5								
5451	70			MC	50/5			86.7	33.2				
			(Bedrock) SANDSTONE, clayey, slightly moist, brown, very hard										
5446	75			MC	50/3			102.9	21.0				

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5446	75		(Bedrock) CLAYSTONE, moist, grey, very hard	MC	50/4	2.4		107.7	20.9				
			Bottom of hole at 79.3 feet.										

RockSol Consulting Group, Inc.

BORING : BR-2

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/16/13 **COMPLETED** 9/16/13
GROUND ELEVATION 5521.3 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689813.7 **EAST** 113159.5
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: EB US 6, Lane 1, West Side of Garrison
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH 35.0 ft on 9/16/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5521	0		Asphalt Pavement approximately 7.5"										
			Concrete Pavement approximately 9.5"				0.02			40	19	21	47.9
			(Fill) SAND, silty to slightly clayey, moist, brown, medium dense	MC	20/12			103.2	15.4				
5516	5		(Fill) CLAY, with sand to sandy, very moist, brown and grey, stiff to very stiff	MC	12/12	0.2		98.2	24.9				
			(US 6 Embankment)										
5511	10			MC	15/12			97.0	23.9				
5506	15			MC	25/12			109.9	19.6				
5501	20		Concrete Debris										
			(Fill) CLAY, sandy, moist, brown, hard					99.0	24.7				
				MC	34/12								
			(Native) CLAY, sandy, moist, brown, hard	MC	36/12			104.8	20.6				
5496	25												
5491	30			MC	40/12			109.3	19.2				
5486	35		▼	MC	34/12			104.9	22.3	38	18	20	56.1

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

RockSol Consulting Group, Inc.

BORING : BR-2

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5481	40		(Native) SAND, silty to clayey, moist to wet, brown, medium dense to dense	MC	14/12			90.0	31.3				
5476	45			MC	17/12			90.6	31.8				
5471	50			MC	22/12			91.9	30.7				
5466	55			MC	37/12			97.8	25.8	40	22	18	47.6
5461	60		(Native) CLAY, sandy, very moist, brown, hard	MC	40/12			106.9	21.0				
5456	65		(Bedrock) CLAYSTONE, sandy in parts, very moist, brown, and grey, very hard	MC	50/3			96.6	24.6	46	24	22	51.8
5451	70			MC	50/4	1.4		93.8	26.2				
5446	75			MC	50/5								
			Bottom of hole at 79.3 feet.	MC	50/3			100.4	22.7				

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

RockSol Consulting Group, Inc.

BORING : BR-3

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/3/13 **COMPLETED** 9/3/13
GROUND ELEVATION 5501.2 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689715.1 **EAST** 113174.9
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: South West Corner of US 6 and Garrison
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES Bottom of Embankment at west side of US 6 bridge over Garrison
WATER DEPTH 16.0 ft on 9/3/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5501	0		Topsoil, SILT, sandy, slightly moist, light brown, soft, approximately 3"										
			(Native) CLAY, sandy to very sandy with clayey sand in parts, moist to very moist to wet, brown, stiff to medium stiff	MC	15/12	2.7	0.00	110.3	15.3	40	25	15	63.8
5496	5			MC	21/12	2.7		117.2	14.6				
5491	10			MC	9/12	-0.3		108.4	16.4				
5486	15			MC	8/12	-0.7		94.2	28.6				
			(Native) SILT, sandy and clayey in parts, wet, brown, loose										
5481	20			MC	6/12			90.9	33.1	32	29	3	54.4
			(Native) SAND, clayey, wet, brown, medium dense										
5476	25			MC	11/12	-0.4		97.6	27.3				
5471	30			MC	8/12								
5466	35			MC	44/12			102.1	25.5				

RockSol Consulting Group, Inc.

BORING : BR-3

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5466	35		(Native) SAND, clayey, wet, brown, medium dense *(continued)*										
			(Native) CLAY, sandy, weathered claystone, moist, grey, very stiff										
5461	40			MC	28/12		0.01	93.4	29.8				
			(Bedrock) CLAYSTONE with INTERBEDED SILTSTONE, silty to sandy in parts, moist, grey brown, very hard										
5456	45			MC	50/7			98.1	28.1				
5451	50			SS	18/28/30		0.01		31.5	59	37	22	92.0
				MC	50/10			97.0	25.3				
			Bottom of hole at 54.8 feet.										

RockSol Consulting Group, Inc.

BORING : BR-4

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/4/13 **COMPLETED** 9/4/13
GROUND ELEVATION 5497.8 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689930.7 **EAST** 113335.7
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: North East Corner of 6th and Garrison
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH 14.5 ft on 9/4/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5498	0		Topsoil, CLAY, sandy, moist, brown, soft, approximately 3" in thickness				0.02			46	22	24	66.2
			(Fill) CLAY, sandy, moist, brown, very stiff	MC	22/12			91.8	13.6				
5493	5		(Native) CLAY, sandy, slightly moist to moist, brown, very stiff to stiff	MC	25/12	1.1	0.00	108.2	19.8				
5488	10			MC	10/12			100.7	21.5				
5483	15		(Native) SAND, silty to clayey, wet, brown, medium dense	MC	10/12			98.0	30.1	39	25	14	44.3
5478	20		(Native) CLAY, sandy with silty SAND in parts, moist to very moist, brown to dark brown, very stiff	MC	12/12			96.9	29.0				
5473	25			MC	13/12			88.1	35.6				
5468	30		(Native) SAND, silty to clayey with clay and gravel in parts, wet, brown, very stiff to dense	MC	15/12			95.6	29.6	41	23	18	47.4
5463	35			MC	22/12			104.1	24.0				

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

RockSol Consulting Group, Inc.

BORING : BR-4

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5463	35		(Native) SAND, silty to clayey with clay and gravel in parts, wet, brown, very stiff to dense *(continued)*										
5458	40			MC	32/12			110.1	19.9	26	24	2	20.4
5453	45		(Bedrock) CLAYSTONE, sandy silty in parts, very moist, brown and grey, very hard	MC	50/10			108.8	22.1				
5448	50			MC	50/12		0.01	92.0	30.7	61	29	32	97.6
5443	55		(Bedrock) SANDSTONE, clayey, slightly moist, light brown, very hard	MC	50/3			103.1	22.6				
			(Bedrock) CLAYSTONE, silty in parts, slightly moist, olive brown grey, very hard	MC	50/5			108.1	18.2				
			Bottom of hole at 59.5 feet.					96.5	26.9				

RockSol Consulting Group, Inc.

BORING : BR-5

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/16/13 **COMPLETED** 10/1/13
GROUND ELEVATION 5520.4 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689815.1 **EAST** 113326.9
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: EB US6, Lane 1, East Side of Garrison
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH 37.0 ft on 9/16/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5520	0		Asphalt Pavement, approximately 8.25"										
			Concrete Pavement approximately 8.5"				0.01			46	19	27	52.2
			Asphalt Pavement, approximately 3.25"										
			(Fill) CLAY, sandy, organics in parts, very moist, grey and brown, very stiff to hard										
5515	5		(US 6 Embankment)	MC	19/12	0.3		97.3	26.7				
5510	10			MC	31/12		0.01	103.5	22.6	52	22	30	60.2
5505	15			MC	30/12			107.2	20.0				
5500	20			MC	48/12			111.1	17.8				
5495	25		(Native) CLAY, sandy, moist, brown, hard										
5490	30			MC	43/12			113.7	17.0				
5485	35												

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5485	35		(Native) CLAY, sandy, moist, brown, hard *(continued)*										
			(Native) SAND, silty to clayey, wet, brown, medium dense										
5480	40			MC	28/12								
5475	45												
5470	50			MC	30/12			97.2	26.3				
5465	55												
5460	60												
5455	65												
			(Bedrock) SANDSTONE, clayey, moist, light brown, very hard										
5450	70			MC	50/1								
5445	75			MC	50/3			96.5	26.9				

RockSol Consulting Group, Inc.

BORING : BR-5

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5445	75		(Bedrock) SANDSTONE, clayey, moist, light brown, very hard *(continued)*										
			(Bedrock) CLAYSTONE, wet, grey, very hard										
			Bottom of hole at 79.1 feet.	MC	50/1								

RockSol Consulting Group, Inc.

BORING : BR-6

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/3/13 **COMPLETED** 9/3/13
GROUND ELEVATION 5501.1 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689747.7 **EAST** 113325.9
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: South East Corner at US 6 and Garrison
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH 18.0 ft on 9/3/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5501	0		Topsoil, SILT, sandy, slightly moist, light brown, soft										
			(Fill) SAND, silty with gravel, slightly moist, light brown, dense	MC	37/12			132.6	3.2	NP	NP	NP	14.1
5496	5		(Native) CLAY, sandy to very sandy, silty sandy in parts, moist to very moist, brown and grey, very stiff	MC	18/12	2.1	0.01	109.5	19.2				
5491	10			MC	23/12	1.2		103.8	21.7				
5486	15			MC	12/12	-0.3		99.8	24.8				
5481	20			MC	9/12	-0.5		100.9	25.1				
5476	25			MC	13/12	-0.3		94.5	29.9				
5471	30			MC	12/12	-1.0		91.7	29.8				
5466	35			MC	13/12		0.02	96.2	27.7				

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/8/14

RockSol Consulting Group, Inc.

BORING : BR-6

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5466	35		(Native) CLAY, sandy to very sandy, silty sandy in parts, moist to very moist, brown and grey, very stiff *(continued)*										
			(Native) CLAY, weathered claystone, silty in parts, moist, grey and brown, hard										
5461	40			MC	33/12			94.9	28.4				
			(Bedrock) SANDSTONE, clayey, moist, light brown, very hard										
5456	45			MC	50/9			106.0	21.0				
			(Bedrock) CLAYSTONE with INTERBEDED SILTSTONE, silty in parts, moist to very moist, brown, very hard										
5451	50			MC	50/10			94.0	25.4				
5446	55			SS	17/19/21				34.9	60	39	21	93.3
			Bottom of hole at 59.3 feet.	MC	50/4								

RockSol Consulting Group, Inc.

BORING : PV-1

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/17/13 **COMPLETED** 9/17/13
GROUND ELEVATION 5513.3 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689853.7 **EAST** 112576.0
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: WB US6 Shoulder 600' West of Garrison Bridge
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH None Encountered on 9/17/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5513	0		Asphalt Pavement, approximately 7.25"										
			Concrete Pavement, approximately 7 1/8"				0.00			46	22	24	47.6
			(Fill) SAND, silty to clayey with gravel, moist, brown, very dense	MC	62/12			119.9	6.0				
5508	5		(Native) CLAY, sandy, very moist to moist, brown, very stiff	MC	26/12	0.0		99.5	22.4				
5503	10			MC	19/12			89.5	30.1				
			Bottom of hole at 10.0 feet.										

RockSol Consulting Group, Inc.

BORING : PV-2

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 10/1/13 **COMPLETED** 10/1/13
GROUND ELEVATION 5498.1 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689778.7 **EAST** 113990.9
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: Shoulder US 6 EB
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH None Encountered on 10/1/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5498	0		Asphalt Pavement, Approximately 7.5"				0.00			38	16	22	86.6
			(Fill) SAND, gravel, moist, black and dark brown, dense	MC	50/6			125.2	5.7				
5493	5		(Native) CLAY, with sand to sandy, moist, grey and brown, very stiff	MC	29/12	0.7		102.0	23.4				
5488	10			MC	32/12			10.1	22.5				
			Bottom of hole at 10.0 feet.										

RockSol Consulting Group, Inc.

BORING : RW-1

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/19/13 **COMPLETED** 9/19/13
GROUND ELEVATION 5514.0 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689858.9 **EAST** 112762.2
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: WB US6 Shoulder 400' West of Garrison
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH 21.0 ft on 9/19/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5514	0		Asphalt Pavement, approximately 9.25"										
			(Fill) CLAY and SAND, sandy, silty to gravelly, very moist, grey, stiff to very hard	MC	14/12	0.8		106.2	20.6				
5509	5			MC	50/12			138.1	3.0				
5504	10		(Native) CLAY, sandy to silty, moist to wet, dark grey and brown, very stiff to stiff	MC	16/12	0.0		97.7	25.4				
5499	15			MC	10/12	0.5	0.00	96.5	26.0				
5494	20			MC	14/12			92.3	29.1				
5489	25			MC	6/12	0.6		85.1	37.4				
5484	30		(Native) SAND, silty, very moist to wet, brown, loose	MC	7/12			90.3	30.2				
			Bottom of hole at 30.0 feet.										

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

RockSol Consulting Group, Inc.

BORING : RW-2

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/17/13 **COMPLETED** 9/19/13
GROUND ELEVATION 5518.9 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689860.4 **EAST** 112982.7
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: WB US6 Shoulder 200' West of Garrison Bridge
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH None Encountered on 9/17/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5519	0		Asphalt Pavement approximately 4"				0.01			38	20	18	43.9
			Concrete Pavement, approximately 7.5"										
			(Fill) CLAY, sandy, very moist, brown, very stiff to hard	MC	19/12	0.5		108.9	18.6				
5514	5			MC	50/5	0.7		110.7	17.3				
			Hit concrete at approximately 5' and stopped drilling. Borehole location offset 5 feet northwest and drilled 9/19/2013.										
			(Fill) SAND, silty to clayey with gravel, very sandy with silty sand, moist, dark grey and brown, medium dense to hard										
5509	10			MC	18/12			111.6	11.4	31	15	16	29.8
5504	15			MC	30/12	0.0	0.01	111.9	14.5				
			(Native) CLAY, sandy to silty with silty sand in parts, very moist to wet, brown, very stiff										
5499	20			MC	25/12			105.4	20.4	47	20	27	76.1
5494	25			MC	15/12			105.4	17.9				
5489	30			MC	10/12	-0.2		103.2	22.9				
5484	35			MC	14/12								

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5484	35		(Native) CLAY, sandy to silty with silty sand in parts, very moist to wet, brown, very stiff *(continued)*										
5479	40			MC	14/12			99.7	24.6				
			Bottom of hole at 40.0 feet.										

RockSol Consulting Group, Inc.

BORING : RW-3

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/4/13 **COMPLETED** 9/4/13
GROUND ELEVATION 5504.8 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689717.4 **EAST** 112929.2
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: Off ramp form EB 6th to Garrison
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH 14.0 ft on 9/4/25013

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5505	0		Topsoil, SAND, gravelly, slightly moist, brown, loose, approximately 6"				0.00			43	20	23	54.3
			(Fill) CLAY, sandy with gravel in parts, moist, dark brown, very stiff	MC	20/12		0.00	117.8	10.1	NP	NP	NP	46.9
			(Native) CLAY, sandy, moist, brown, very stiff										
5500	5			MC	28/12	1.4		108.8	19.7				
5495	10			MC	17/12	-0.1		107.2	18.7				
			(Native) SAND, silty to clayey with gravel, sandy with clay in parts, silty to clayey, very moist to wet, medium dense										
5490	15			MC	12/12	-0.4		97.7	25.9	40	23	17	38.2
5485	20			MC	12/12			97.2	27.3				
5480	25			MC	12/12			96.0	30.7				
5475	30			MC	13/12								
			Bottom of hole at 30.0 feet.										

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

RockSol Consulting Group, Inc.

BORING : RW-4

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 10/1/13 **COMPLETED** 10/1/13
GROUND ELEVATION 5516.4 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689773.0 **EAST** 113491.7
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: Shoulder Pavement EB US6, 100' East of Garrison St.
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES
WATER DEPTH 37.0 ft on 10/1/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5516	0		Asphalt Pavement, approximately 7.75"										
			(Fill) CLAY, sandy with trace gravel, moist, grey and dark brown, very stiff	MC	15/12	0.1		112.7	17.8				
5511	5			MC	24/12			107.5	19.6	37	19	18	48.8
5506	10			MC	40/12			112.6	9.4				
5501	15			MC	22/6			100.7	18.6				
			Concrete rubble encountered between 16' and 19'										
5496	20		(Native) CLAY, sandy, gravelly, moist, brown, very stiff	MC	31/12			110.0	16.0	34	25	9	27.1
5491	25			MC	30/12	-0.3	0.00	106.6	17.7				
5486	30		(Native) SAND, gravelly, moist, light brown, dense	MC	44/12			116.5	7.7				
5481	35		(Native) SAND, silty with clay, moist to wet, light brown, medium dense to dense	MC	30/12	-0.2		95.8	28.4				

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5481	35		(Native) SAND, silty with clay, moist to wet, light brown, medium dense to dense *(continued)*										
5476	40			MC	69/11			98.4	29.1				
			(Native) CLAY, sandy, wet, light brown, very stiff										
5471	45			MC	27/12			89.5	30.8				
			(Native) SAND, clayey, wet, light brown, medium dense										
5466	50							90.7	31.9				
			Bottom of hole at 50.0 feet.	MC	31/12								

RockSol Consulting Group, Inc.

BORING : RW-5

CLIENT CH2M HILL
PROJECT NAME US 6 over Garrison Final Design
PROJECT NUMBER 321.01
PROJECT LOCATION Lakewood, CO
DATE STARTED 9/19/13 **COMPLETED** 9/19/13
GROUND ELEVATION 5499.5 ft
DRILLING CONTRACTOR Dakota Drilling
NORTH 689755.9 **EAST** 113696.9
DRILLING METHOD Solid Stem Auger **HOLE SIZE** 4"
BORING LOCATION: US6 SE Frontage Road
LOGGED BY J. Biller
GROUND WATER LEVELS:
NOTES EB US6 Frontage Road, Inside Lane
WATER DEPTH 20.5 ft on 9/19/13

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
5500	0		Asphalt Pavement, approximately 6"										
			(Native) CLAY, sandy, very moist, brown, stiff	MC	11/12	3.0		96.8	27.9				
5495	5			MC	11/12	0.1	0.00	104.3	19.2				
			(Native) SAND, silty, clayey in parts, very moist, brown, medium dense										
5490	10			MC	14/12			104.9	15.5	36	28	8	54.3
5485	15			MC	11/12			99.9	21.8				
			(Native) CLAY, sandy to silty, very moist, brown, stiff										
5480	20			MC	11/12			109.5	19.0				
			(Native) SAND, silty to clayey with sandy clay in parts, very moist to wet, brown, loose to medium dense										
5475	25			MC	15/12								
5470	30			MC	8/12								
5465	35			MC	6/12								

LOG - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 1/7/14

RockSol Consulting Group, Inc.

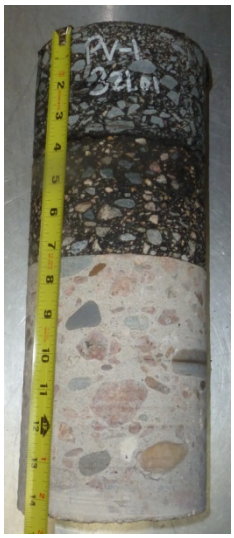
CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

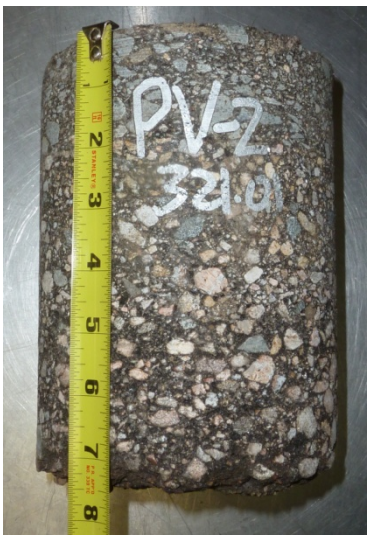
PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO

ELEVATION (ft)	DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS	SWELL POTENTIAL (%)	SULFATE (%)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
										LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
5465	35		(Native) SAND, silty to clayey with sandy clay in parts, very moist to wet, brown, loose to medium dense *(continued)*										
5460	40		(Bedrock) CLAYSTONE, silty in parts, moist, brown and grey, very hard	MC	51/12			100.6	26.3				
			Bottom of hole at 40.0 feet.										

APPENDIX B

PAVEMENT CORE LOG SUMMARY

CORE ID: PV-1	**General Location: WB US 6, Station 104+30, Lane 3 (At Borehole PV-1)**
	Thickness of Asphalt Pavement: 7 ¼ inches Thickness of Concrete Pavement: 7 ⅛ inches Number of Identifiable Asphalt layers: 3 1. 3 ½ inches (top) 2. 1 ¾ inches 3. 2 inches Condition of Asphalt: Fair Condition of Concrete: good Comments: No visible signs of de-laminating or raveling, slight loss of fines in lower asphalt layers.

CORE ID: PV-2	**General Location: EB US 6, Station 118+45, Outside Shoulder (At Borehole PV-2)**
	Thickness of Asphalt Pavement: 7 ½ inches Number of Identifiable Asphalt layers: 4 1. 1 ⅞ inches (top) 2. 2 ⅛ inches 3. 1 ⅜ inches 4. 2 ⅛ inches Condition of Asphalt: Fair Comments: Minor loss of fines, slight raveling at bottom.

CORE ID: RW-1 General Location: WB US 6, Station 106+15, Outside Shoulder (At Borehole RW-1)	
	Thickness of Asphalt Pavement: 9 ¼ inches Number of Identifiable Asphalt layers: 4 1. 1 ½ inches (top) 2. 3 inches 3. 1 ½ inches 4. 3 ½ inches Condition of Concrete: Fair to Poor Comments: Significant Loss of fines, and raveling at bottom, delamination and raveling at layer interface.

CORE ID: RW-2 General Location: WB US 6, Station 108+35, Outside Shoulder (At Borehole RW-2)	
	Thickness of Asphalt Pavement: 4 inches Thickness of Concrete Pavement: 7 ½ inches Number of Identifiable Asphalt layers: 2 1. 1 ¾ inches (top) 2. 2 ¼ inches Condition of Asphalt: Fair Condition of Concrete: Good Comments: Minor loss of fines throughout, raveling in lower asphalt later. No signs of delamination.

CORE ID: RW-4 **General Location: EB US 6, Station 113+45, Outside Shoulder (At Borehole RW-4)**	
	Thickness of Asphalt Pavement: 7 ¾ inches Number of Identifiable Asphalt layers: 4 1. 1 inches (top) 2. 1 ⅞ inches 3. 1 ⅞ inches 4. 3 inches Condition of Asphalt: Fair to Poor Comments: Major signs of raveling and loss of fines, delamination between lower layers of pavement.

CORE ID: BR-1 **General Location: WB US 6, Station 110+15, Outside Shoulder (At Borehole BR-1)**	
	Thickness of Asphalt Pavement: 5 inches Thickness of Concrete Pavement: 10 ¼ inches Number of Identifiable Asphalt layers: 2 1. 2 ⅝ inches (top) 2. 2 ⅜ inches Condition of Asphalt: Fair to Poor Condition of Concrete: Good Comments: Minor loss of fines (asphalt), and some raveling at bottom, delamination between layers, lower layer of asphalt fell apart when removing core.

CORE ID: BR-2 General Location: EB US 6 , Station 110+10, Lane 1 (At Borehole BR-2)

Thickness of Asphalt Pavement: 7 ½ inches
Thickness of Concrete Pavement: 9 ½ inches
Number of Identifiable Asphalt layers: 3

1. 2 ¾ inches (top)
2. 1 ½ inches
3. 3 ¼ inches

Condition of Asphalt: Fair to Poor
Condition of Concrete: Good
Comments: Loss of fines throughout asphalt, cracking in lower layers of asphalt, delamination present between lower asphalt and concrete, raveling visible in lower asphalt layer.

CORE ID: BR-5 General Location: EB US 6, Station 111+80, Lane 1 (At Borehole BR-5)

Thickness of Upper Asphalt Pavement: 8 ¼ inches
Thickness of Concrete Pavement: 8 ½ inches
Thickness of Lower Asphalt Pavement: 3 ¼ inches
Number of Identifiable Asphalt layers: 4

1. 3 ⅛ inches (top)
2. 2 ⅜ inches
3. 2 ¾ inches
4. 3 ¼ inches (lower)

Condition of Asphalt: Fair to Poor
Comments: Moderate loss of fines throughout. Visible signs, of raveling and delamination.

APPENDIX C

LABORATORY TEST RESULTS

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT CH2M HILL

PROJECT NAME US 6 over Garrison Final Design

PROJECT NUMBER 321.01

PROJECT LOCATION Lakewood, CO

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
BR-1	4				1.8				21.4	104.8								
BR-1	9	32	15	17		59	CL	A-6 (7)	18.1	108.5								
BR-1	14								19.1	109.8								
BR-1	19								21.8	101.7		0.00		7.3	0.01			
BR-1	24								24.1	99.9								
BR-1	29	52	24	28		70	CH	A-7-6 (19)	25.9	97.6								
BR-1	34								31.2	91.5								
BR-1	44								25.5	100.8								
BR-1	54								31.3	91.0								
BR-1	59								21.5	109.5								
BR-1	69								33.2	86.7	43.7							
BR-1	74								21.0	102.9								
BR-1	79				2.4				20.9	107.7								
BR-2	1.4-10	40	19	21		48	SC	A-6 (6)				0.02	370 oHM-CM @ 23.5%	7.3	0.06			
BR-2	2								15.4	103.2								
BR-2	4				0.2				24.9	98.2								
BR-2	9								23.9	97.0								
BR-2	14								19.6	109.9								
BR-2	21								24.7	99.0								
BR-2	24								20.6	104.8								
BR-2	29								19.2	109.3								
BR-2	34	38	18	20		56	CL	A-6 (8)	22.3	104.9								
BR-2	39								31.3	90.0								
BR-2	44								31.8	90.6								
BR-2	49								30.7	91.9								
BR-2	54	40	22	18		48	SC	A-6 (5)	25.8	97.8								
BR-2	59								21.0	106.9								
BR-2	64	46	24	22		52	CL	A-7-6 (8)	24.6	96.6								
BR-2	69				1.4				26.2	93.8								
BR-2	79								22.7	100.4								

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT CH2M HILL

PROJECT NAME US 6 over Garrison Final Design

PROJECT NUMBER 321.01

PROJECT LOCATION Lakewood, CO

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
BR-3	1.9-14	40	25	15		64	CL	A-6 (8)				0.00		6.9	0.01			
BR-3	2				2.7				15.3	110.3								
BR-3	4				2.7				14.6	117.2								
BR-3	9				-0.3				16.4	108.4								
BR-3	14				-0.7				28.6	94.2								
BR-3	19	32	29	3		54	ML	A-4 (0)	33.1	90.9								
BR-3	24				-0.4				27.3	97.6								
BR-3	34								25.5	102.1								
BR-3	39								29.8	93.4		0.01						
BR-3	44								28.1	98.1								
BR-3	49	59	37	22		92	MH	A-7-5 (26)	31.5			0.01						
BR-3	54								25.3	97.0	83.0							
BR-4	0-10	46	22	24		66	CL	A-7-6 (14)				0.02	575 Ohm-cm @ 31.1%	7.6	0.01			
BR-4	2								13.6	91.8								
BR-4	4				1.1				19.8	108.2		0.00						
BR-4	9								21.5	100.7								
BR-4	14	39	25	14		44	SC	A-6 (3)	30.1	98.0								
BR-4	19								29.0	96.9								
BR-4	24								35.6	88.1								
BR-4	29	41	23	18		47	SC	A-7-6 (5)	29.6	95.6								
BR-4	34								24.0	104.1								
BR-4	39	26	24	2		20	SM	A-1-b (0)	19.9	110.1								
BR-4	44								22.1	108.8								
BR-4	49	61	29	32		98	CH	A-7-6 (37)	30.7	92.0		0.01						
BR-4	54								22.6	103.1								
BR-4	59								18.2	108.1	65.7							
BR-4	74								26.9	96.5								
BR-5	1.25-10	46	19	27		52	CL	A-7-6 (10)				0.01	360 Ohm-cm @ 28.8%	7.2	0.07			
BR-5	4				0.3				26.7	97.3								
BR-5	9								22.6	103.5								

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT CH2M HILL

PROJECT NAME US 6 over Garrison Final Design

PROJECT NUMBER 321.01

PROJECT LOCATION Lakewood, CO

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
BR-5	-20														0.05			
BR-5	10-20	52	22	30		60	CH	A-7-6 (16)				0.01	380 Ohm-cm @ 30.8%	7.0				
BR-5	14								20.0	107.2								
BR-5	19								17.8	111.1								
BR-5	29								17.0	113.7								
BR-5	49								26.3	97.2								
BR-5	74								26.9	96.5								
BR-6	2	NP	NP	NP		14	SM	A-1-a (0)	3.2	132.6								
BR-6	4				2.1				19.2	109.5		0.01						
BR-6	9				1.2				21.7	103.8								
BR-6	14				-0.3				24.8	99.8								
BR-6	19				-0.5				25.1	100.9								
BR-6	24				-0.3				29.9	94.5								
BR-6	29				-1.0				29.8	91.7								
BR-6	34								27.7	96.2		0.02						
BR-6	39								28.4	94.9								
BR-6	44								21.0	106.0								
BR-6	49								25.4	94.0	86.1							
BR-6	54	60	39	21		93	MH	A-7-5 (26)	34.9									
PV-1	1.25-10	46	22	24		48	SC	A-7-6 (8)				0.00	360 Ohm-cm @ 29.1%	7.7	0.06			
PV-1	2								6.0	119.9								
PV-1	4				0.0				22.4	99.5								
PV-1	9								30.1	89.5								
PV-2	0.75-5	38	16	22		87	CL	A-6 (19)				0.00						
PV-2	2								5.7	125.2								
PV-2	4				0.7				23.4	102.0								
PV-2	9								22.5	10.1								
RW-1	2				0.8				20.6	106.2								
RW-1	4								3.0	138.1								
RW-1	9				0.0				25.4	97.7								

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT CH2M HILL

PROJECT NAME US 6 over Garrison Final Design

PROJECT NUMBER 321.01

PROJECT LOCATION Lakewood, CO

Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
RW-1	14				0.5				26.0	96.5		0.00						
RW-1	19								29.1	92.3								
RW-1	24				0.6				37.4	85.1								
RW-1	29								30.2	90.3								
RW-2	1-5	38	20	18		44	SC	A-6 (4)				0.01	430 Ohm-cm @ 25.8%	8.0	0.05			
RW-2	2				0.5				18.6	108.9								
RW-2	4				0.7				17.3	110.7								
RW-2	9	31	15	16		30	SC	A-2-6 (1)	11.4	111.6								
RW-2	14				0.0				14.5	111.9		0.01						
RW-2	19	47	20	27		76	CL	A-7-6 (20)	20.4	105.4								
RW-2	24								17.9	105.4								
RW-2	29				-0.2				22.9	103.2								
RW-2	39								24.6	99.7								
RW-3	0-10	43	20	23		54	CL	A-7-6 (9)				0.00	675 Ohm-cm @ 21.2%	7.3	0.04			
RW-3	2	NP	NP	NP		47	SM	A-4 (0)	10.1	117.8		0.00						
RW-3	4				1.4				19.7	108.8								
RW-3	9				-0.1				18.7	107.2								
RW-3	14	40	23	17	-0.4	38	SC	A-6 (2)	25.9	97.7								
RW-3	19								27.3	97.2								
RW-3	24								30.7	96.0								
RW-4	2				0.1				17.8	112.7								
RW-4	4	37	19	18		49	SC	A-6 (5)	19.6	107.5								
RW-4	9								9.4	112.6								
RW-4	14								18.6	100.7								
RW-4	19	34	25	9		27	SM	A-2-4 (0)	16.0	110.0								
RW-4	24				-0.3				17.7	106.6		0.00						
RW-4	29								7.7	116.5								
RW-4	34				-0.2				28.4	95.8								
RW-4	39								29.1	98.4								
RW-4	44								30.8	89.5								

RockSol Consulting Group, Inc.

SUMMARY OF PHYSICAL & CHEMICAL TEST RESULTS

CLIENT CH2M HILL

PROJECT NAME US 6 over Garrison Final Design

PROJECT NUMBER 321.01

PROJECT LOCATION Lakewood, CO

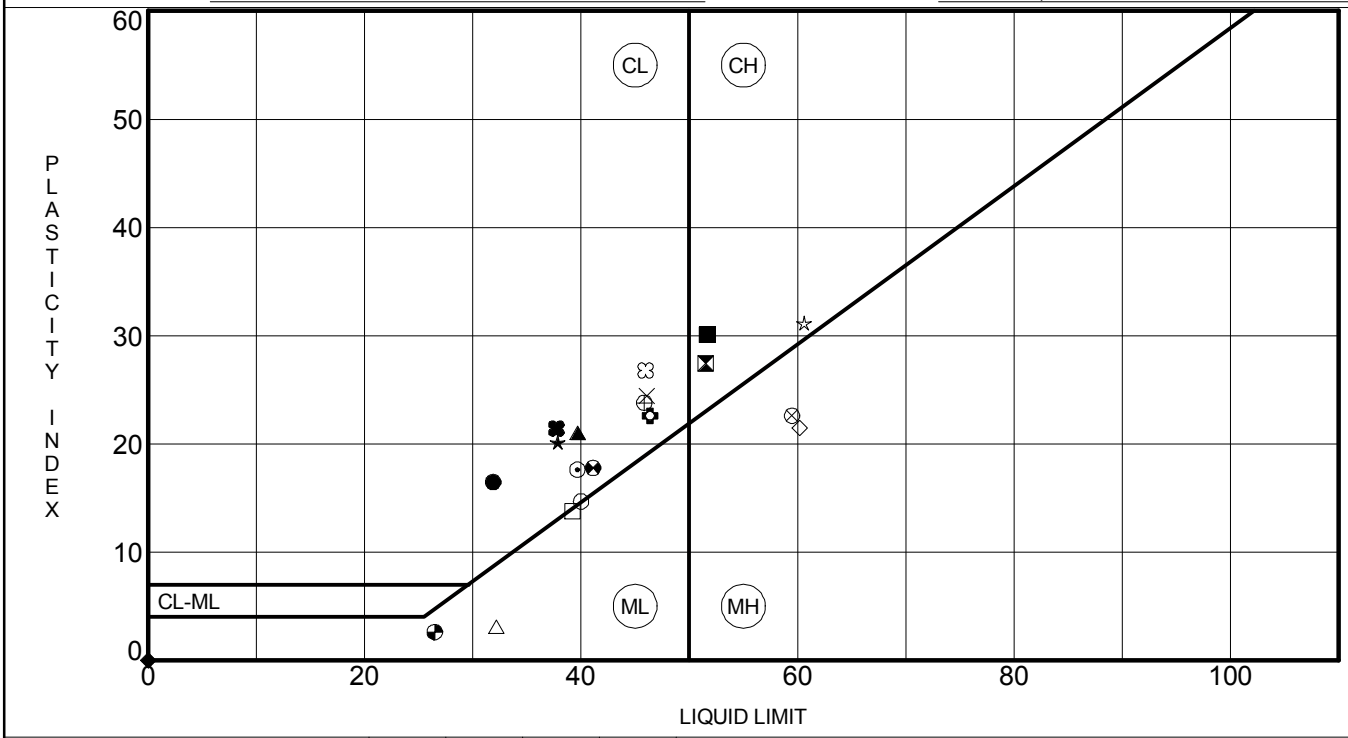
Borehole	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	Swell Potential (%)	%<#200 Sieve	Classification		Water Content (%)	Dry Density (pcf)	Unconfined Compressive Strength (psi)	Sulfate (%)	Resistivity (ohm-cm)	pH	Chlorides (%)	Proctor S=Standard M=Modified		
							USCS	AASHTO								MDD	OMC	S/M
RW-4	49								31.9	90.7								
RW-5	2				3.0				27.9	96.8								
RW-5	4				0.1				19.2	104.3		0.00						
RW-5	9	36	28	8		54	ML	A-4 (3)	15.5	104.9								
RW-5	14								21.8	99.9								
RW-5	19								19.0	109.5								
RW-5	39								26.3	100.6								

RockSol Consulting Group, Inc.

ATTERBERG LIMITS RESULTS
AASHTO T89 Method A/T90

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



	Specimen Identification		LL	PL	PI	Fines	Classification
●	BR-1	9.0	32	15	17	59.2	SANDY LEAN CLAY (CL)
⊠	BR-1	29.0	52	24	28	70.2	FAT CLAY with SAND (CH)
▲	BR-2	1.4-10.0	40	19	21	47.9	CLAYEY SAND (SC)
★	BR-2	34.0	38	18	20	56.1	SANDY LEAN CLAY (CL)
⊙	BR-2	54.0	40	22	18	47.6	CLAYEY SAND (SC)
✿	BR-2	64.0	46	24	22	51.8	(Bedrock) CLAYSTONE (CL)
○	BR-3	1.9-14.0	40	25	15	63.8	SANDY LEAN CLAY (CL)
△	BR-3	19.0	32	29	3	54.4	SANDY SILT (ML)
⊗	BR-3	49.0	59	37	22	92.0	(Bedrock) SILTSTONE (MH)
⊕	BR-4	0.0-10.0	46	22	24	66.2	SANDY LEAN CLAY (CL)
□	BR-4	14.0	39	25	14	44.3	CLAYEY SAND (SC)
⊛	BR-4	29.0	41	23	18	47.4	CLAYEY SAND (SC)
◒	BR-4	39.0	26	24	2	20.4	SILTY SAND (SM)
☆	BR-4	49.0	61	29	32	97.6	(Bedrock) CLAYSTONE (CH)
⊠	BR-5	1.3-10.0	46	19	27	52.2	SANDY LEAN CLAY (CL)
■	BR-5	10.0-20.0	52	22	30	60.2	SANDY FAT CLAY (CH)
◆	BR-6	2.0	NP	NP	NP	14.1	SILTY SAND with GRAVEL (SM)
◇	BR-6	54.0	60	39	21	93.3	(Bedrock) SILTSTONE (MH)
×	PV-1	1.3-10.0	46	22	24	47.6	CLAYEY SAND (SC)
✖	PV-2	0.8-5.0	38	16	22	86.6	LEAN CLAY (CL)

ATTERBERG LIMITS RESULTS
AASHTO T89 Method A/T90

RockSol Consulting Group, Inc.

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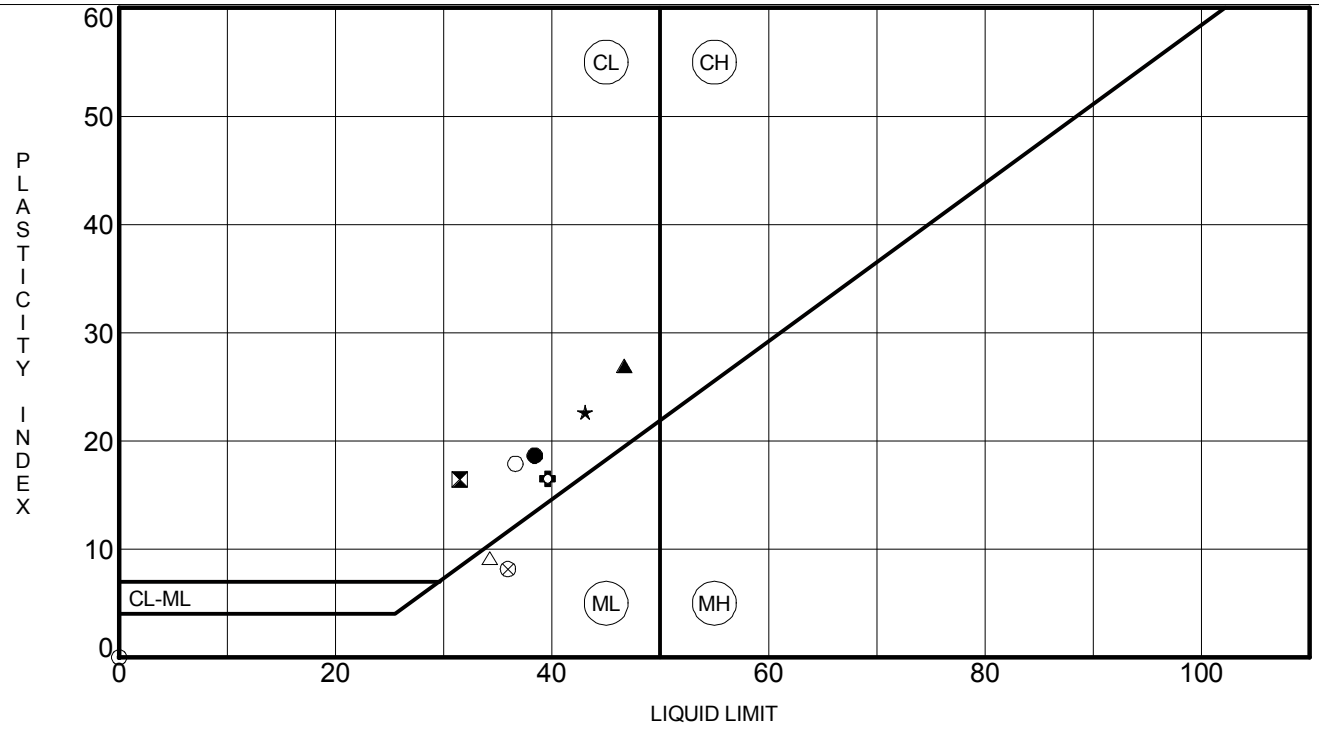

	Specimen Identification		LL	PL	PI	Fines	Classification
●	RW-2	1.0-5.0	38	20	18	43.9	CLAYEY SAND with GRAVEL (SC)
⊠	RW-2	9.0	31	15	16	29.8	CLAYEY SAND with GRAVEL (SC)
▲	RW-2	19.0	47	20	27	76.1	LEAN CLAY with SAND (CL)
★	RW-3	0.0-10.0	43	20	23	54.3	SANDY LEAN CLAY (CL)
⊙	RW-3	2.0	NP	NP	NP	46.9	SILTY SAND (SM)
✿	RW-3	14.0	40	23	17	38.2	CLAYEY SAND (SC)
○	RW-4	4.0	37	19	18	48.8	CLAYEY SAND (SC)
△	RW-4	19.0	34	25	9	27.1	SILTY SAND (SM)
⊗	RW-5	9.0	36	28	8	54.3	SANDY SILT (ML)

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GRAIN SIZE DISTRIBUTION

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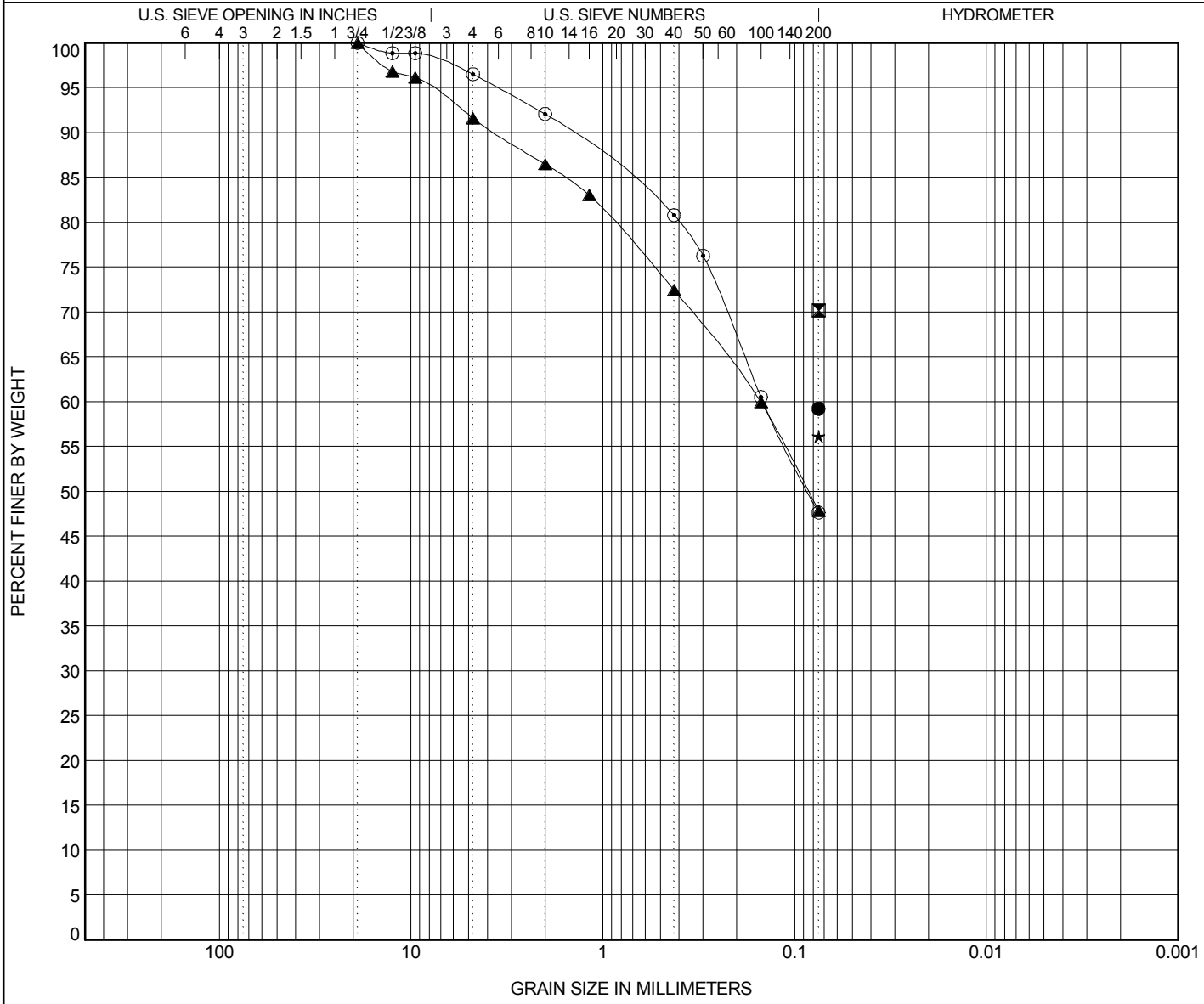
PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR-1	9	SANDY LEAN CLAY (CL)	32	15	17		
⊠	BR-1	29	FAT CLAY with SAND (CH)	52	24	28		
▲	BR-2	1-10.0	CLAYEY SAND (SC)	40	19	21		
★	BR-2	34	SANDY LEAN CLAY (CL)	38	18	20		
⊙	BR-2	54	CLAYEY SAND (SC)	40	22	18		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-1	9	0.075						59.2	
⊠	BR-1	29	0.075						70.2	
▲	BR-2	1-10.0	19	0.151			8.4	43.8	47.9	
★	BR-2	34	0.075						56.1	
⊙	BR-2	54	19	0.146			3.5	48.9	47.6	

GRADATION - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 10/24/13

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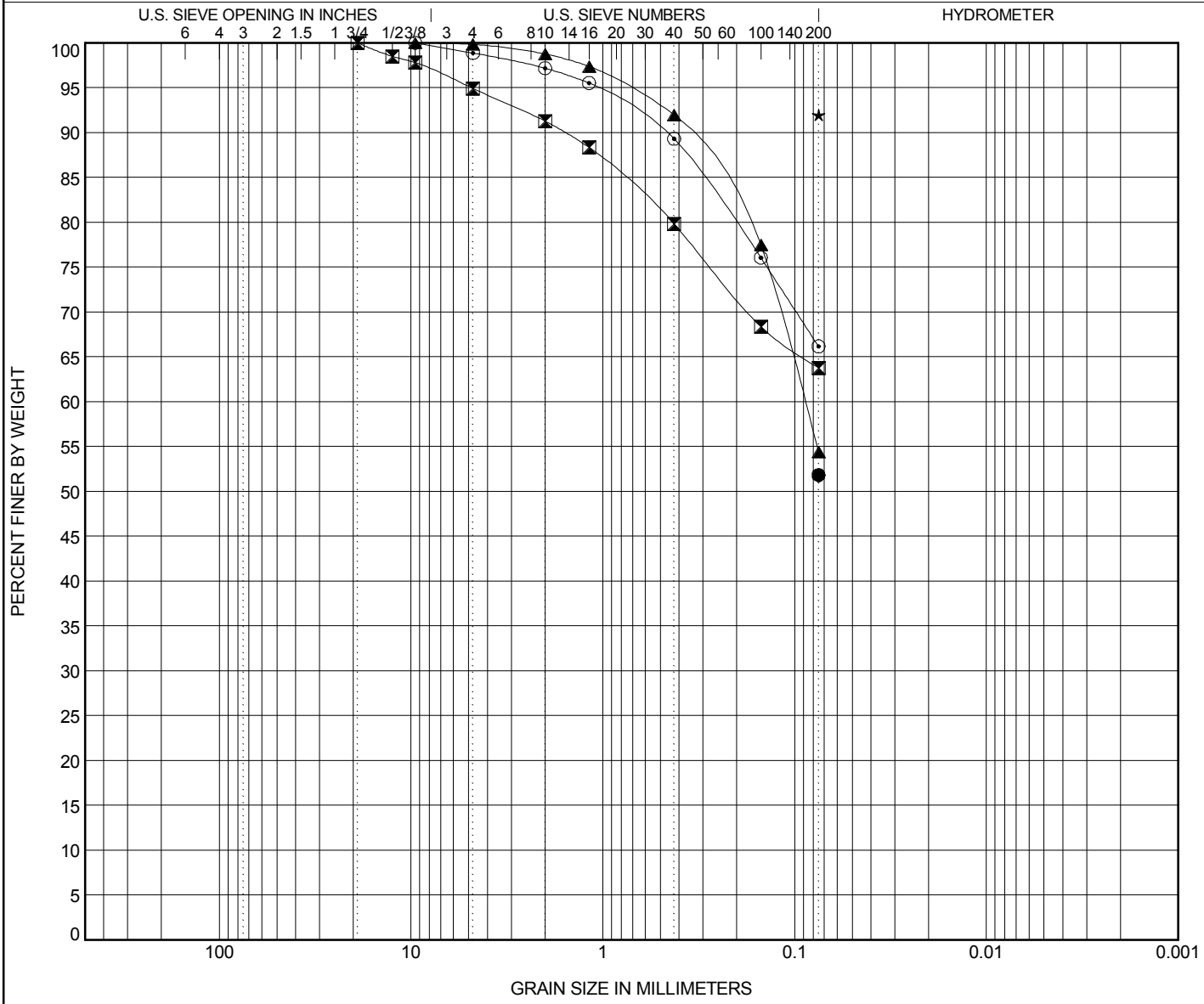

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR-2	64	(Bedrock) CLAYSTONE (CL)	46	24	22		
⊠	BR-3	2-14.0	SANDY LEAN CLAY (CL)	40	25	15		
▲	BR-3	19	SANDY SILT (ML)	32	29	3		
★	BR-3	49	(Bedrock) SILTSTONE (MH)	59	37	22		
⊙	BR-4	0-10.0	SANDY LEAN CLAY (CL)	46	22	24		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-2	64	0.075						51.8	
⊠	BR-3	2-14.0	19				5.1	31.1	63.8	
▲	BR-3	19	9.5	0.089			0.2	45.5	54.4	
★	BR-3	49	0.075						92.0	
⊙	BR-4	0-10.0	9.5				1.1	32.7	66.2	

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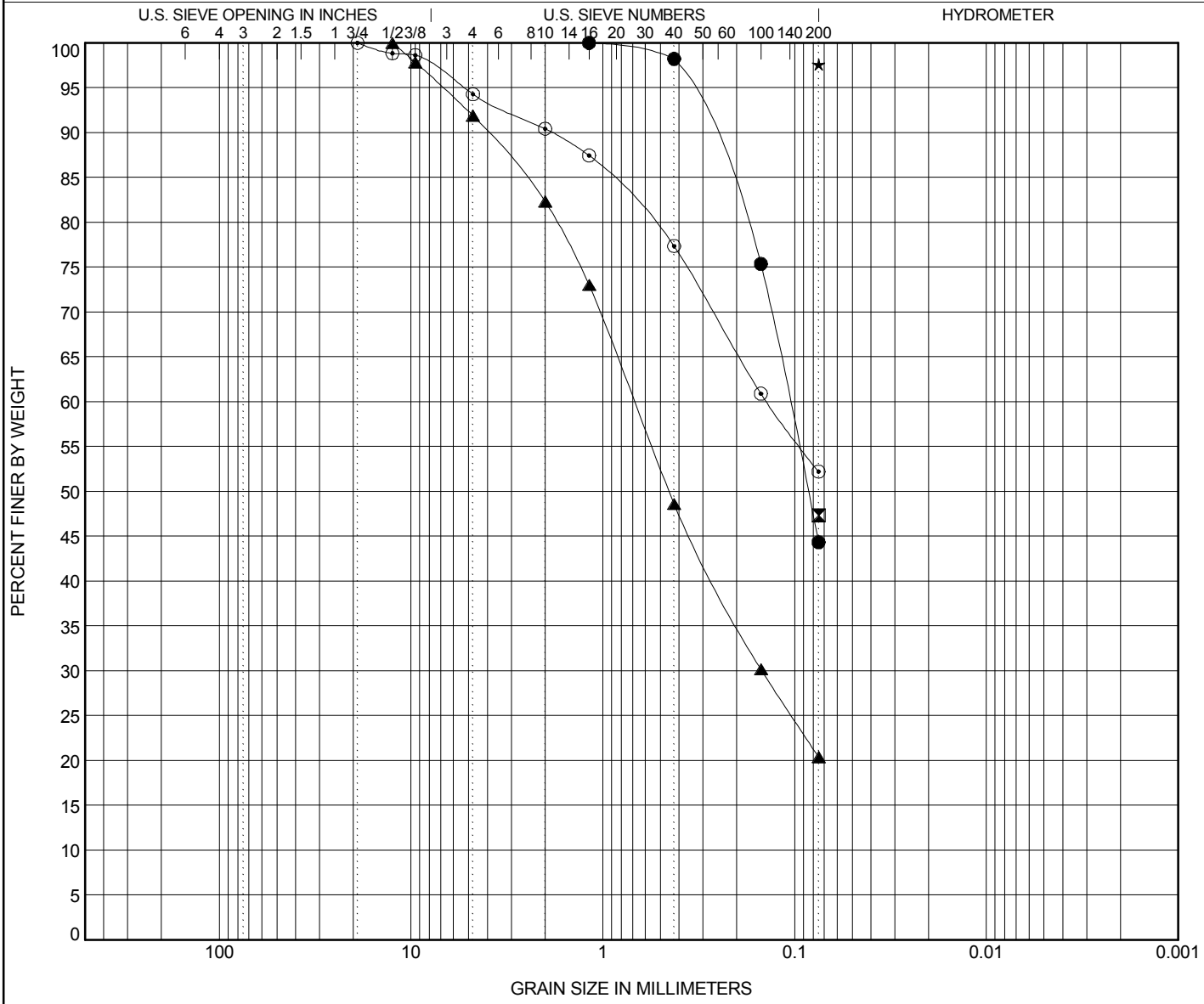

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	BR-4	14	CLAYEY SAND (SC)	39	25	14		
⧓	BR-4	29	CLAYEY SAND (SC)	41	23	18		
▲	BR-4	39	SILTY SAND (SM)	26	24	2		
★	BR-4	49	(Bedrock) CLAYSTONE (CH)	61	29	32		
⊙	BR-5	1-10.0	SANDY LEAN CLAY (CL)	46	19	27		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-4	14	1.18	0.106			0.0	55.7	44.3	
⧓	BR-4	29	0.075						47.4	
▲	BR-4	39	12.5	0.684	0.148		8.1	71.5	20.4	
★	BR-4	49	0.075						97.6	
⊙	BR-5	1-10.0	19	0.14			5.7	42.1	52.2	

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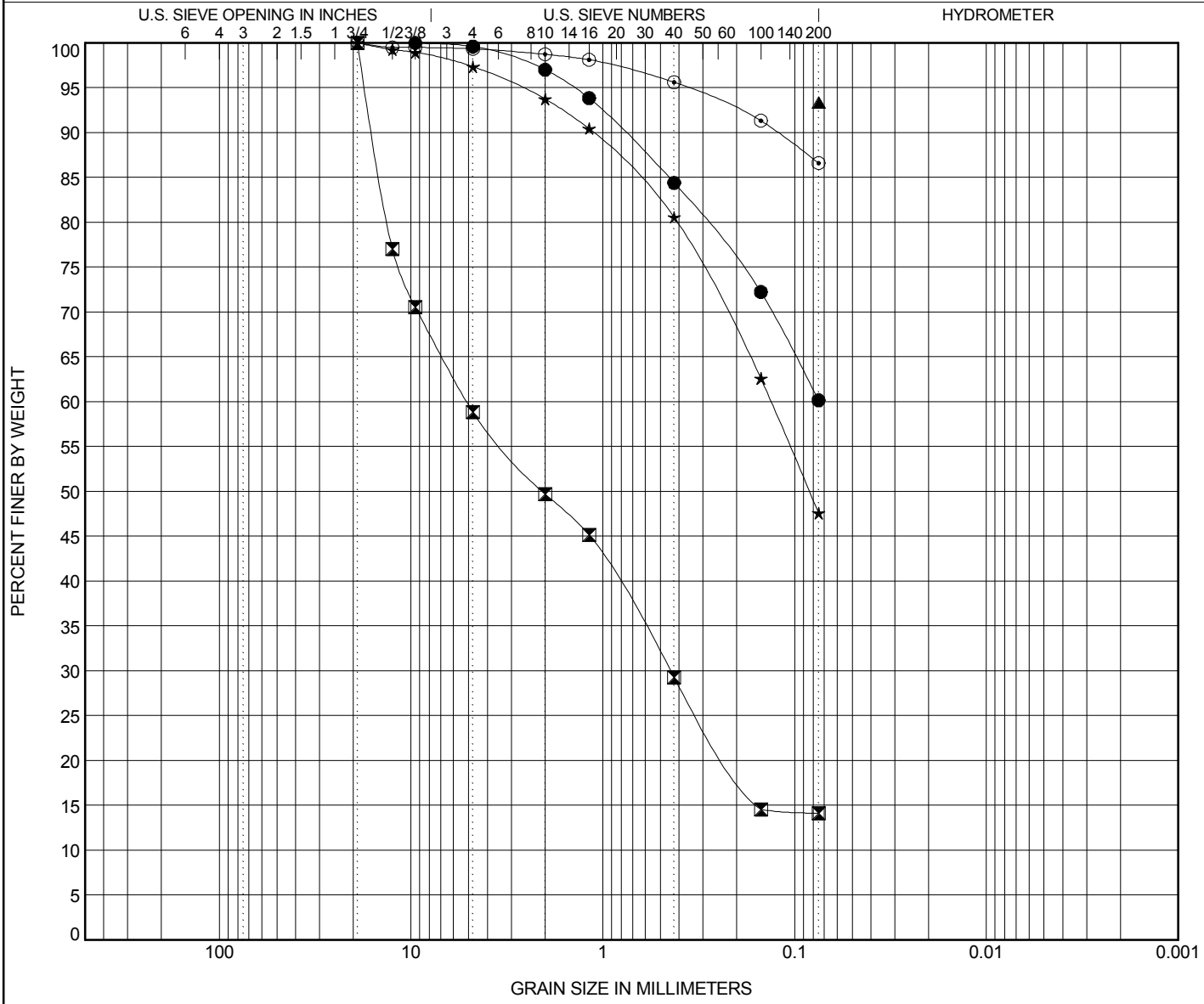

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	BR-5	10-20.0	SANDY FAT CLAY (CH)	52	22	30		
⊠	BR-6	2	SILTY SAND with GRAVEL (SM)	NP	NP	NP		
▲	BR-6	54	(Bedrock) SILTSTONE (MH)	60	39	21		
★	PV-1	1-10.0	CLAYEY SAND (SC)	46	22	24		
⊙	PV-2	1-5.0	LEAN CLAY (CL)	38	16	22		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	BR-5	10-20.0	9.5				0.4	39.4	60.2	
⊠	BR-6	2	19	5.084	0.445		41.1	44.7	14.1	
▲	BR-6	54	0.075						93.3	
★	PV-1	1-10.0	19	0.133			2.6	49.8	47.6	
⊙	PV-2	1-5.0	19				0.7	12.7	86.6	

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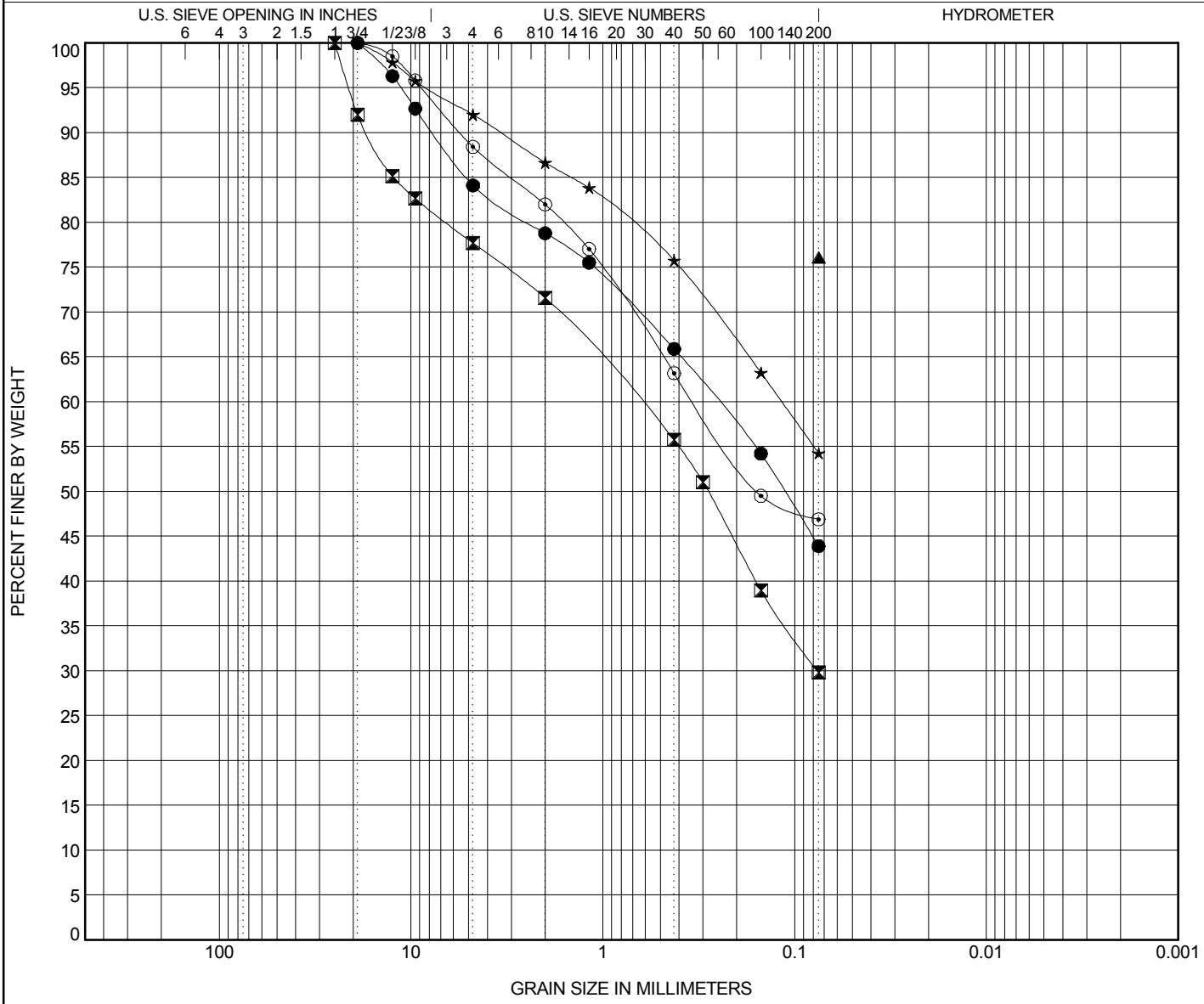

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification			Classification	LL	PL	PI	Cc	Cu
●	RW-2	1-5.0	CLAYEY SAND with GRAVEL (SC)	38	20	18		
⊠	RW-2	9	CLAYEY SAND with GRAVEL (SC)	31	15	16		
▲	RW-2	19	LEAN CLAY with SAND (CL)	47	20	27		
★	RW-3	0-10.0	SANDY LEAN CLAY (CL)	43	20	23		
⊙	RW-3	2	SILTY SAND (SM)	NP	NP	NP		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW-2	1-5.0	19	0.251			15.9	40.2	43.9	
⊠	RW-2	9	25	0.645	0.076		22.3	47.9	29.8	
▲	RW-2	19	0.075						76.1	
★	RW-3	0-10.0	19	0.117			8.0	37.7	54.3	
⊙	RW-3	2	19	0.334			11.6	41.5	46.9	

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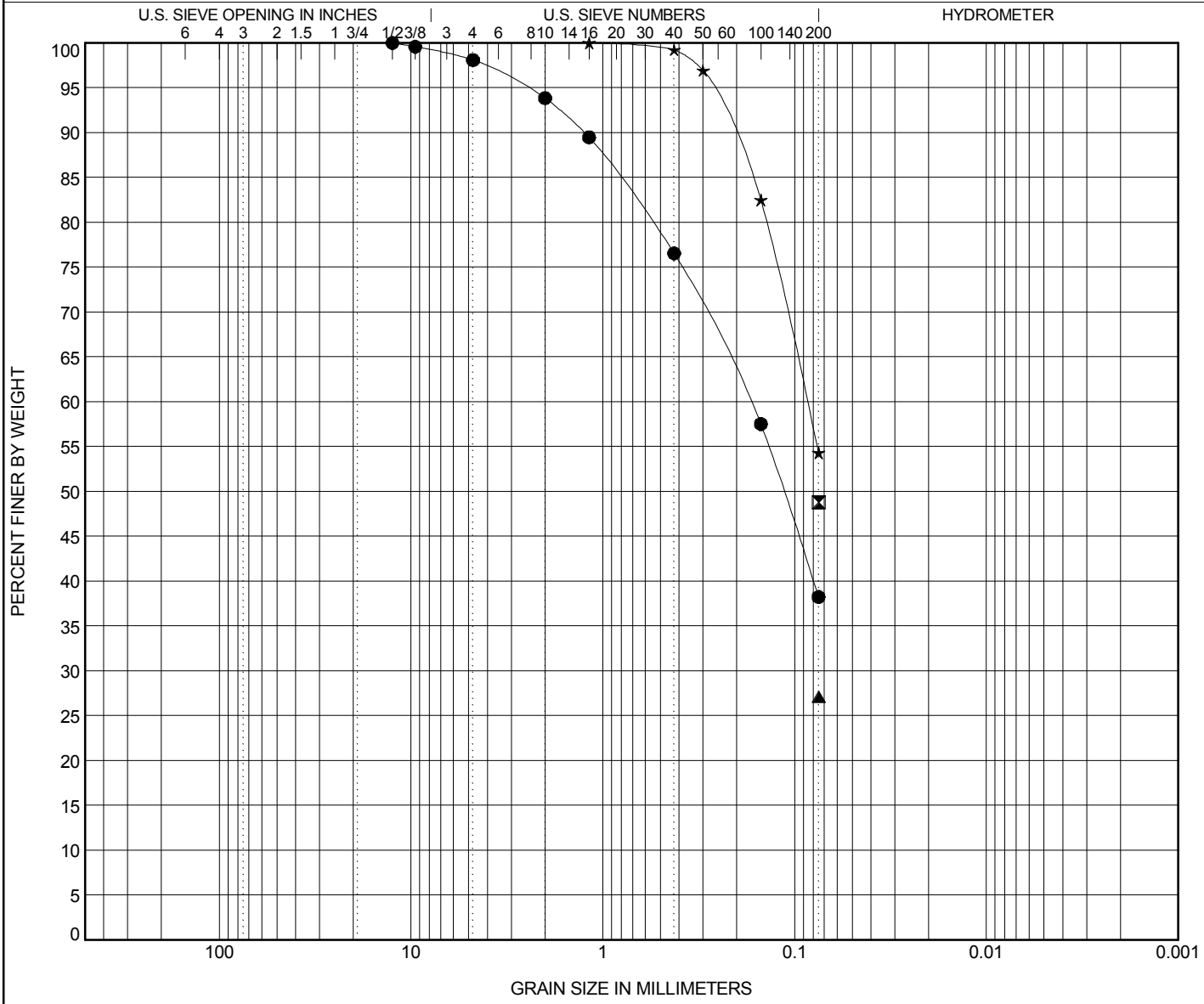

COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	RW-3	14	CLAYEY SAND (SC)	40	23	17		
⧓	RW-4	4	CLAYEY SAND (SC)	37	19	18		
▲	RW-4	19	SILTY SAND (SM)	34	25	9		
★	RW-5	9	SANDY SILT (ML)	36	28	8		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	RW-3	14	12.5	0.172			1.9	59.9	38.2	
⧓	RW-4	4	0.075						48.8	
▲	RW-4	19	0.075						27.1	
★	RW-5	9	1.18	0.086			0.0	45.7	54.3	

GRADATION - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 10/24/13

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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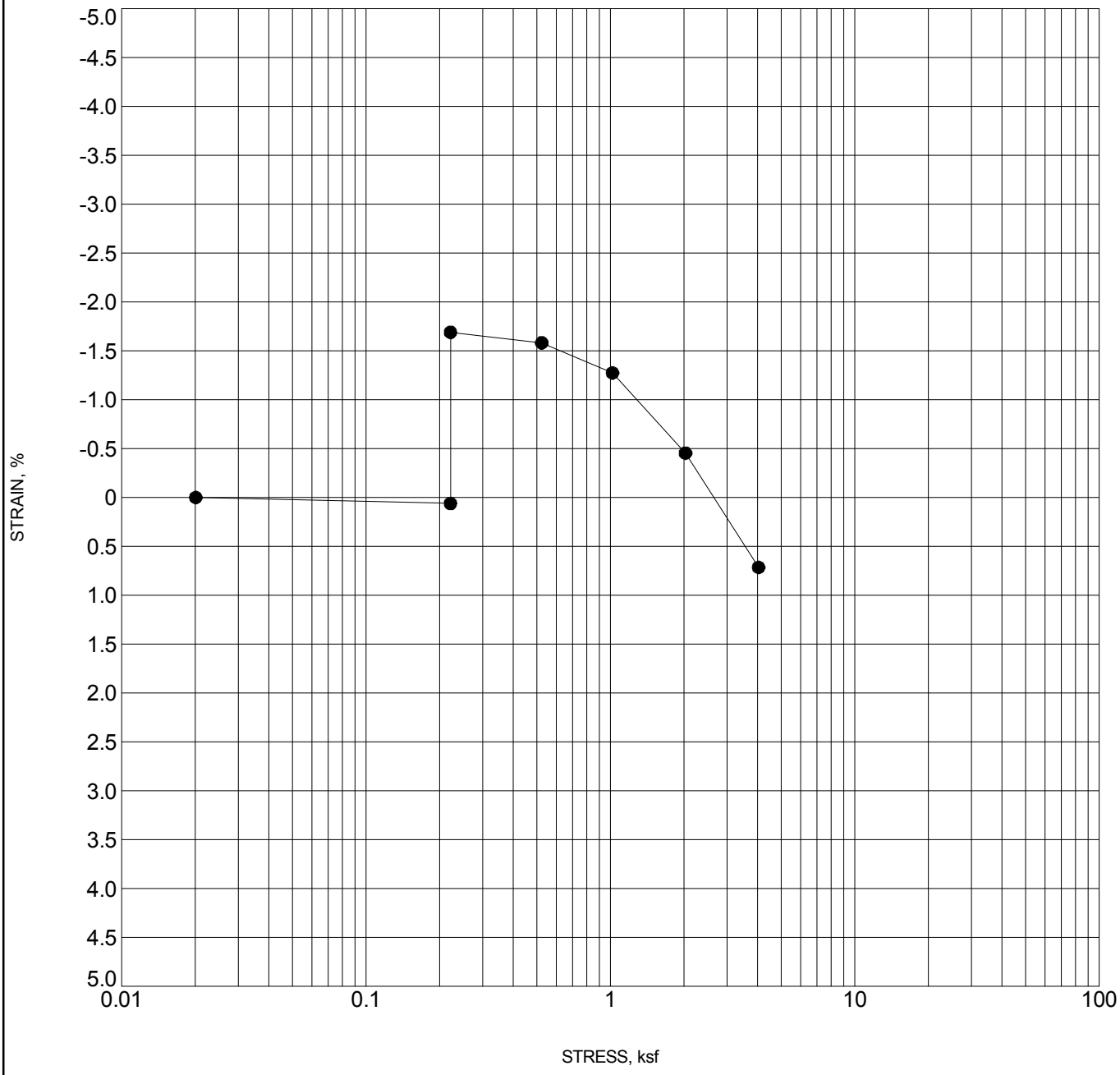
PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-1** **4**	**SANDY CLAY**	**1.8**	**104.8**	**21.4**

SWELL - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 10/24/13

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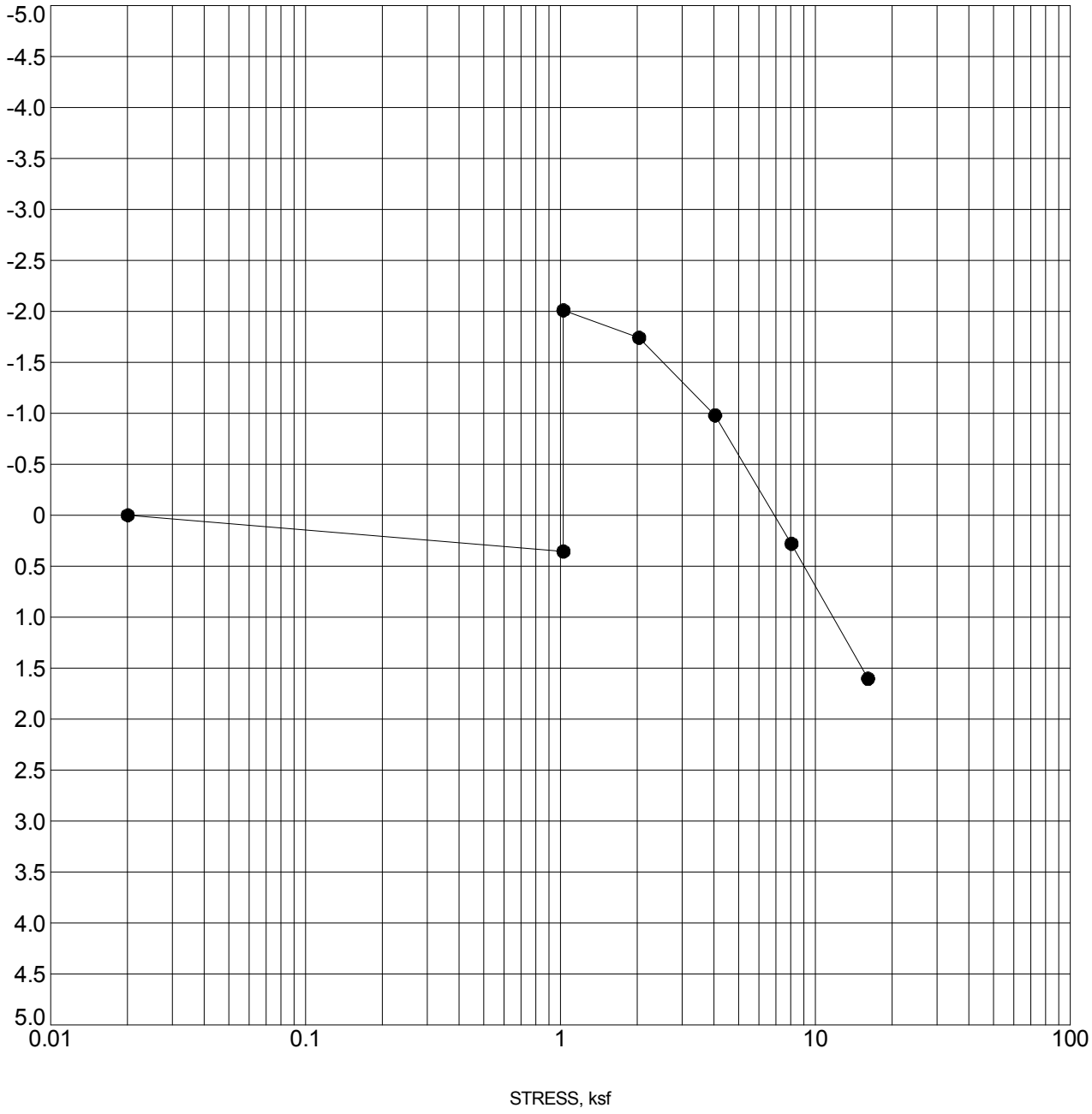

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-1**	**79**	**(Bedrock) CLAYSTONE**	**2.4**	**107.7**	**20.9**

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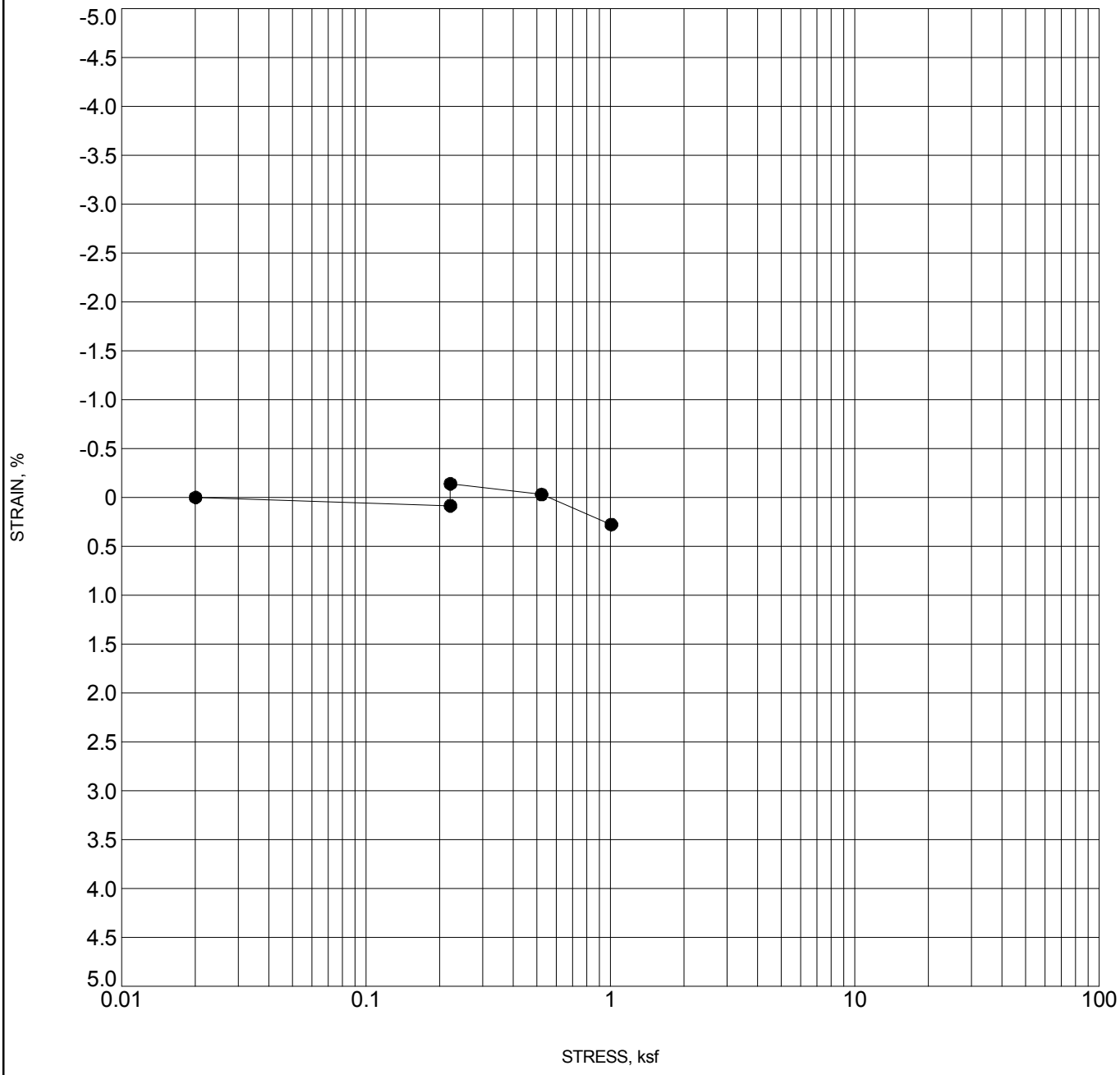

Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR-2 4	SANDY CLAY	0.2	98.2	24.9

SWELL - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 10/24/13

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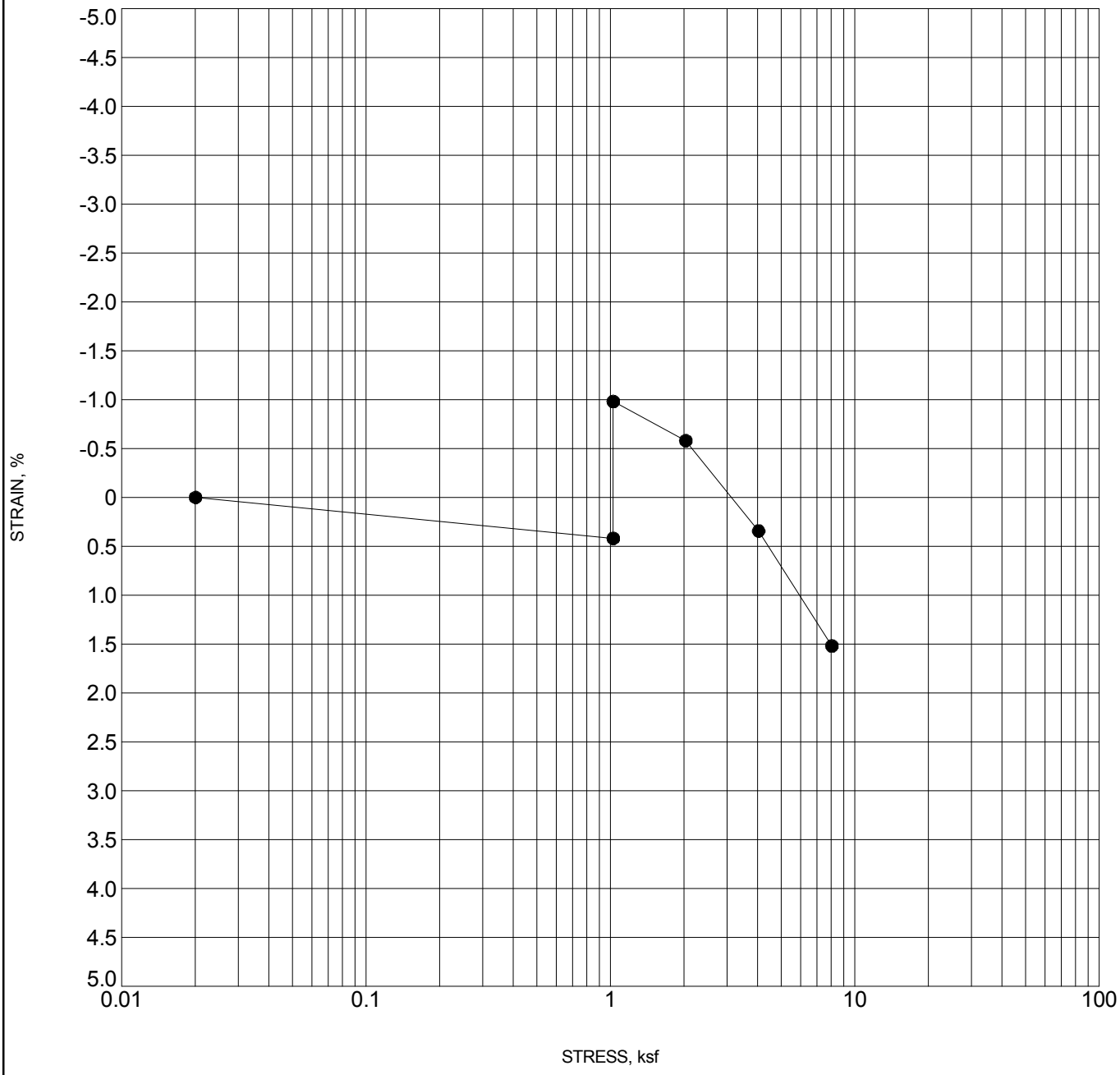

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-2**	**69**	**(Bedrock) CLAYSTONE**	**1.4**	**93.8**	**26.2**

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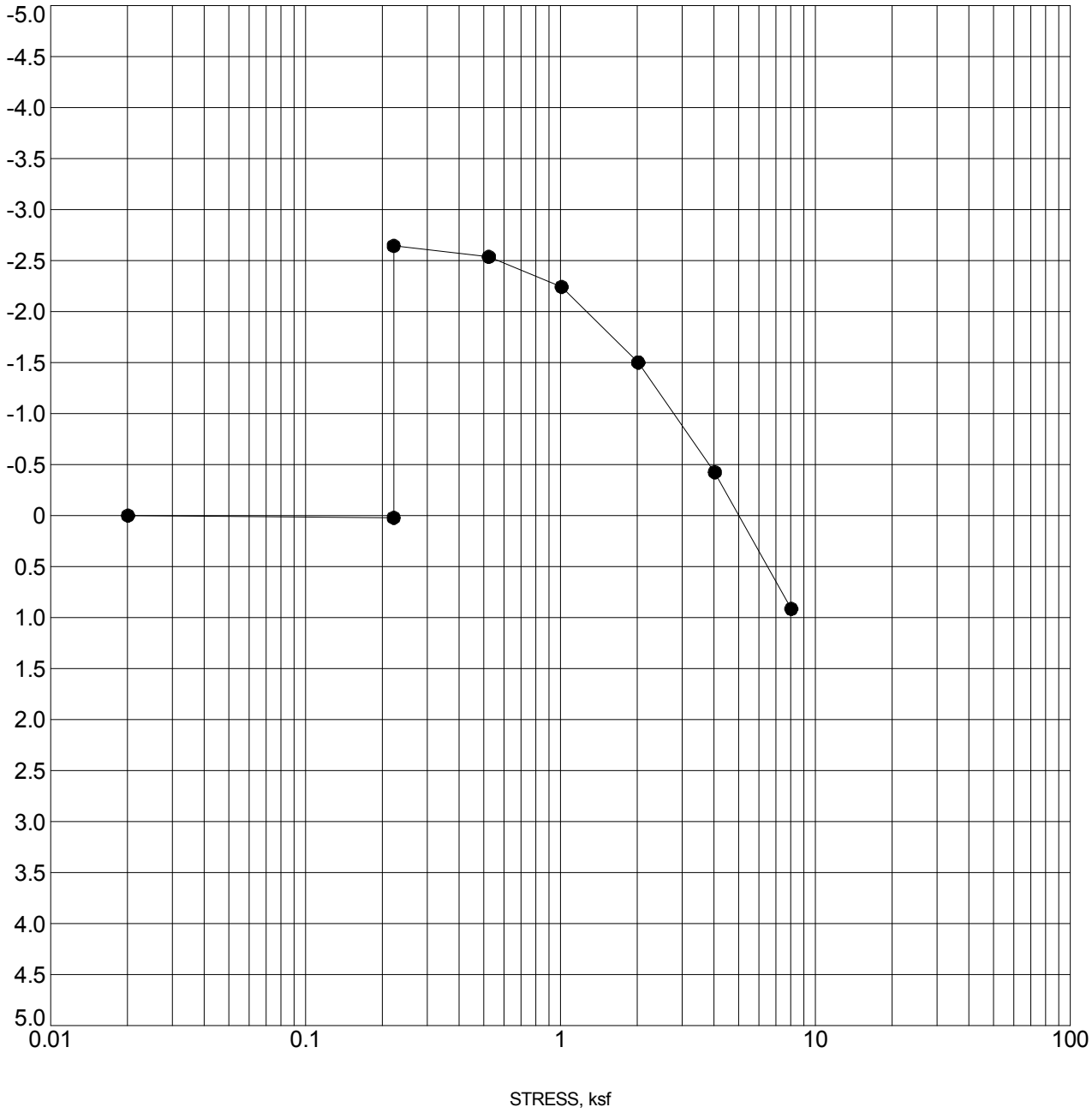

Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-3 2**	**SANDY CLAY**	**2.7**	**110.3**	**15.3**

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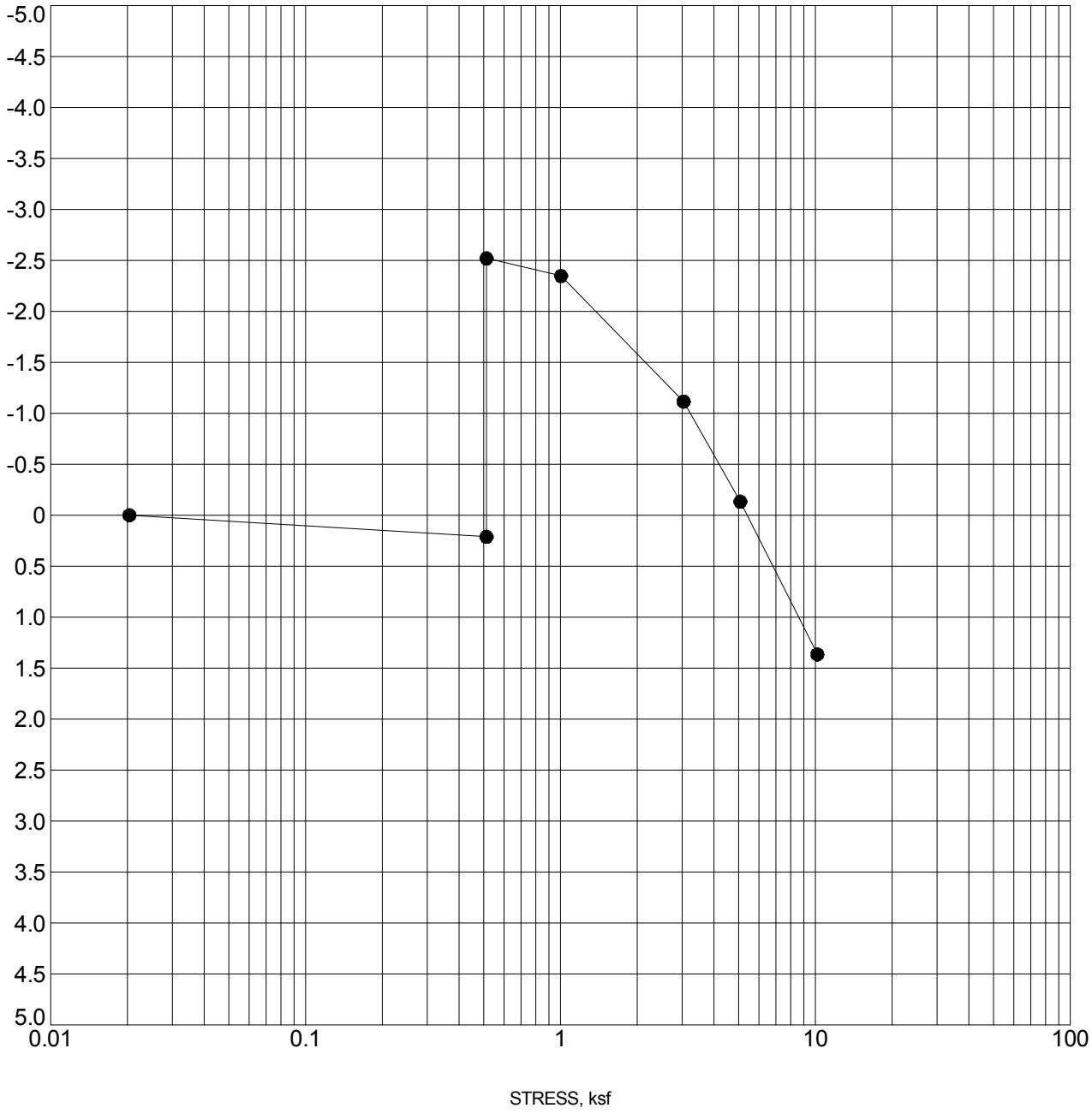

Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-3 4**	**SANDY CLAY**	**2.7**	**117.2**	**14.6**

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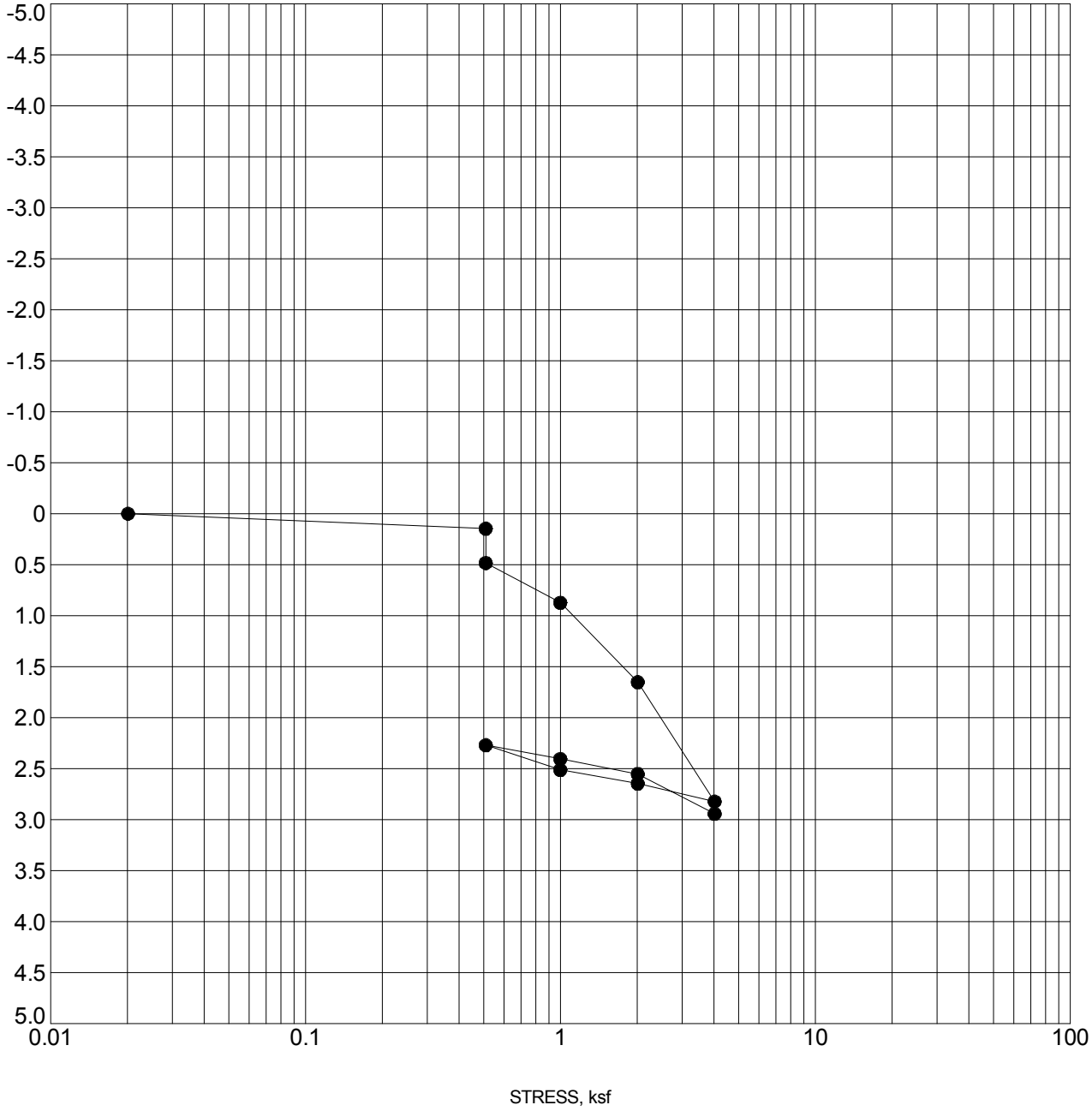

Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-3 9**	**SANDY CLAY**	**-0.3**	**108.4**	**16.4**

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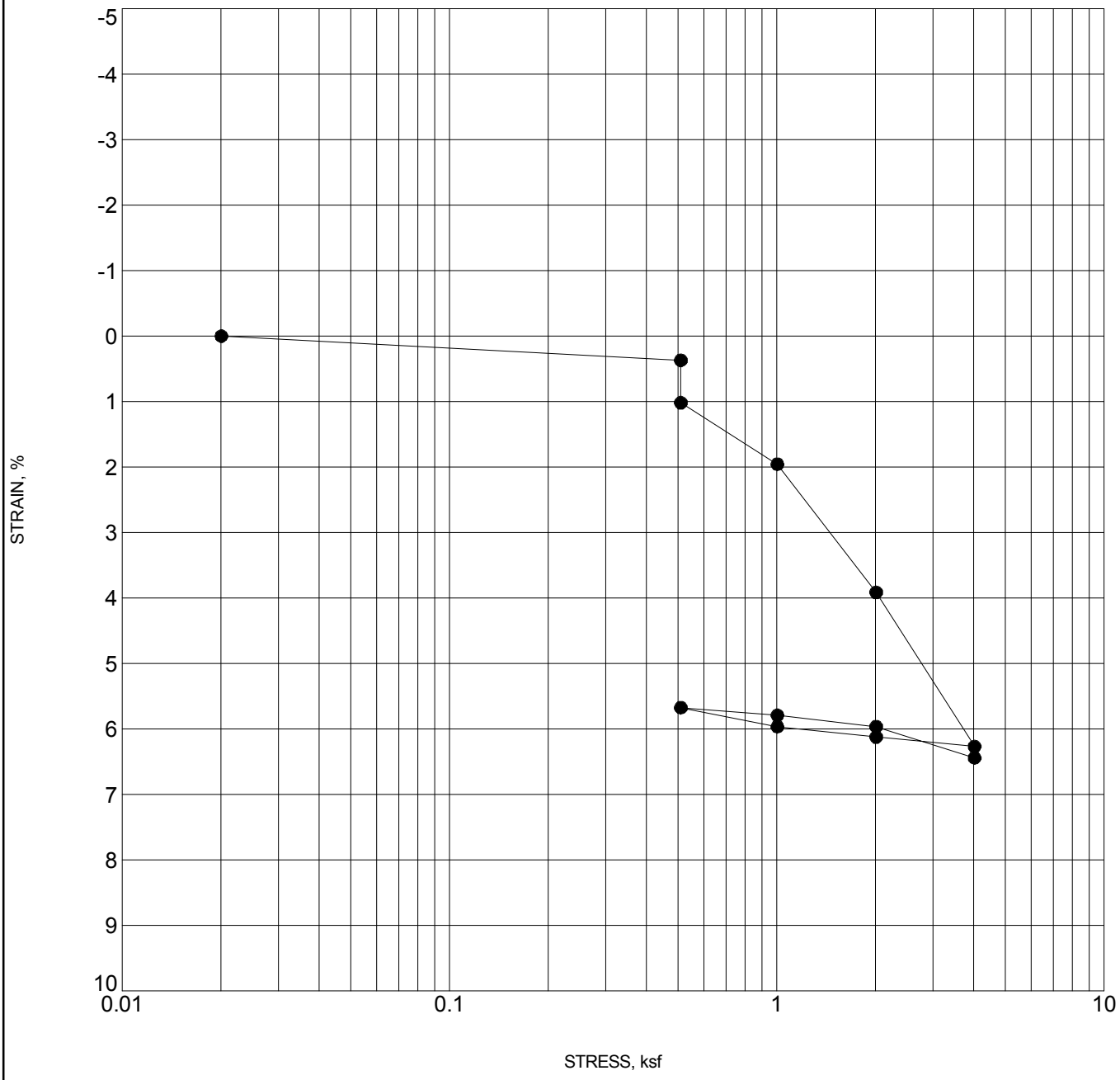

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-3**	**14**	**SANDY CLAY**	**-0.7**	**94.2**	**28.6**

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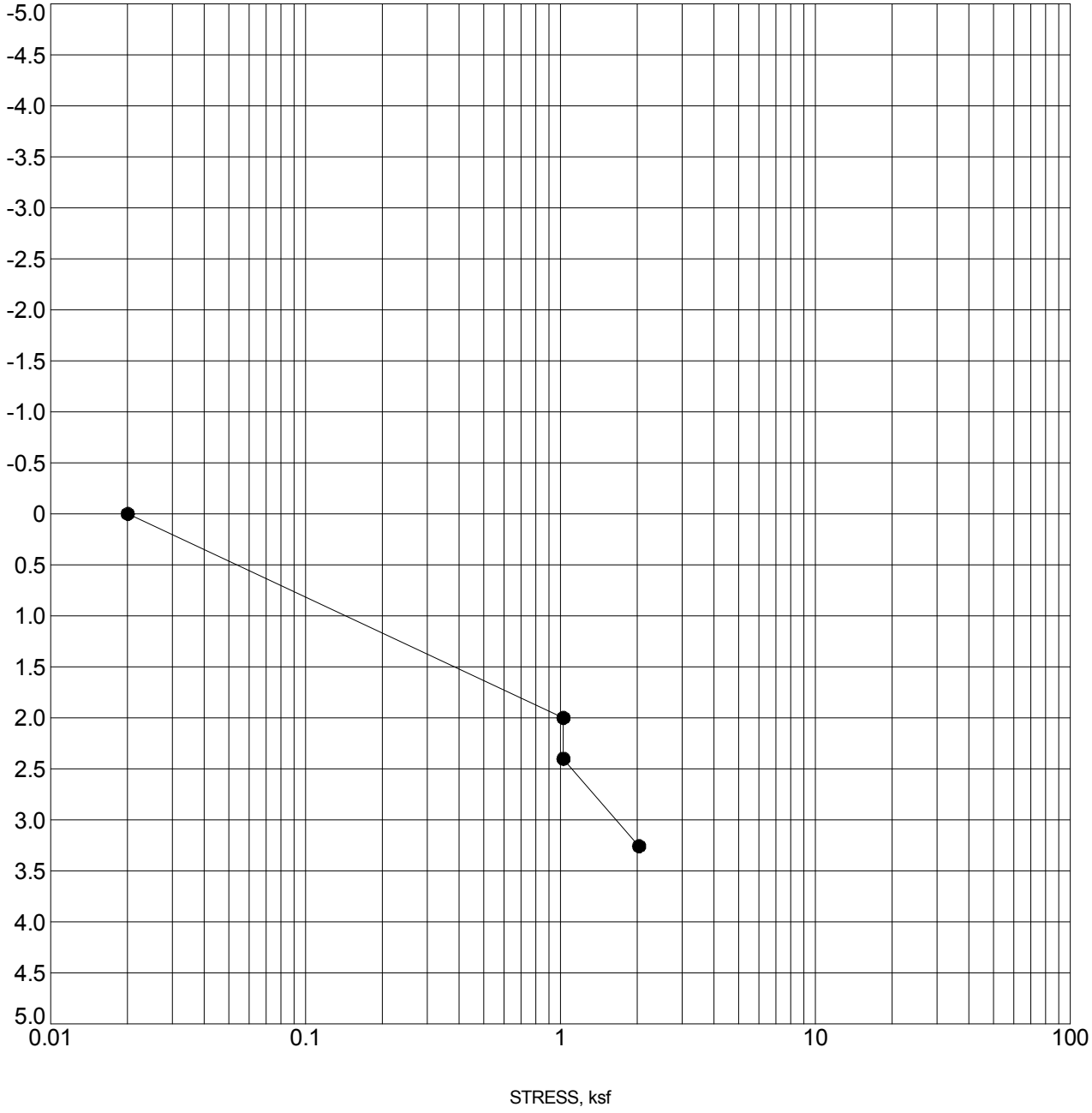

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-3**	**24**	**CLAYEY SAND**	**-0.4**	**97.6**	**27.3**

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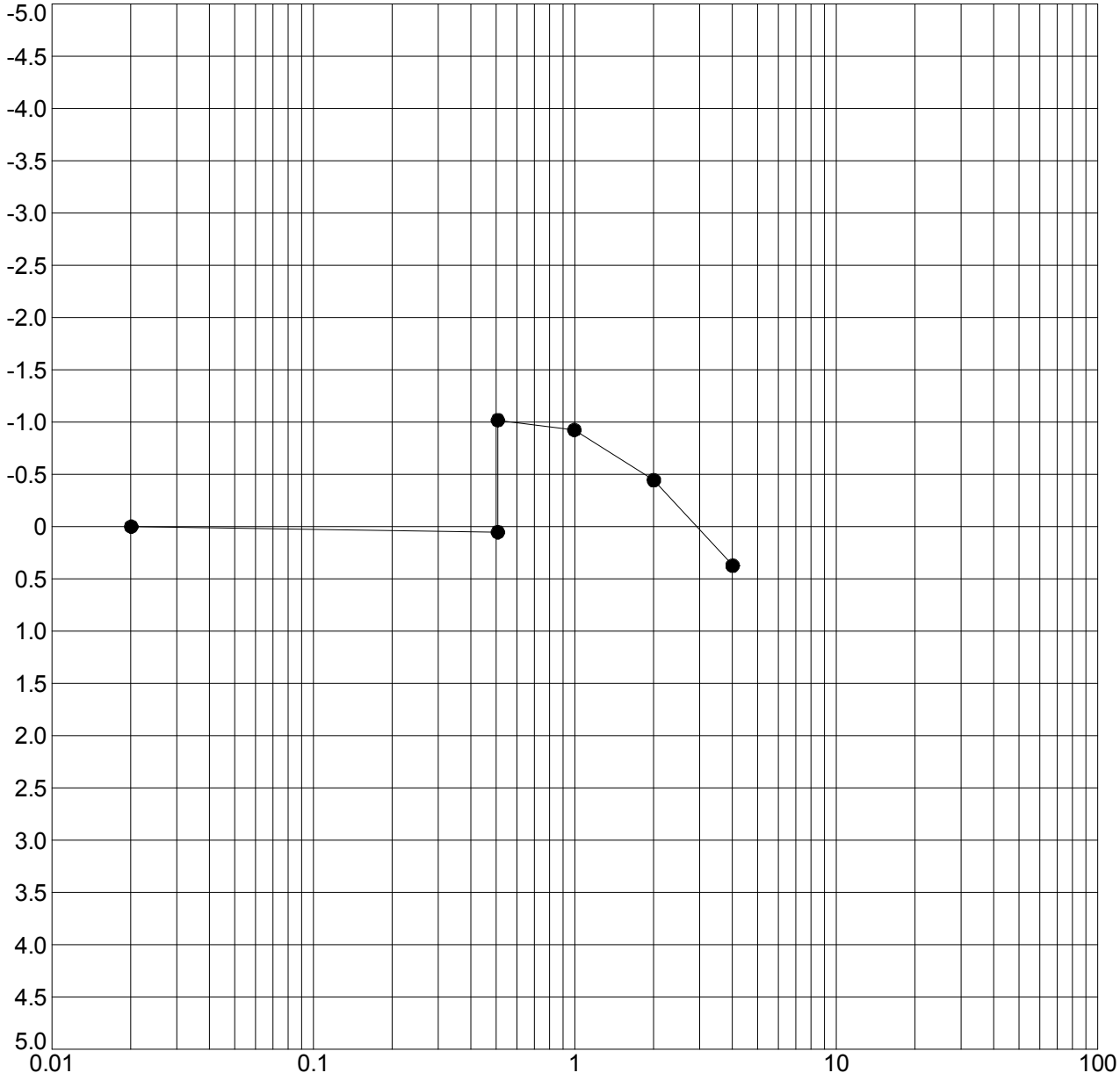

Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-4 4**	**SANDY CLAY**	**1.1**	**108.2**	**19.8**

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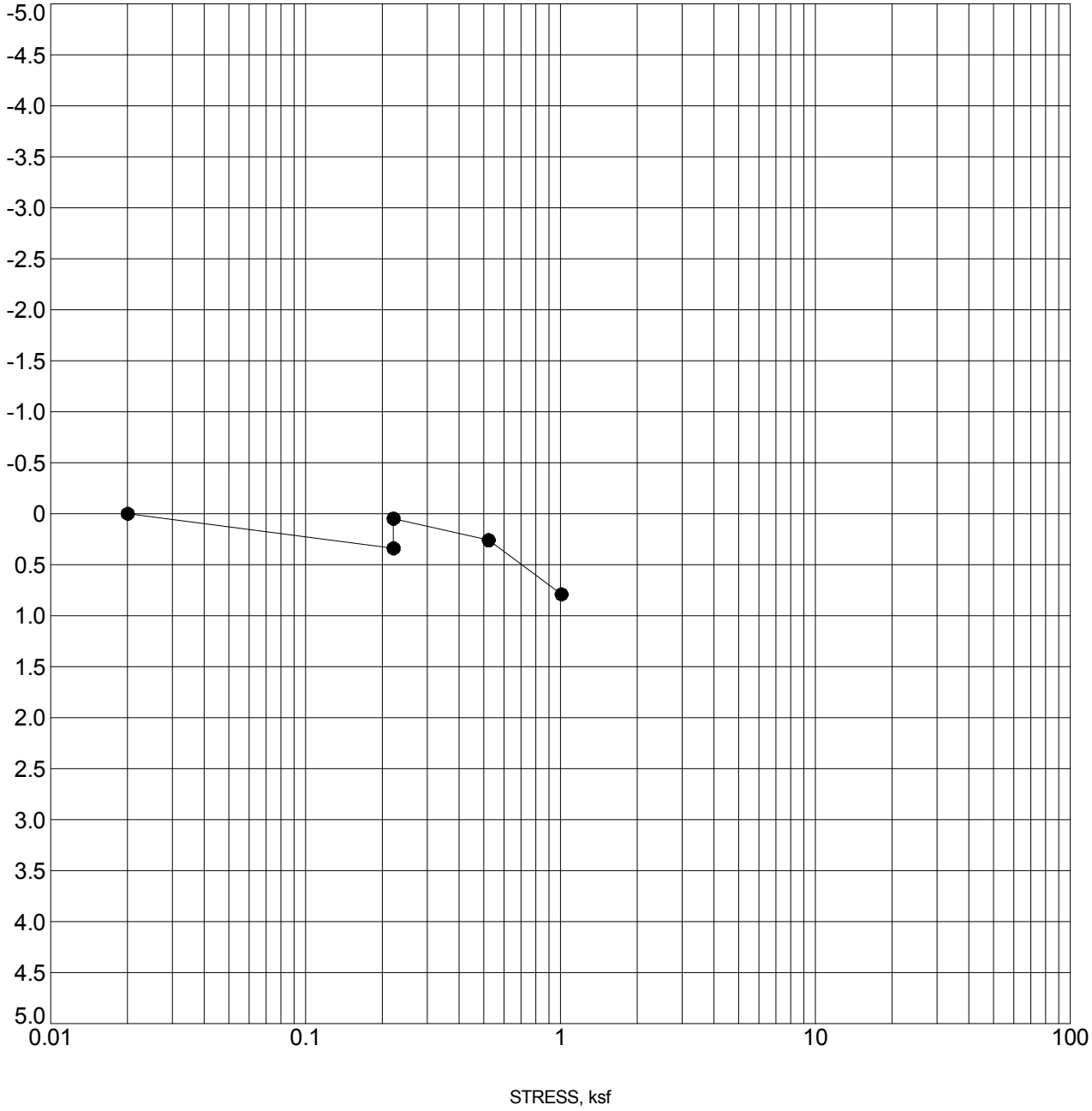


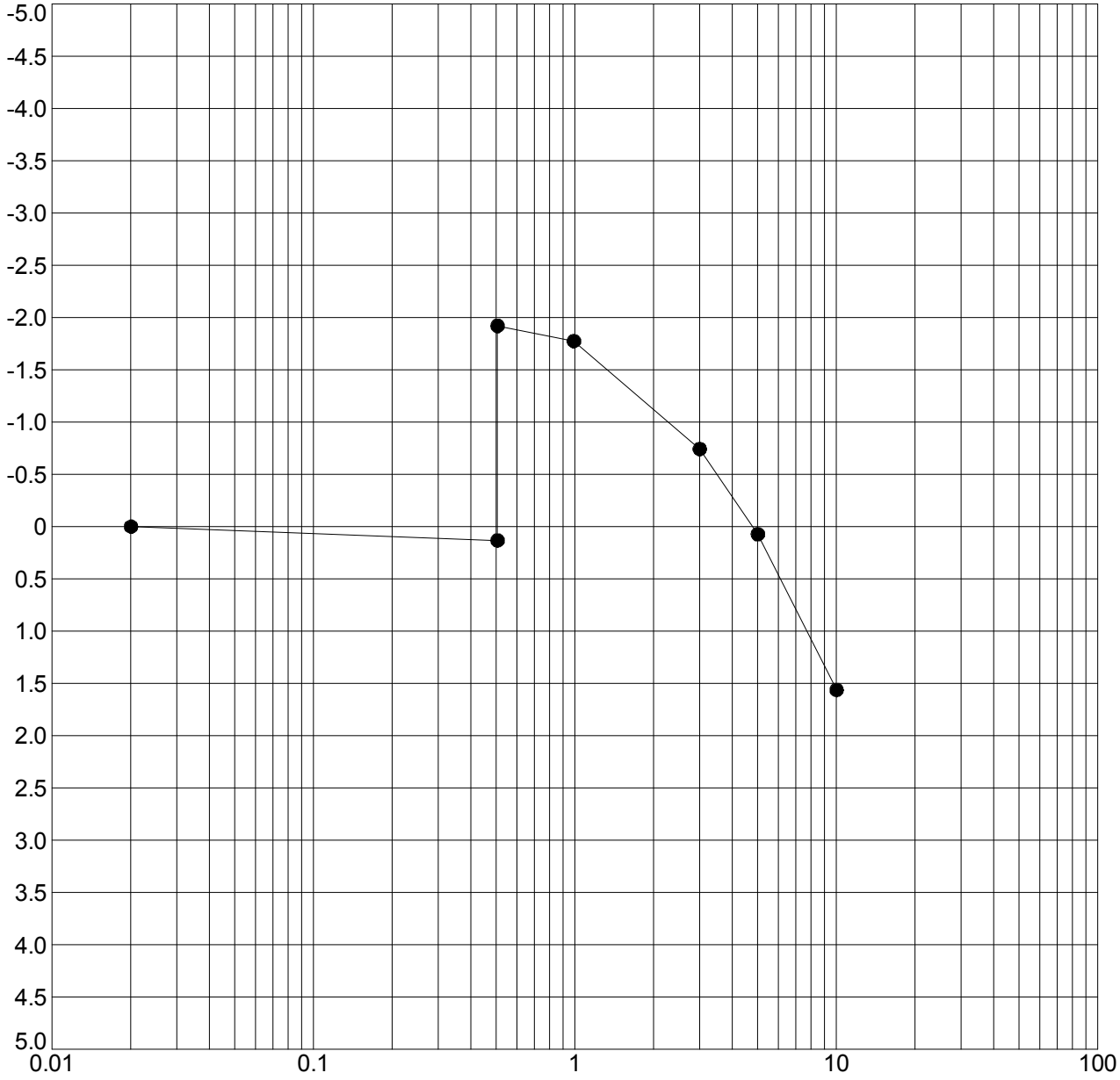
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-5 4**	**SANDY CLAY**	**0.3**	**97.3**	**26.7**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



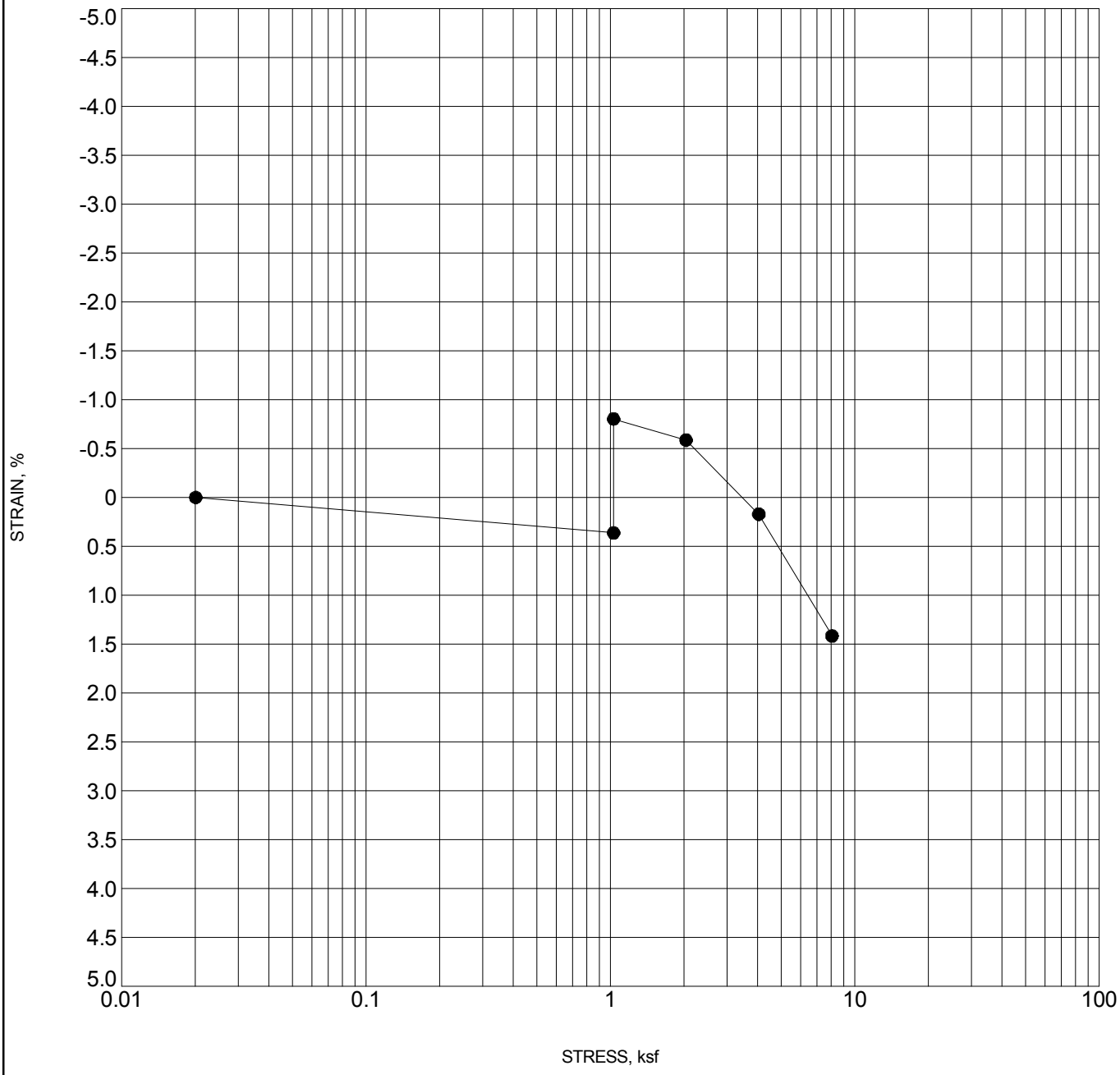
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-6 4**	**SANDY CLAY**	**2.1**	**109.5**	**19.2**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-6 9**	**SANDY CLAY**	**1.2**	**103.8**	**21.7**

SWELL - CONSOLIDATION TEST

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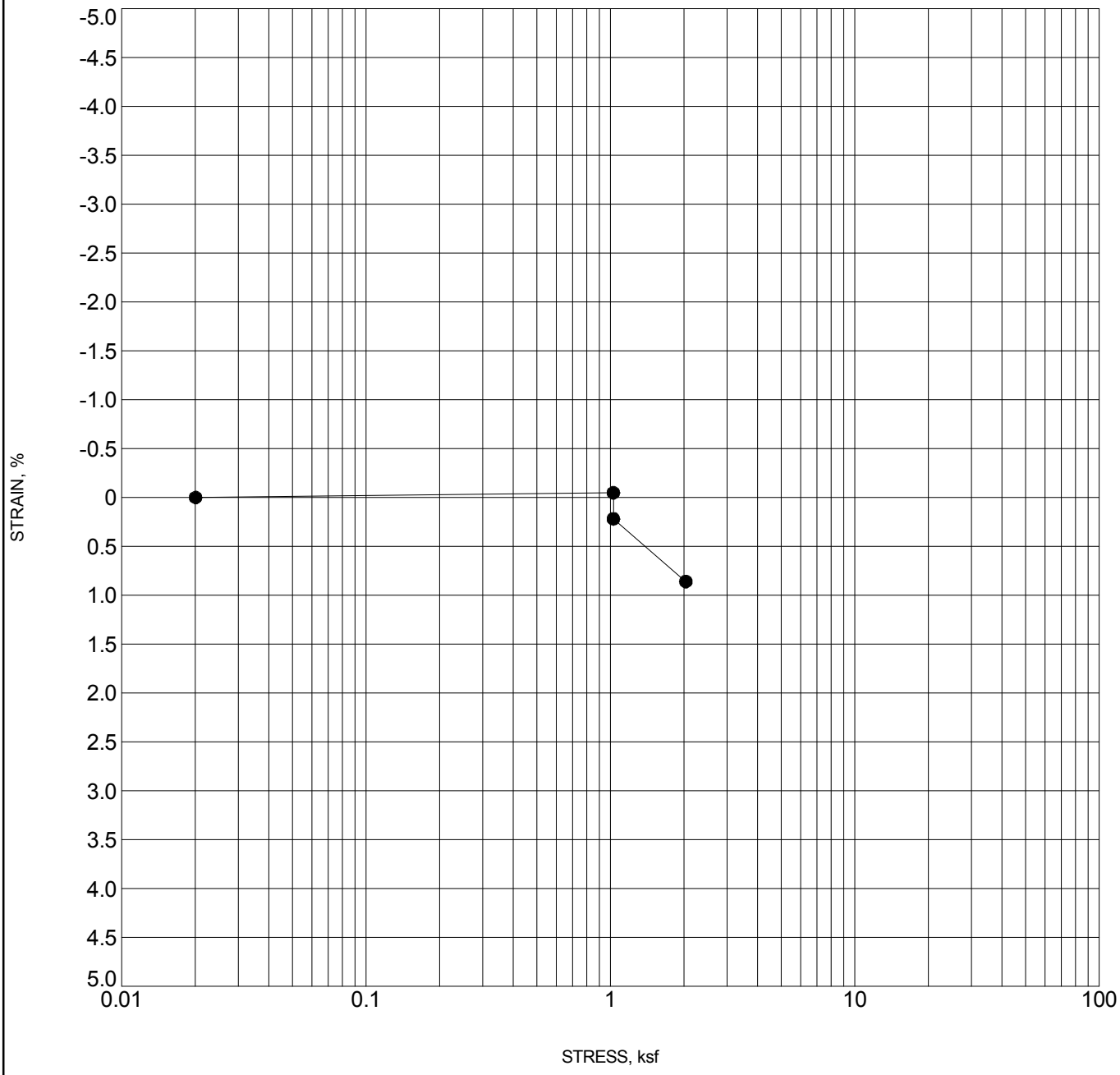

Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● BR-6 14	SANDY CLAY	-0.3	99.8	24.8

SWELL - CONSOLIDATION TEST

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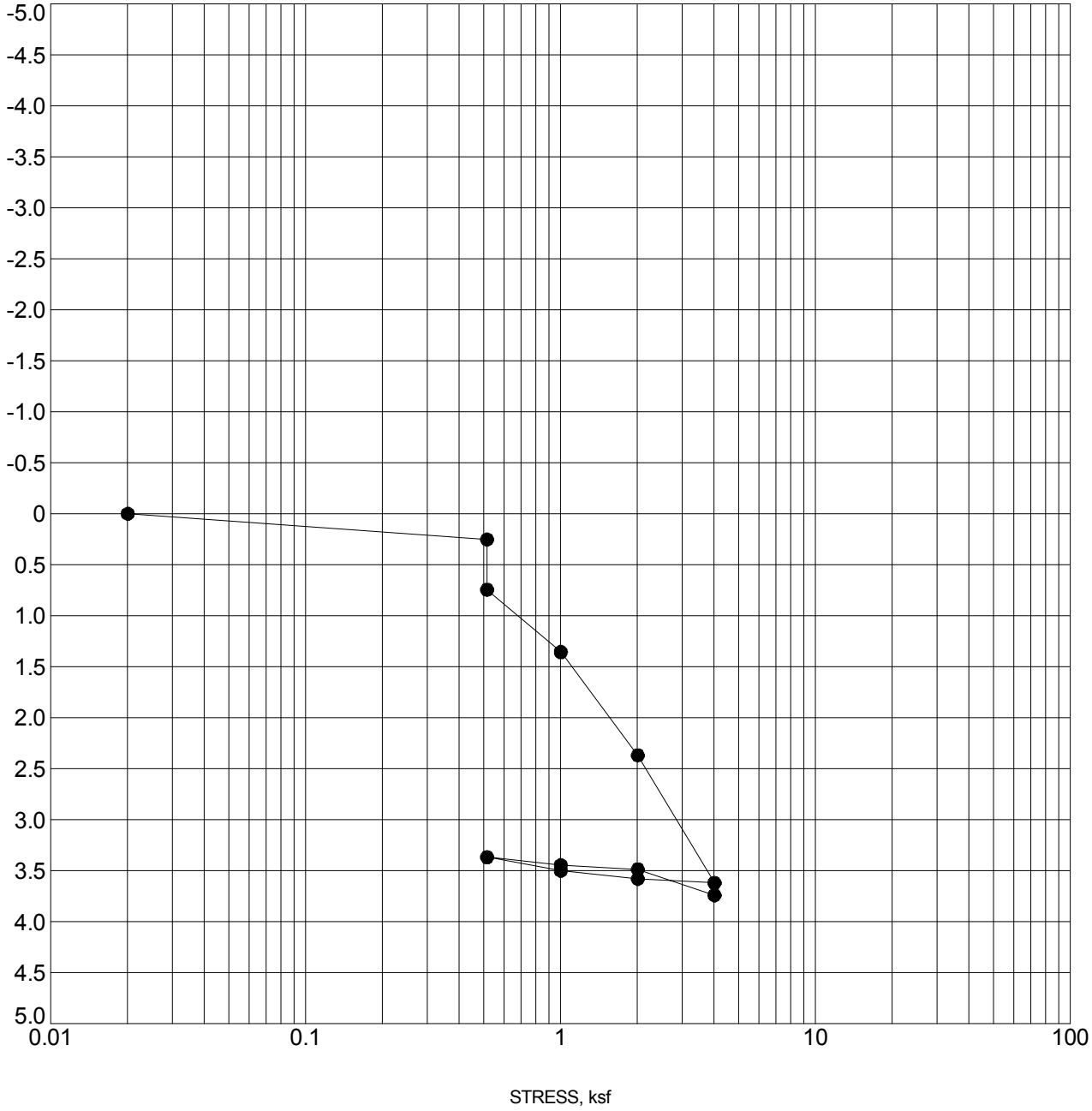


Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-6**	**19**	**SANDY CLAY**	**-0.5**	**100.9**	**25.1**

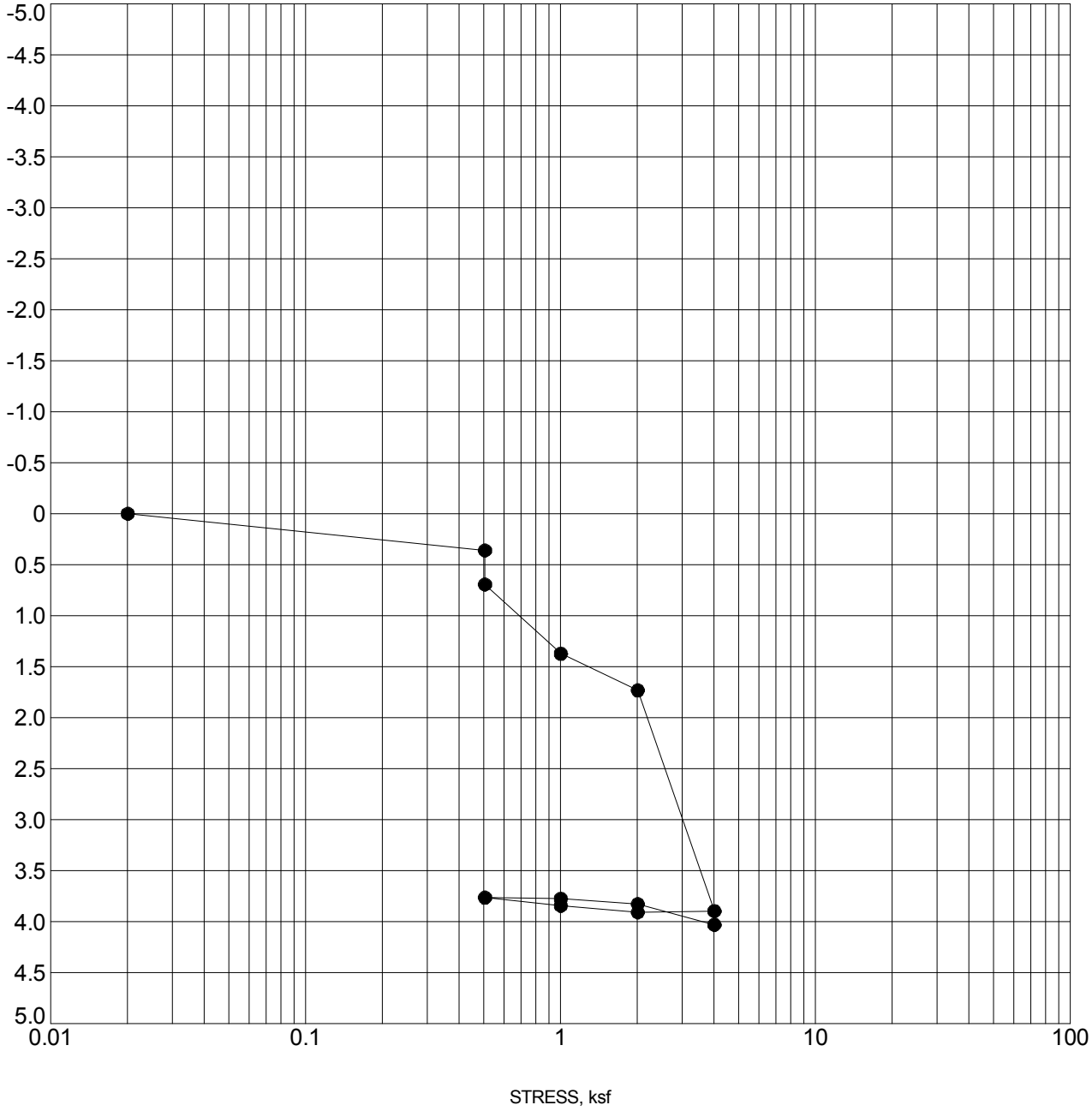
SWELL - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 10/24/13

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-6**	**24**	**SANDY CLAY**	**-0.3**	**94.5**	**29.9**

SWELL - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 10/24/13

SWELL - CONSOLIDATION TEST

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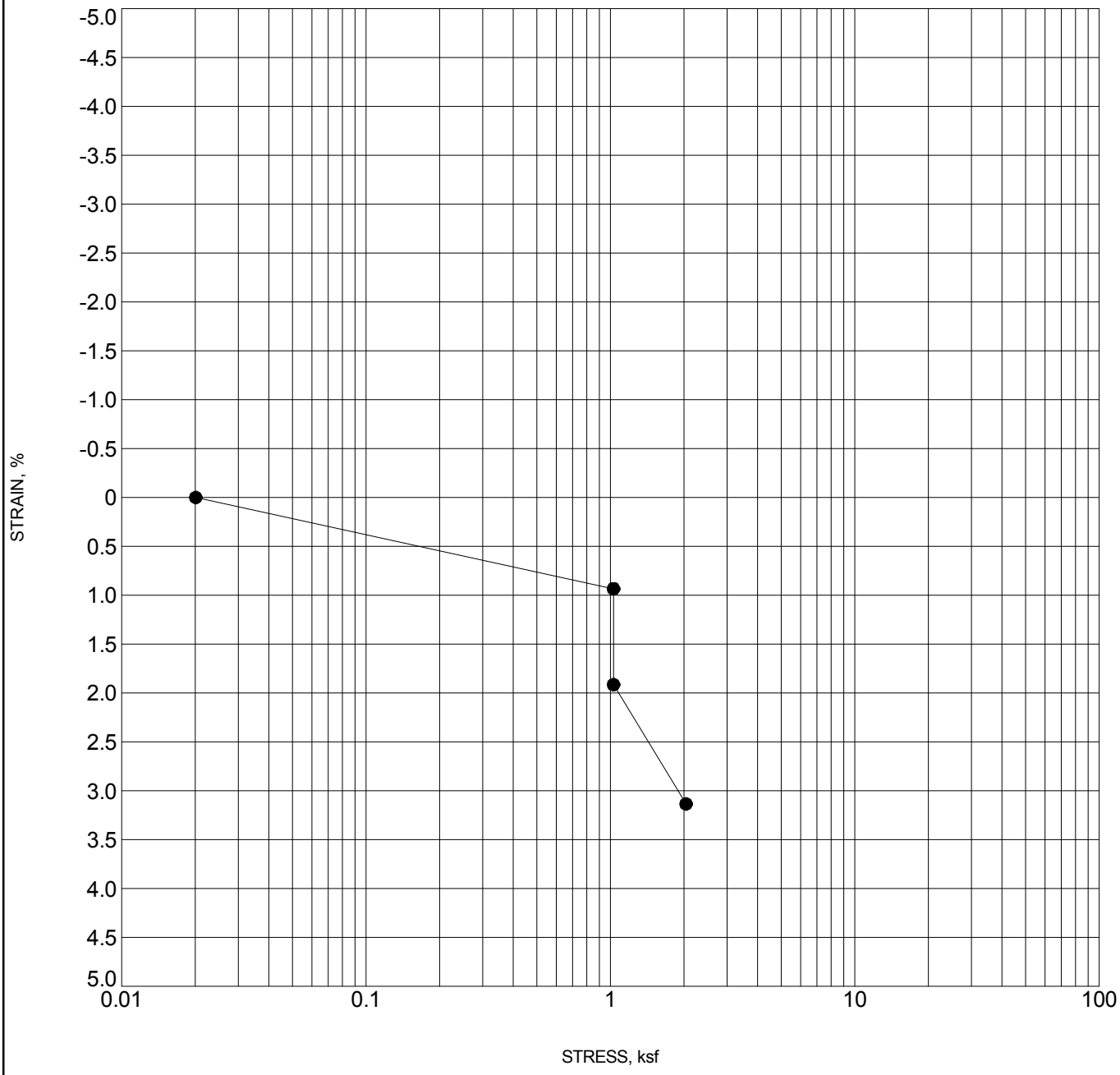
PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **BR-6**	**29**	**SANDY CLAY**	**-1.0**	**91.7**	**29.8**

SWELL - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 10/24/13

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

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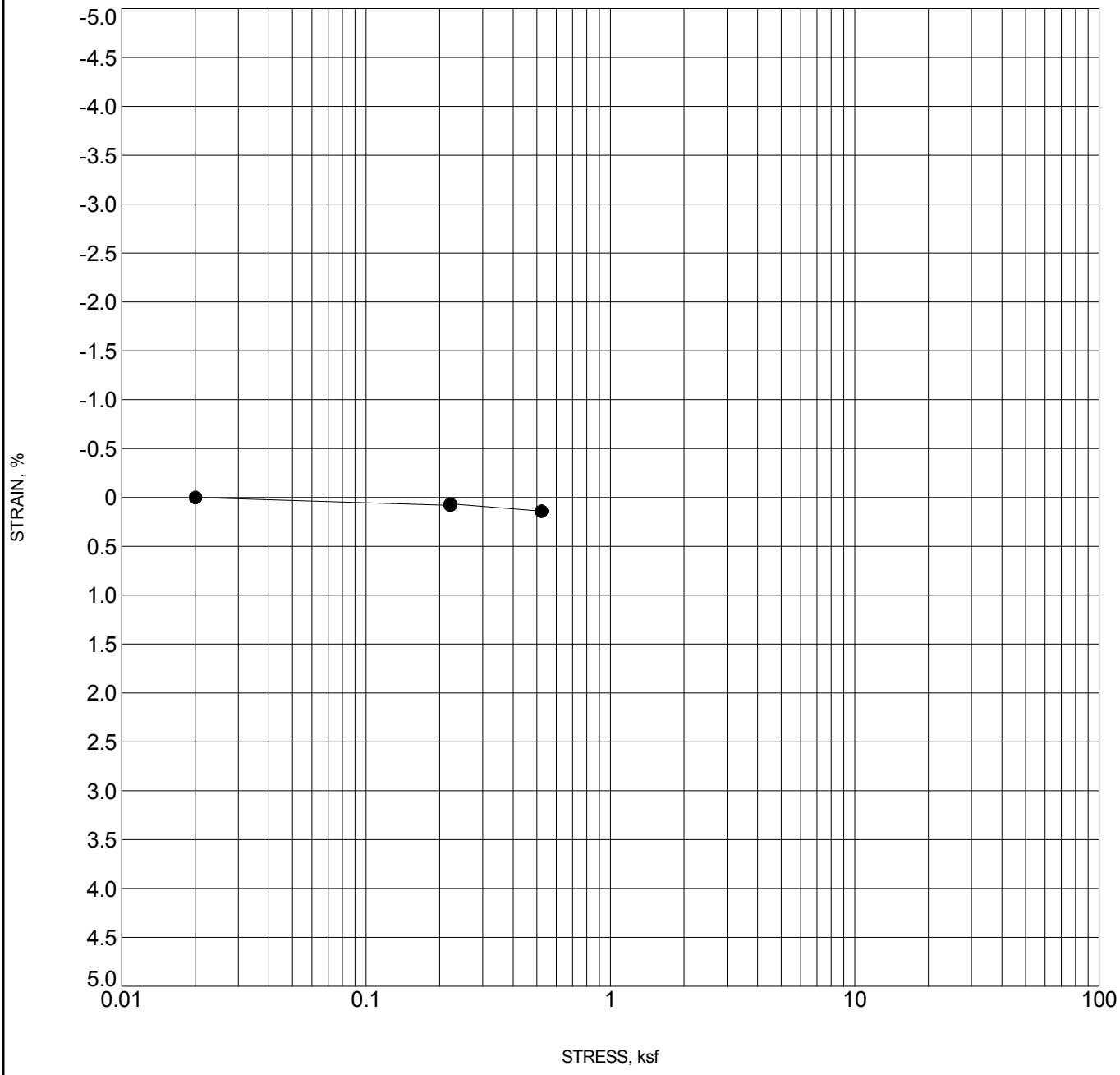


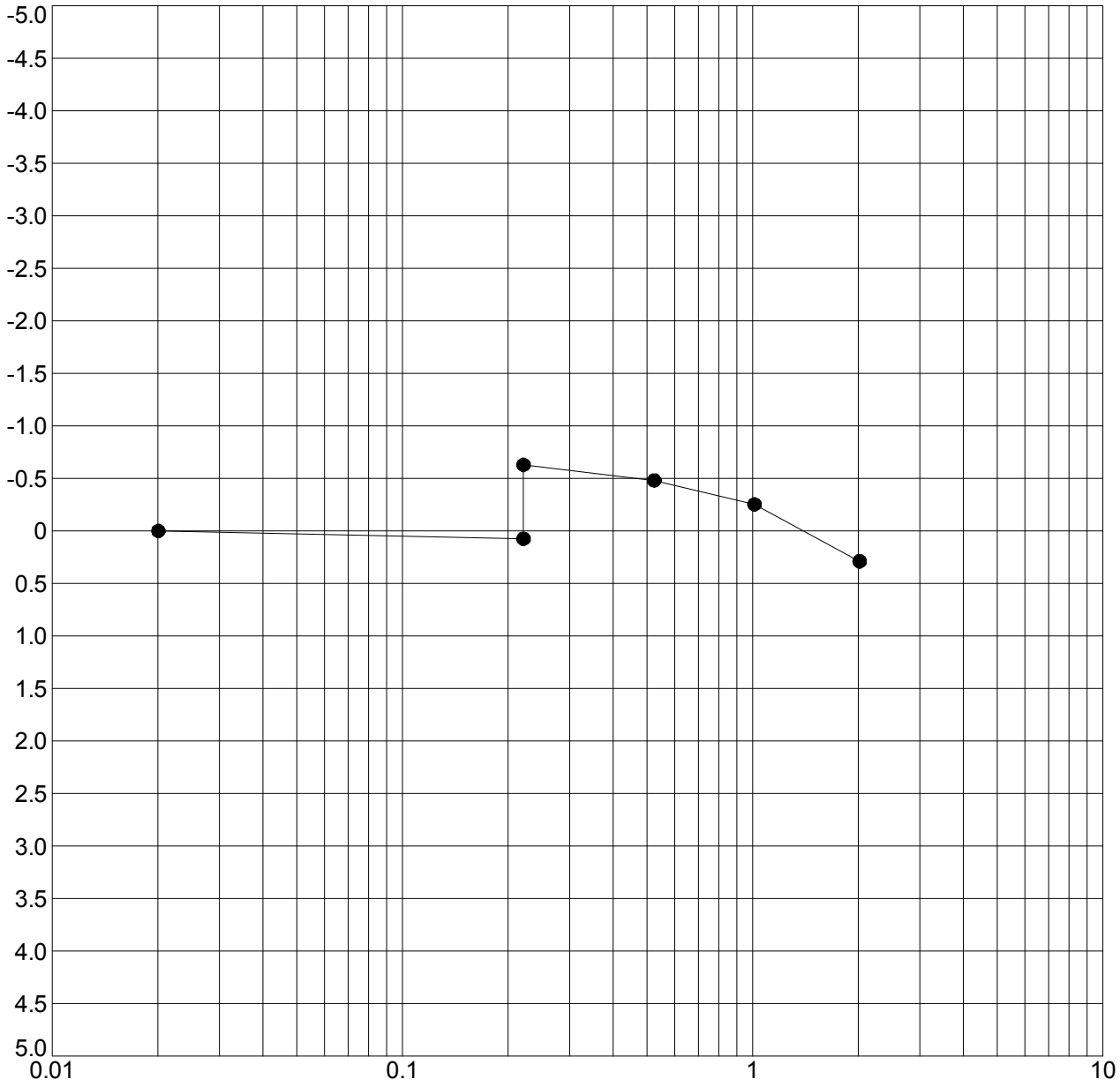
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● PV-1 4	SANDY CLAY	0.0	99.5	22.4

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **PV-2 4**	**CLAY with SAND**	**0.7**	**102.0**	**23.4**

SWELL - CONSOLIDATION TEST

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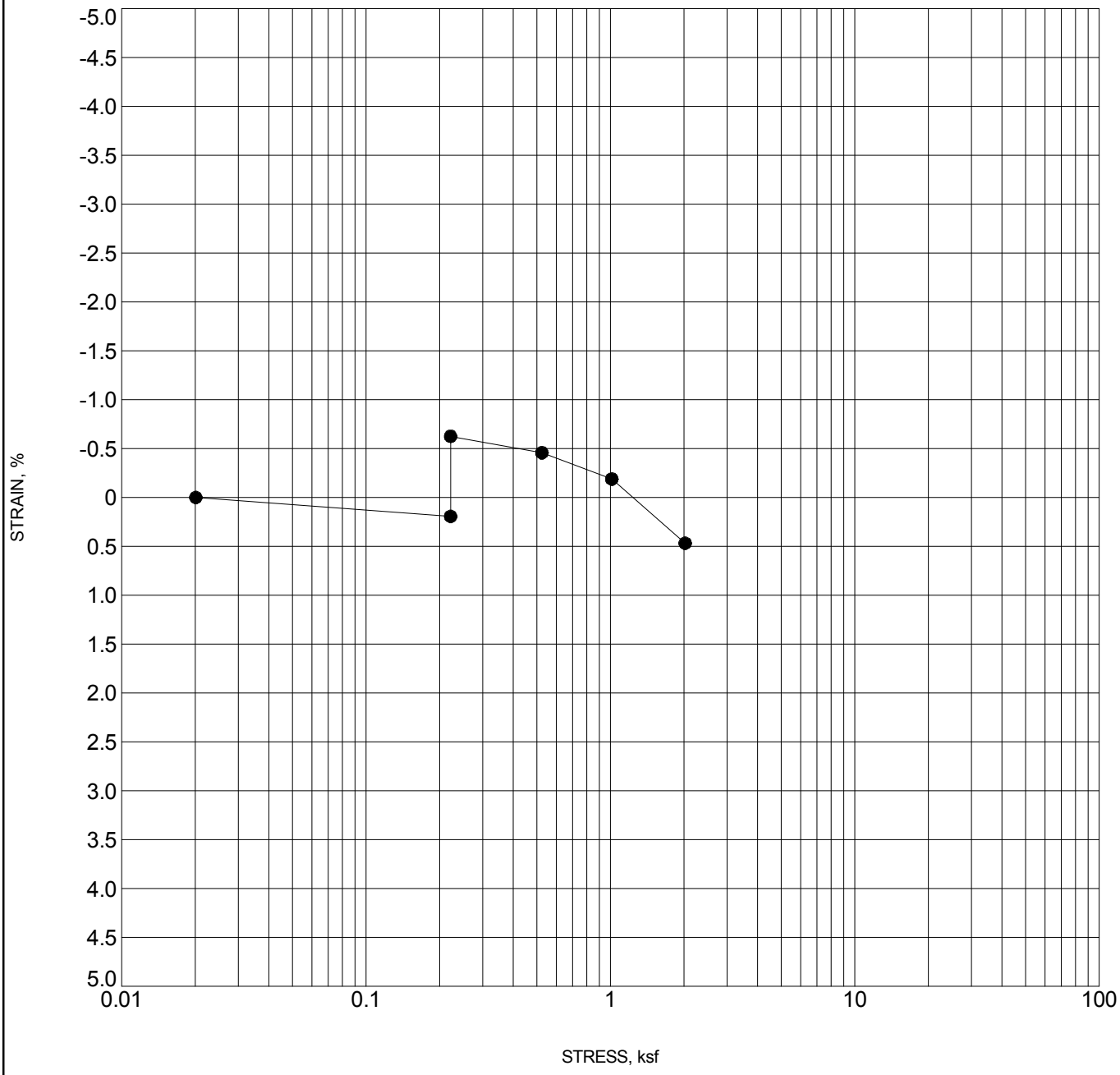


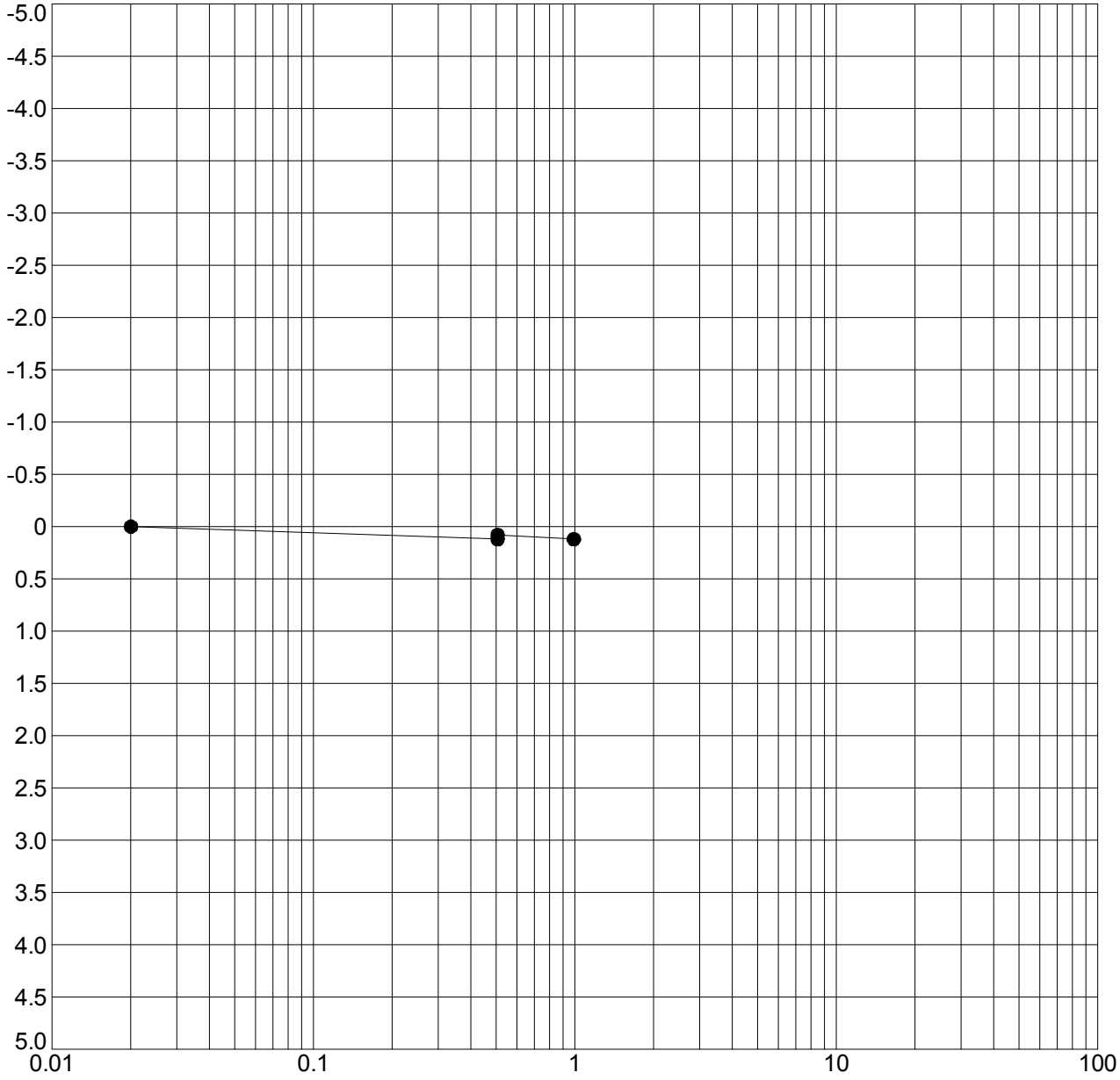
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-1 2**	**SANDY CLAY**	**0.8**	**106.2**	**20.6**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



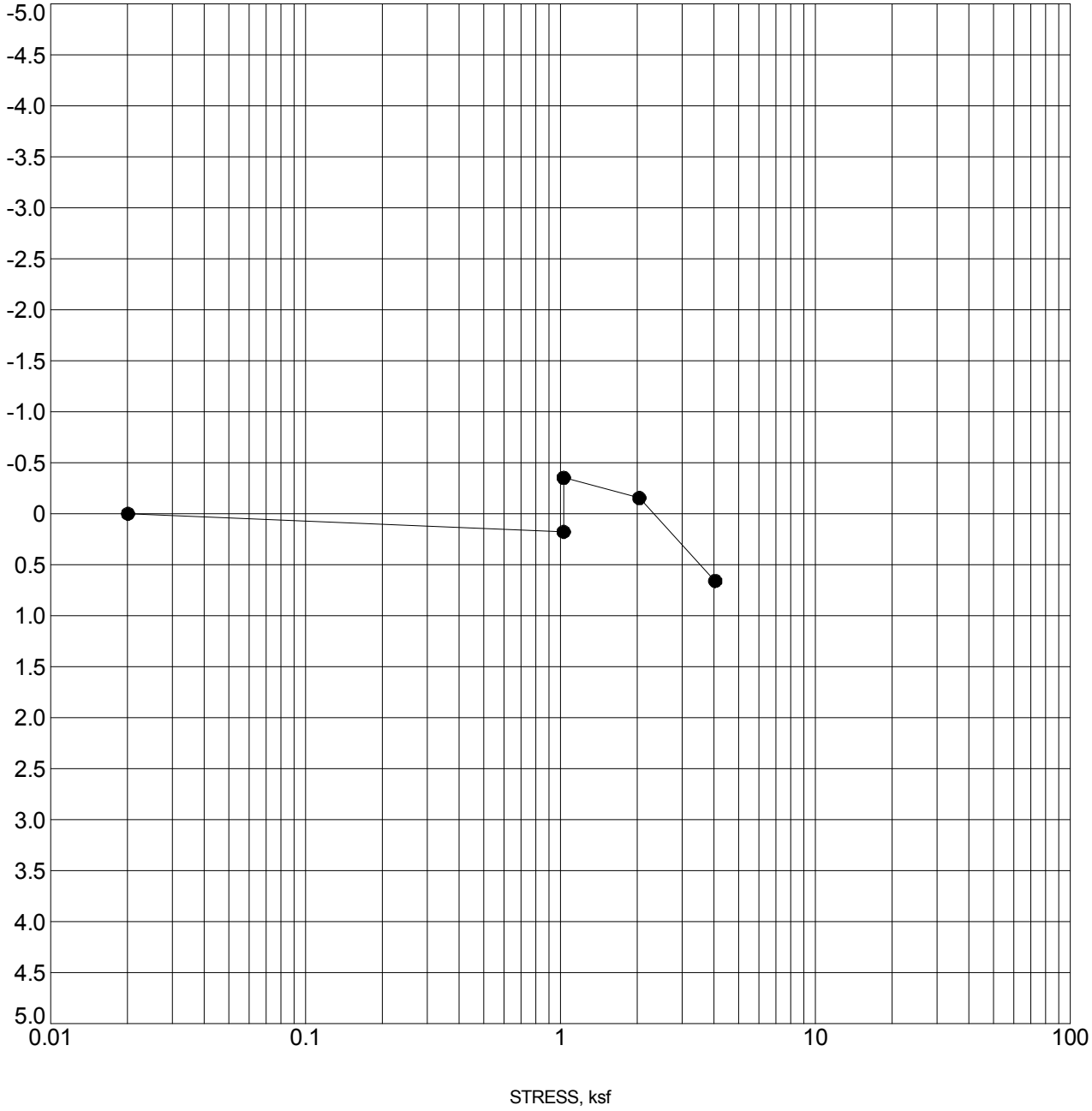
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-1 9**	**SANDY CLAY**	**0.0**	**97.7**	**25.4**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-1**	**14**	**SANDY CLAY**	**0.5**	**96.5**	**26.0**

SWELL - CONSOLIDATION TEST

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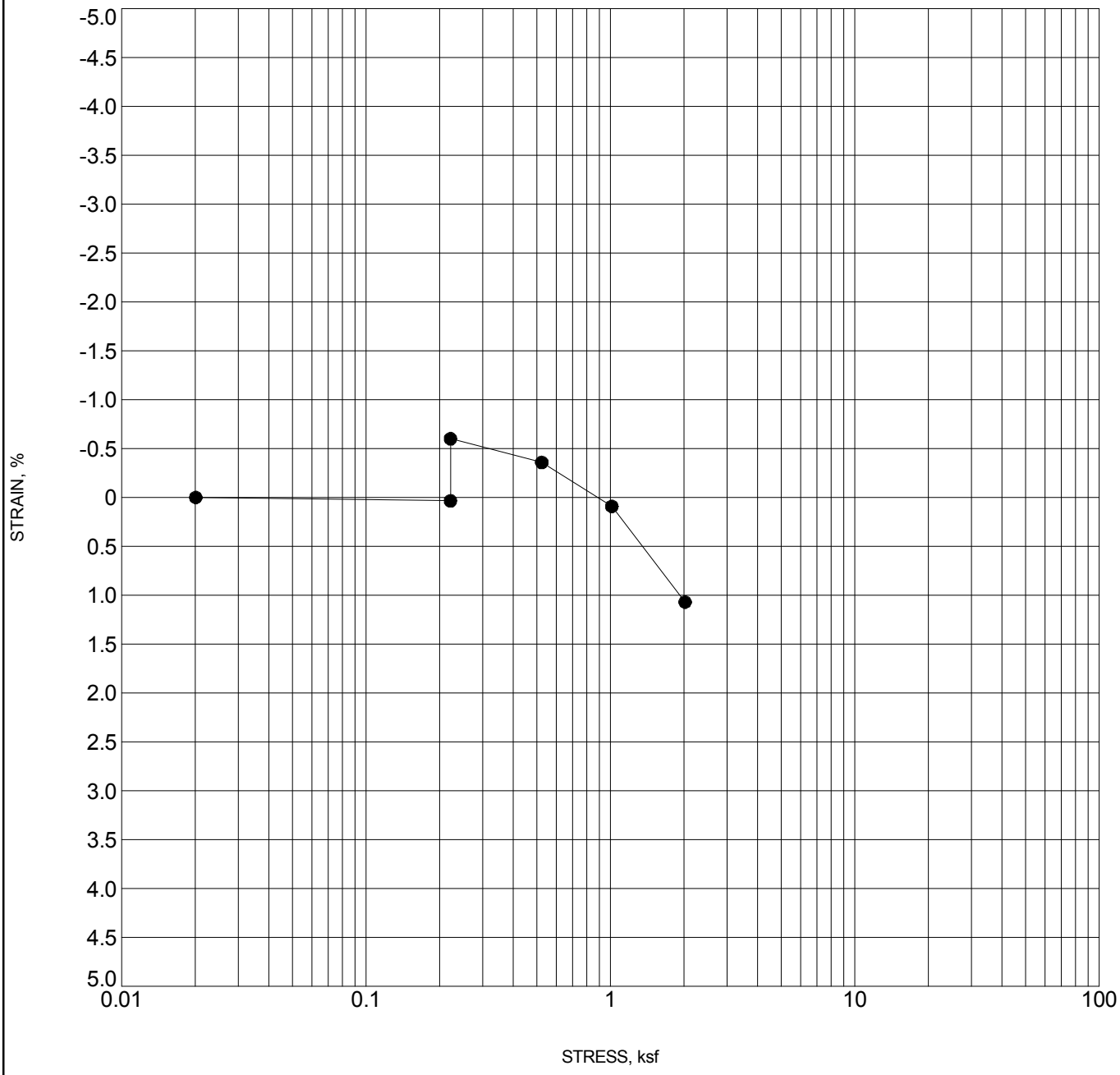
CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-1**	**24**	**SANDY CLAY**	**0.6**	**85.1**	**37.4**

SWELL - CONSOLIDATION TEST

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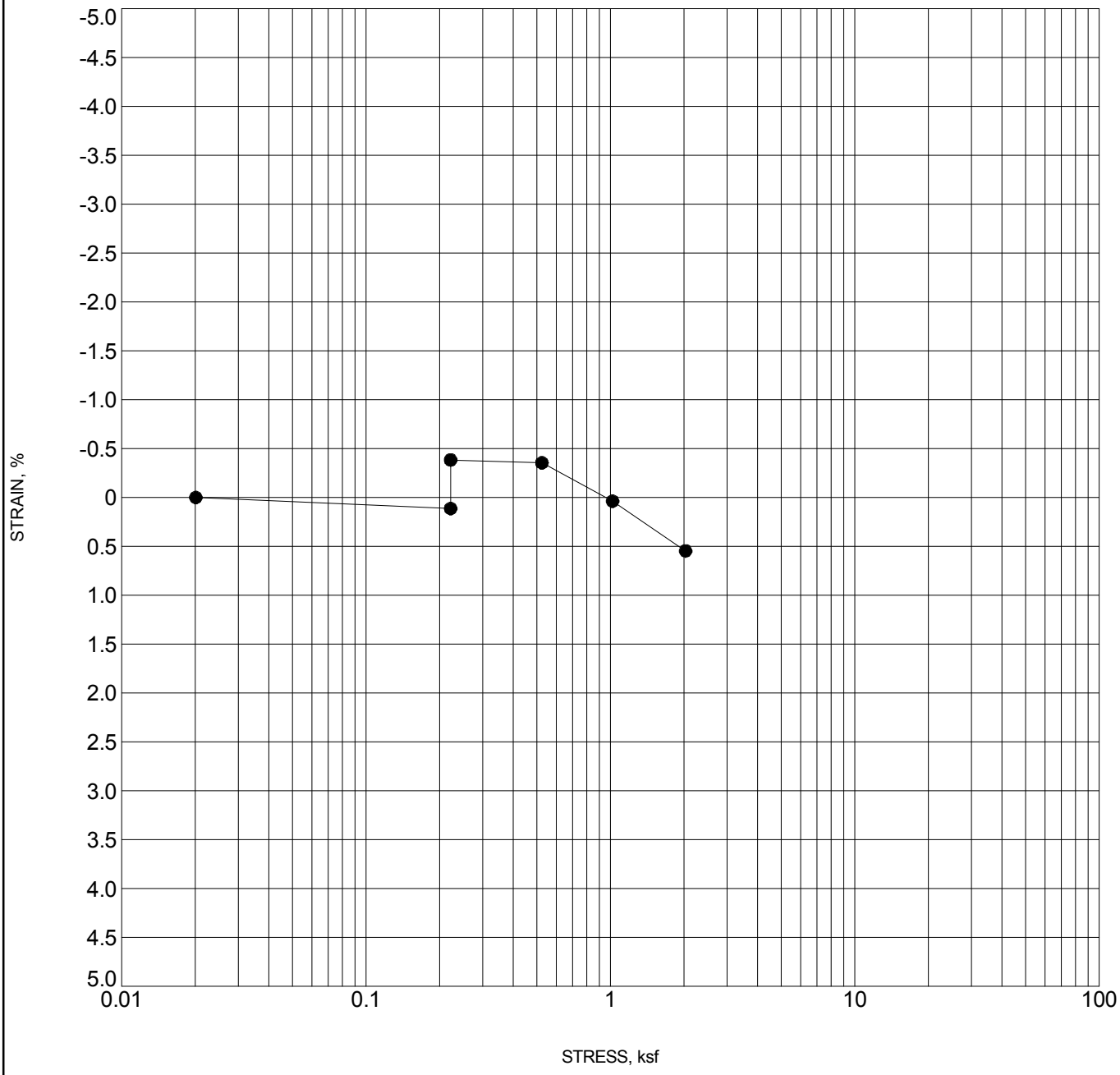
PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



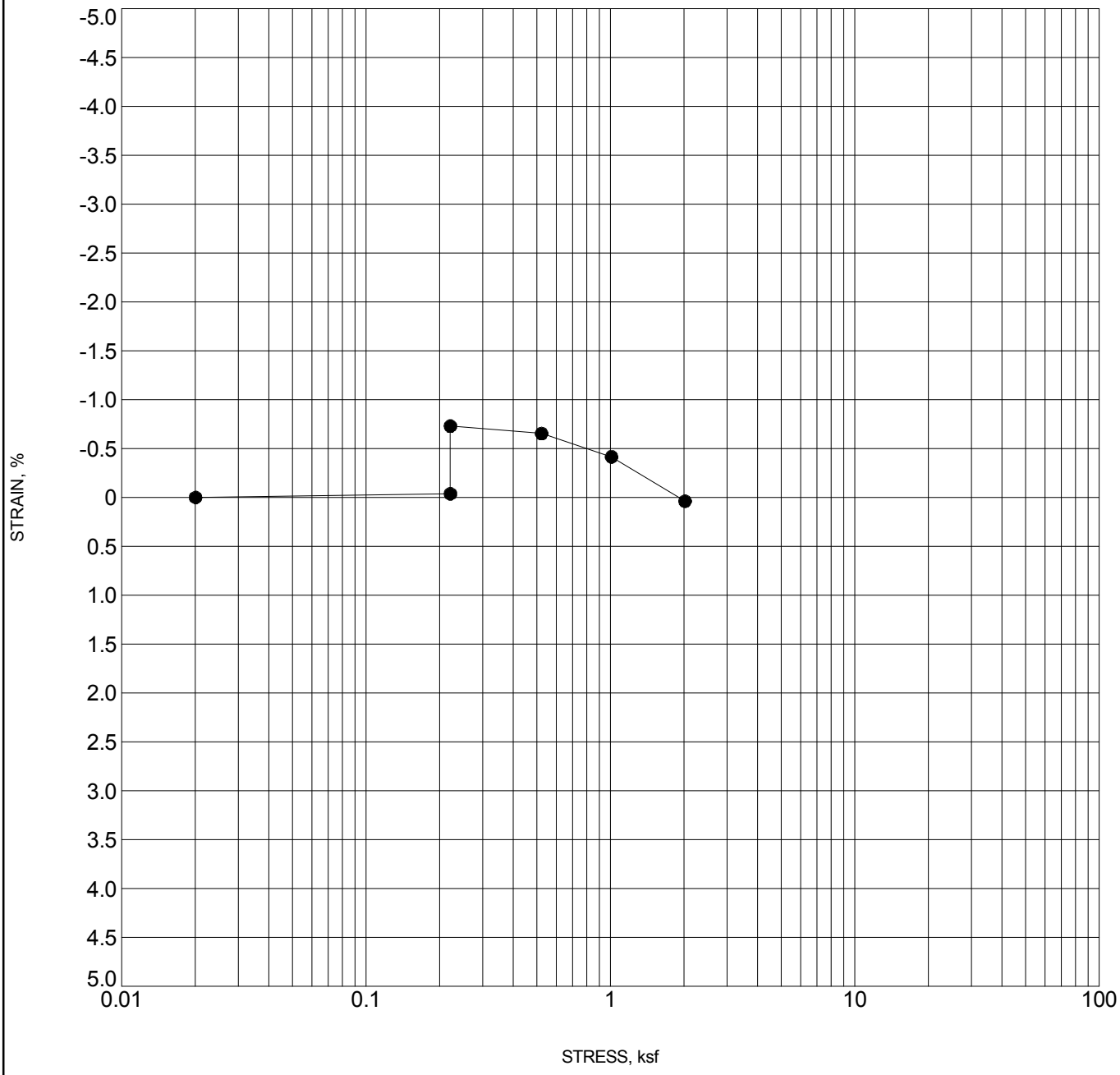
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-2 2**	**SANDY CLAY**	**0.5**	**108.9**	**18.6**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



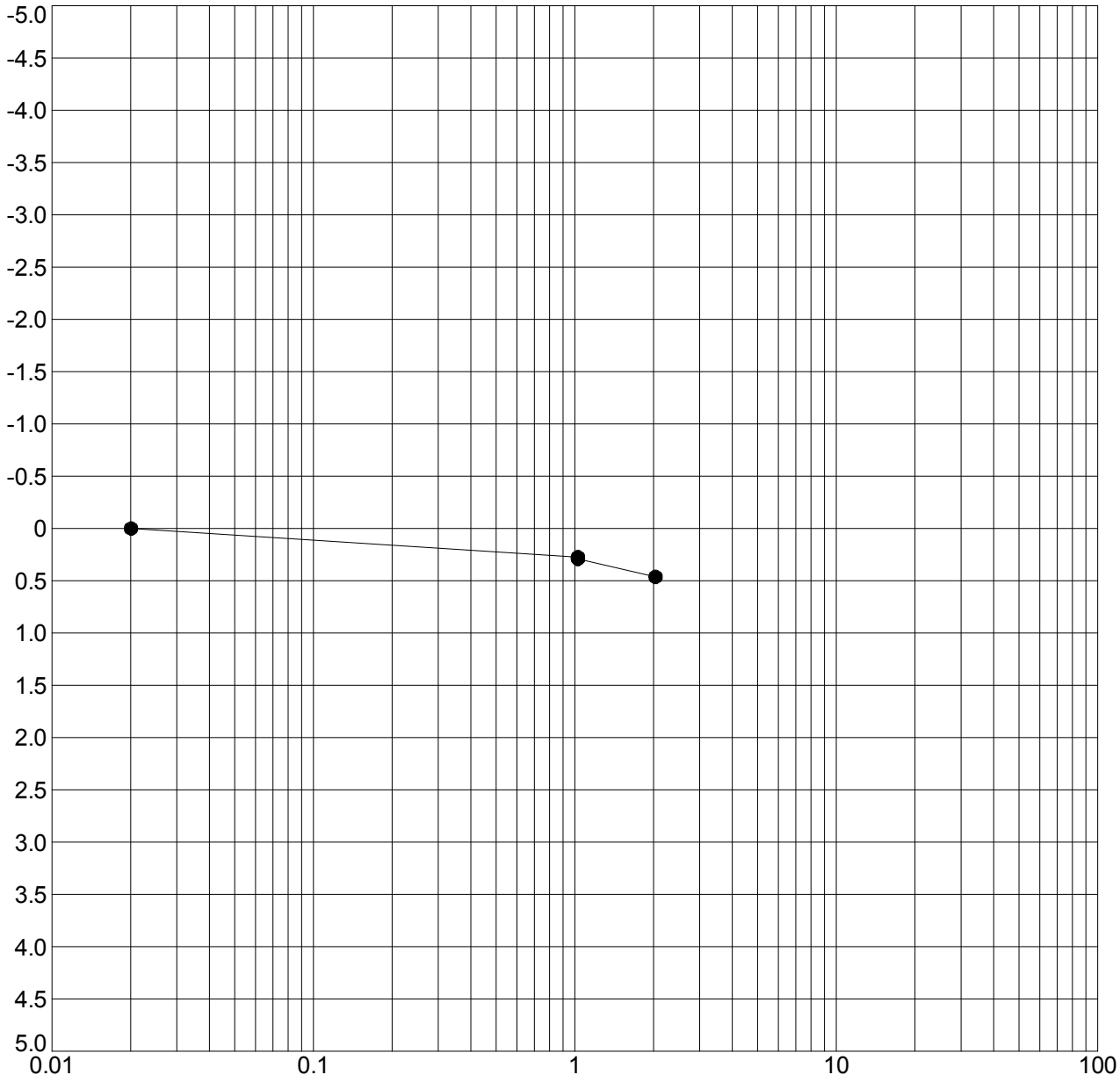
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-2 4**	**SANDY CLAY**	**0.7**	**110.7**	**17.3**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-2**	**14**	**SANDY CLAY**	**0.0**	**111.9**	**14.5**

SWELL - CONSOLIDATION TEST

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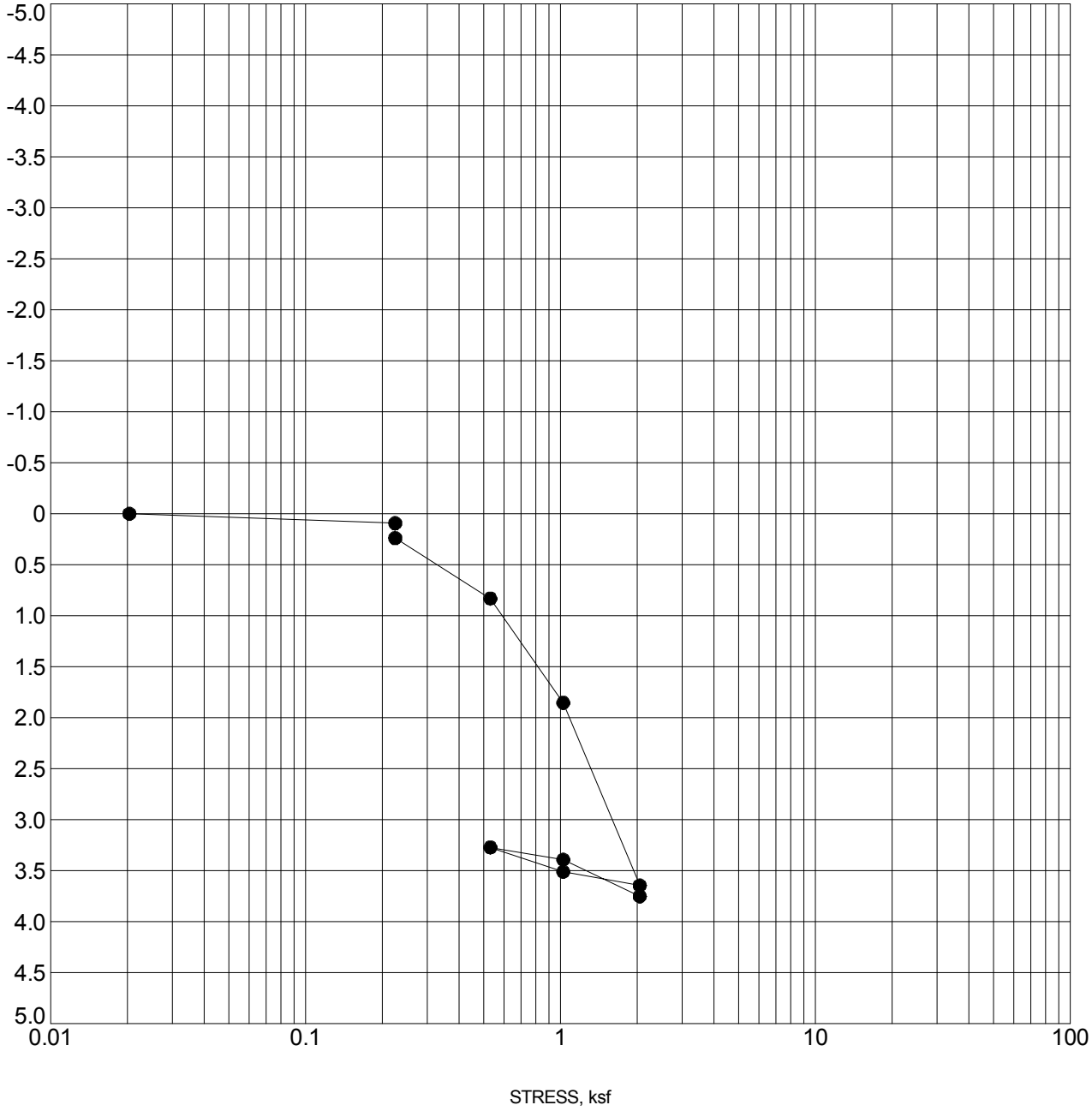

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-2**	**29**	**SANDY CLAY**	**-0.2**	**103.2**	**22.9**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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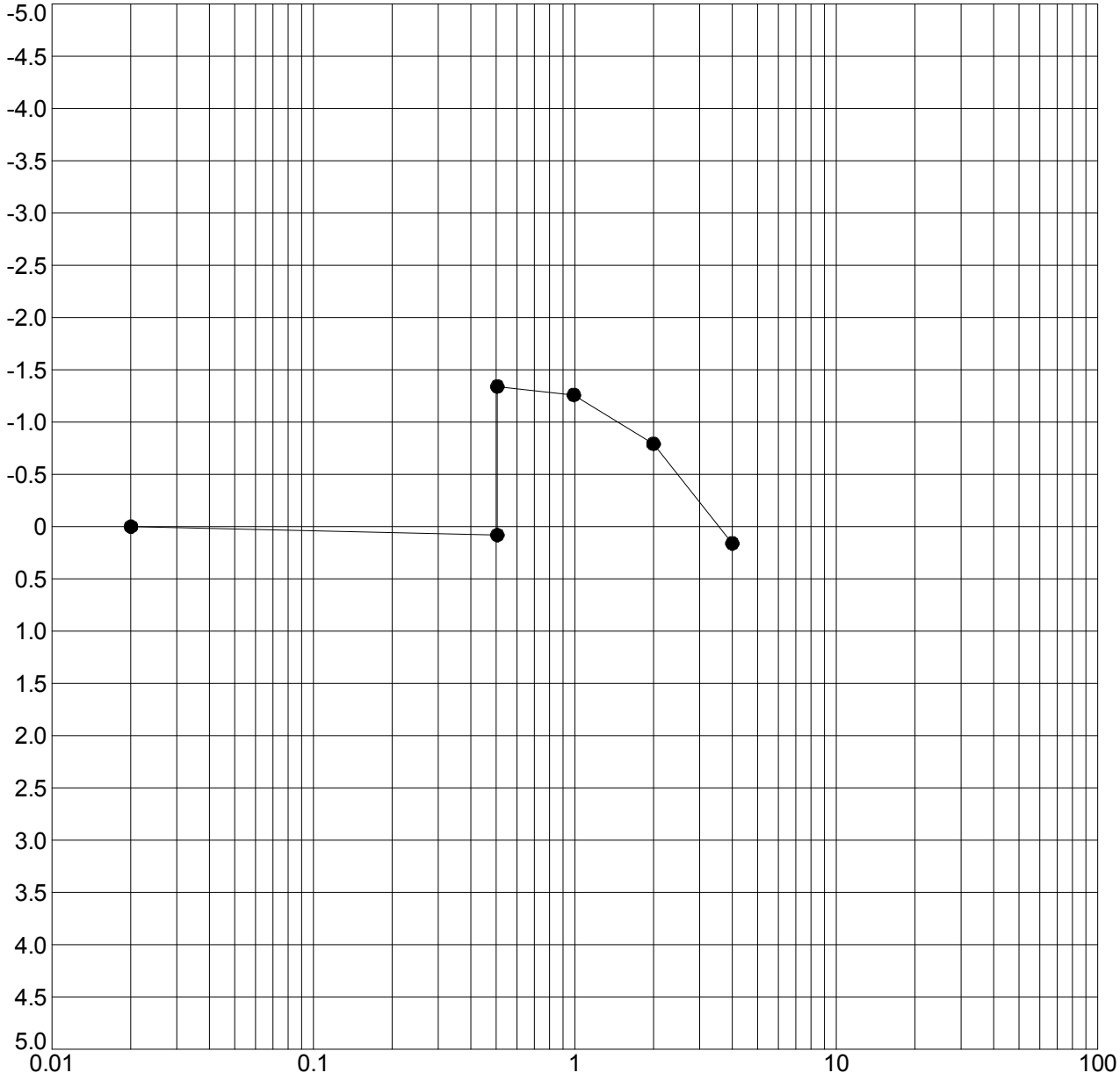
PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



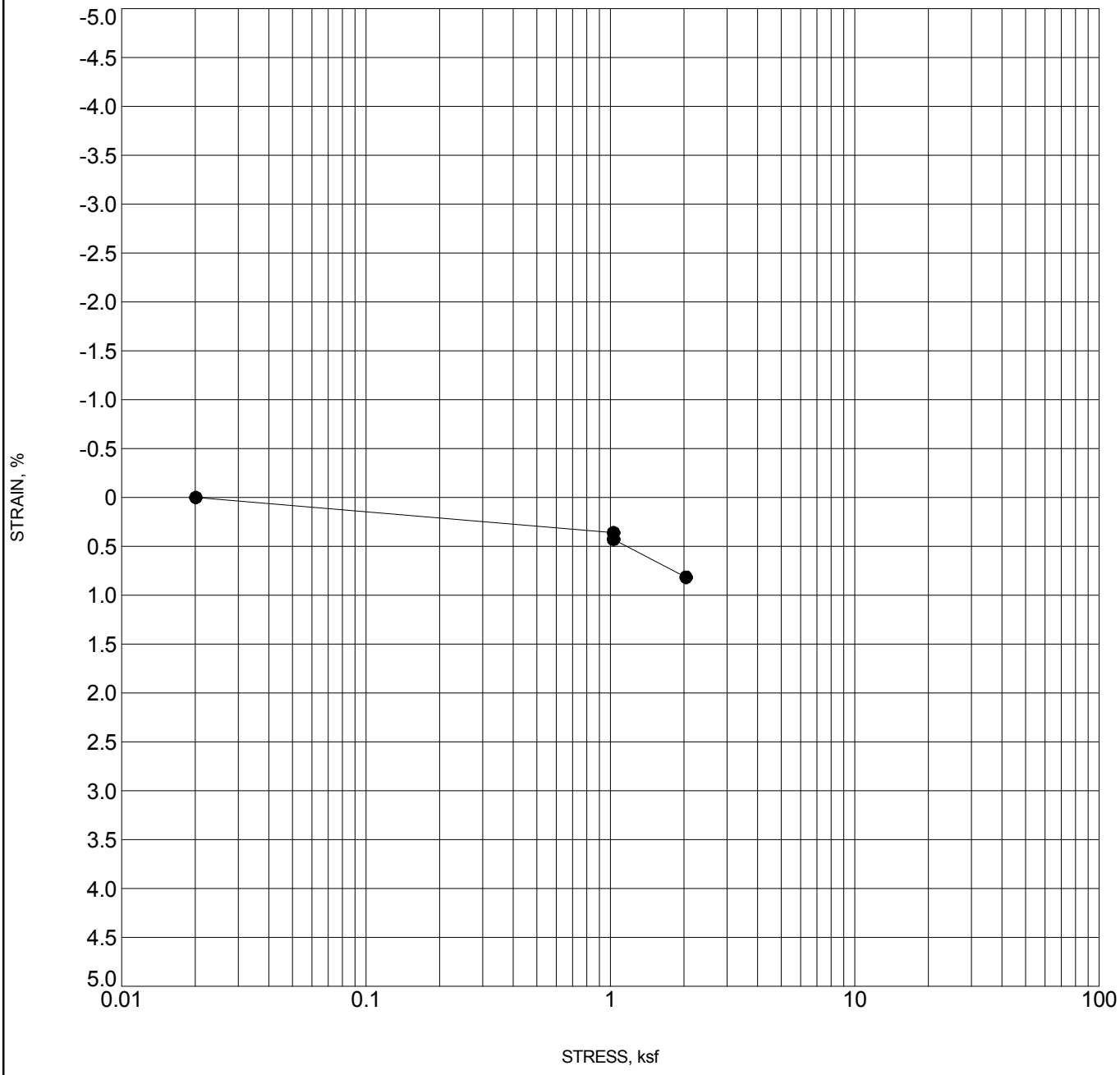
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-3 4**	**SANDY CLAY**	**1.4**	**108.8**	**19.7**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



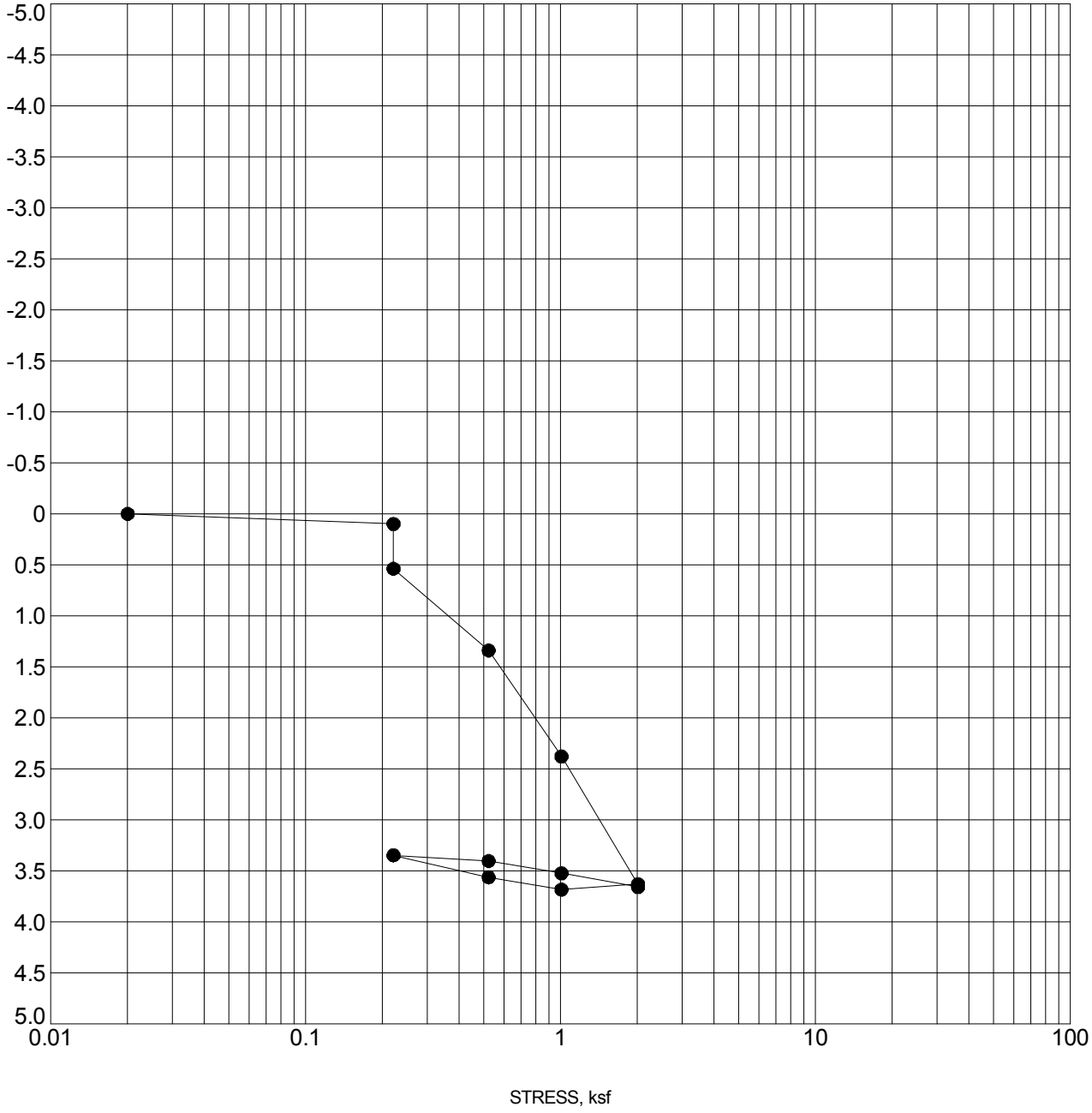
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-3 9**	**SANDY CLAY**	**-0.1**	**107.2**	**18.7**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-3**	**14**	**CLAYEY SAND (SC)**	**-0.4**	**97.7**	**25.9**

SWELL - STANDARD US6 OVER GARRISON FINAL DESIGN.GPJ ROCKSOL TEMPLATE.GDT 10/24/13

SWELL - CONSOLIDATION TEST

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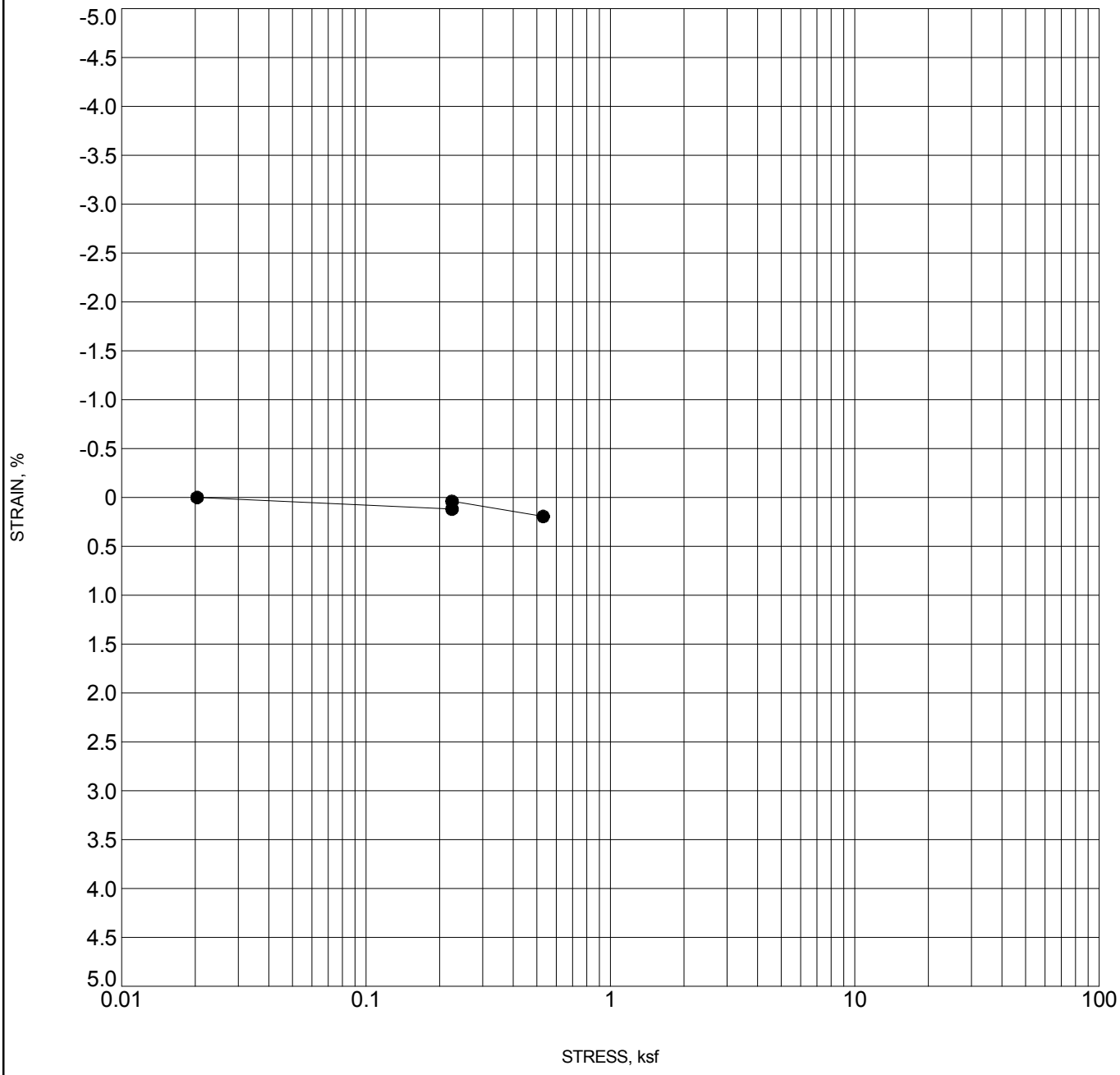


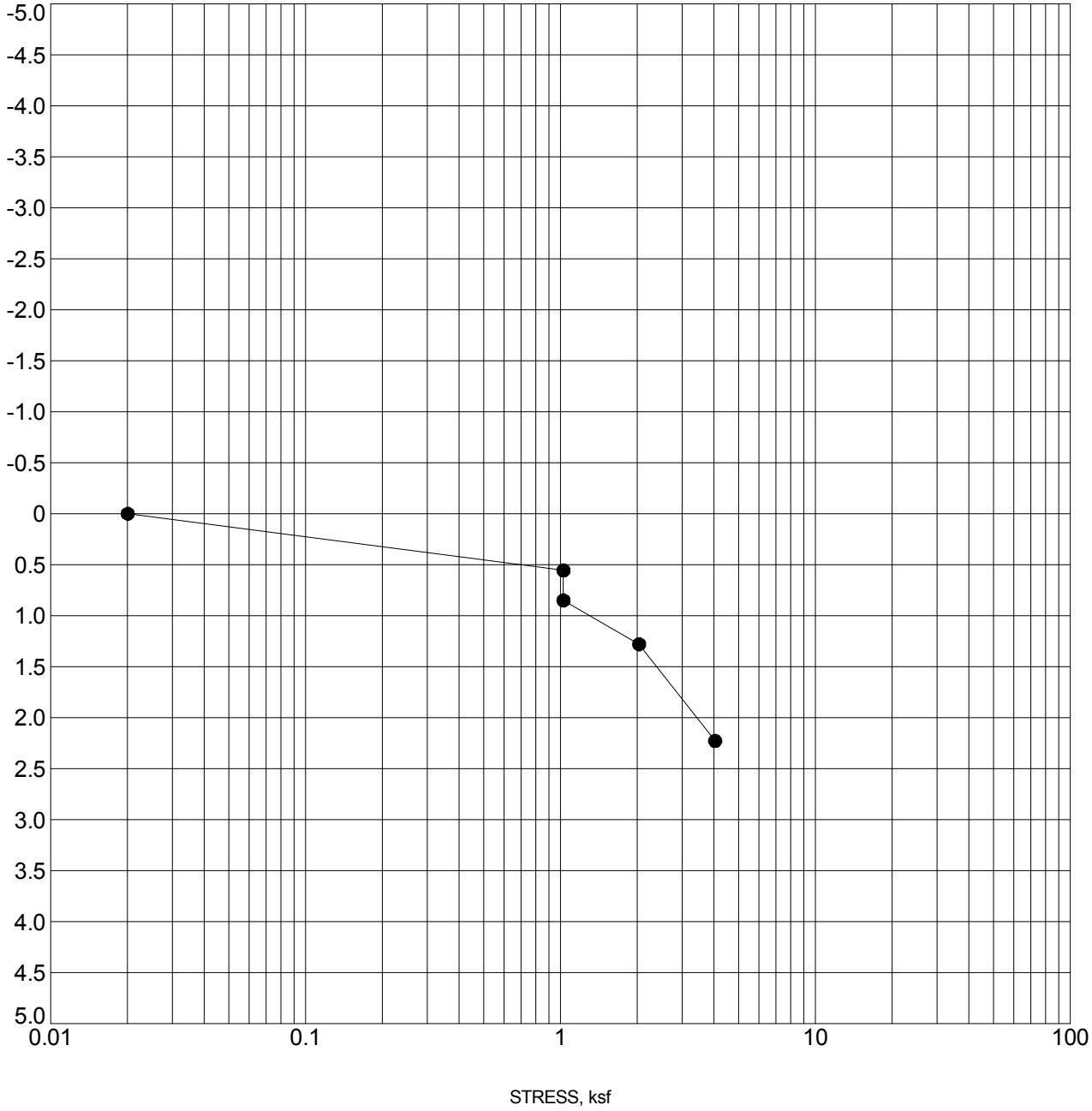
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-4 2**	**SANDY CLAY**	**0.1**	**112.7**	**17.8**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-4**	**24**	**SANDY CLAY**	**-0.3**	**106.6**	**17.7**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

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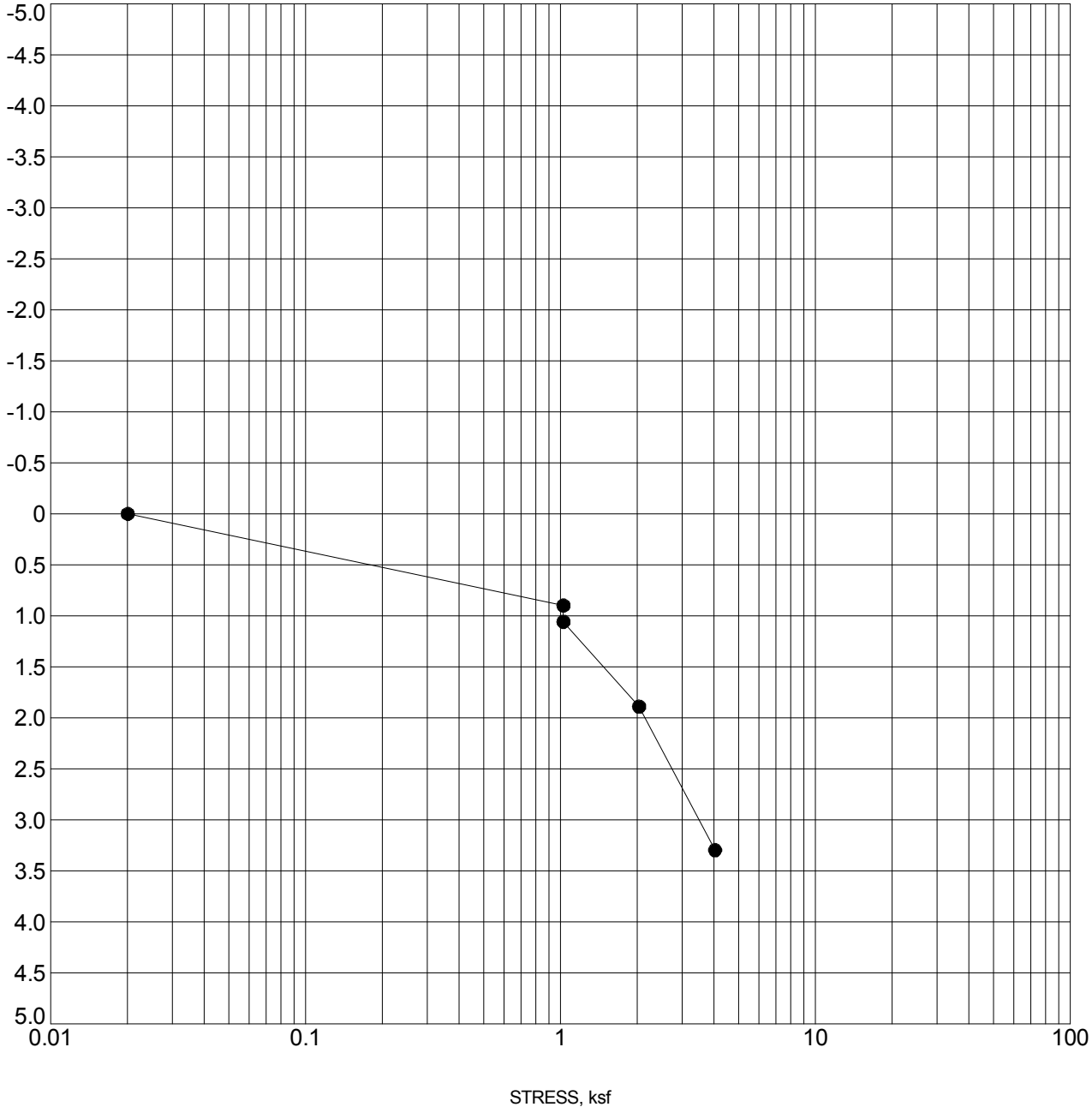

Specimen Identification		Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-4**	**34**	**SILTY SAND with CLAY**	**-0.2**	**95.8**	**28.4**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

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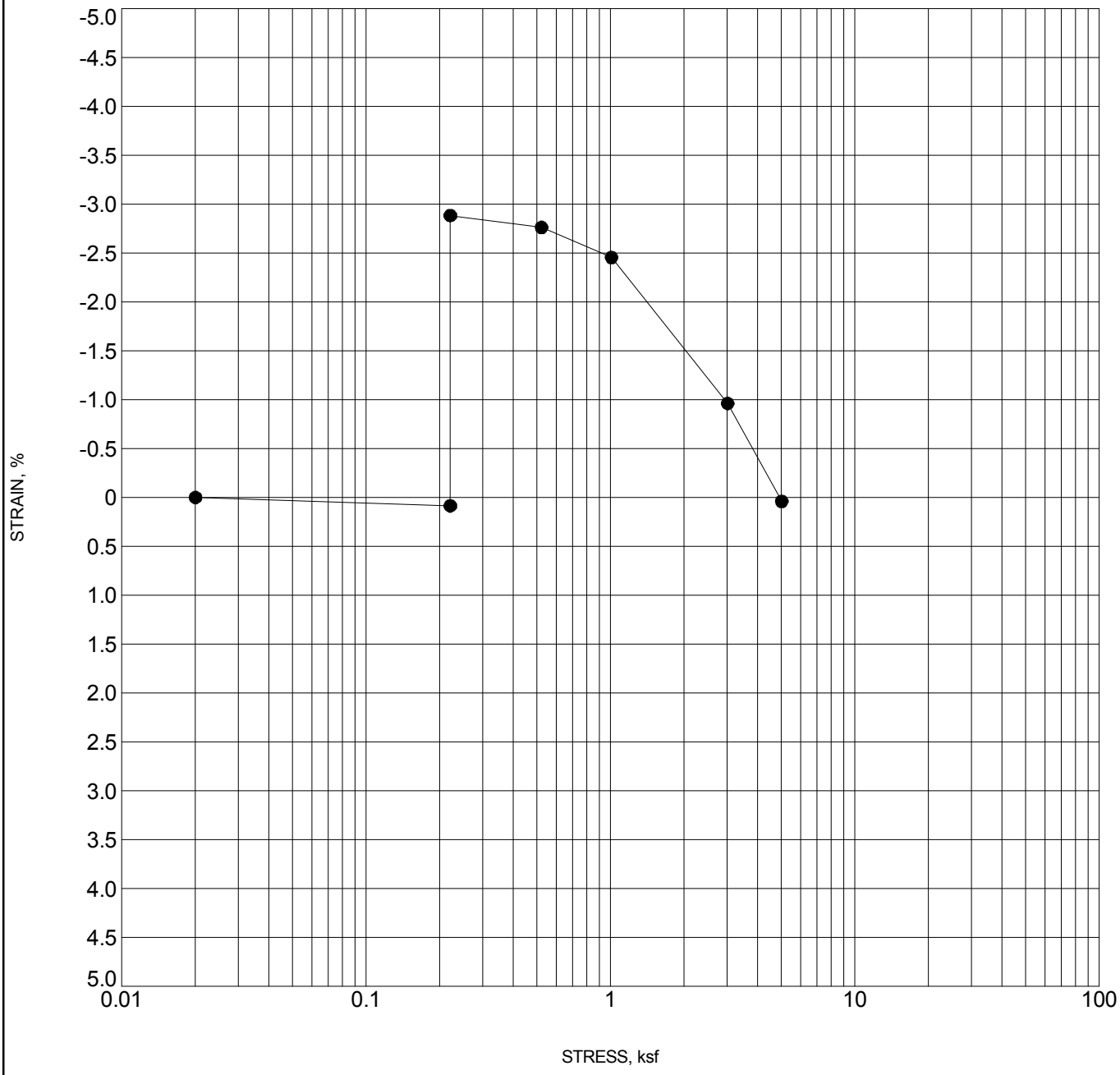
PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



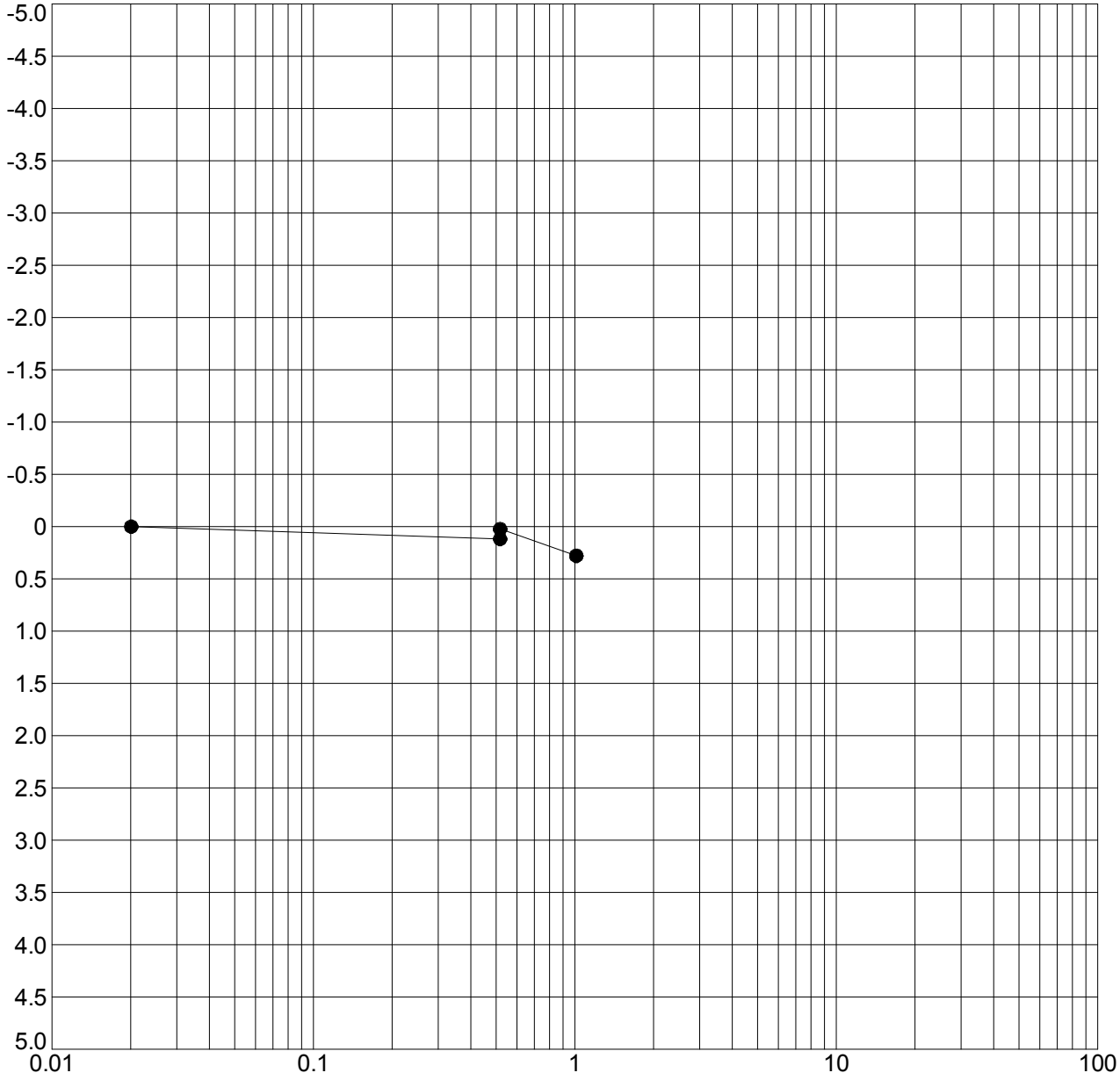
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-5 2**	**SANDY CLAY**	**3.0**	**96.8**	**27.9**

SWELL - CONSOLIDATION TEST

RockSol Consulting Group, Inc.

CLIENT CH2M HILL **PROJECT NAME** US 6 over Garrison Final Design

PROJECT NUMBER 321.01 **PROJECT LOCATION** Lakewood, CO



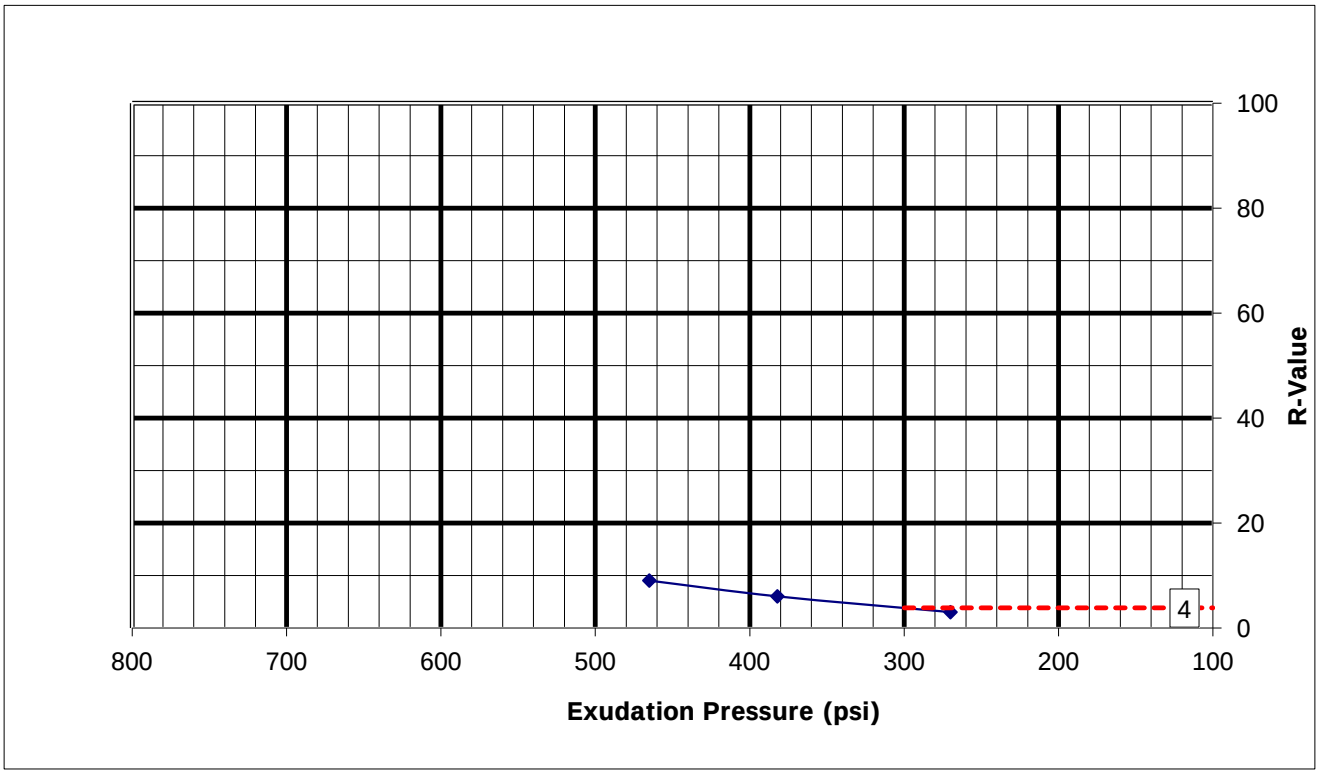
Specimen Identification	Classification	Swell/Consol. (%)	γ_d (pcf)	MC%
● **RW-5 4**	**SANDY CLAY**	**0.1**	**104.3**	**19.2**

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

AASHTO R18

R-Value Test Graph (AASHTO T-190 / Colorado Procedure CP-L 3101)

Project Number:	13.023, RockSol Consulting Group	Date:	22-Oct-13
Project Name:	US 6 and Garrison Bridge Replacement (RockSol Proj. No. 321.01)	Technician:	R. Zoetewey
Lab ID Number:	1321599	Reviewer:	E. Arndt
Sample Location:	PV-2 at 8" to 5', EB US 6 Shoulder Pavement, 740' East of Garrison		
Visual Description:	CLAY, sandy, brown		



R-Value @ Exudation Pressure 300 psi: 4

Specification:

CDOT Pavement Design Manual, 2011. Eq. 2.1 & 2.2, page 2-3.

$S_1 = [(R-5)/11.29]+3$ **S_1= 2.89**

$M_R = 10^{[(S_1+18.72)/6.24]}$ **M_R= 2,909**

M_R = Resilient Modulus, psi

S_1 = the Soil Support Value

R = the R-Value obtained

Test Specimen:	1	2	3
Moisture Content, %:	19.5	21.3	23.5
Expansion Pressure, psi:	0.49	0.21	0.09
Dry Density, pcf:	105.2	103.0	101.8
R-Value:	9	6	3
Exudation Pressure, psi:	465	382	270

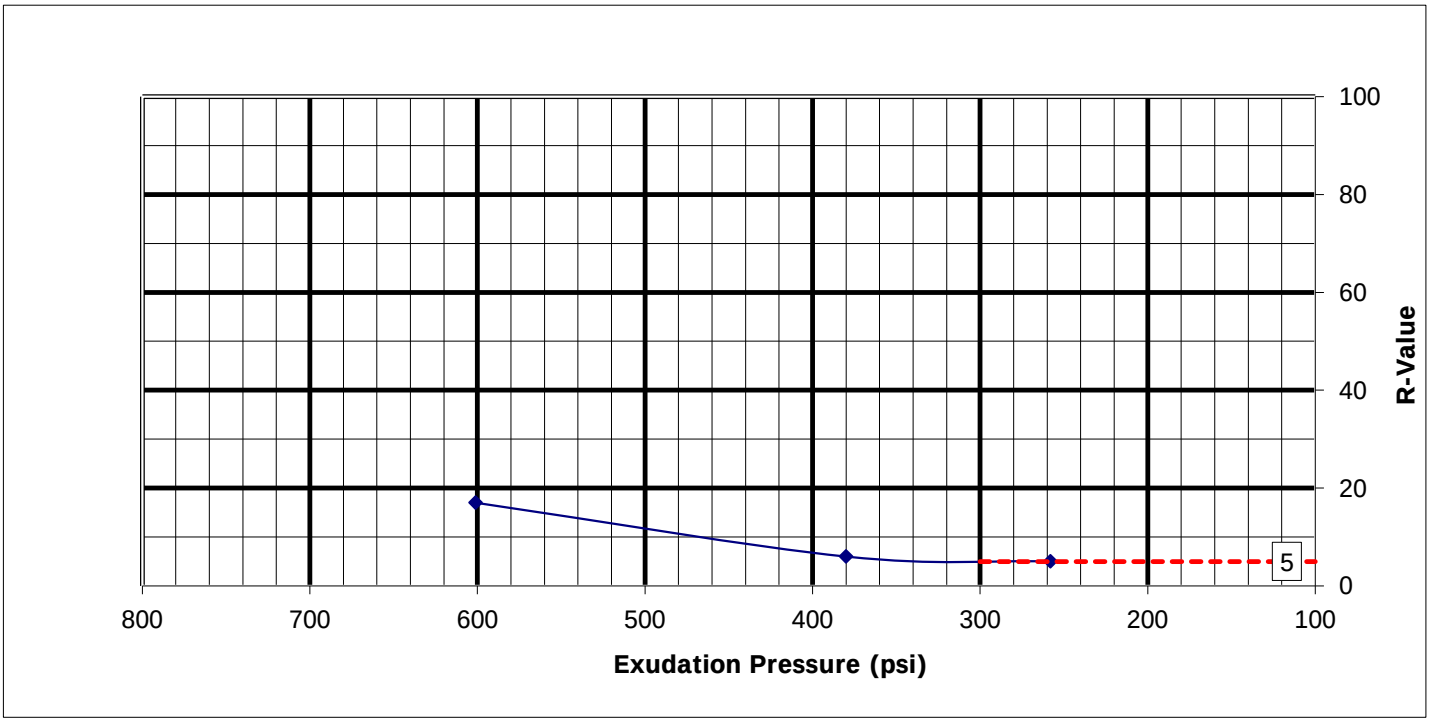
Note: The R-Value is measured; the M_R is an approximation from correlation formulas.

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

AASHTO R18

R-Value Test Graph (AASHTO T-190 / Colorado Procedure CP-L 3101)

Project Number:	13.023, RockSol Consulting Group	Date:	23-Oct-13
Project Name:	US 6 and Garrison Bridge Replacement (RockSol Proj. No. 321.01)	Technician:	R. Zoetewey
Lab ID Number:	1321598	Reviewer:	E. Arndt
Sample Location:	PV-1 at 15" to 10', WB US 6 Shoulder Pavement, 680' West of Garrison		
Visual Description:	CLAY, sandy, brown		



R-Value @ Exudation Pressure 300 psi: 5

Specification:

CDOT Pavement Design Manual, 2011.
Eq. 2.1 & 2.2, page 2-3.

$S_1 = [(R-5)/11.29]+3$ **S_1 = 3.00**

$M_R = 10^{[(S_1+18.72)/6.24]}$ **M_R = 3.025**

M_R = Resilient Modulus, psi

S_1 = the Soil Support Value

R = the R-Value obtained

Test Specimen:	1	2	3
Moisture Content, %:	21.0	24.8	25.5
Expansion Pressure, psi:	1.03	0.33	0.15
Dry Density, pcf:	106.5	100.9	99.0
R-Value:	17	6	5
Exudation Pressure, psi:	601	380	258

Note: The R-Value is measured; the M_R is an approximation from correlation formulas.

APPENDIX D

EQUIVALENT SINGLE AXLE LOAD CALCULATIONS
(From CH2M HILL)

Equivalent Single Axle Load Calculations

PREPARED FOR: CDOT US 6/Garrison Preliminary and Final Design

PREPARED BY: Lynch, Zeke/DEN

DATE: November 22, 2013

PROJECT NUMBER: 473244

The purpose of this memo is to calculate the Equivalent Single Axle Loads (ESALs) to aid in the pavement design for the US 6 and Garrison Street project.

Traffic data was obtained from the CDOT Online Transportation Information System (OTIS) website and the US 6 & Wadsworth Boulevard Environmental Assessment.

The 18 kip ESALs were determined in accordance with the *Colorado Department of Transportation (CDOT) 2014 Pavement Design Manual*. The ESALs for the flexible pavement were calculated assuming a 20-year design life. The ESALs for the rigid pavement were calculated assuming a 30-year design life. Assuming an opening year of 2015, a design year of 2035 was used for the flexible pavement and a design year of 2045 was used for the rigid pavement.

The OTIS website was used to obtain the 2012 traffic counts. The 2035 traffic data were obtained from the Environmental Assessment. For the US 6 Eastbound off ramp at Garrison, the 2012 traffic counts were obtained by linear extrapolation between 2008 and 2035. As shown in Exhibit 1, the projected average daily traffic volume for the 2045 design year was determined by linear extrapolation utilizing the existing 2012 traffic counts and expected future traffic estimates for 2035.

EXHIBIT 1
Existing and Future Daily Traffic Volumes

Location	2012[1]	2035[2]	2045[3]
US 6 West of Garrison	100,000	139,500	154,000
US 6 East of Garrison	92,000	133,800	150,000
US 6 Eastbound off ramp at Garrison[2]	8,000	9,750	10,600

Source:
[1] CDOT Online Transportation Information System (OTIS) website
[2] US 6 & Wadsworth Boulevard Environmental Assessment: Final Traffic Study March 2009
[3] Linear extrapolation

As shown in Exhibit 2, based on Figure 1.1 in the *2014 CDOT Pavement Design Manual,* the projected traffic was distributed into three vehicle classifications (passenger cars & pickup trucks, single unit trucks, and combination trucks) using 2012 CDOT vehicle classification counts.

EXHIBIT 2
Vehicle Classification

Location	Auto[1]	Medium Truck[2]	Heavy Truck[3]
US 6 West of Garrison	96.9%	1.7%	1.4%
US 6 East of Garrison	96.8%	1.9%	1.3%
US 6 Eastbound off ramp at Garrison[4]	96.9%	1.7%	1.4%

Source: CDOT Online Transportation Information System (OTIS) website: 2012 Traffic Counts
[1] Passenger cars and pickup trucks
[2] Single unit trucks
[3] Combination trucks
[4] No vehicle classification count available – assumed same distribution as the US 6 w/o Garrison location

Since traffic volume is a major factor that degrades the pavement condition and traffic increases annually, ESALs are calculated based on the cumulative traffic expected over the life time of the pavement (20 years for flexible and 30 years for rigid). The total lifetime traffic for each of these classifications was multiplied by the CDOT equivalency factors shown in Exhibit 3.

EXHIBIT 3
Colorado Equivalency Factors

3-Bin Vehicle Classification	Flexible Pavement	Rigid Pavement
Passenger Cars & Pickup Trucks	0.003	0.003
Single Unit Trucks	0.249	0.285
Combination Trucks	1.087	1.692

Source: 2014 CDOT Pavement Design Manual

Then a design lane factor of 0.30 was applied for US6 mainline locations, per Table 1.1 in the *2014 CDOT Pavement Design Manual* for 6-lane facilities with 3 lanes in each direction. Although the section of US6 west of Garrison Street does have four travel lanes, the outside lane is an auxiliary lane that connects the on and off ramps between Garrison Street and Kipling Street. The majority of traffic will utilize the three through lanes instead of the four lanes present; therefore the 0.30 design lane factor was appropriate. Since all of the traffic on the eastbound off ramp will be in a single lane, the design lane factor is 1. The resulting total design ESALs for rigid and flexible pavement are shown in Exhibits 4, 5, and 6.

EXHIBIT 4
US 6 West of Garrison Street: Design ESALs

		Total Lifetime Traffic	Equivalency Factor	Design Lane Factor	18k ESALs
Flexible Pavement	Passenger Cars & Pickup Trucks	850,611,000	0.003	0.30	766,000
	Single Unit Trucks	14,923,000	0.249	0.30	1,115,000
	Combination Trucks	12,290,000	1.087	0.30	4,008,000
	TOTAL	**877,824,000**			**5,889,000**
Rigid Pavement	Passenger Cars & Pickup Trucks	1,377,662,000	0.003	0.30	1,240,000
	Single Unit Trucks	24,170,000	0.285	0.30	2,066,000
	Combination Trucks	19,904,000	1.692	0.30	10,103,000
	TOTAL	**1,421,736,000**			**13,409,000**

EXHIBIT 5
US 6 East of Garrison Street: Design ESALs

		Total Lifetime Traffic	Equivalency Factor	Design Lane Factor	18k ESALs
Flexible Pavement	Passenger Cars & Pickup Trucks	800,398,000	0.003	0.30	720,000
	Single Unit Trucks	15,710,000	0.249	0.30	1,174,000
	Combination Trucks	10,749,000	1.087	0.30	3,505,000
	TOTAL	**826,857,000**			**5,399,000**
Rigid Pavement	Passenger Cars & Pickup Trucks	1,309,642,000	0.003	0.30	1,179,000
	Single Unit Trucks	25,706,000	0.285	0.30	2,198,000
	Combination Trucks	17,588,000	1.692	0.30	8,928,000
	TOTAL	**1,352,936,000**			**12,305,000**

EXHIBIT 6
US 6 Eastbound Off Ramp at Garrison Street: Design ESALs

		Total Lifetime Traffic	Equivalency Factor	Design Lane Factor	18k ESALs
Flexible Pavement	Passenger Cars & Pickup Trucks	63,154,000	0.003	1.00	189,000
	Single Unit Trucks	1,108,000	0.249	1.00	276,000
	Combination Trucks	912,000	1.087	1.00	992,000
	TOTAL	**65,174,000**			**1,457,000**
Rigid Pavement	Passenger Cars & Pickup Trucks	98,994,000	0.003	1.00	297,000
	Single Unit Trucks	1,737,000	0.285	1.00	495,000
	Combination Trucks	1,430,000	1.692	1.00	2,420,000
	TOTAL	**102,161,000**			**3,212,000**

APPENDIX E

FLEXIBLE AND RIGID PAVEMENT CALCULATION SHEETS (DARwin/AASHTO 98)

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 321.01
Description: US6 West of Garrison

Location: US6 and Garrison

Slab Thickness Design

Pavement Type	JRCP	
18-kip ESALs Over Initial Performance Period (million)	13.50	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	64	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**10.35**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	^{o}F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.99**	^{o}F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi

Seasonally Adjusted Modulus of Subgrade Reaction	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section	psi/in

Traffic

Performance Period	years
Two-Way ADT	
Number of Lanes in Design Direction	
Percent of All Trucks in Design Lane	
Percent Trucks in Design Direction	

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs	million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 321.01
Description: US6 East of Garrison

Location: US6 and Garrison

Slab Thickness Design

Pavement Type	JRCP	
18-kip ESALs Over Initial Performance Period (million)	12.40	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	64	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**10.22**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	^{o}F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**7.93**	^{o}F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi

Seasonally Adjusted Modulus of Subgrade Reaction	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section	psi/in

Traffic

Performance Period	years
Two-Way ADT	
Number of Lanes in Design Direction	
Percent of All Trucks in Design Lane	
Percent Trucks in Design Direction	

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs	million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.05**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

Rigid Pavement Design - Based on AASHTO Supplemental Guide

Reference: *LTPP DATA ANALYSIS - Phase I: Validation of Guidelines for k-Value Selection and Concrete Pavement Performance Prediction*

Results

Project # 321.01
Description: US6 Eastbound offramp at Garrison

Location: US6 and Garrison

Slab Thickness Design

Pavement Type	JRCP	
18-kip ESALs Over Initial Performance Period (million)	3.30	million
Initial Serviceability	4.5	
Terminal Serviceability	2.5	
28-day Mean PCC Modulus of Rupture	650	psi
Elastic Modulus of Slab	3,400,000	psi
Elastic Modulus of Base	25,000	psi
Base Thickness	6.0	in.
Mean Effective k-Value	64	psi/in
Reliability Level	95	%
Overall Standard Deviation	0.34	
Calculated Design Thickness	**8.44**	in

Temperature Differential

Mean Annual Wind Speed	8.8	mph
Mean Annual Air Temperature	50.2	^{o}F
Mean Annual Precipitation	19.5	in
Maximum Positive Temperature Differential	**6.85**	^{o}F

Modulus of Subgrade Reaction

Period	Description	Subgrade k-Value, psi

Seasonally Adjusted Modulus of Subgrade Reaction	psi/in
Modulus of Subgrade Reaction Adjusted for Rigid Layer and Fill Section	psi/in

Traffic

Performance Period	years
Two-Way ADT	
Number of Lanes in Design Direction	
Percent of All Trucks in Design Lane	
Percent Trucks in Design Direction	

Vehicle Class	Percent of ADT	Annual Growth	Initial Truck Factor	Annual Growth in Truck Factor	Accumulated 18-kip ESALs (millions)

Total Calculated Cumulative ESALs	million

Faulting

Doweled

Dowel Diameter	1.5	in
Drainage Coefficient	1.00	
Average Fault for Design Years with Design Inputs	**0.04**	in
Criteria Check **PASS**		

Nondoweled

Drainage Coefficient	1	
Average Fault for Design Years with Design Inputs		in
Criteria Check		

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

Eastbound Offramp at Garrison

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	1,500,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	5.11 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	9.75	-	4.29
2	ABC	0.15	1	6	-	0.90
Total	-	-	-	15.75	-	5.19

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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DARWin Pavement Design and Analysis System

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Computer Software Product

Flexible Structural Design Module

US6 East of Garrison Street

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,400,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	6.06 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	11.75	-	5.17
2	ABC	0.15	1	6	-	0.90
Total	-	-	-	17.75	-	6.07

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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US6 West of Garrison Street

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	5,900,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	6.13 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	12	-	5.28
2	ABC	0.15	1	6	-	0.90
Total	-	-	-	18.00	-	6.18

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Computer Software Product

Flexible Structural Design Module

US6
Temporary Pavement
6 months

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	160,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	3.71 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	7.25	-	3.19
2	ABC	0.15	1	4	-	0.60
Total	-	-	-	11.25	-	3.79

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

US6
Temporary Pavement
9 months

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	250,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	3.96 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	7.75	-	3.41
2	ABC	0.15	1	4	-	0.60
Total	-	-	-	11.75	-	4.01

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Computer Software Product

Flexible Structural Design Module

US6
Temporary Pavement
12 months

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	325,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	4.12 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	8	-	3.52
2	ABC	0.15	1	4	-	0.60
Total	-	-	-	12.00	-	4.12

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

US6
Temporary Pavement
18 months

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	485,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	4.37 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	8.75	-	3.85
2	ABC	0.15	1	4	-	0.60
Total	-	-	-	12.75	-	4.45

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

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Flexible Structural Design Module

US6
Temporary Pavement
6 months

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	160,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	3.71 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	6.5	-	2.86
2	ABC	0.15	1	6	-	0.90
Total	-	-	-	12.50	-	3.76

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

US6
Temporary Pavement
9 months

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	250,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	3.96 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	7	-	3.08
2	ABC	0.15	1	6	-	0.90
Total	-	-	-	13.00	-	3.98

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

US6
Temporary Pavement
12 months

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	325,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	4.12 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	7.5	-	3.30
2	ABC	0.15	1	6	-	0.90
Total	-	-	-	13.50	-	4.20

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

1993 AASHTO Pavement Design

DARWin Pavement Design and Analysis System

A Proprietary AASHTOWare
Computer Software Product

Flexible Structural Design Module

US6
Temporary Pavement
18 months

Flexible Structural Design

18-kip ESALs Over Initial Performance Period	485,000
Initial Serviceability	4.5
Terminal Serviceability	2.5
Reliability Level	95 %
Overall Standard Deviation	0.44
Roadbed Soil Resilient Modulus	3,025 psi
Stage Construction	1
Calculated Design Structural Number	4.37 in

Specified Layer Design

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Thickness (Di)(in)	Width (ft)	Calculated SN (in)
1	HMA	0.44	1	8	-	3.52
2	ABC	0.15	1	6	-	0.90
Total	-	-	-	14.00	-	4.42

Layered Thickness Design

Thickness precision Actual

Layer	Material Description	Struct Coef. (Ai)	Drain Coef. (Mi)	Spec Thickness (Di)(in)	Min Thickness (Di)(in)	Elastic Modulus (psi)	Width (ft)	Calculated Thickness (in)	Calculated SN (in)
Total	-	-	-	-	-	-	-	-	-

*Note: This value is not represented by the inputs or an error occurred in calculation.

APPENDIX F

PAVEMENT DESIGN PARAMETER SHEETS (NEW CONSTRUCTION AND DETOUR) AND LTPPBIND PG BINDER SELECTION REPORTS

LOCATION : US 6 – East of Garrison Street

Design Parameter	HMA	PCCP
Design Life (years)	20	30
Design Lane 18k ESAL	5,400,000	12,400,000
% Trucks	3.2	3.2
Initial Serviceability	4.5	4.5
Terminal Serviceability	2.5	2.5
% Reliability	95	95
R-Value Design	5	5
Soil Resilient Modulus (psi)	3,025	3,025
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	6.06	-
PCC Modulus of Rupture (psi)	-	650
PCC Modulus of Elasticity (psi)	-	3,400,000
PCC Load Transfer Coefficient	-	2.8
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	64
Drainage Coefficient	1.0	1.0
Pavement Thickness (in)	12.0	10.5
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	6	6
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2.5 - 2.25 – 2.25	-
Top Lift Grading/Binder	SMA (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 – West of Garrison Street

Design Parameter	HMA	PCCP
Design Life (years)	20	30
Design Lane 18k ESAL	5,900,000	13,500,000
% Trucks	3.2	3.2
Initial Serviceability	4.5	4.5
Terminal Serviceability	2.5	2.5
% Reliability	95	95
R-Value Design	5	5
Soil Resilient Modulus (psi)	3,025	3,025
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	6.13	-
PCC Modulus of Rupture (psi)	-	650
PCC Modulus of Elasticity (psi)	-	3,400,000
PCC Load Transfer Coefficient	-	2.8
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	64
Drainage Coefficient	1.0	1.0
Pavement Thickness (in)	12.0	11.0
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	6	6
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2.5 - 2.25 – 2.25	-
Top Lift Grading/Binder	SMA (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : Eastbound US 6 Exit Ramp to Garrison Street

Design Parameter	HMA	PCCP
Design Life (years)	20	30
Design Lane 18k ESAL	1,500,000	3,300,000
% Trucks	3.2	3.2
Initial Serviceability	4.5	4.5
Terminal Serviceability	2.5	2.5
% Reliability	95	95
R-Value Design	5	5
Soil Resilient Modulus (psi)	3,025	3,025
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	5.11	-
PCC Modulus of Rupture (psi)	-	650
PCC Modulus of Elasticity (psi)	-	3,400,000
PCC Load Transfer Coefficient	-	2.8
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	64
Drainage Coefficient	1.0	1.0
Pavement Thickness (in)	10.0	9.0
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	6	6
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2.5- 2.5	-
Top Lift Grading/Binder	SMA (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 Temporary Pavement (6 months with 4 inches ABC)

Design Parameter	HMA	PCCP
Design Life (months)	6	-
Design Lane 18k ESAL	160,000	-
% Trucks	3.1	-
Initial Serviceability	4.5	-
Terminal Serviceability	2.5	-
% Reliability	95	-
R-Value Design	5	-
Soil Resilient Modulus (psi)	3,025	-
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	3.71	-
PCC Modulus of Rupture (psi)	-	-
PCC Modulus of Elasticity (psi)	-	-
PCC Load Transfer Coefficient	-	-
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	-
Drainage Coefficient	1.0	-
Pavement Thickness (in)	7.25	-
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	4	-
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2.25	-
Top Lift Grading/Binder	SX (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 Temporary Pavement (9 months with 4 inches ABC)

Design Parameter	HMA	PCCP
Design Life (months)	9	-
Design Lane 18k ESAL	250,000	-
% Trucks	3.1	-
Initial Serviceability	4.5	-
Terminal Serviceability	2.5	-
% Reliability	95	-
R-Value Design	5	-
Soil Resilient Modulus (psi)	3,025	-
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	3.96	-
PCC Modulus of Rupture (psi)	-	-
PCC Modulus of Elasticity (psi)	-	-
PCC Load Transfer Coefficient	-	-
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	-
Drainage Coefficient	1.0	-
Pavement Thickness (in)	7.75	-
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	4	-
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3.5	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2.25	-
Top Lift Grading/Binder	SX (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 Temporary Pavement (12 months with 4 inches ABC)

Design Parameter	HMA	PCCP
Design Life (months)	12	-
Design Lane 18k ESAL	325,000	-
% Trucks	3.1	-
Initial Serviceability	4.5	-
Terminal Serviceability	2.5	-
% Reliability	95	-
R-Value Design	5	-
Soil Resilient Modulus (psi)	3,025	-
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	4.12	-
PCC Modulus of Rupture (psi)	-	-
PCC Modulus of Elasticity (psi)	-	-
PCC Load Transfer Coefficient	-	-
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	-
Drainage Coefficient	1.0	-
Pavement Thickness (in)	8	-
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	4	-
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	3	-
Top Lift Grading/Binder	SX (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 Temporary Pavement (18 months with 4 inches ABC)

Design Parameter	HMA	PCCP
Design Life (months)	18	-
Design Lane 18k ESAL	485,000	-
% Trucks	3.1	-
Initial Serviceability	4.5	-
Terminal Serviceability	2.5	-
% Reliability	95	-
R-Value Design	5	-
Soil Resilient Modulus (psi)	3,025	-
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	4.37	-
PCC Modulus of Rupture (psi)	-	-
PCC Modulus of Elasticity (psi)	-	-
PCC Load Transfer Coefficient	-	-
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	-
Drainage Coefficient	1.0	-
Pavement Thickness (in)	8.75	-
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	4	-
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	2.75	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2	-
Top Lift Grading/Binder	SX (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 Temporary Pavement (6 months with 6 inches ABC)

Design Parameter	HMA	PCCP
Design Life (months)	6	-
Design Lane 18k ESAL	160,000	-
% Trucks	3.1	-
Initial Serviceability	4.5	-
Terminal Serviceability	2.5	-
% Reliability	95	-
R-Value Design	5	-
Soil Resilient Modulus (psi)	3,025	-
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	3.71	-
PCC Modulus of Rupture (psi)	-	-
PCC Modulus of Elasticity (psi)	-	-
PCC Load Transfer Coefficient	-	-
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	-
Drainage Coefficient	1.0	-
Pavement Thickness (in)	6.5	-
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	6	-
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	2.5	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2	-
Top Lift Grading/Binder	SX (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 Temporary Pavement (9 months with 4 inches ABC)

Design Parameter	HMA	PCCP
Design Life (months)	9	-
Design Lane 18k ESAL	250,000	-
% Trucks	3.1	-
Initial Serviceability	4.5	-
Terminal Serviceability	2.5	-
% Reliability	95	-
R-Value Design	5	-
Soil Resilient Modulus (psi)	3,025	-
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	3.96	-
PCC Modulus of Rupture (psi)	-	-
PCC Modulus of Elasticity (psi)	-	-
PCC Load Transfer Coefficient	-	-
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	-
Drainage Coefficient	1.0	-
Pavement Thickness (in)	7	-
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	6	-
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2	-
Top Lift Grading/Binder	SX (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 Temporary Pavement (12 months with 4 inches ABC)

Design Parameter	HMA	PCCP
Design Life (months)	12	-
Design Lane 18k ESAL	325,000	-
% Trucks	3.1	-
Initial Serviceability	4.5	-
Terminal Serviceability	2.5	-
% Reliability	95	-
R-Value Design	5	-
Soil Resilient Modulus (psi)	3,025	-
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	4.12	-
PCC Modulus of Rupture (psi)	-	-
PCC Modulus of Elasticity (psi)	-	-
PCC Load Transfer Coefficient	-	-
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	-
Drainage Coefficient	1.0	-
Pavement Thickness (in)	7.5	-
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	6	-
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	2.5	-
Top Lift Grading/Binder	SX (100) PG 76-28	-
Top Lift Thickness (in)	2	-

LOCATION : US 6 Temporary Pavement (18 months with 4 inches ABC)

Design Parameter	HMA	PCCP
Design Life (months)	18	-
Design Lane 18k ESAL	485,000	-
% Trucks	3.1	-
Initial Serviceability	4.5	-
Terminal Serviceability	2.5	-
% Reliability	95	-
R-Value Design	5	-
Soil Resilient Modulus (psi)	3,025	-
Structural Coefficient - HMA	0.44	-
Structural Coefficient - ABC	0.15	-
Required Structural Number (SN) (Flexible Pavement)	4.37	-
PCC Modulus of Rupture (psi)	-	-
PCC Modulus of Elasticity (psi)	-	-
PCC Load Transfer Coefficient	-	-
Effective Modulus of Subgrade Reaction (psi/in) (Rigid Pavement)	-	-
Drainage Coefficient	1.0	-
Pavement Thickness (in)	8	-
Overlay Thickness (in)	-	-
Milling Thickness (in)	-	-
Aggregate Base Thickness (in)	6	-
Bottom Lift Grading/Binder	S(100) PG 64-22	-
Bottom Lift Thickness (in)	3	-
Intermediate Lift Grading/Binder	S(100) PG 64-22	-
Intermediate Lift(s) Thickness (in)	3	-
Top Lift Grading/Binder	SX (100) PG 76-28	-
Top Lift Thickness (in)	2	-

PG Binder Selection Report - Intermediate and Lower Layers

LTPPBind V3.0 PG Binder Selection Report (Date: 4/4/2014)

Parameter	A=1 km	B=3 km
Station ID	CO4762	CO8995
Elevation, m	5239	5077
Degree-Days >10 C	2708	2988
Low Air Temperature, C	-23.9	-24.5
Low Air Temp. Std Dev	3.6	4.1

Input Data

Latitude, Degree	39.74
Yearly Degree-Days>10C	2848
Lowest Yearly Air Temp., Deg. C	-24.2
Low Temp. Std. Dev., Deg. C	3.9
Base HT PG	58

Traffic Adjustments for HT

Desired Reliability, Percent	98
Traffic Loading, Million ESAL	3 to 10 M. ESAL
Traffic Speed	Fast
High Temp. Adjustment	7.1

PG Temperature	HIGH	LOW
PG Temp. at 50% Reliability	55.3	-16.5
PG Temp. at Desired Reliability	57.6	-23.8
Adjustments for Traffic	7.1	
Adjustments for Depth	-6.4	3.8
Adjusted PG Temperature	58.3	-20.0
Selected PG Binder Grade	64	-22

PG Binder Selection Report - Top Lift

LTPPBind V3.0 PG Binder Selection Report (Date: 4/4/2014)

Parameter	A=1 km	B=3 km
Station ID	CO4762	CO8995
Elevation, m	5239	5077
Degree-Days >10 C	2708	2988
Low Air Temperature, C	-23.9	-24.5
Low Air Temp. Std Dev	3.6	4.1

Input Data

Latitude, Degree	39.74
Yearly Degree-Days>10C	2848
Lowest Yearly Air Temp., Deg. C	-24.2
Low Temp. Std. Dev., Deg. C	3.9
Base HT PG	58

Traffic Adjustments for HT

Desired Reliability, Percent	98
Traffic Loading, Million ESAL	3 to 10 M. ESAL
Traffic Speed	Fast
High Temp. Adjustment	7.1

PG Temperature	HIGH	LOW
PG Temp. at 50% Reliability	55.3	-16.5
PG Temp. at Desired Reliability	57.6	-23.8
Adjustments for Traffic	7.1	
Adjustments for Depth	0.0	0.0
Adjusted PG Temperature	64.7	-23.8
Selected PG Binder Grade	70	-28

PG Binder Selection Report US6 & Garrison Ramps - Top Lift

LTPPBind V3.0 PG Binder Selection Report (Date: 4/4/2014)

Parameter	A=1 km	B=3 km
Station ID	CO4762	CO8995
Elevation, m	5239	5077
Degree-Days >10 C	2708	2988
Low Air Temperature, C	-23.9	-24.5
Low Air Temp. Std Dev	3.6	4.1

Input Data

Latitude, Degree	39.74
Yearly Degree-Days>10C	2848
Lowest Yearly Air Temp., Deg. C	-24.2
Low Temp. Std. Dev., Deg. C	3.9
Base HT PG	58

Traffic Adjustments for HT

Desired Reliability, Percent	98
Traffic Loading, Million ESAL	Up to 3 M. ESAL
Traffic Speed	Slow
High Temp. Adjustment	2.7

PG Temperature	HIGH	LOW
PG Temp. at 50% Reliability	55.3	-16.5
PG Temp. at Desired Reliability	57.6	-23.8
Adjustments for Traffic	2.7	
Adjustments for Depth	0.0	0.0
Adjusted PG Temperature	60.3	-23.8
Selected PG Binder Grade	64	-28

To minimize number of mix designs recommend PG 76-28 for Top Lift at Ramp

PG Binder Selection Report - US6 & Garrison Ramps (Intermediate and Base Lifts)

LTPPBind V3.0 PG Binder Selection Report (Date: 4/4/2014)

Parameter	A=1 km	B=3 km
Station ID	CO4762	CO8995
Elevation, m	5239	5077
Degree-Days >10 C	2708	2988
Low Air Temperature, C	-23.9	-24.5
Low Air Temp. Std Dev	3.6	4.1

Input Data

Latitude, Degree	39.74
Yearly Degree-Days>10C	2848
Lowest Yearly Air Temp., Deg. C	-24.2
Low Temp. Std. Dev., Deg. C	3.9
Base HT PG	58

Traffic Adjustments for HT

Desired Reliability, Percent	98
Traffic Loading, Million ESAL	Up to 3 M. ESAL
Traffic Speed	Slow
High Temp. Adjustment	2.7

PG Temperature	HIGH	LOW
PG Temp. at 50% Reliability	55.3	-16.5
PG Temp. at Desired Reliability	57.6	-23.8
Adjustments for Traffic	2.7	
Adjustments for Depth	-6.4	3.8
Adjusted PG Temperature	53.9	-20.0
Selected PG Binder Grade	58	-22

To minimize number of mix designs recommend PG 64-22 for Intermediate and Base Lifts at Ramp