WESTERN TECHNOLOGIES INC.

3611 West Tompkins Avenue
Las Vegas, Nevada 89103
(702) 798-8050

Contract 2349

June 2, 1989

G.C. Wallace Inc.
1555 South Rainbow Boulevard
Las Vegas, Nevada 89102

Attention: Mr. James Duddleston, P.E. 363.1200 Project No. 4129J001

Reference: Geotechnical Exploration
Proposed Interchanges at Cheyenne Avenue,
Alexander Road and Craig Road
Oran K. Gragson Highway
Clark County, Nevada

Gentlemen:

Enclosed herewith are the results of the geotechnical exploration performed for the referenced project. The exploration was authorized by Mr. James Duddleston of G.C. Wallace, Inc. on May 5, 1989. The field and laboratory investigation was performed in accordance with the Nevada Department of Transportation guidelines provided by G.C. Wallace Inc.

SUBSURFACE EXPLORATION PROGRAM

The subsurface exploration program consisted of drilling a total of 14 borings to depths ranging from 15 to 31 1/2 feet below existing grade at the three interchange sites. Samples were obtained to aid in material classification and for laboratory testing. Laboratory tests included direct shear and consolidation tests. A more detailed discussion of the subsurface exploration and testing programs is presented in the Appendix.

ALEXANDER ROAD INTERCHANGE

Three borings were drilled to depths of 15 to 30 feet. Boring No. A-1 was located along the Type 3 retaining wall

location and Boring Nos. A-2 and A-3 were located near the proposed ends of a reinforced concrete box (RCB) structure at the west abutment location.

Soils encountered at the two structure locations were similar. Fill consisting of silty sand with gravel was encountered in Boring No. A-1 to a depth of 1/2 foot. There could be deper and/or poorer quality fill in areas beyond our exploration locations. Natural soils generally consisted of firm to moderately hard sandy silt, clayey silt, gravelly clay, and silty clay. Moderately hard to hard caliche was first encountered in one exploration at a depth of 5 feet below existing grade. Water was not encountered within the depths explored.

Type 3 Retaining Wall (Station AL 24+30 to AL 25+50)

The retaining wall was analyzed for worst case condition for bearing capacity and assuming soils would be saturated. This occurred at the highest point of the wall near station 24+90. Maximum height of the wall is approximately 4 feet which requires a footing 4 feet wide in accordance with design manual.[1] A net bearing value of 1600 pounds per square foot (psf) was obtained for the wall, based on size and classification.[2] Based on subsurface conditions encountered and data provided, a factor of safety of 5.0 was obtained against bearing capacity failure.

The retaining wall and associated slope was analyzed for rotational stability. Two cases were examined:

1. Slope failure occurs below wall.

2. Sliding wedge failure occurs directly beneath the wall footing.

1- NDOT Standard Plans for Road and Bridge Construction, 1988, Plates B-2.7.1 to B-2.7.1.5.

2- Ibid.

Factor of safety determined for Case 1 and Case 2 were 1.63 and 2.62, respectively. Based on the analyses performed, rotational stability of the wall should not pose any problems.

RCB at West Abutment (Station AL 18+39)

The RCB structure at the west abutment will have approximate dimensions of 40 feet of 127 feet. Information regarding fill slopes and heights was obtained from Sheet 10D of Alexander Road Special Details (NDOT). The worst case condition or (highest depth of fill) occurs at the right side (south) of the roadway. A total of 26.7 feet of fill would be placed over the RCB at the roadway level. Maximum settlement was determined to be 3 1/4 inches at the center of Alexander Road. We estimate that differential settlement of approximately 2 3/4 inches would occur over a distance of 60 feet, from the centerline of the road to the end of the RCB.

2"

CRAIG ROAD INTERCHANGE

Two borings were drilled to depths of 30 and 31 1/2 feet. The borings were located near the proposed ends of a reinforced concrete box (RCB) structure at the west abutment location, Station CG 18+35.

Fill soils were not encountered at the boring locations. There could be fill or poorer quality soils in areas beyond our exploration locations. Natural soils generally consisted of stiff to moderately hard sandy clay and silty clay. Loose to medium dense clayey sand and silty sand were encountered to depths of 1 to 2 feet below grade in both borings. Moderately hard to very hard caliche was first encountered at depths of 19 to 25 feet below existing grade. Water was not encountered within the depths explored.

1"

The RCB structure at the west abutment will have approximate dimensions of 40 feet by 226 feet. Information regarding fill slopes and heights was obtained from sheet 10B of Craig Road Special Details (NDOT). The worst case condition (highest depth of fill) occurs at the left side (north) of the roadway. A total of 22 feet of fill would be placed over the RCB at roadway level. Maximum settlement was determined to be 2 3/4 inches at centerline of Craig Road. We estimate that differential settlement of approximately 2 1/2 inches would occur over a distance of 105 feet, from the centerline of the road to the end of the RCB.

CHEYENNE AVENUE INTERCHANGE

Nine borings were drilled to depths of approximately 25 feet. Borings CH-1 and CH-2 were located along the Type 3 retaining wall proposed at Ramp 7 and Cheyenne Avenue. Borings CH-3 through Ch-9 were located along the proposed alignment for a Type 1 retaining wall proposed on Ramp 5.

Soils encountered at the two structure locations were similar. There was 1/2 foot of fill encountered at the surface in 2 explora- tions. The fill consisted of silty sand with gravel. There could be deeper and/or poorer quality fill in areas beyond our exploration locations. Natural soils consisted of loose to very dense gravelly sand, clayey sand, silty sand and sandy gravel, and firm to moderately hard sandy silt, clayey silt, sandy clay and silty clay. Cemented deposits consisting of either caliche or cemented sand and gravel were encountered in 4 of the 9 explorations. The cemented deposits were first encountered at depths of 3 1/2 to 16 1/2 feet below existing site grade. Water was not encountered within the depths explored.

Type 3 Retaining Wall (Station CH 25+14 to CH 26+53)

The retaining wall was analyzed for worst case conditions for bearing capacity. Information regarding the wall was obtained from Sheet 10A of Cheyenne Road Special Details (NDOT). The wall is actually used as a water barrier along a grouted channel. Design height of the wall is approximately 6 feet which required a footing 5 feet wide.[3] A net design bearing value of 2200 psf was obtained from the manual, based on wall size and classification. Based on the subsurface conditions encountered and data provided, a factor of safety of 19.9 was obtained against bearing capacity failure.

Based on previous experience, rotational stability of the wall should not pose any problems.

Type 1 Retaining Wall (R-5 Station 56+33 to 65+05)

The retaining wall was analyzed for worst case condition for bearing capacity. Information regarding the wall was obtained from Sheet 10 of Cheyenne Road Special Details (NDOT). The wall will be used as a retention structure and barrier rail along a highway ramp. Design height of the wall for retention is 6 feet which requires a footing width of 4 feet from design manual.[4] A net design bearing value of 1900 psf was obtained from the manual based on wall size and classification. Based on the subsurface conditions encountered and data provided, a factor of safety of 5.9 was obtained against bearing capacity failure.

Based on previous experience, rotational stability of the wall should not pose any problems.

3- Ibid.

4- Ibid.

Our professional services have been performed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical engineers practicing in this or similar localities. No other warranty, express or implied, is made. Should you have any questions regarding this project, please do not hesitate to contact us.

Sincerely,

WESTERN TECHNOLOGIES INC.

Michael J. Feist

MICHAEL J. FEIST, P.E.
Project Engineer

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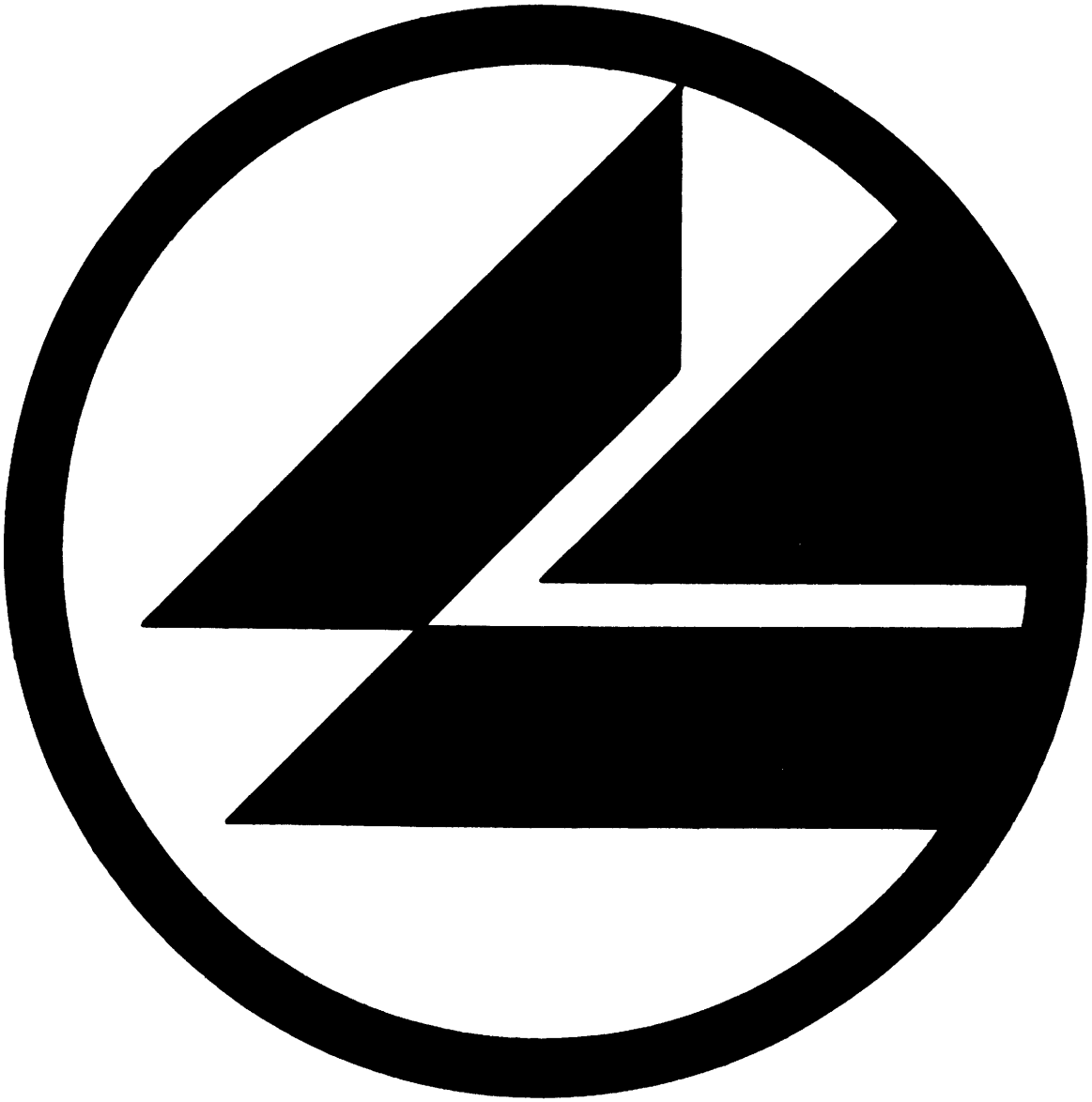
APPENDIX



APPENDIX

Subsurface Explorations

Each of the three interchange sites were explored by drilling borings using an auger-type drill rig equipped with a hollow-stem auger. Soils encountered were logged and samples were obtained to aid in classification and for laboratory testing. Logs of the borings are presented on Plates A-1 through A-15. Boring elevations and stations were provided by G.C. Wallace, Inc. The number of blows required to drive the sampler 12 inches is shown to the left on the boring logs. Soils are classified in accordance with the Unified Soil Classification System. An explanation of material classifications used in this report is presented on Plate B.

Laboratory Tests

Consolidation tests were performed on representative samples to illustrate the compressibility of onsite soils. Water was added during testing to illustrate the influence of moisture on compressibility. Plates C-1 through C-3 present the test results.

Direct shear tests were performed on samples to determine the strength of the soils. Tests were performed at near saturated moisture contents and at various surcharge pressures. Test results are presented on Plate D.

DATE DRILLED: 5-24-89 **BORING NO.** A-1 **ELEVATION:** 2312.21 ft.

LOCATION: Station 24+87.5, 49.9 ft. rt of C_L

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						FILL	FILL-SILTY SAND -w/so.gr., lt. brn.	sl.m.	
						CL	SILTY CLAY -w/some caliche gravel, lt. brown	moist	firm-stiff
			SPT	10			lt. gray w/caliche gravel, partially cemented	sl.m.	v.s.-m.h.
5							no cementation, some caliche gravel, brown	moist	stiff
			SPT	24			w/caliche gravel, lt. brown		
10							brown		stiff to very stiff
			SPT	49					
							SANDY CLAY -w/tr. cal.gr., brown		
							SILTY CLAY -w/so. cal.gr., brown		
15							Bottom at 15 feet		
20									
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING LB. DRIVING WEIGHT AND INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: ____ APPROV: ____

GS13

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BORING LOG AND TEST SUMMARY

PLATE A-1

DATE DRILLED: 5-24-89 **BORING NO.** A-2 **ELEVATION:** 2315.57 ft.

LOCATION: Station 18+39, 50 ft. lt of $\mathbb{C}_L$

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						CL	SILTY CLAY -w/some gravel, lt. gray	sl.m.	firm
							w/gravel, lt. brown	sl.m. to moist	stiff
				14			w/caliche gravel		m.hard
5			SPT	50/3"			CALICHE -lt. brown	d.-sl.m.	hard
						CL	SILTY CLAY -w/some caliche gravel, lt. brown	sl.m. to moist	stiff
				13					
10			SPT	8			w/sand w/some caliche gravel	moist	firm-stiff
								sl. moist to moist	stiff
				17					
15			SPT	58/11"			GRAVELLY CLAY -w/sand, brown		v.stiff
							CALICHE -lt. brown	dry-sl.m.	m.h.-h.
						CL	SILTY CLAY -w/some caliche gravel, brown w/thin cemented layer	sl.m.-moist	stiff
			SPT	50			GRAVELLY CLAY -w/sand, lt. gray	sl.m.	
20							SILTY CLAY -brown to lt. brown	moist	stiff to very stiff
			SPT	81/8"			GRAVELLY CLAY -w/some sand, lt. gray	sl.m.	v.stiff
25							SILTY CLAY -w/some caliche gravel, brown	sl. moist to moist	stiff to very stiff
			SPT	71			GRAVELLY CLAY -w/some sand, lt.gray	sl.m.	v.stiff
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Bottom at 30 feet
Water not encountered
Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: _____ APPROV: _____

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-2

GSI3

DATE DRILLED: 5-24-89 **BORING NO.** A-3 **ELEVATION:** 2316.32

LOCATION: Station 18+39, 77 ft. rt of $\mathbb{G}_L$

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						ML	SANDY SILT -w/tr.cal.gr.,porous,brn.	sl. moist	firm
									stiff
			SPT	16		CL	SILTY CLAY -w/some caliche gravel, lt. brown		firm-stiff
							brown		
				14			w/some sand	moist	
5									
			SPT	36					stiff
							w/thin cemented layers	sl. moist	
10									
			SPT	32			w/caliche gravel	moist	stiff to very stiff
								sl.m.	
15									
			SPT	41			w/some caliche gravel	moist	
							lt. brown		stiff
20								sl. moist	
			SPT	25			w/caliche gravel, lt. gray		stiff to very stiff
							w/some caliche gravel		
25						ML	CLAYEY SILT -w/some caliche gravel, partially cemented, lt. brown		v.stiff -m.hard
			SPT	77		CL	SANDY CLAY -w/some caliche gravel, brown		stiff
							w/caliche gravel, partially cemented	moist	v.stiff -m.hard
30							Bottom at 30 feet		

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: _____ APPROV: _____

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WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-3

DATE DRILLED: 5-23-89 **BORING NO.** CG-1 **ELEVATION:** 2320.29

LOCATION: Station 18+25, 118 ft. lt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						SM	SILTY SAND -w/clay and gravel, lt. brown	sl. moist	loose
						CL	SILTY CLAY -w/sand and caliche gravel lt. brown		f.-s.
			SPT	6				sl. moist to moist	
				11					
5				24					
			SPT	9					stiff
						CL/CH	SILTY CLAY -w/trace caliche gravel, green	moist	
10				16		CL	SANDY CLAY -w/caliche gravel, lt. green		
			SPT	16					
							SILTY CLAY -w/caliche gravel, lt. gray		
15				47			SANDY CLAY -w/some caliche gravel, lt. gray	very	
			SPT	11					
								moist	f.-s.
									firm
20									f.-s.
				12					stiff
									firm
			SPT	9					f.-s.
									s.-v.s.
									stiff
25			SPT	50/1"	X		CALICHE -lt. gray w/thin uncemented layer	dry-sl.m.	very hard
						CL	SILTY CLAY -w/so. cal.gr., lt. gray	v.moist	stiff
							CALICHE -lt. gray	d.-sl.m.	m.h.-h.
						CL	SILTY CLAY -w/caliche gravel, brown	very moist	firm
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered
SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: CR APPROV: _____

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-4

GS13

DATE DRILLED: 5-23-89 BORING NO. CG-1 (cont'd) ELEVATION: 2320.29

LOCATION: Station 18+25, 118 ft. lt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
30			SPT	5	■	CL	SILTY CLAY -w/caliche gravel, brown	v.moist	firm
							Bottom at 31 1/2 feet		
35									
40									
45									
50									
55									
60									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: CR APPROV: _____

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-5

DATE DRILLED: 5-23-89 **BORING NO.** CG-2 **ELEVATION:** 2319.81

LOCATION: Station 18+25, 109 ft. rt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						SM	SILTY SAND -w/cal. gr., brown	sl. moist	loose
						SC	CLAYEY SAND -w/cal.gr.,gr.,lt.brn.		l.-m.d.
						CL	SANDY CLAY -w/so. cal. gravel, lt. brown		stiff v.stiff
							SILTY CLAY -w/caliche gravel, lt. brown		
5				19			brown to lt. brown w/sand	sl. moist to moist	stiff
			SPT	29					stiff-v.stiff
									stiff
10				37					
			SPT	37					stiff to very stiff
							w/trace caliche gravel and some sand, brown	moist	
15				46					
			SPT	32			SANDY CLAY -w/caliche gravel, lt. brown	sl. moist	
			SPT	50/1"			CALICHE -lt. brown	d.-sl.m.	m.h.-h.
20						CL	SANDY CLAY -w/some caliche gravel and sand, brown w/thin cemented layer	sl.m.-m moist	very stiff
							partially cemented		v.s.-m.h.
25			SPT	50/2"			CALICHE -lt. brown	dry to sl. moist	m.h.-h. hard v.hard hard
			SPT	50/0"			Bottom at 30 feet		
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: CR APPROV: _____

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WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-6

DATE DRILLED: 5-24-89 **BORING NO.** CH-1 **ELEVATION:** 2308.19

LOCATION: Station 25+14, 139 ft. rt of C_L

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						FILL	FILL -SILTY SAND -w/gravel, lt. brn.	sl.m.	
						SM	SILTY SAND -w/gravel, brown	moist	loose
			SPT	15		SC	CLAYEY SAND -w/trace gravel, lt. brn.	sl. moist	m.dense
						CL	SANDY CLAY -w/trace gravel, lt. brown		stiff
5				74/10"					very stiff
			SPT	90/10"			SILTY CLAY -w/trace gravel and sand, brown	sl.m.-moist	
							GRAVELLY CLAY -w/sand, partially cemented, lt. brown	sl. moist	v.stiff -m.hard
							CALICHE -lt. brown	d.-sl.m.	m.h.-h.
10						CL	SANDY CLAY -w/some gravel and caliche gravel, brown partially cemented	sl. moist	s.-v.s.
			SPT	93/8"					v.s.-m.h
						SM	SILTY SAND -w/gravel and clay, brown		med. dense to dense
15			SPT	34					
			SPT	65		CL	SANDY CLAY -w/gravel, brown		v.s.-m.h.
20							Bottom at 20 feet		
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered
SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: _____ APPROV: _____

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WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-7

DATE DRILLED: 5-24-89 **BORING NO.** CH-2 **ELEVATION:** 2307.40

LOCATION: Station 26+54, 59 ft. rt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						FILL	FILL -CLAYEY SAND -w/gravel, lt. brn.		
						CL	SANDY CLAY -w/so.cal.gr., lt. brn.	sl.m.	f.-s.
						SC	CLAYEY SAND -w/tr.cal.gr.,gr.,lt.brn.	moist	m.dense
						CL	SANDY CLAY -w/so. cal.gr.,gr.,lt.brn.	sl.m.	stiff
				57		SC	CLAYEY SAND -w/some caliche gravel and trace gravel, brown	moist	dense
5			SPT	40		CL	SILTY CLAY -w/so. caliche gravel, lt. brown	sl. moist	
							w/trace caliche gravel, brown	moist	very stiff
							w/sand and some gravel		
10			SPT	65					
							SANDY CLAY -w/some gravel, brown		stiff
15			SPT	5			SILTY CLAY -w/some sand and trace gravel, brown to lt. gray	very moist	soft-firm
				3					soft
							brown	moist	firm
			SPT	23			SANDY CLAY -w/gravel, brown		stiff
20							Bottom at 20 feet		
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: _____ APPROV: _____

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WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-8

DATE DRILLED: 5-24-89 **BORING NO.** CH-3 **ELEVATION:** 2316.31

LOCATION: Station 56+33, 28 ft. lt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						SM	SILTY SAND -w/trace gravel, lt. brown	sl. moist	loose; m.dense
						CL	SANDY CLAY -w/so. gravel, brown		stiff
						SM	GRAVELLY SAND -w/so. silt, brown		
5				50/6"	X	GM	SANDY GRAVEL -w/silt, brown		very dense
						CL	SANDY CLAY -w/gravel, brown sl. cemented	dry to sl. moist	very stiff
10			SPT	74/11"	■		w/thin partially cemented layers		very stiff-mod. hard
							SILTY CLAY -w/trace caliche gravel, lt. gray	sl. moist	
15			SPT	20	■		lt. brown to brown		stiff
			SPT	48	■	SC	CLAYEY SAND -brown		v.dense
20							Bottom at 20 feet		
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: ____ APPROV: ____

GSI3

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-9

DATE DRILLED: 5-24-89 **BORING NO.** CH-4 **ELEVATION**: 2314.30

LOCATION: Station 57+80, 25 ft. lt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						SM	SILTY SAND -w/gravel, lt. brown w/clay		loose / l.-m.d.
				64 / 10"		CL	SANDY CLAY -w/gravel, brown	sl. moist	stiff
5			SPT	95 / 9"		SC	CLAYEY SAND -w/gravel, brown sl. cemented		very dense
						CL	SANDY CLAY -w/some gravel, lt. brown		very stiff
							SILTY CLAY -w/sand, brown		f.-s.
10			SPT	24			SANDY CLAY -w/gravel, brown w/some gravel	moist / sl. moist	stiff
				45		SC	CLAYEY SAND -w/so. gravel, lt. brown		m.dense
15			SPT	14		CL	SILTY CLAY -w/gravel and sand, brown w/trace caliche gravel, brown to lt. brown	sl. moist to moist	stiff
			SPT	56					very stiff
20							Bottom at 20 feet		
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: ____ APPROV: ____

GS13

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-10

DATE DRILLED: 5-24-89 **BORING NO.** CH-5 **ELEVATION:** 2313.53

LOCATION: Station 59+30, 21 ft. lt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						SM	SILTY SAND -w/some gravel, brown		loose
						SC	CLAYEY SAND -w/gravel, brown		m.dense
						CL	SANDY CLAY -w/gravel, brown		v.stiff
5			SPT	84	■	SC	CLAYEY SAND -w/gravel, brown	sl. moist	very dense
10			SPT	87/10"	■	CL	SANDY CLAY -w/gravel, brown		very stiff
							SILTY CLAY -brown to lt. green	moist	stiff
15			SPT	59/11"	■	CH	CLAY -w/silt, green		
						CL	SILTY CLAY -w/cal. gr., lt. gray		
							CALICHE -lt. gray	sl. moist	hard
									m.h.-h.
									m.hard
20				94/9"		CL	SILTY CLAY -w/caliche gravel, brown	sl.m. to moist	very stiff
			SPT		■	SC	CLAYEY SAND -brown	sl.m.	v.dense
25							Bottom at 21 1/2 feet		
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: ____ APPROV: ____

GS13

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-11

DATE DRILLED: 5-24-89 **BORING NO.** CH-6 **ELEVATION:** 2312.26 ft.

LOCATION: Station 60+80, 21 ft. lt of $\mathbb{C}_L$

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						SM	SILTY SAND -w/trace gr., lt. brn.	sl. moist	l.-m.d.
						ML	SANDY SILT -w/so. caliche gravel, porous, brown		firm
						CL	SILTY CLAY -w/trace gravel, brown	moist	stiff
			SPT	71 / 8"			Cemented SAND and GRAVEL -lt. brown		m.hard
						CL	SILTY CLAY -w/so. gravel- lt. green		v.stiff
5						SC	CLAYEY SAND -w/gravel, lt. brown		d.-v.d.
						CL	SILTY CLAY -w/some sand and gravel, lt. gray w/trace gravel, lt. brown partially cemented	sl. moist	very stiff
			SPT	71 / 11"					very stiff to mod. hard
10				50 / 2"			SANDY CLAY -w/some gravel and caliche gravel, partially cemented, lt. brown no cementation		s.-v.s.
			SPT	46			SILTY CLAY -w/sand and some gravel, brown	moist	very stiff
15							SANDY CLAY -w/gravel, lt. brown	sl.m.	
							Cemented SAND and GRAVEL -lt. brown	d.-sl.m.	m.hard
						CL	SILTY CLAY -w/some caliche gravel, brown	moist	stiff-v.stiff
			SPT	73					v.stiff
20							Bottom at 20 feet		
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: _____ APPROV: _____

GSI3

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-12

DATE DRILLED: 5-24-89 **BORING NO.** CH-7 **ELEVATION:** 2311.15

LOCATION: Station 62+30, 21 ft. lt of G_L

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						FILL	FILL -SILTY SAND -w/so.gr., lt.brn.		
						SM	SILTY SAND -w/tr.gr.,clay, lt. brn.		m.dense
			SPT	34		CL	SANDY CLAY -w/tr. gravel, lt. brown		stiff to very stiff
5							SILTY CLAY -w/some sand and caliche gravel, lt. brown w/gravel	sl. moist	
			SPT	45			w/some caliche gravel and trace gravel,lt. gray w/trace caliche gravel, brown lt. brown		
				84/10"			SANDY CLAY -w/some gravel, brown w/gravel	sl.m.-m. / sl. moist	very stiff
10							SILTY CLAY -w/so. sand, gravel, brown	moist	s.-v.s.
			SPT	61			SANDY CLAY -w/gravel, lt. brown lt. gray		
							SILTY CLAY -w/some sand and gravel, lt. brown		very stiff
15							Cemented SAND and GRAVEL -lt. brown	d.-sl.m.	hard
						CL	SILTY CLAY -w/caliche gravel, lt. brown	sl.m.-m	stiff-v.stiff
			SPT	46			w/some sand and trace caliche gravel, brown w/no sand	moist	very stiff
20							Bottom at 20 feet		
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: _____ APPROV: _____

GS13

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-13

DATE DRILLED: 5-23-89 **BORING NO.** CH-8 **ELEVATION:** 2310.98

LOCATION: Station 63+80, 21 ft. lt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						SM	SILTY SAND -w/tr. gravel, brown		loose
						CL	SANDY CLAY -w/gravel, brown	moist	firm
							SILTY CLAY -w/sand, brown		stiff
				55			SANDY CLAY -w/caliche gravel and gravel, lt. brown	sl. moist	very stiff
			SPT	68/11"					
5						SC	GRAVELLY SAND -w/some clay, brown	moist	dense
						CL	SANDY CLAY -w/silt and gravel, lt. gray		stiff
			SPT	93/8"			w/some gravel	sl. moist	very stiff
10									
							SILTY CLAY -w/sand and caliche gravel, gray to lt. gray		stiff
			SPT	26					
15									very stiff
			SPT	65/11"					
20							Bottom at 20 feet		
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: ____ APPROV: ____

GSI3

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-14

DATE DRILLED: 5-24-89 **BORING NO.** CH-9 **ELEVATION:** 2310.76

LOCATION: Station 65+05, 21 ft. lt of ℄

DEPTH IN FEET	FIELD MOISTURE %	DRY DENSITY PCF	OTHER TESTS*	BLOWS/FT.**	SAMPLES	SYMBOL	SOIL DESCRIPTION	MOISTURE	CONSIST.
0						ML	CLAYEY SILT -porous, lt. brown	sl.m.	firm
						SM	SILTY SAND -w/clay, rust brown	moist	m.dense
				19		CL	SANDY CLAY -brown w/some caliche gravel, brown		f.-s.
							SILTY CLAY -w/so. cal.gr., sand, lt. brown		stiff
5			SPT	51			SANDY CLAY -w/some gravel, lt. brown		very stiff
							SILTY CLAY -w/sand and some caliche gravel, lt. brown w/trace sand and caliche gravel	sl.m.-m moist	stiff
10			SPT	36			SANDY CLAY -w/so. gravel, lt. brown		
							SILTY CLAY -w/trace gravel and cal. gravel, brown w/some gravel w/trace gravel w/some sand, lt. gray	v.moist	stiff to very stiff
							SANDY CLAY -w/tr. gr., lt.green brn.	m.-v.m.	firm
15			SPT	13			SILTY CLAY -w/trace caliche gravel, brown	moist	firm to stiff
			SPT	50/3"			partially cemented no cementation	moist-v.moist	v.s.-m.h v.stiff
20							Bottom at 20 feet		
25									
30									

*OTHER TESTS: C-CONSOLIDATION, A-ATTERBERG, S-SHEAR G-GRAIN SIZE, E-EXPANSION, CH-CHEMICAL

** USING 140 LB. DRIVING WEIGHT AND 2.5 INCH (I.D.) DIAMETER SAMPLER

NOTES: Water not encountered

SPT -Standard penetration test

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

BY: _____ APPROV: _____

WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

BORING LOG AND TEST SUMMARY

PLATE A-15

COARSE-GRAINED SOILS

LESS THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
GW	WELL-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	GRAVELS More than half of coarse fraction is larger than No. 4 sieve size
GP	POORLY-GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LESS THAN 5% FINES	
GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES, MORE THAN 12% FINES	
GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES, MORE THAN 12% FINES	
SW	WELL-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	SANDS More than half of coarse fraction is smaller than No. 4 sieve size
SP	POORLY-GRADED SANDS OR GRAVELLY SANDS, LESS THAN 5% FINES	
SM	SILTY SANDS, SAND-SILT MIXTURES, MORE THAN 12% FINES	
SC	CLAYEY SANDS, SAND-CLAY MIXTURES, MORE THAN 12% FINES	

NOTE:
Coarse-grained soils receive dual symbols if they contain 5 to 12% fines (e.g. SW-SM, GP-GC, etc.)

FINE-GRAINED SOILS

MORE THAN 50% FINES*

GROUP SYMBOLS	DESCRIPTION	MAJOR DIVISIONS
ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS	SILTS AND CLAYS Liquid limit less than 50
CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS	
OL	ORGANIC SILTS OR ORGANIC SILTY-CLAYS OF LOW PLASTICITY	
MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS	SILTS AND CLAYS Liquid limit more than 50
CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS	
OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY	
PT	PEAT, MUCK, AND OTHER HIGHLY ORGANIC SOILS	HIGHLY ORGANIC SOILS

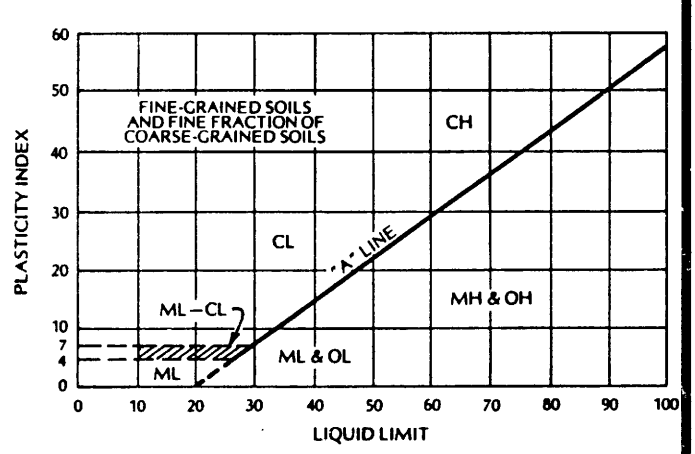
NOTE:
Fine-grained soils receive dual symbols if their limits plot in the hatched zone on the Plasticity Chart (ML-CL)

SOIL SIZES

COMPONENT	SIZE RANGE
BOULDERS	ABOVE 12 in.
COBBLES	3 in. to 12 in.
GRAVEL	No. 4 to 3 in.
Coarse	¾ in. to 3 in.
Fine	No. 4 to ¾ in.
SAND	No. 200 to No 4
Coarse	No. 10 to No. 4
Medium	No. 40 to No. 10
Fine	No. 200 to No. 40
*FINES (Silt or Clay)	BELOW No. 200

NOTE:
Only sizes smaller than three inches are used to classify soils.

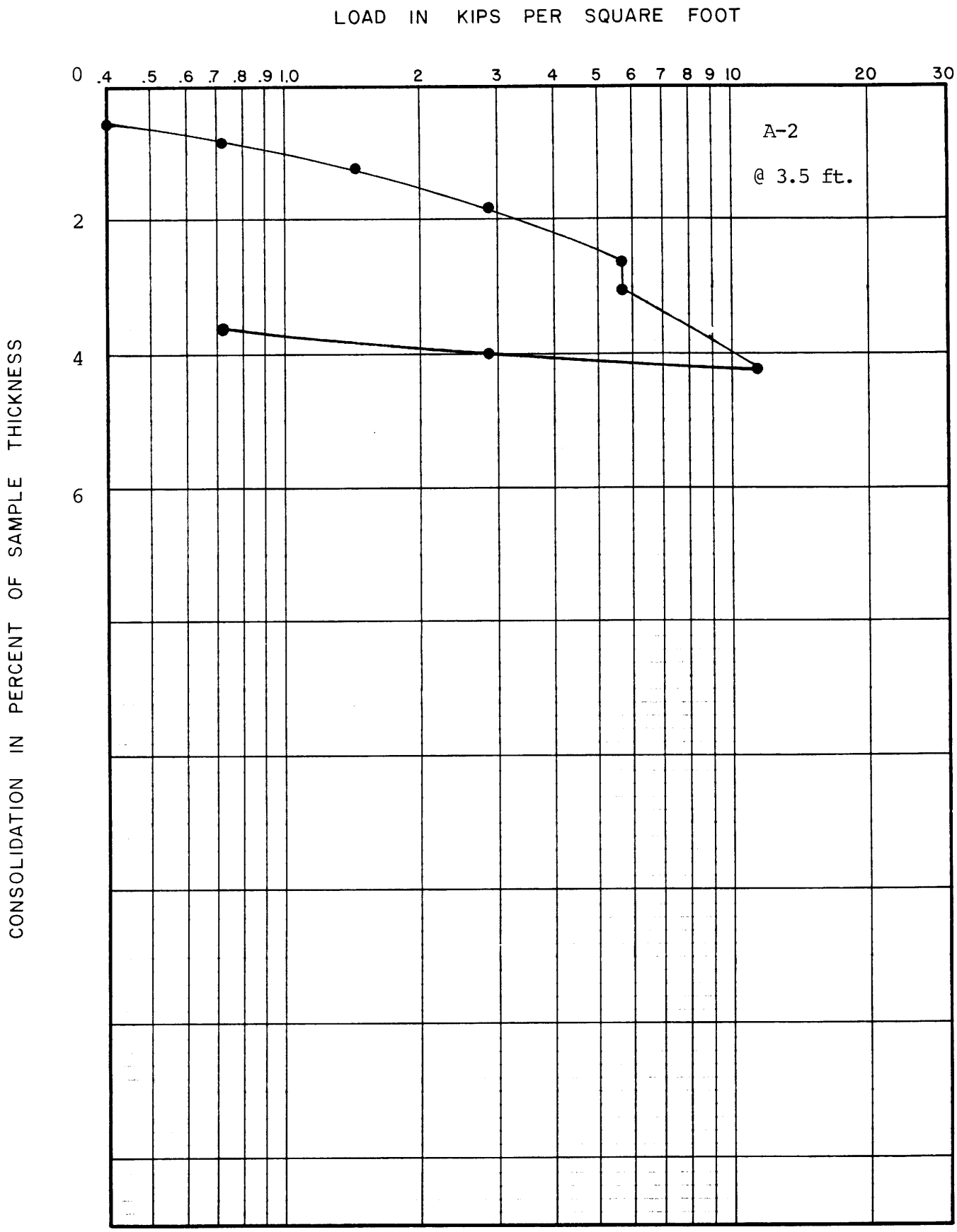
PLASTICITY CHART



WESTERN TECHNOLOGIES INC.

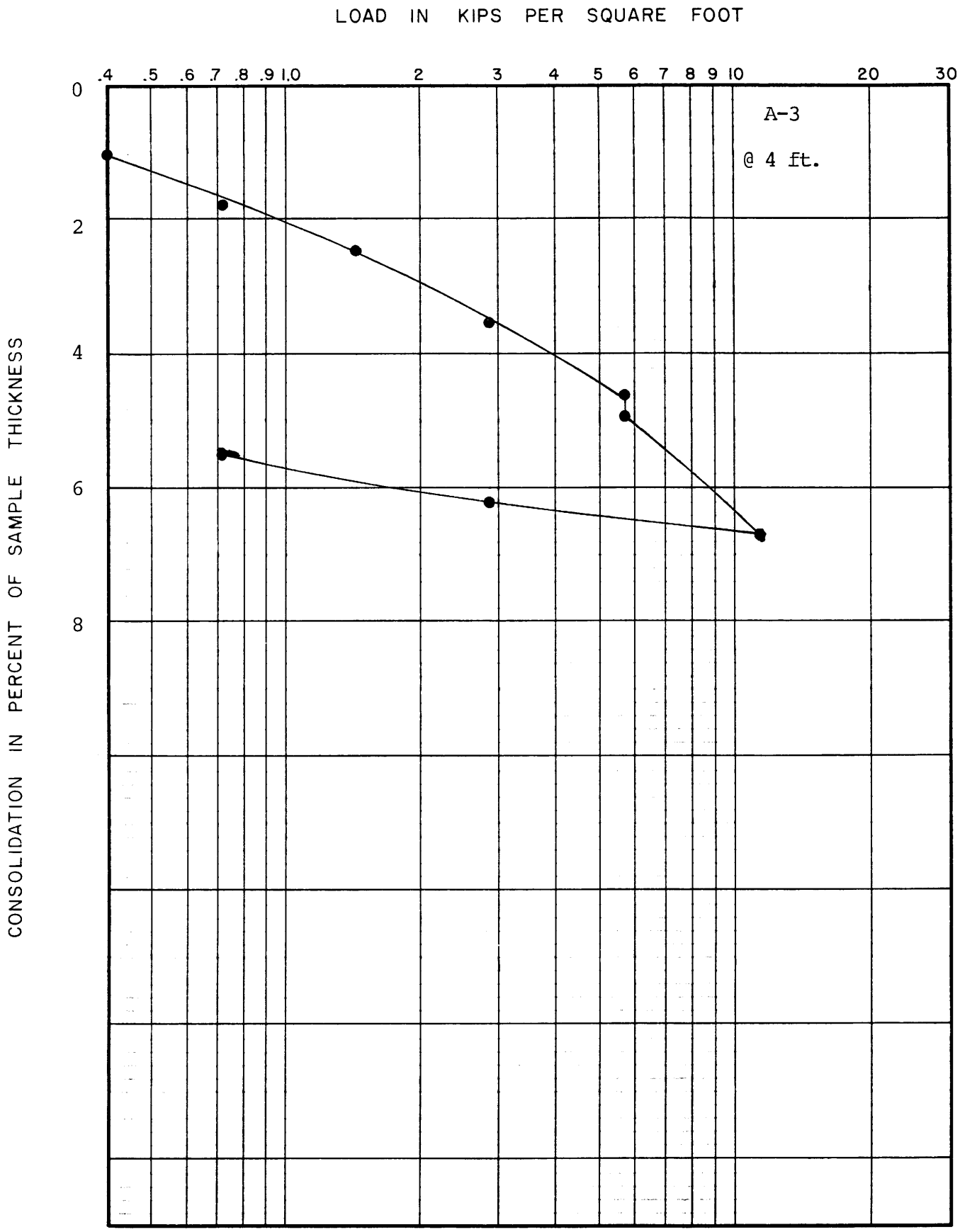
EXPLANATION OF MATERIAL CLASSIFICATIONS

PLATE B



WESTERN TECHNOLOGIES INC.	CONSOLIDATION TEST DATA	PLATE C-1
PROJECT NO. 4129J001		

GS19



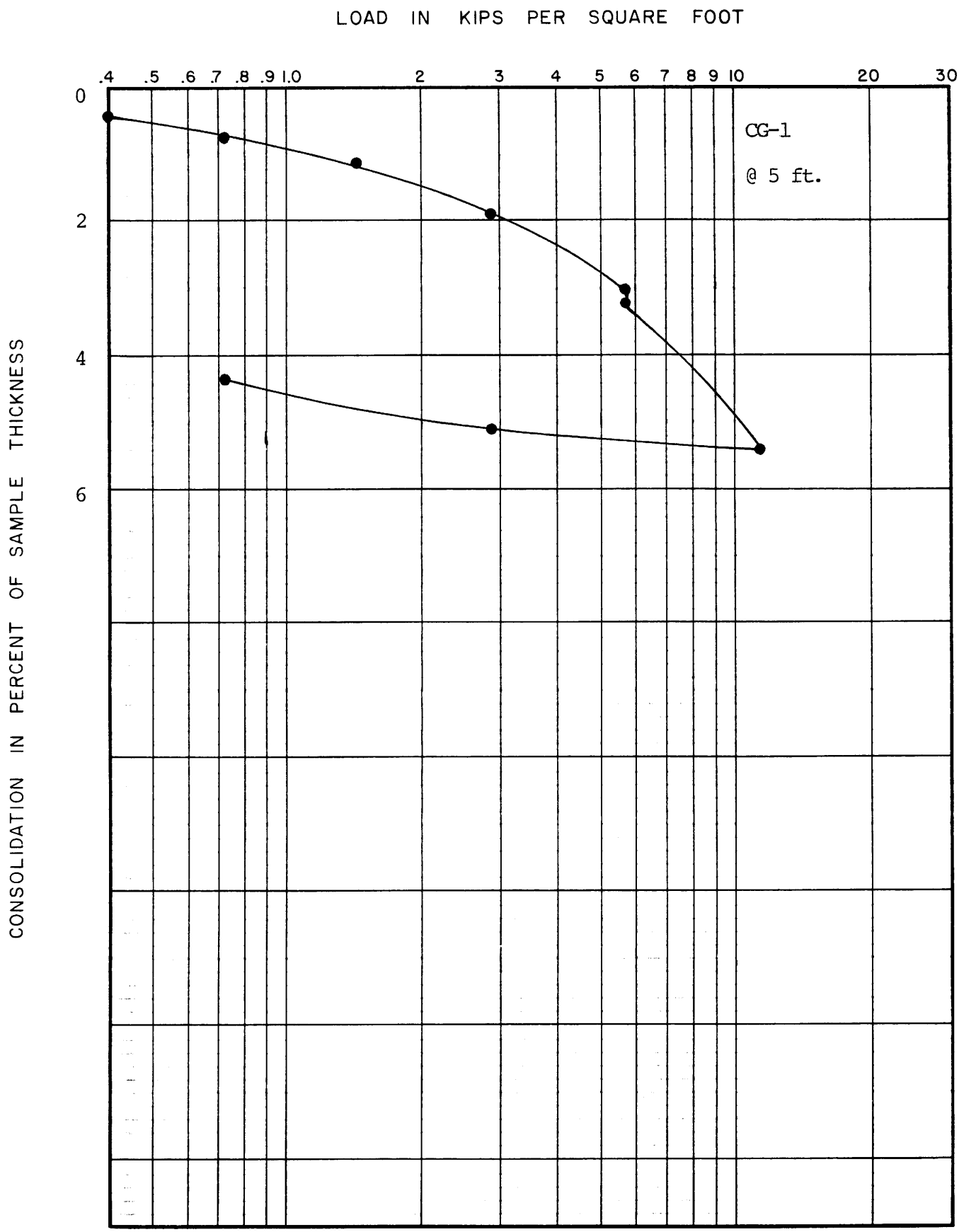
WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

CONSOLIDATION TEST DATA

PLATE C-2

GSI9



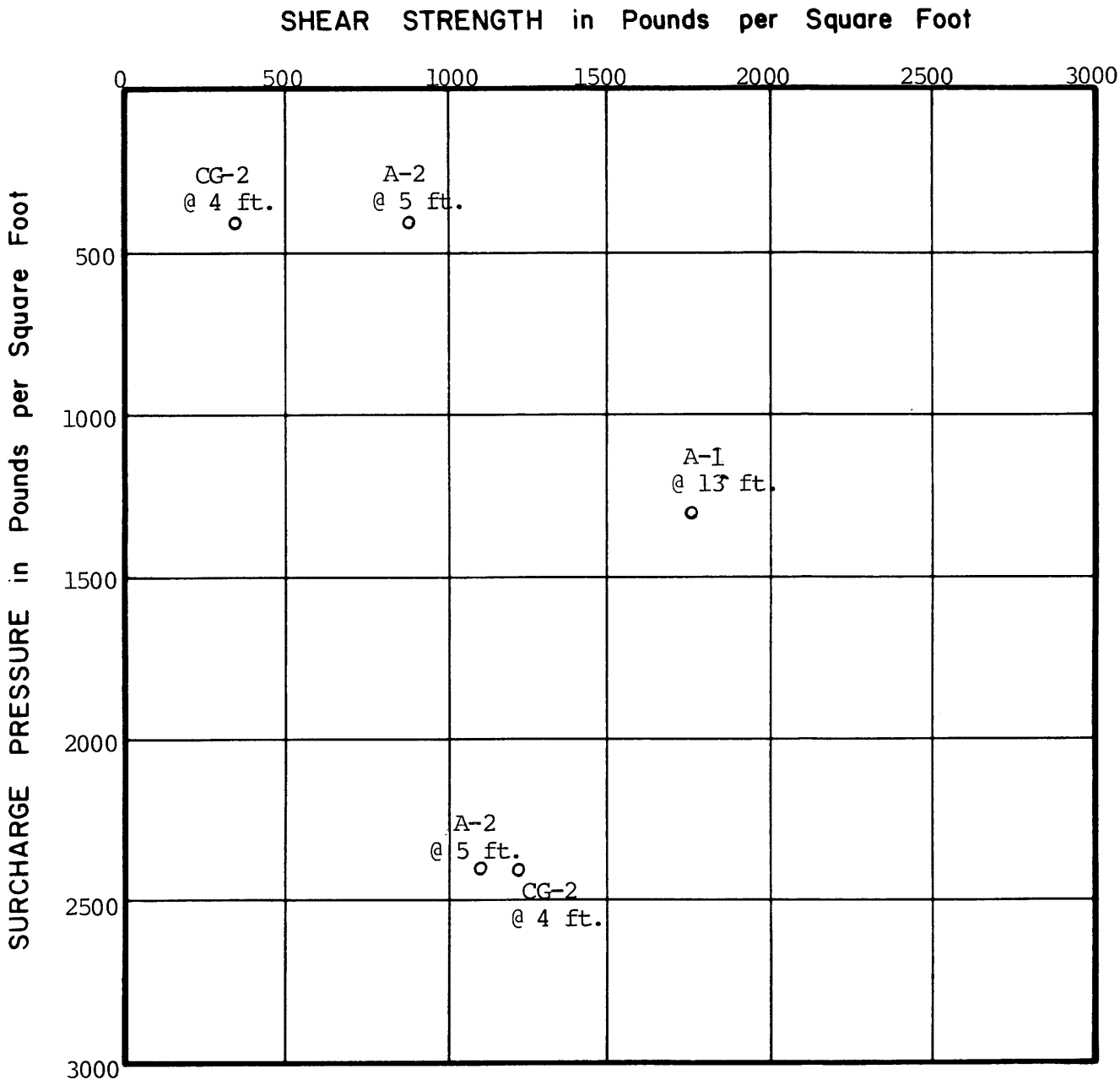
WESTERN TECHNOLOGIES INC.

PROJECT NO. 4129J001

CONSOLIDATION TEST DATA

PLATE C-3

GS19



EXPLANATION:

● Tests at field moisture content

○ Tests at increased moisture content

WESTERN TECHNOLOGIES INC.	DIRECT SHEAR TEST DATA	PLATE D
PROJECT NO. 4129J001		