RB&G
ENGINEERING
INC.

1435 WEST 820 NORTH
PROVO, UT 84601-1343
801 374-5771 Provo
801 521-5771 SLC

LEGACY PARKWAY

BOX CULVERT & SIGN FOUNDATIONS

Salt Lake & Davis Counties, Utah

Utah Department of Transportation
SP-0067(5)0

October 2006

Subsurface Explorations and Geotechnical Recommendations

200801-140 & 200801-150

RB&G ENGINEERING INC.

October 6, 2006

Mr. Sohail Khan
Carter & Burgess
420 East South Temple Suite 342
Salt Lake City, Utah 84111-1321

Reference: Legacy Parkway Project No. SP-0067(5)0

Gentlemen:

Subsurface explorations have been completed for Box Culverts and Sign Foundations for the Legacy Parkway Project in Salt Lake and Davis Counties, Utah. The results of the investigations, along with geotechnical recommendations are summarized in the report transmitted herewith.

We appreciate the opportunity of providing this service for you. If there are any questions relating to the information contained herein, please call.

Sincerely,

RB&G ENGINEERING, INC.

REGISTERED PROFESSIONAL ENGINEER
NO.162291
BRADFORD E. PRICE
STATE OF UTAH

Bradford E. Price, P.E.

bep/jag

1435 WEST 820 NORTH
PROVO, UT 84601-1343

PROVO 801-374-5771
SALT LAKE CITY 801-521-5771

Subsurface Explorations &
Geotechnical Recommendations

Legacy Parkway

Box Culvert & Sign Foundations

Salt Lake & Davis Counties, Utah

Utah Department of Transportation
SP-0067(5)0

October 2006

RB&G ENGINEERING, INC.

Professional Engineers

Box Culverts

RB&G Engineering, Inc.

Memo

To: Sohail T. Khan, P.E.
Larry Reasch, P.E.

From: Rob Johnson

Reviewed by: Brad Price, P.E.

Date: October 6, 2006

Re: Legacy Parkway
Subsurface Data and Geotechnical Recommendations for Box Culverts

---

Subsurface investigations have been performed for selected box culvert locations on the Legacy Parkway project. It is our understanding that a total of nine concrete box structures are planned for the project. Geotechnical recommendations for the trail underpass structures at Center Street (E-2570) and 500 South (E-2571) are provided in separate reports for structures at those sites. Geotechnical considerations for the LP1 trail underpass (E-2569) are discussed in the LP1 bridge report. Recommendations for the trail underpass structures at the Mill Creek (E-2572) and D&RGW RR (E-2573) sites are also provided in a separate report.

At culverts E-2555 (LP over Rick's Creek) and E-2562 (LP over DS&B Channel), borings were completed previously by others within about 40 feet of the new culvert alignments, allowing evaluation of culvert design parameters without requiring new borings. New borings were performed for structures E2E-1324 (City Drain Extension under I-215 and LP), E-2553 (LP Frontage Road over DS&B Channel, E.-2554 (LP over Drainage Canal near 1000 North), and E-2559 (LP over A1/A2 Canals). The logs for the borings located closest to each of the six culvert sites are attached, along with applicable laboratory test results.

Recommended Foundation Parameters

An evaluation of anticipated subgrade parameters has been performed for Legacy Parkway box culvert sites, based on the borings performed in the vicinity of each culvert location. Estimates of subgrade parameters for each site are summarized below.

Culvert	Location	Nearest Boring	Approx. Invert Elevation (ft)	Predominant Soil Type Below Invert	Undrained Shear Strength (psf)	Nominal Bearing Resistance (psf)
E2E-1324	City Drain Ext. under I-215 & LP	RSB-C-656	4212	Clay	700	3598
E-2553	LP Frontage Rd over DS&B Channel	RSB-C-654	4211	Clay	1100	5654
E-2554	LP over Drainage Canal near 1000 N	RSB-C-655	4212	Silt/Clay	700	3598
E-2555	LP over Rick's Creek	RB-412	4217	Clay/Silt	900	4626
E-2559	LP over A1/A2 Canals	RSB-C-657	4210	Silt/Clay	800	4112
E-2562	LP over DS&B Channel	RB-406	4213	Clay/Silt/Sand	1100	5654

It will be noted that the recommended subgrade parameters for some structures are different than the preliminary estimates provided in the Memo dated April 17, 2006. The preliminary estimates were based on the nearest available subsurface information, and these values have been refined to better reflect the new site-specific data.

The Strength I bearing resistance for each site can be estimated by multiplying the nominal resistance shown on the table by a resistance factor of 0.50. The bearing resistance values listed herein are applicable to structures placed on the existing subgrade soils prior to placement of roadway embankment fill around the structures. It should be noted that the placement of roadway embankment fill will consolidate subgrade soils, and the clayey and silty soils will gain strength with consolidation. If roadway embankments adjacent to the culverts are constructed in such a manner that loads from the roadway fill weight do not exceed the bearing resistance of the subgrade, bearing resistance will not be critical for the culverts. At some locations, staged construction, lightweight embankment fill, or subgrade reinforcement/modification may be necessary to provide sufficient bearing capacity for the new fill and the buried culverts.

The shallow cohesive soils at each of the six culvert sites were firm to moderately stiff. We recommend that a coefficient of subgrade reaction of 50 pounds per cubic inch be used to design the culverts. This estimated coefficient of subgrade reaction is for a 12-inch square footing area and is based on typical values for firm clays. As a minimum, it is recommended that a six inch layer of granular fill be placed beneath culverts to provide a working platform. The coefficient of subgrade reaction can be increased to 100 pci by placing 12 inches of compacted granular fill beneath the culverts.

It is anticipated that significant consolidation settlement may occur due to placement of new roadway embankment at some locations, and that differential and total settlement considerations may control the design of the box culverts. If structures cannot be designed to tolerate the anticipated settlements, it may be advisable to preload the culvert subgrade area with temporary embankment fill, allow consolidation to occur, and then excavated the temporary fill to construct the culverts.

Lateral Earth Pressures

Lateral earth pressures can generally be calculated using the equation

$$P = \tfrac{1}{2} \gamma K H^2$$

Where
- P = total lateral force on the wall, plf
- K = earth pressure coefficient
- γ = unit weight of the soil (depends on fill material)
- H =height of the wall

The earth pressure coefficient used in designing the walls will depend upon whether the wall is free to move during backfilling operations, or whether the wall is restrained during backfilling. If the wall is free to move away from the soil during backfilling operations, we recommend that an active earth pressure coefficient be used in the above equation to calculate the lateral earth pressures. If the walls are restrained or braced from movement during backfilling (as is generally the case with box culverts and similar structures), we recommend that an at-rest earth pressure coefficient be used to calculate the lateral earth pressures. A passive earth pressure coefficient should be used to calculate the lateral soil resistance where the wall is being pushed toward the soil. It should be recognized that the pressures, calculated by the above equation, are earth pressures only and do not include hydrostatic pressures. Where hydrostatic pressures may exist behind a retaining structure, we recommend either the wall be designed to resist

hydrostatic pressure, or that a drainage system be placed behind the wall to prevent the development of hydrostatic pressures.

Lateral earth pressure coefficients and other recommendations for computing lateral earth pressures have been provided previously and are attached for reference. A general earth pressure coefficient has been provided for calculation of earth pressures where mechanical compaction equipment is expected to be operated near non-yielding walls less than about 8 feet high. This scenario is anticipated during placement of fill around culverts. The residual pressure from compaction equipment can be reduced by limiting the proximity and weight of compacting equipment near culvert walls.

Recommendations based on the Mononobe-Okabe approach for active and passive seismic lateral earth forces are also attached. For non-yielding walls, recommended equations for calculating the dynamic thrust and dynamic overturning moment are also provided.

Soil Chemical Analyses

Selected samples from the borings were tested to determine the pH, resistivity, and water-soluble sulfate and chloride contents. The results of these chemical tests are summarized below.

BORING NO.	DEPTH BELOW GROUND SURFACE (ft)	pH	RESISTIVITY (ohm-cm)	SULFATE (ppm)	CHLORIDES (ppm)	USCS / AASHTO CLASSIFICATION
RSB-C-654	3-4.5	7.9	14,276	695	505	CL / A-6(17)
RSB-C-655	3-4.5	8.9	12,978		746	ML / A-4(0)
RSB-C-656	9-10.5	8.6	6,765	869	738	CL / A-6(9)
RSB-C-657	3-4.5	8.3	6,567	43	122	CL / A-6(14)

* Visual Classification

The following table taken from the Bureau of Reclamation Concrete Manual indicates the amount of sulfate producing adverse effects on concrete in contact with soil containing sulfate.

Relative Degree of Sulfate Attack	Percent Water-Soluble Sulfate (as SO_4) in Soil Samples	mg/l Sulfate (as SO_4) in Water Samples
Negligible	0.00 to 0.10	0 to 150
Positive[1]	0.10 to 0.20	150 to 1,500
Severe[2]	0.20 to 2.00	1,500 to 10,000
Very Severe[3]	2.00 or more	10,000 or more

1 Use type II cement.

2 Use type V cement, or approved combination of portland cement and pozzolan which has been shown by tests to provide comparable sulfate resistance when used in concrete.

3 Use type V cement plus approved pozzolan which has been determined by tests to improve sulfate resistance when used in concrete with type V cement.

The water-soluble sulfate content of all samples tested was less than 0.1 percent, and a positive degree of sulfate attack is not expected based on these test results. In general, Type II cement is preferred for all concrete in contact with soil, due to its superior resistance to deterioration.

Groundwater

Measurements of the static groundwater level at the time of drilling are shown on the boring logs. It is anticipated that the water table elevation adjacent to each culvert will generally coincide with the water surface elevations inside the culverts.

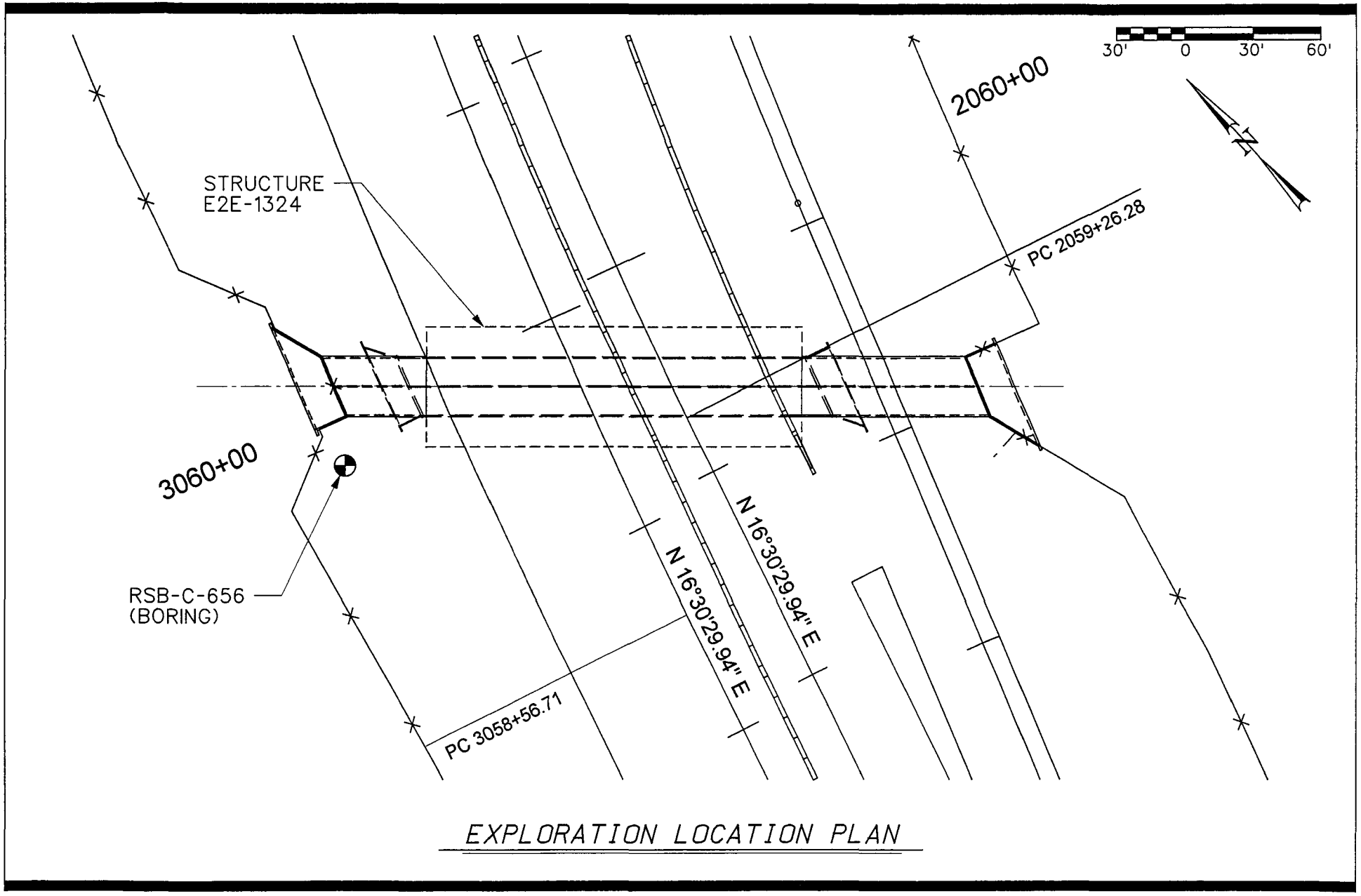
Construction Considerations

As a minimum, the upper 6 inches should be stripped from the foundation area to remove excess organic matter. Following foundation excavation, the area should be proof rolled with light ground pressure equipment. Soft areas should be over excavated and stabilized.

Based on anticipated foundation elevations and groundwater levels encountered in the borings, some dewatering is expected to be necessary for construction of the box culverts. It is recommended that the groundwater be lowered to a depth of 2 feet below the bottom of the excavations. It is anticipated that dewatering can best be achieved using sumps and drain trenches where clay exists at the foundation level.

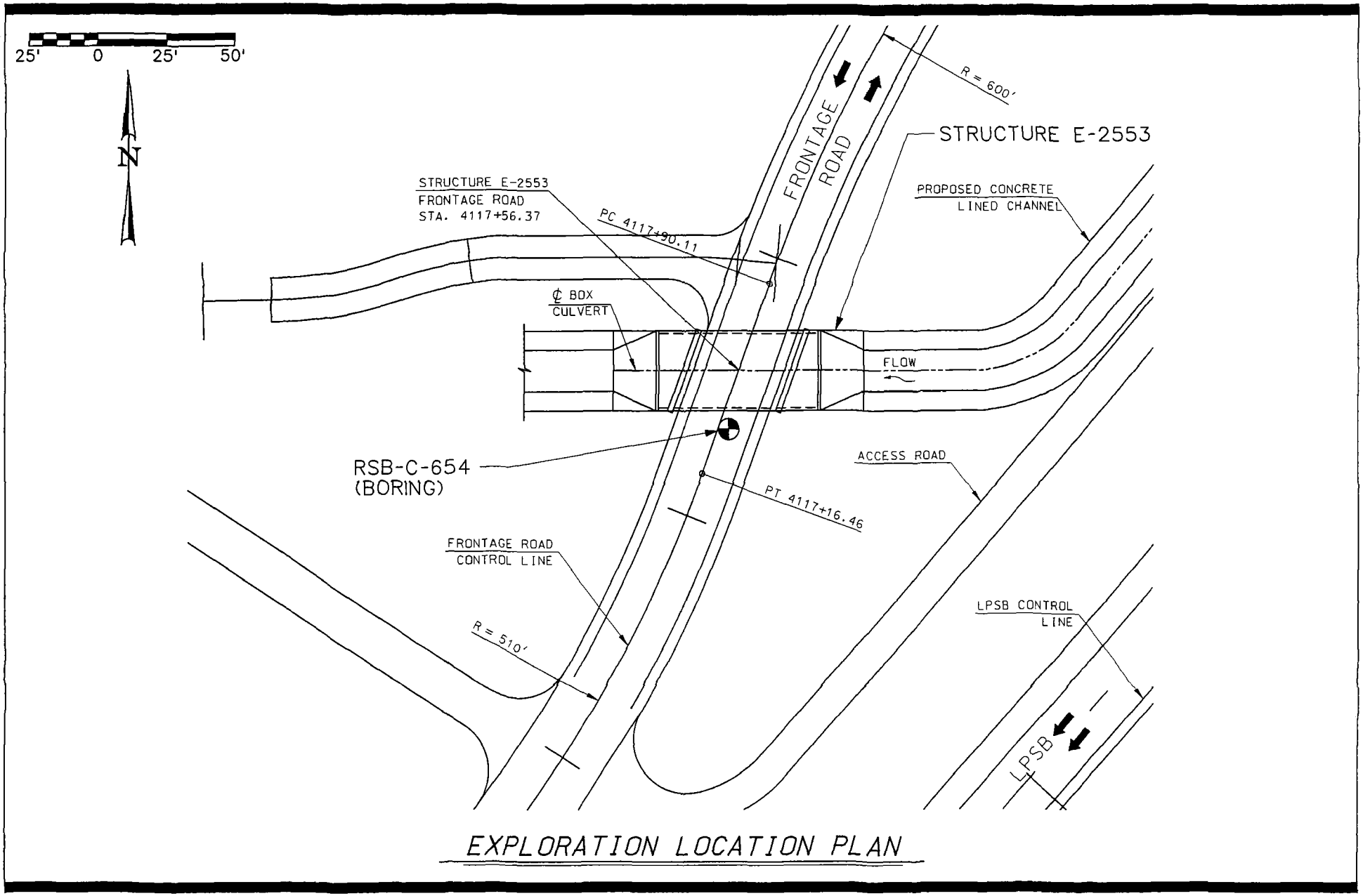
Soils at the bottom of excavations may be too soft to provide an adequate working surface. Stabilization methods will depend upon conditions encountered. Moderately soft areas can be stabilized by over excavating the foundation footprint to a depth of about 1 foot, placing a geotextile fabric such as Mirafi 500X or equal and backfilling with compacted sandy gravel. Very soft areas may be stabilized by tamping cobble rock (preferably angular to subangular) into the subgrade as needed.

Depending upon construction sequence and methods employed, excavation and shoring of embankment preload fill may be necessary. Maximum excavation slopes in compacted granular fill material of 1H:1V can be used for temporary cuts less than 20 feet deep. For temporary cuts between 20 and 30 feet deep, 1.5H:1V cut slopes or flatter should be used for the entire depth of the cut. The stability of cuts in uncompacted fill and/or natural subgrade soils should be evaluated on a case-by-case basis.



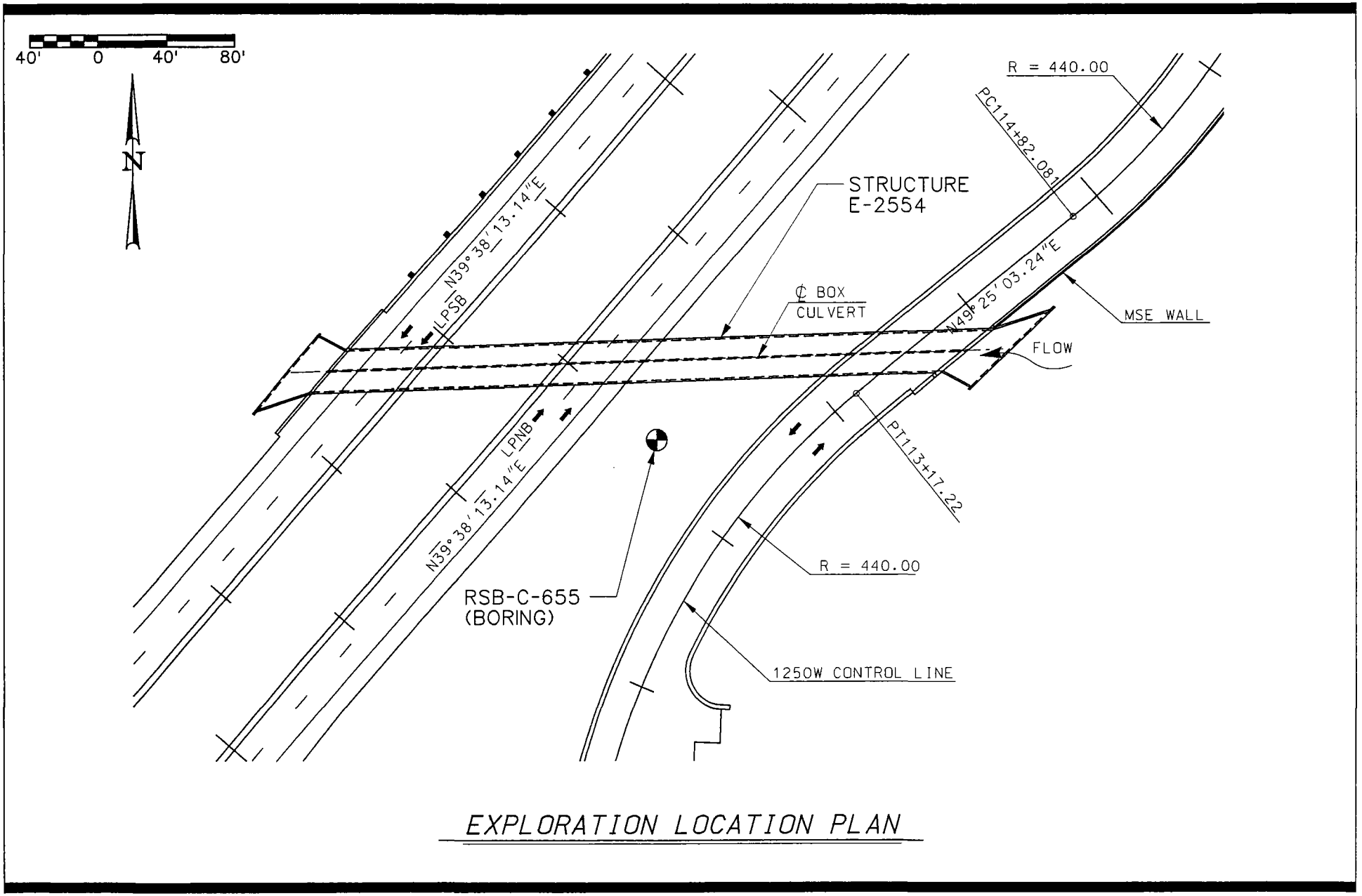
RB&G ENGINEERING INC.
Provo, Utah

Figure 1. SITE PLAN & TEST HOLE LOCATIONS
Legacy Parkway - Structure E2E-1324
(City Drain Extension Under I-215 & Legacy Parkway)
Salt Lake/Davis, Utah



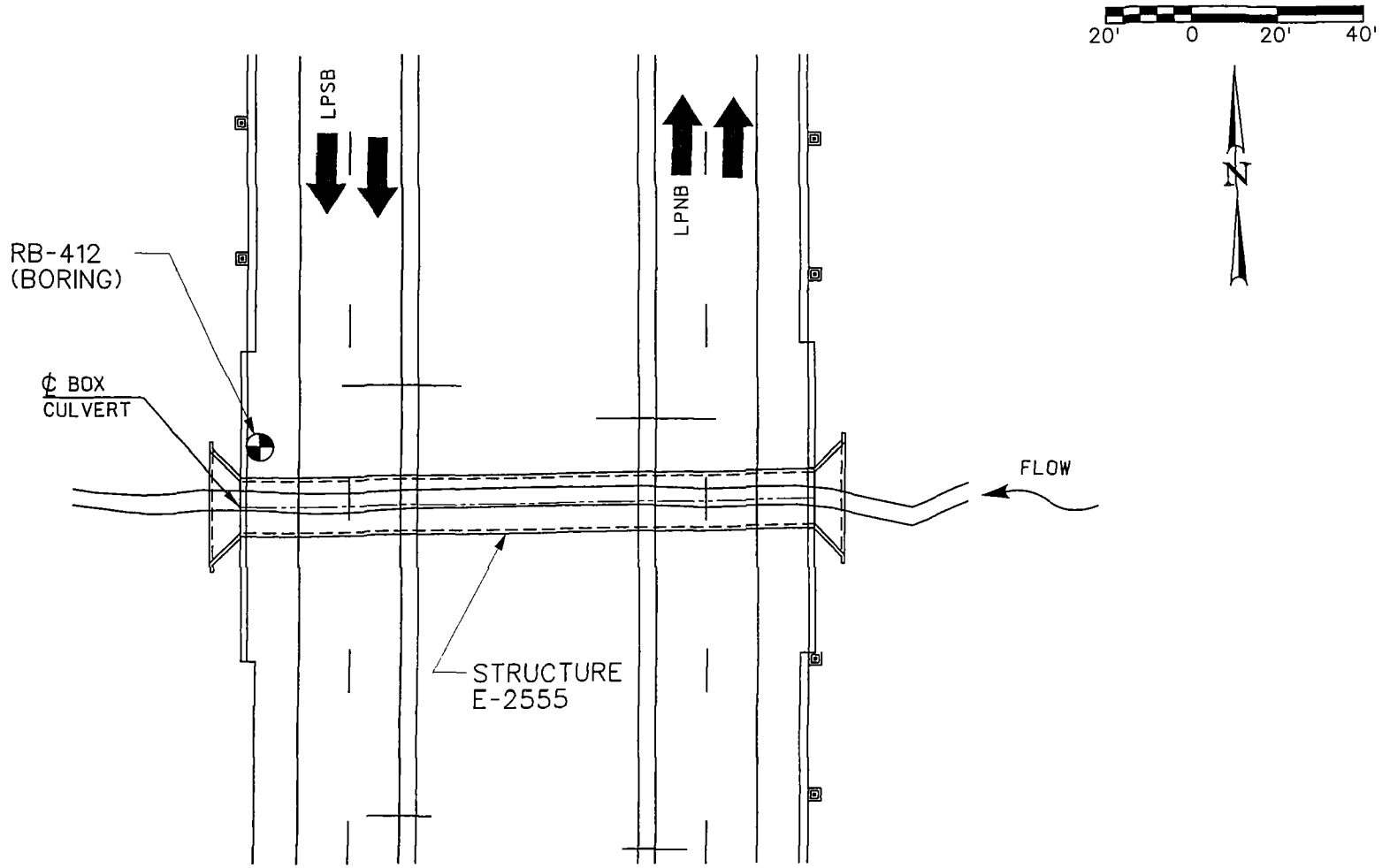
RB&G ENGINEERING INC.
Provo, Utah

Figure 2. SITE PLAN & TEST HOLE LOCATIONS
Legacy Parkway - Structure E-2553
(Legacy Parkway Frontage Road Over DS&B Channel)
Salt Lake/Davis County, Utah



RB&G ENGINEERING INC.
Provo, Utah

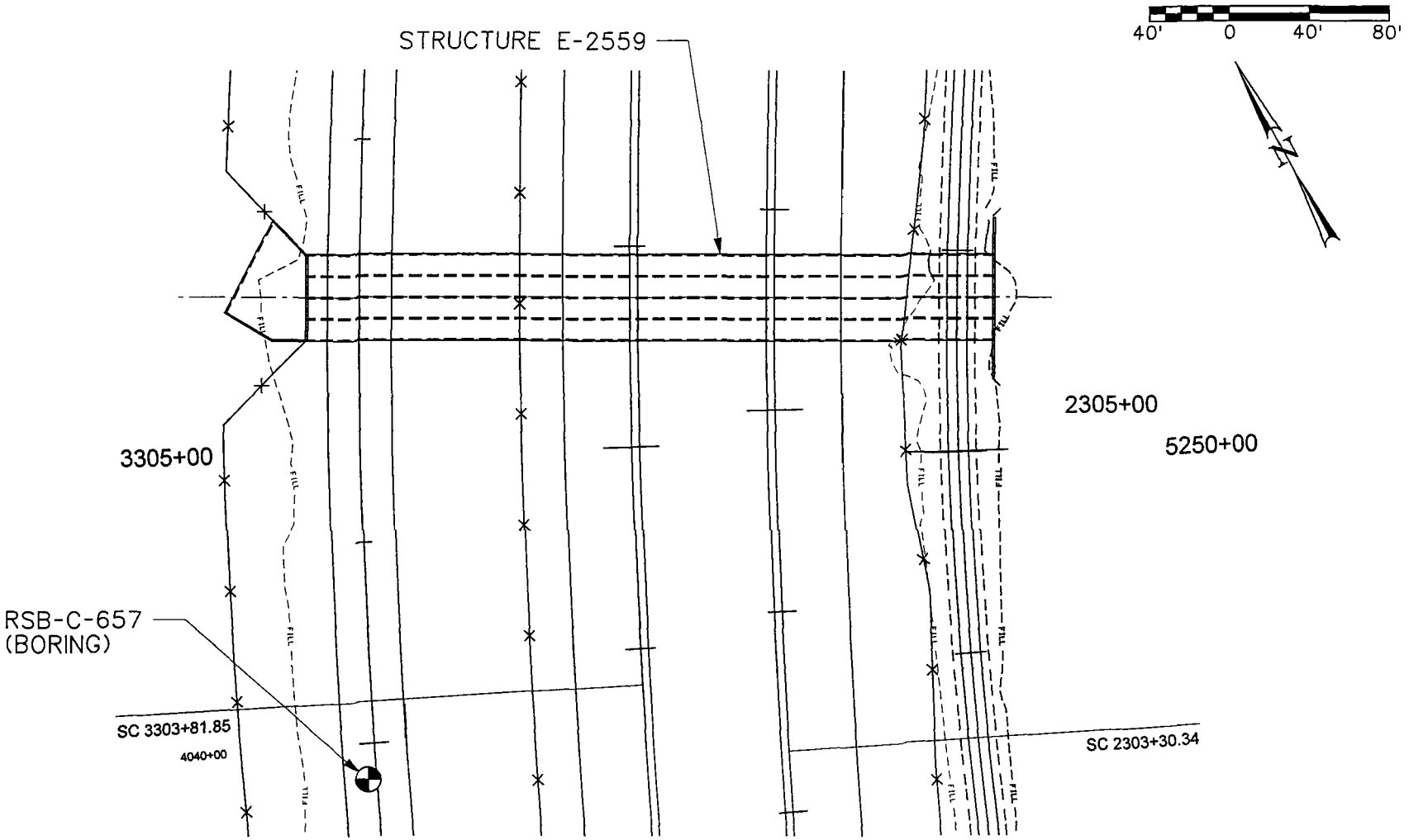
Figure 3. SITE PLAN & TEST HOLE LOCATIONS
Legacy Parkway - Structure E-2554
(Legacy Parkway Over Drainage Canal Near 1000 North)
Salt Lake/Davis County, Utah



EXPLORATION LOCATION PLAN

RB&G ENGINEERING INC.
Provo, Utah

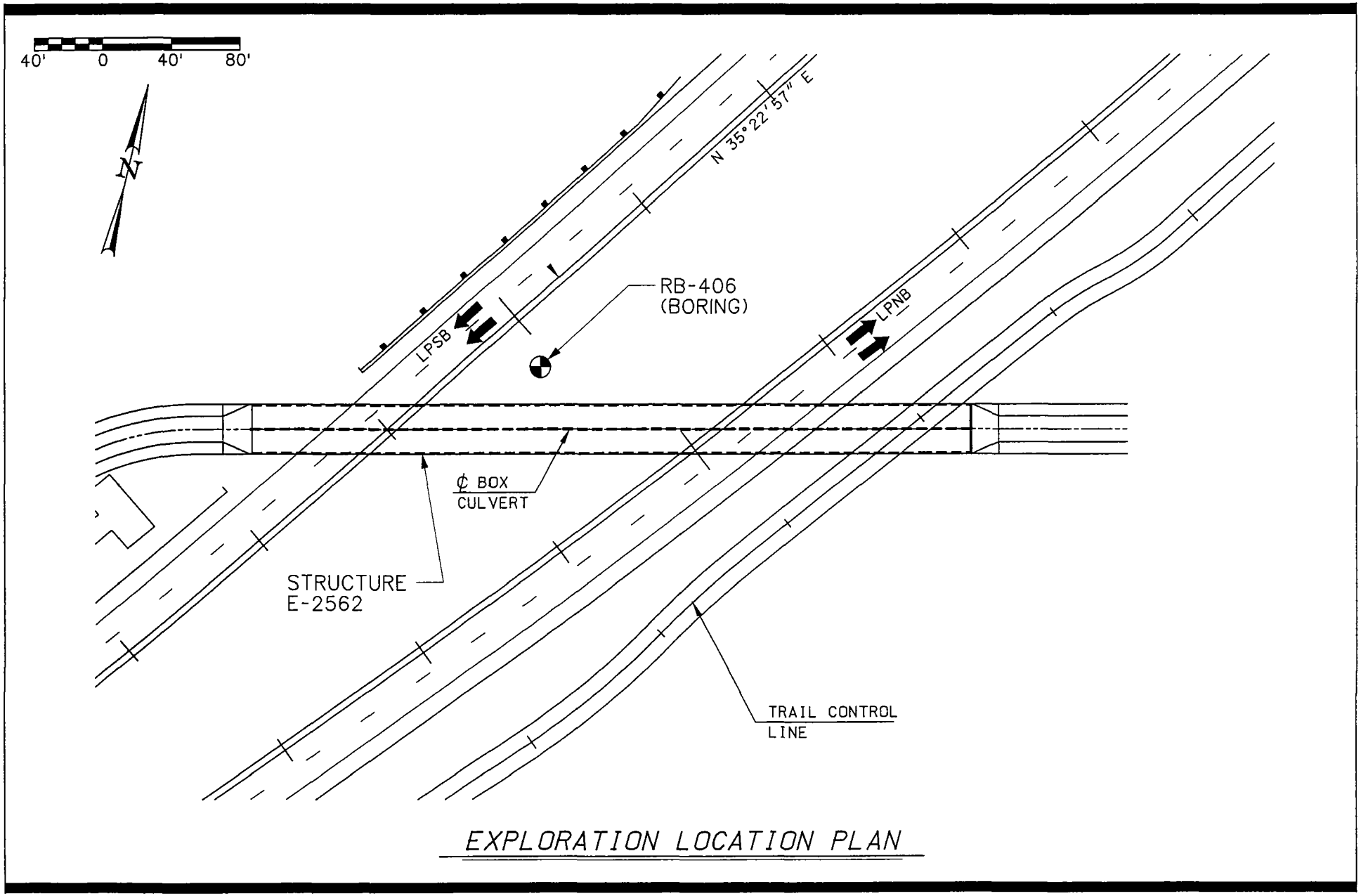
Figure 4. SITE PLAN & TEST HOLE LOCATIONS
Legacy Parkway - Structure E-2555
(Legacy Parkway Over Rick's Creek)
Salt Lake/Davis County, Utah



EXPLORATION LOCATION PLAN

RB&G ENGINEERING INC.
Provo, Utah

Figure 5. SITE PLAN & TEST HOLE LOCATIONS
Legacy Parkway - Structure E-2559
(Legacy Parkway Over A1/A2 Canals)
Salt Lake/Davis County, Utah



RB&G ENGINEERING INC.
Provo, Utah

Figure 6. SITE PLAN & TEST HOLE LOCATIONS
Legacy Parkway - Structure E-2562
(Legacy Parkway Over DS&B Channel)
Salt Lake/Davis County, Utah

Boring: RB-406
Sheet 1 of 1

SAMPLE DESCRIPTION
(ASTM D 2488/D 2487)

Elevation (m)	Depth ft	Depth m	Graphic Log	Type	Recovery (mm)	Soil Classification USCS	Soil Classification AASHTO	N, Blows per 0.15 m (or interval shown)	SPT $(N_1)_{60}$ / SPT $(N_1)_{60}$ (Greater than 50 Blows)	Test Results: S_u kPa (torvane in italics)	Dry Density, kN/m³	Moisture, %	Liquid Limit	Plasticity Index	% Passing No. 200	Other Tests
				MC	254	CL	A-6	6 12 11 6	29							
1285		1		SPT	610			3 3 5 7	13							
	5	2		SH	508	SM	A-2-4			57						
				SPT	457	ML	A-4	3 4 5	14						79	
	10	3		MC	584	CL	A-6	6 10 12 14	26							
		4		SPT	406			4 4 7	14							
	15	5		SH	610					64 77	14.5	31	38	19		C SG
				SPT	457			2 2 2	6							
1280		6				ML	A-4									
	20			MC	610	CL	A-6	4 3 3 3	6							
						SM	A-2-4									
		7		SPT	457	CL	A-6	0 2 2	4							
	25			SH	584					43						
		8		SPT	457			4 3 3	6							
	30	9		MC	610			1 3 3 3	6							
1275	35	10														
		11														
	40	12														
		13														
	45	14														
		15														
1270	50	16														
	55	17														
		18														
	60	19														
	65															

Lean CLAY - very stiff, moist, dark gray

Silty SAND - medium dense, wet, tan

SILT with sand - stiff, wet, gray

Lean CLAY - very stiff, wet, gray to tan

- grades to stiff, occasional very thin lenses of fine-grained sand

SILT - medium stiff, wet, gray

Lean CLAY - medium stiff, wet, gray

Silty SAND - medium dense, wet, gray

Lean CLAY - medium stiff, wet, gray,

- grades to soft

- grades to medium stiff

UTDOT Z803SUP.GPJ 6/1/00

Legacy Parkway - Preferred Alternative
I-215 to I-15/US 89 Interchange

KLEINFELDER

Project No. 35-8163-05

FIELD TEST BORING LOG

Boring: RB-406

Sheet 1 of 1

Logged by:	R. Khandokar
Date Start:	5/11/00
Date Finish:	5/11/00
Station:	6011+725.000 0.00 RT
Line:	D Mainline
Coordinates (m):	N 115,503.490 E 18,027.912
Elevation (m):	1285.770
Total Depth Drilled (m):	9.4
Drill Contractor:	RC Exploration
Driller:	M. Labenski
Rig Type:	Diedrich D-120 ATV
Drilling Method:	Hollow-Stem Auger
Hammer Type:	Automatic
Rod Type:	AW
Boring Diameter:	152 mm

LEGEND/NOTES

Elevations based upon North American Vertical Datum of 1988 (NAVD '88)

Coordinates are NAD '83

▽ = Observed Groundwater depth at time of drilling

Blows = Number of blows required to drive split spoon sampler 150 mm or interval shown

USCS = Unified Soil Classification System

AASHTO = American Association of State Highway and Transportation Officials

= See Key to Soil Logs for list of abbreviations and descriptions of tests

SAMPLE TYPE

SPT = Standard Penetration Test, 34.9mm ID and 50.8mm OD split spoon sampler

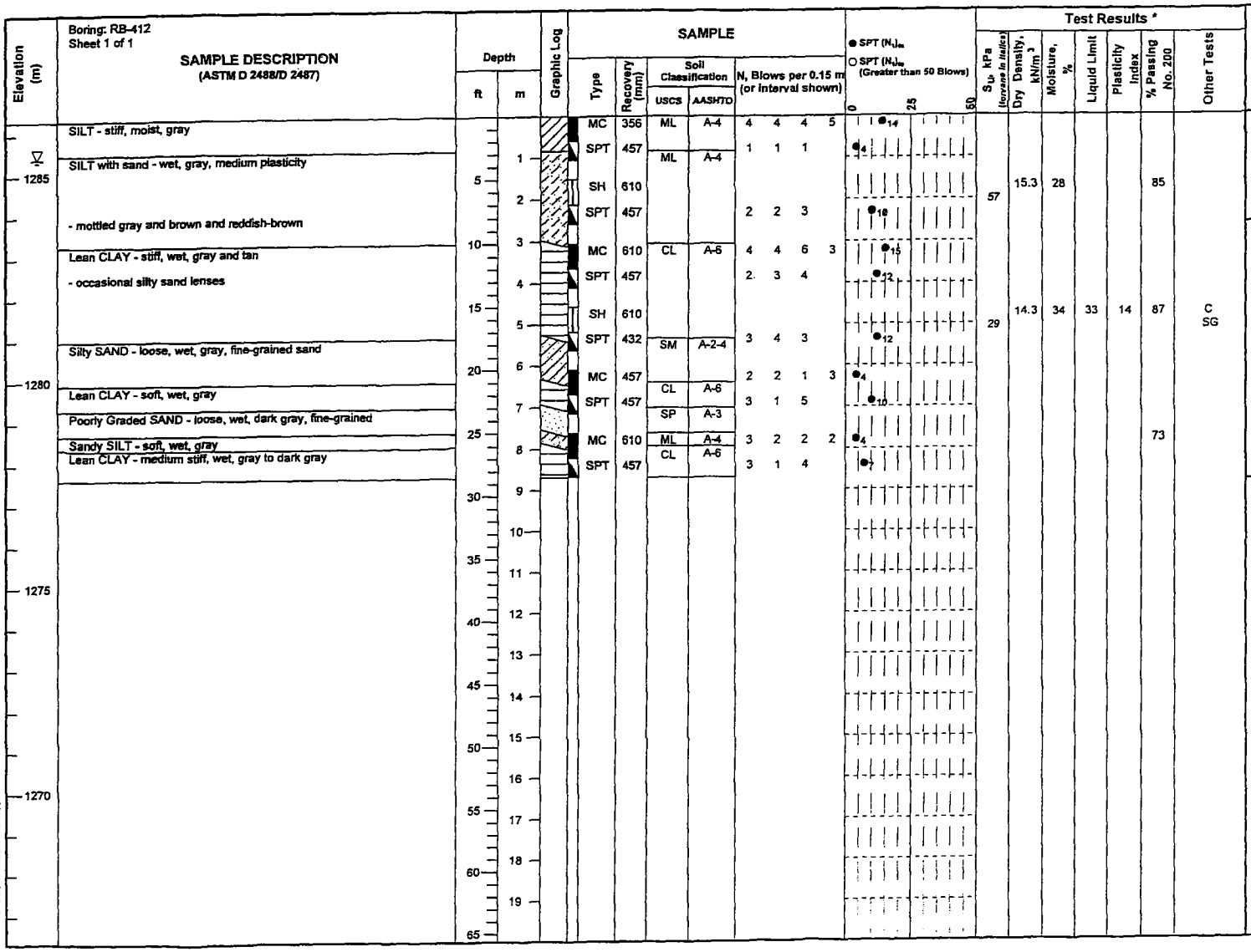
MC = Modified California Sampler, 50.8mm ID and 63.5mm OD split spoon sampler

P = Piston Sampler, 76.2 mm OD

SH = Shelby Tube, 76.2mm OD, pushed

BAG = Bulk Sample

PLATE D-86



Legacy Parkway - Preferred Alternative
I-215 to I-15/US 89 Interchange

KLEINFELDER

Project No. 35-8163-05

FIELD TEST BORING LOG

Boring: **RB-412**

Sheet 1 of 1

Logged by:	R. Khandokar
Date Start:	5/18/00
Date Finish:	5/18/00
Station:	6016+150.000 0.00 RT
Line:	D Mainline
Coordinates (m):	N 119,225.500 E 19,868.686
Elevation (m):	1286.314
Total Depth Drilled (m):	8.7
Drill Contractor:	RC Exploration
Driller:	M. Labenski
Rig Type:	Diedrich D-120 ATV
Drilling Method:	Hollow-Stem Auger
Hammer Type:	Automatic
Rod Type:	AW
Boring Diameter:	152 mm

LEGEND/NOTES

Elevations based upon North American Vertical Datum of 1988 (NAVD '88)

Coordinates are NAD '83

▽ = Observed Groundwater depth at time of drilling

Blows = Number of blows required to drive split spoon sampler 150 mm or interval shown

USCS = Unified Soil Classification System

AASHTO = American Association of State Highway and Transportation Officials

• = See Key to Soil Logs for list of abbreviations and descriptions of tests

SAMPLE TYPE

SPT = Standard Penetration Test, 34.9mm ID and 50.8mm OD split spoon sampler

MC = Modified California Sampler, 50.8mm ID and 63.5mm OD split spoon sampler

P = Piston Sampler, 76.2 mm OD

SH = Shelby Tube, 76.2mm OD, pushed

BAG = Bulk Sample

UTDOT Z603SUP.GPJ 8/1/00

PLATE D-92

DRILL HOLE LOG

BORING NO. RSB-C-654

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - STRUCTURE E-2553 (DS&B BOX CULVERT (S))
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: N 378,323, E 58,387
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 1.8' **AFTER 24 HOURS:** ▼ 2.0'

PROJECT NUMBER: 200601.149
DATE STARTED: 4/17/06
DATE COMPLETED: 4/17/06
GROUND ELEVATION: 4215.1'
LOGGED BY: G. PEASLEE

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				12	13,16,10,(41)	GM	brown, moist, med. dense — SILTY GRAVEL W/SAND								
				18	3,5,6,(17) *0.80*	CL (A-6(17))	dk. brown, moist, stiff			34	19	0	5	95	
4210	5			14	Pushed	CL (A-6(21))	lt. gray-brown, moist, stiff	99.7	22.4	40	21	0	6	94	CT UC
				18	4,8,11,(30)	CL	lt. gray-brown, moist, stiff — LEAN CLAY W/SAND LENSES								
4205	10			15	3,4,6,(16) *0.89,0.60*	CL	lt. brown, moist, stiff								
				12	Pushed *0.85*	CL (A-7-5(25))	lt. brown-gray, moist, stiff	102.2	24.8	42	23	0	0	100	UC
4200	15			18	2,4,4,(11) *0.79,0.70*	CH	gray, moist, stiff — FAT CLAY								
				15	Pushed *0.55*	SM	gray, moist, med. dense — SILTY SAND W/CLAY LENSES								
4195	20			18	2,2,2,(5) *0.58*	CH (A-7-5(30))	dk. gray, wet, stiff — FAT CLAY		51.7	51	29	0	7	93	
4190	25			15	Pushed *0.42*	SM	gray, wet, med. dense — SILTY SAND								
						CL	gray, wet, firm — LEAN CLAY								

DH_LOGV1 C_654_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-C-655

SHEET 1 OF 1

PROJECT LEGACY PARKWAY - STRUCTURE E-2554 (1000 N BOX CULVERT)
CLIENT UTAH DEPARTMENT OF TRANSPORTATION
LOCATION N 386,243, E 64,237
DRILLING METHOD CME-55 NO 2 / N W CASING W/TRICONE BIT
DRILLER D SAMPSON
DEPTH TO WATER - INITIAL ▽ 2 7' **AFTER 24 HOURS** ▼ 0 2'

PROJECT NUMBER 200601 149
DATE STARTED 4/17/06
DATE COMPLETED 4/17/06
GROUND ELEVATION 4216 8'
LOGGED BY G PEASLEE

Elev (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter Liquid Limit	Atter Plast Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
							5" ASPHALT								
4215				6	44 28 20 (75)	GM	dk brown, wet dense SILTY GRAVEL W/SAND								
							SAND								
	5			19	3,2 3,(8) 0 22	ML (A-4(0))	brown moist loose SILT W/SAND		28 9		NP	0	20	80	
4210				15	Pushed 0 37	ML (A 4(4))	lt brown moist firm SILT	89 2	30 2	29	4	0	1	99	CT UC
	10			18	2,2,2,(6) 0 32 0 56	CL	lt brown wet firm to stiff LEAN CLAY W/SAND LENSES								
4205				17	Pushed 0 16	CL (A 6(15))	brown moist soft	96 8	29 8	34	15	0	2	98	UC
							LEAN CLAY								
	15			8	1,1,0,(1)	CL	gray-browm, wet, very soft								
4200				18	2 2 2,(5) 0 03	CH	dk gray to black wet very soft								
	20						FAT CLAY								
4195				19	2,1,2,(4) 0 04	CH	dk gray wet very soft								
	25			18	Pushed 0 05	CL	gray brown, wet, very soft LEAN CLAY								
4190															

DH_LOGV1 C_655_LOG GPJ US EVAL GDT 10/5/06

RB&G ENGINEERING INC.
PROVO UTAH

LEGEND

DISTURBED SAMPLE: 2 3 2 (6) ← Blow Count per 6; (N1)60 Value
0 45 ← Torvane (tsf)

UNDISTURBED SAMPLE: PUSHED
0 45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Tnaxial Shear

DRILL HOLE LOG

BORING NO. RSB-C-656

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - STRUCTURE E2E-1324 (CITY 1)
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: N 349,652, E 50,112
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING WITH TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 7.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.149
DATE STARTED: 6/2/06
DATE COMPLETED: 6/2/06
GROUND ELEVATION: 4213.5'
LOGGED BY: B. HORROCKS

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				10	14,38,38,(+99)	GM	brown, dry, dense — SILTY GRAVEL W/SAND								
4210				10	3,3,4,(11) *0.29*	CL	lt. brown, moist, firm — SANDY LEAN CLAY								
	5						LEAN CLAY								
				16	0/13",2,(3) *0.15*	CL	lt. brown, wet, soft								
					0.11	CL	gray-brown, wet, soft								
4205							SANDY LEAN CLAY								
	10			18	Pushed	CL (*A-6(9)*)	gray-brown		31.8	35	12	0	21	79	UC
				18	3,4,6,(13)	SM	gray, wet, loose — SILTY SAND								
				11	3,4,2,(8)	SM									
4200						ML	SANDY SILT								
	15			9	2,7,7,(16)	ML	gray								
4195				14	Pushed *0.24*	CH (*A-7-5(36)*)	gray-brown to black, wet, firm — FAT CLAY		51.7	59	31	0	2	98	
	20			16	2,3,3,(6) *0.21*	CH CL-ML	gray, wet, stiff — SILTY CLAY								
4190							SILTY SAND								
	25			16	6,3,5,(8)	SM CL SM	LEAN CLAY; gray, wet, loose — SILTY SAND								
4185															

DH_LOGV1 C_656_LOG.GPJ US EVAL.GDT 8/3/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(16) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear
CBR = California Bearing Ratio

DRILL HOLE LOG

BORING NO. RSB-C-657

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - CULVERT E-2559 (A1/A2)
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: N 373,052, E 53,534
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 7.9' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.149
DATE STARTED: 5/23/06
DATE COMPLETED: 5/23/06
GROUND ELEVATION: 4216.0'
LOGGED BY: D. WINTERTON

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4215															
				3	5,4,3,(11)	CL	dk. brown, slightly moist, stiff SANDY LEAN CLAY W/ORGANICS								
						CL									
				17	Pushed 0.65	CL (A-6(14))	lt. brown, moist, stiff	103.1	23.6	34	15	0	5	95	UC
	5														
4210															
				17	4,5,6,(17) 0.35	CL	wet, firm								
							LEAN CLAY								
				0	Pushed	CL									
	10														
4205				11	Pushed 0.38	CL (A-6(19))	gray, firm	90.9	29.1	36	20	0	3	97	UC
				14	2,2,2,(5) 0.35	CL	firm								
	15														
4200				18	Pushed 0.15	CL-ML (A-4(3))	gray, wet, soft SILTY CLAY		26.1	24	5	0	9	91	
							LEAN CLAY								
	20														
4195				18	2,2,3,(5) 0.46	CL	gray, firm								

DH_LOGV1 C_657_LOG.GPJ US EVAL.GDT 8/3/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:

DISTURBED SAMPLE: 2,3,2,(16) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE: PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear
CBR = California Bearing Ratio

Table 1

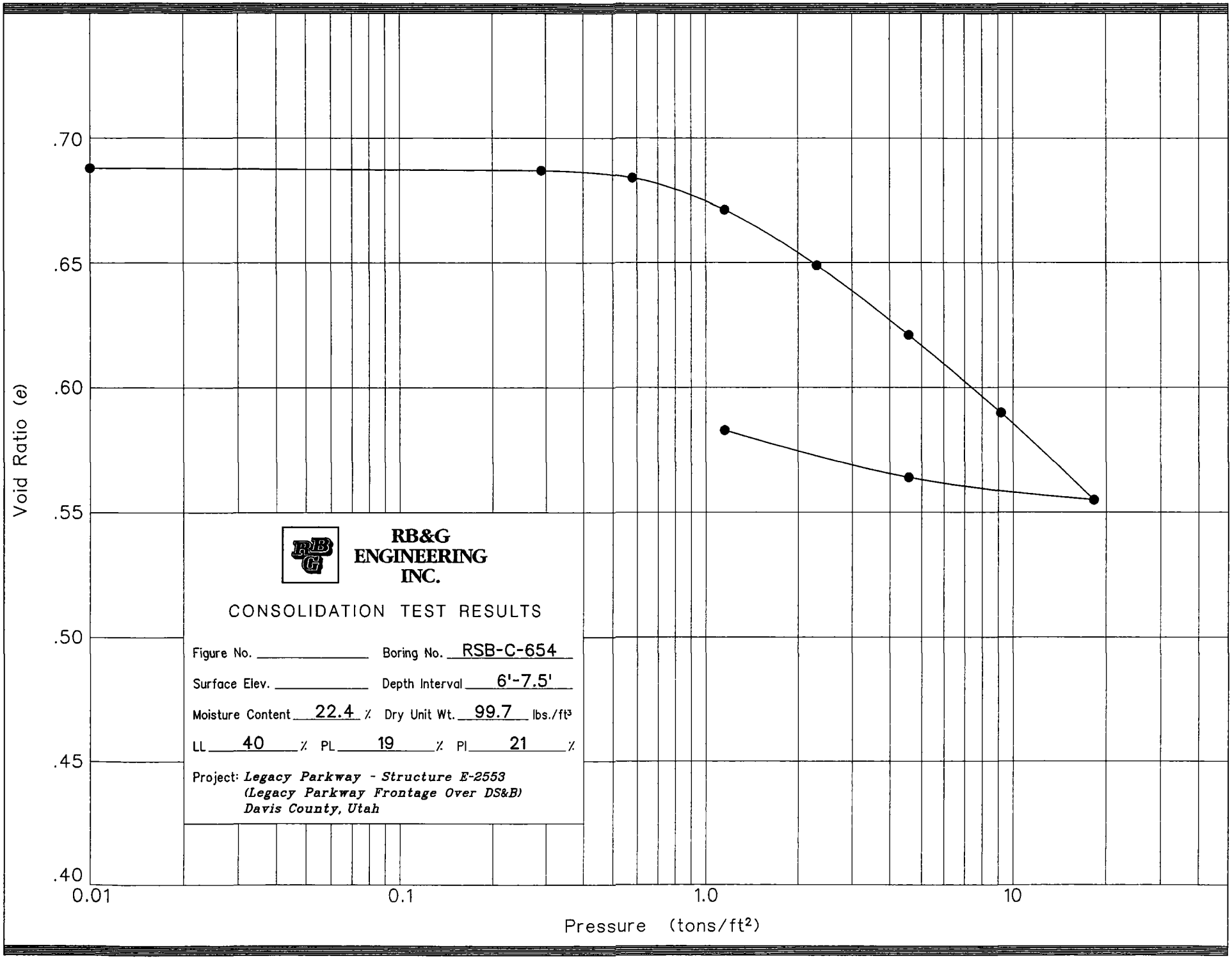
SUMMARY OF TEST DATA

PROJECT Legacy Parkway – Box Culverts
LOCATION Various – Salt Lake and Davis Counties, Utah

PROJECT NO. 200601-149
FEATURE Foundations

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	STANDARD PENETRATION BLOWS PER FOOT	IN-PLACE		UNCONFINED COMPRESSIVE STRENGTH (psf)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO Classification)
			DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
RSB-C-654	3-4.5	11				34	15	19	0	5	95	CL / A-6(17)
	6-7.5		99.7	22.4	2539	40	19	21	0	6	94	CL / A-6(21)
	12-13.5		102.2	24.8	2088	42	19	23	0	0	100	CL / A-7-5(25)
	21-22.5	4		51.7		51	22	29	0	7	93	CH / A-7-5(30)
RSB-C-655	3-4.5	5		28.9				NP	0	20	80	ML / A-4(0)
	6.5-8		89.2	30.2	995	29	25	4	0	1	99	ML / A-4(4)
	12-13.5		96.8	29.8	2046	34	19	15	0	2	98	CL / A-6(15)
RSB-C-656	9-10.5			31.8	1314	35	23	12	0	21	79	CL / A-6(9)
	18-19.5			51.7		59	28	31	0	2	98	CH / A-7-5(36)
RSB-C-657	3-4.5		103.1	23.6	1655	34	19	15	0	5	95	CL / A-6(14)
	10.5-12		90.9	29.1	1548	36	16	20	0	3	97	CL / A-6(14)
	15-16.5			26.1		24	19	5	0	9	91	CL-ML (A-4(3)

NP=Nonplastic



RB&G ENGINEERING INC.

CONSOLIDATION TEST RESULTS

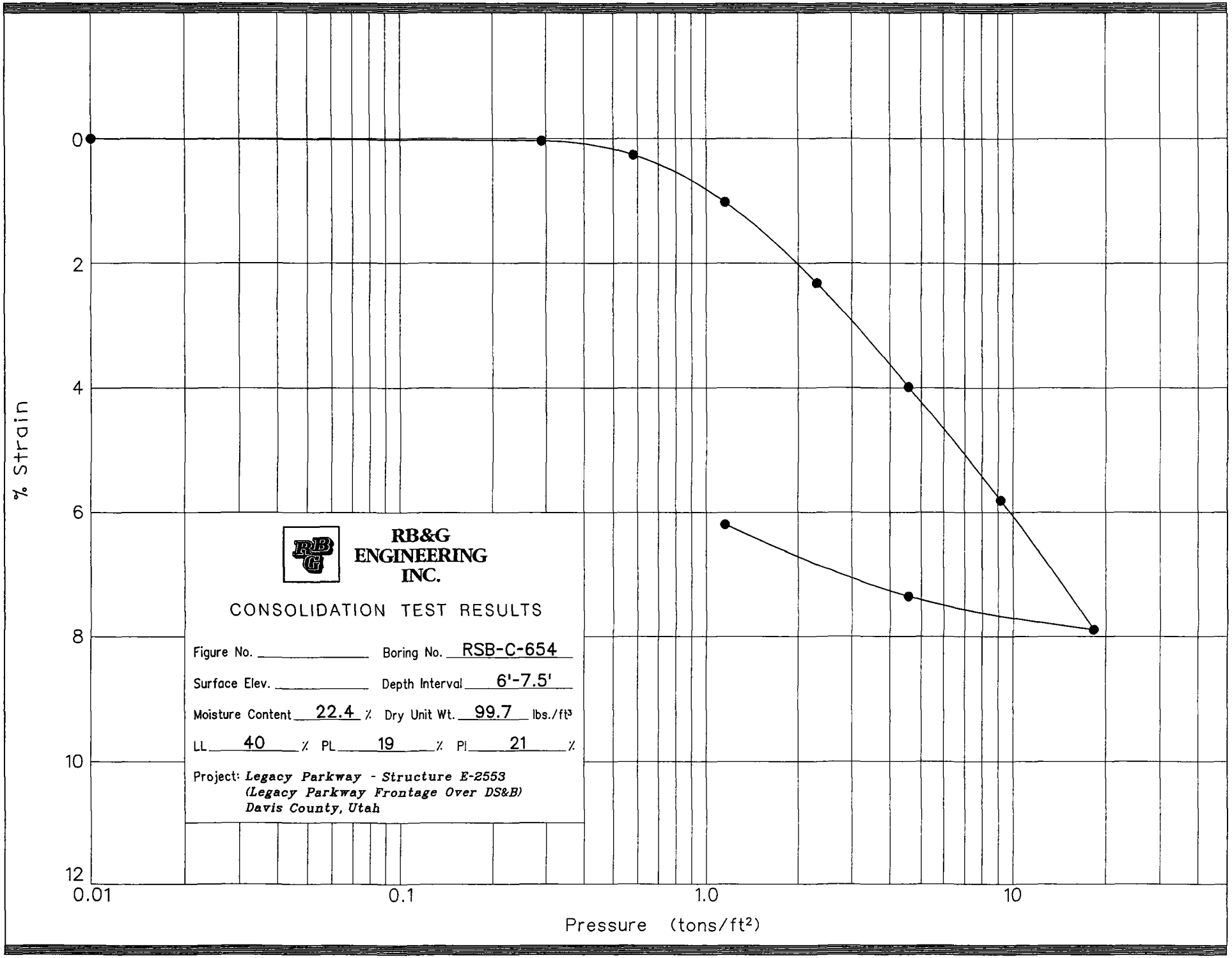
Figure No. _____ Boring No. RSB-C-654

Surface Elev. _____ Depth Interval 6'-7.5'

Moisture Content 22.4 % Dry Unit Wt. 99.7 lbs./ft³

LL 40 % PL 19 % PI 21 %

Project: *Legacy Parkway - Structure E-2553*
(Legacy Parkway Frontage Over DS&B)
Davis County, Utah



RB&G ENGINEERING INC.

CONSOLIDATION TEST RESULTS

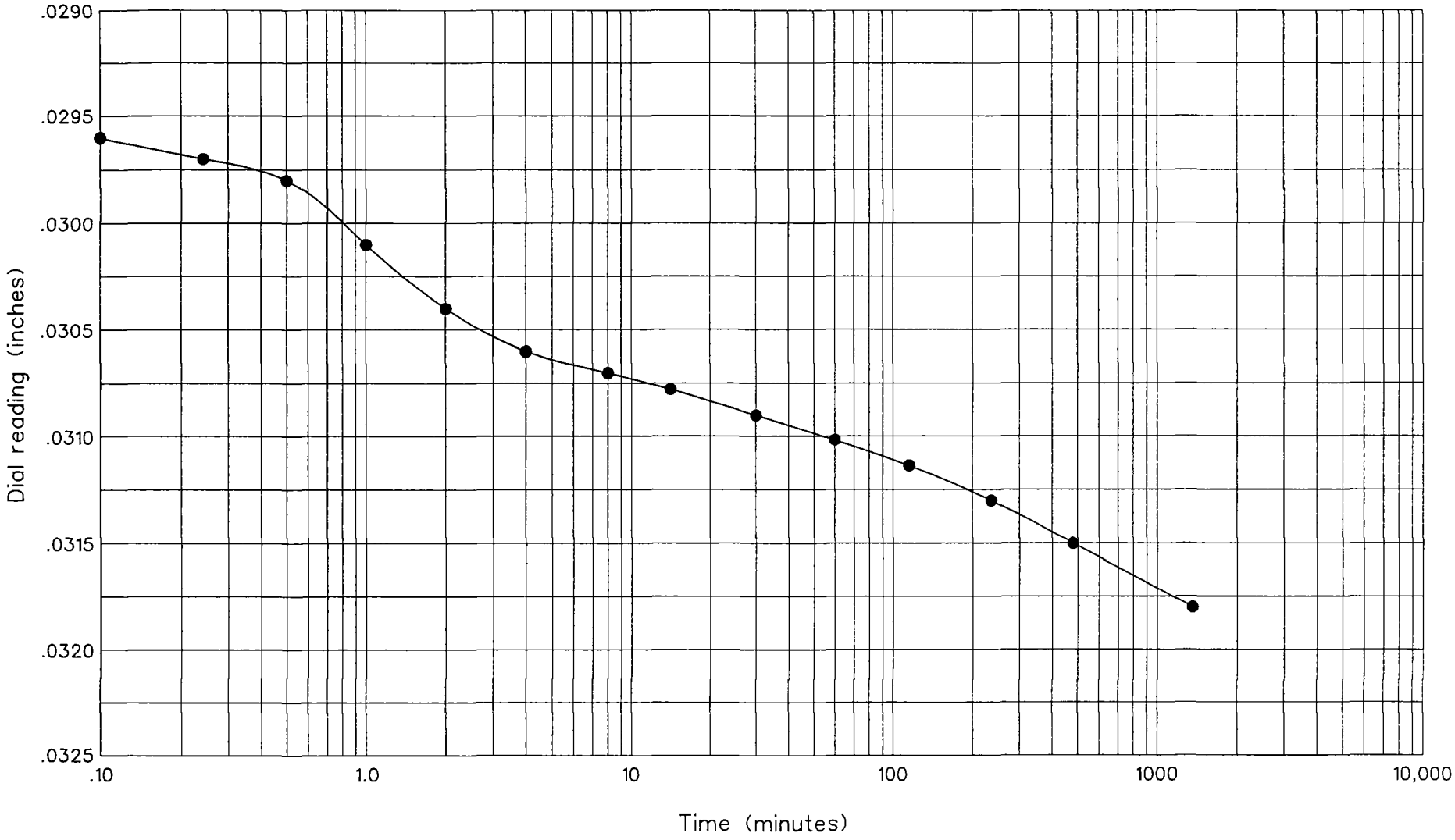
Figure No. _____ Boring No. RSB-C-654

Surface Elev. _____ Depth Interval 6'-7.5'

Moisture Content 22.4 % Dry Unit Wt. 99.7 lbs./ft³

LL 40 % PL 19 % PI 21 %

Project: *Legacy Parkway - Structure E-2553*
(Legacy Parkway Frontage Over DS&B)
Davis County, Utah



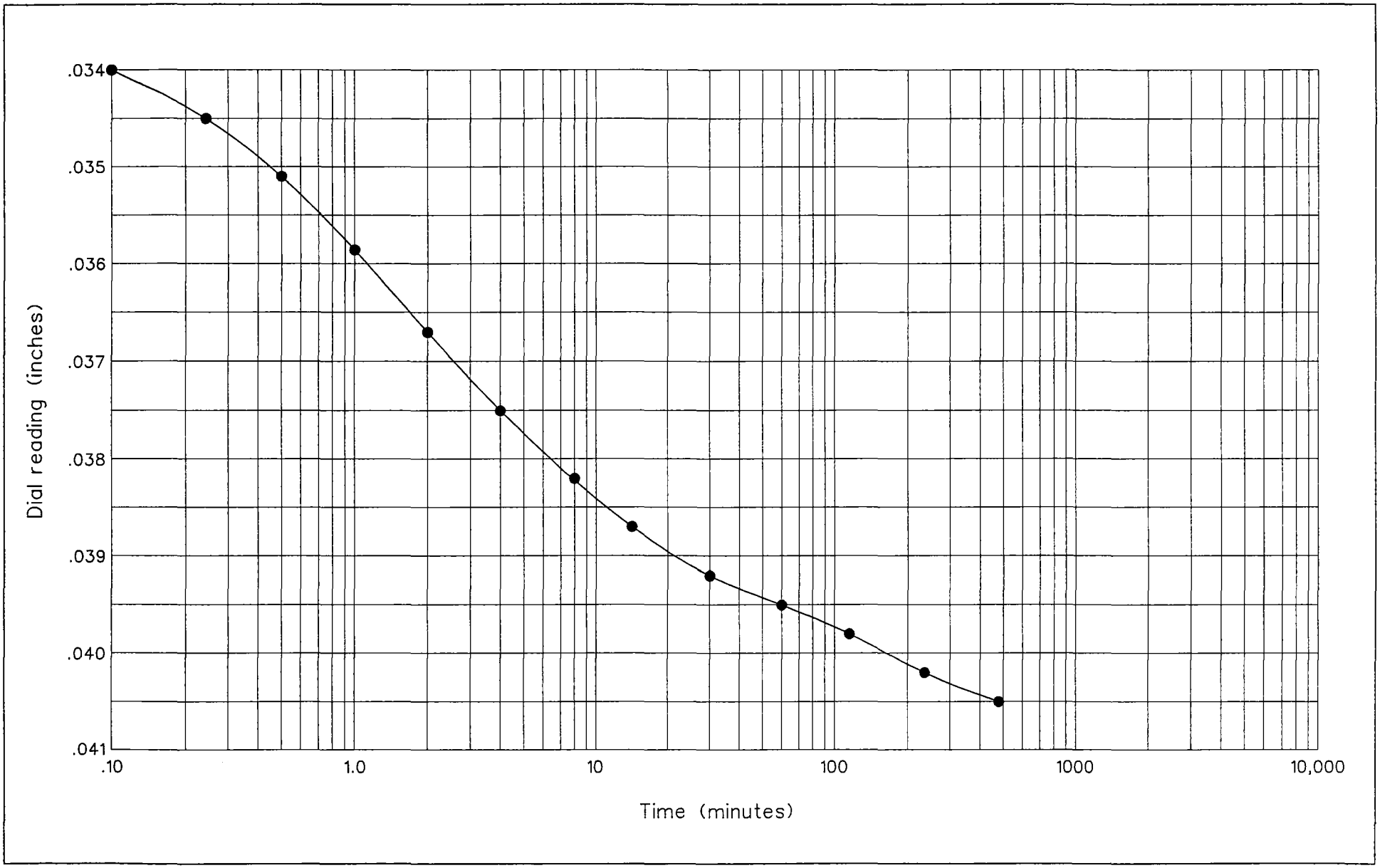
RB&G ENGINEERING INC.
Provo, Utah

Hole no.: RSB-C-654
Depth: 6'-7.5'
Load: 0.58 to 1.15 tons

TIME CONSOLIDATION

Legacy Parkway - Structure E-2553
(Legacy Parkway Frontage Over DS&B)
Davis County, Utah

Figure



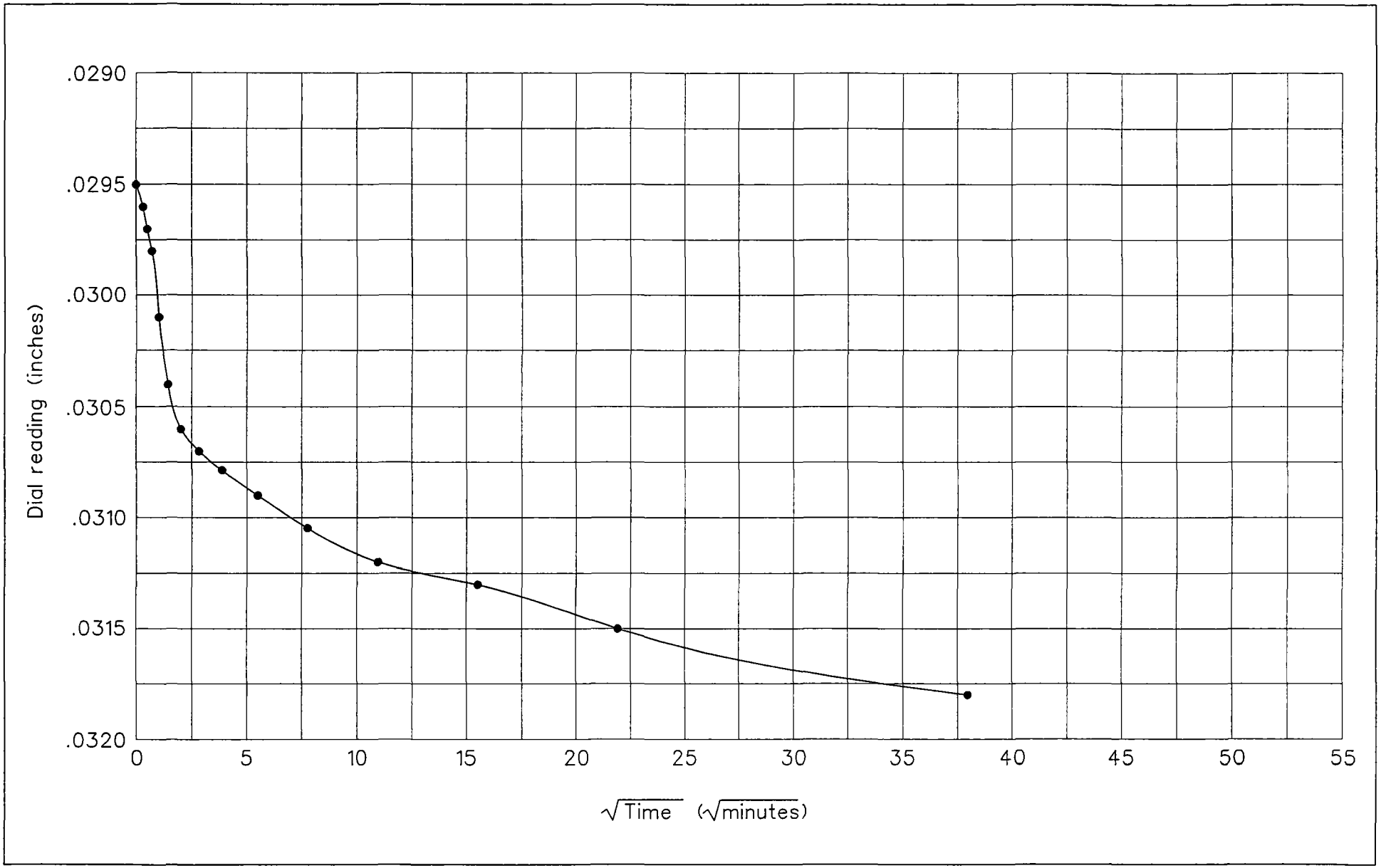
RB&G ENGINEERING INC.
Provo. Utah

Hole no.: RSB-C-654
Depth: 6'-7.5'
Load: 1.15 to 2.30 tons

TIME CONSOLIDATION

Legacy Parkway - Structure E-2553
(Legacy Parkway Frontage Over DS&B)
Davis County, Utah

Figure



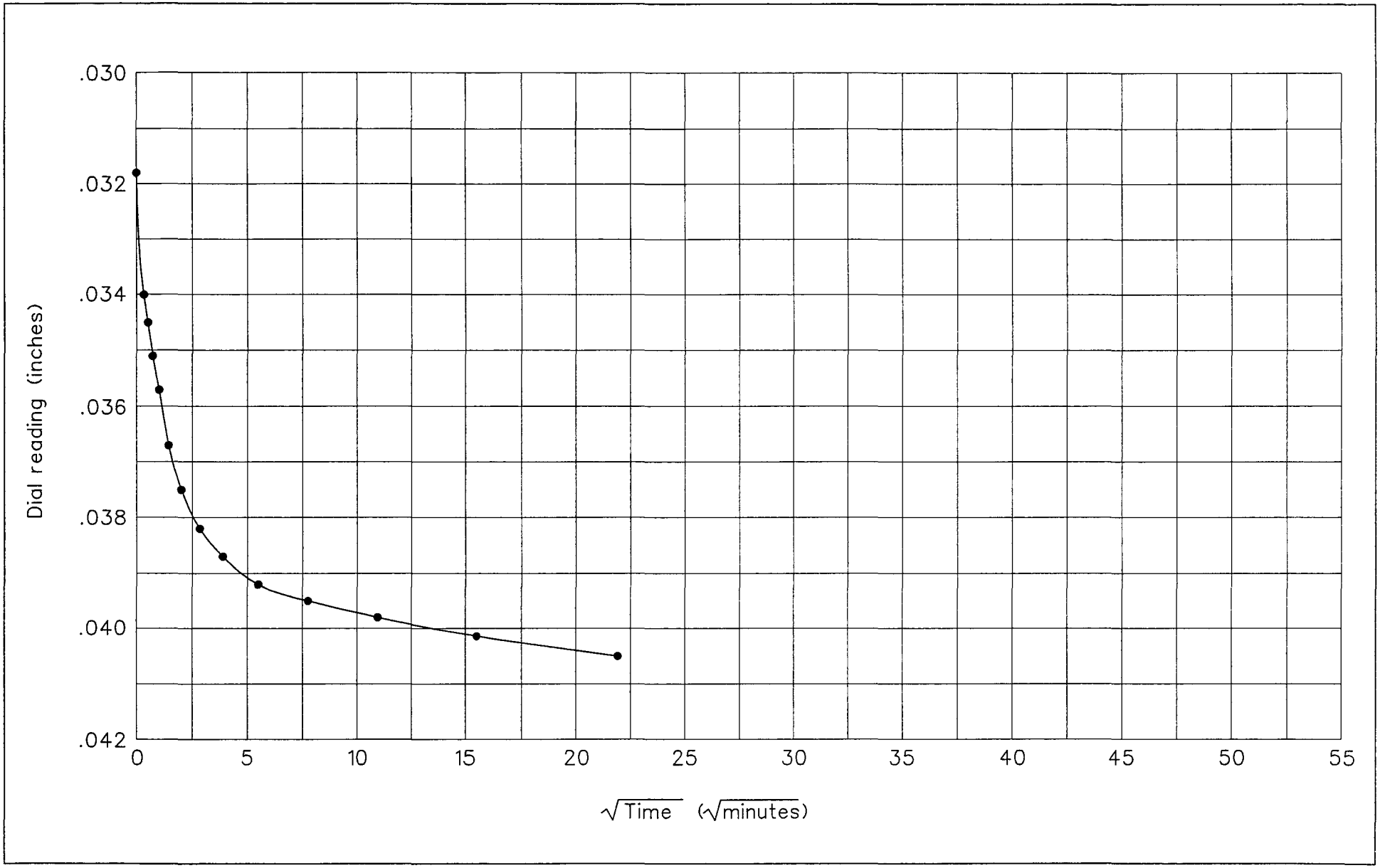
RB&G ENGINEERING INC.
Provo, Utah

Hole no.: RSB-C-654
Depth: 6'-7.5'
Load: 0.58 to 1.15 tons

TIME CONSOLIDATION

Legacy Parkway - Structure E-2553
(Legacy Parkway Frontage Over DS&B)
Davis County, Utah

Figure



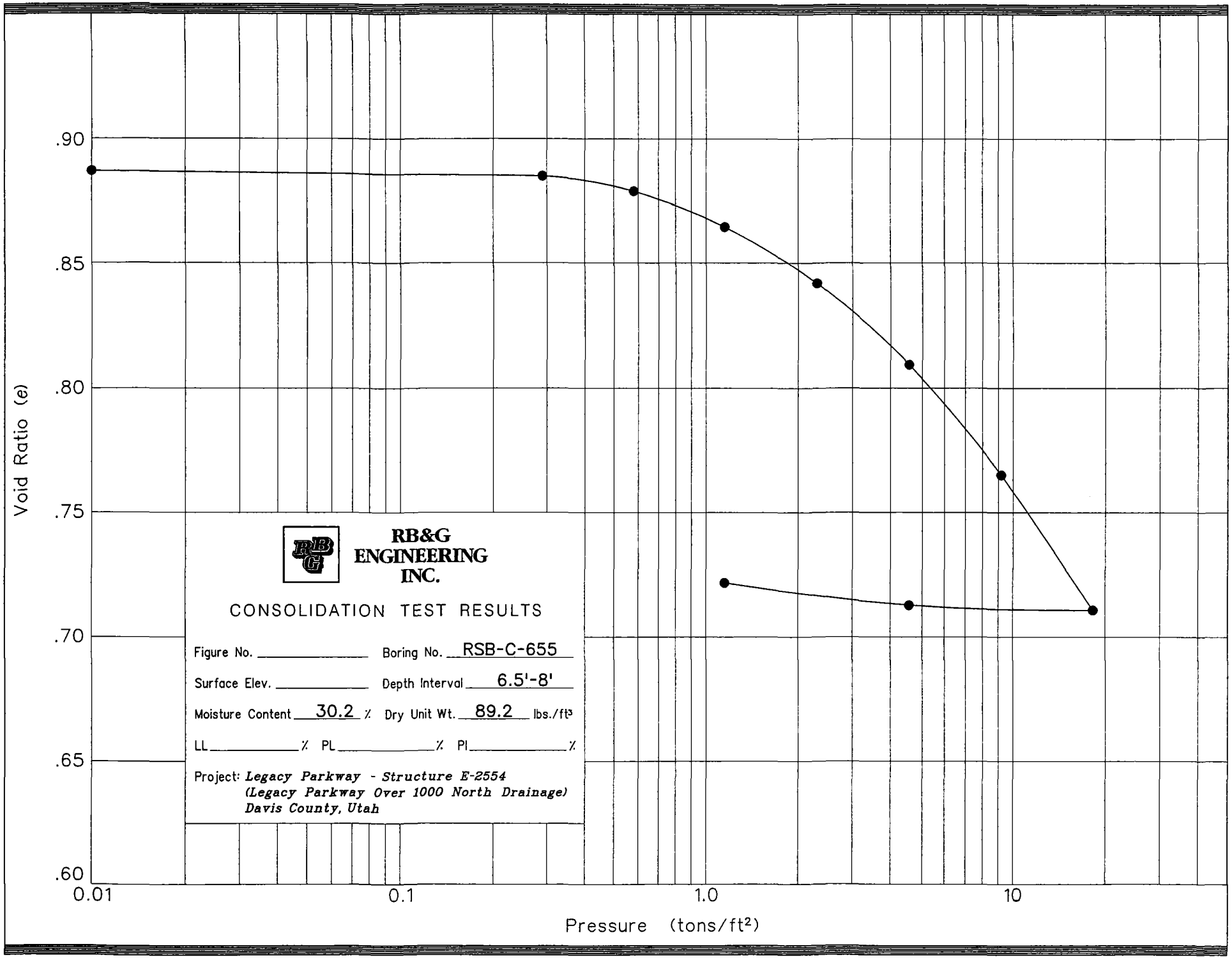
RB&G ENGINEERING INC.
Provo, Utah

Hole no.: RSB-C-654
Depth: 6'-7.5'
Load: 1.15 to 2.30 tons

TIME CONSOLIDATION

Legacy Parkway - Structure E-2553
(Legacy Parkway Frontage Over DS&B)
Davis County, Utah

Figure



RB&G ENGINEERING INC.

CONSOLIDATION TEST RESULTS

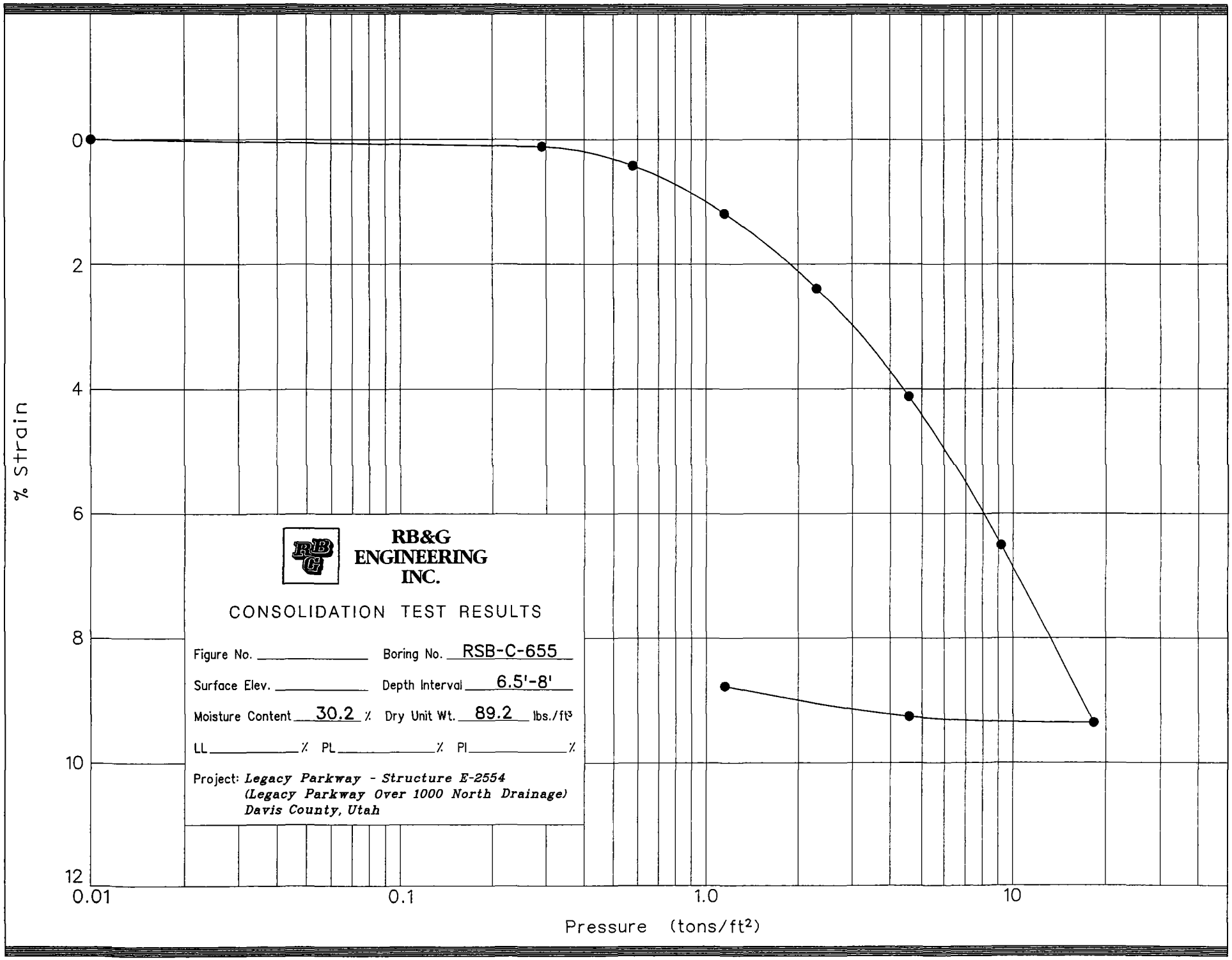
Figure No. _____ Boring No. RSB-C-655

Surface Elev. _____ Depth Interval 6.5'-8'

Moisture Content 30.2 % Dry Unit Wt. 89.2 lbs./ft³

LL _____ % PL _____ % PI _____ %

Project: *Legacy Parkway - Structure E-2554*
(Legacy Parkway Over 1000 North Drainage)
Davis County, Utah



RB&G ENGINEERING INC.

CONSOLIDATION TEST RESULTS

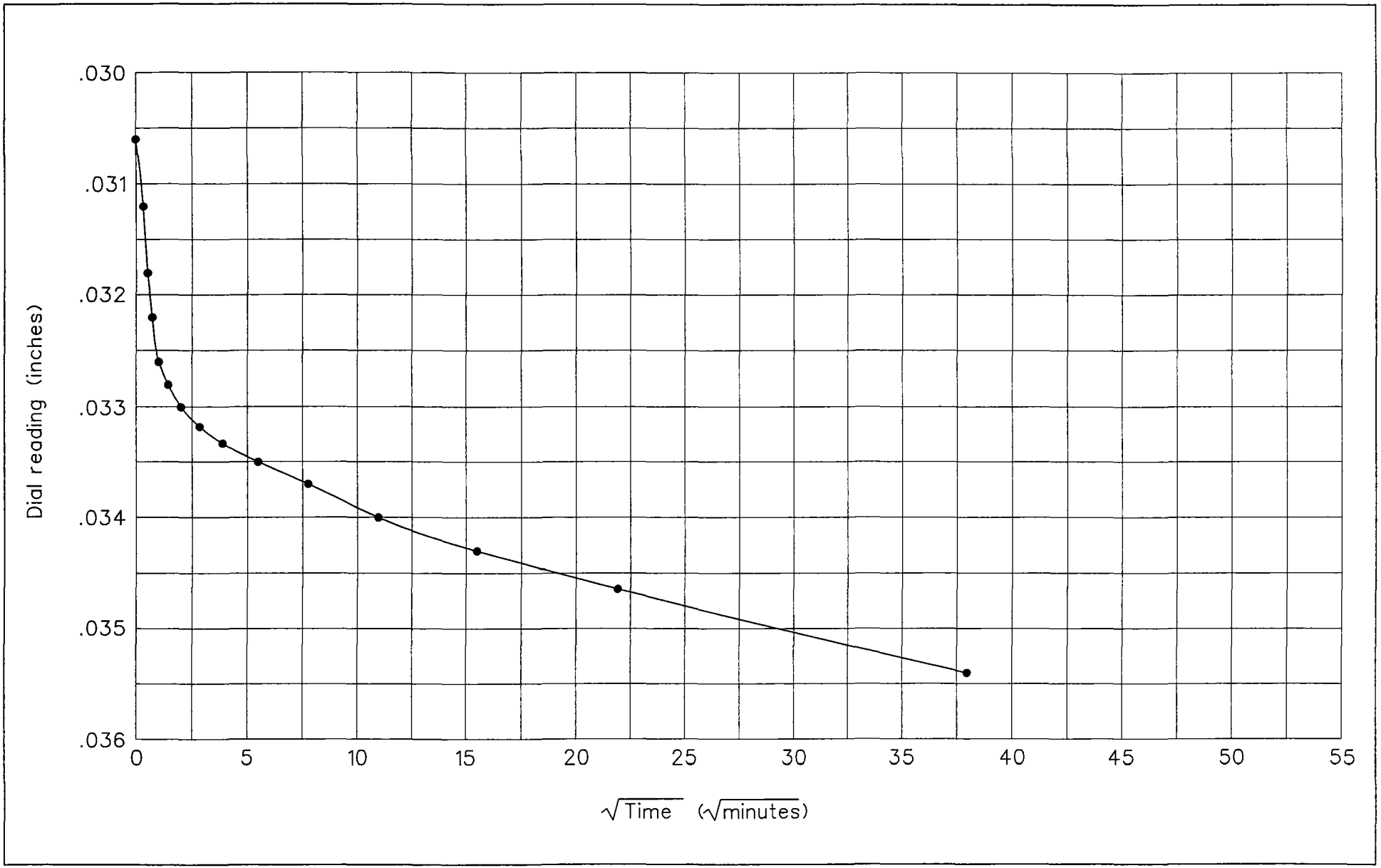
Figure No. _____ Boring No. RSB-C-655

Surface Elev. _____ Depth Interval 6.5'-8'

Moisture Content 30.2 % Dry Unit Wt. 89.2 lbs./ft³

LL _____ % PL _____ % PI _____ %

Project: *Legacy Parkway - Structure E-2554*
(Legacy Parkway Over 1000 North Drainage)
Davis County, Utah



RB&G ENGINEERING INC.
Provo, Utah

Hole no.: RSB-C-655
Depth: 6.5'-8'
Load: 0.58 to 1.15 tons

TIME CONSOLIDATION

Legacy Parkway - Structure E-2554
(Legacy Parkway Over 1000 North Drainage)
Davis County, Utah

Figure

Legacy Parkway Project

Summary of Lateral Earth Pressure Recommendations

Recommended Soil Parameters

Fill Description	Total Unit Weight (pcf)	Internal Friction Angle (degrees)	Cohesion (psf)	Comments
Sandy Gravel	150	38	0	Recommend 150 pcf and 38 degrees for loads, and 125 pcf and 34 degrees for resistance.*
Silty Sand	125	34	0	
Pumice	85	38	0	Recommend 85 pcf for loads and 80 pcf for resistance.*

*Recommendations per Memo dated April 18, 2006

In the equations listed herein:
γ = effective unit weight of soil
H = height of wall

(1) Active Lateral Earth Force (yielding walls)

$P_A = 0.5K_A\gamma H^2$ (triangular distribution)

$K_A = 0.24$ for Sandy Gravel and Pumice

0.28 for Silty Sand

(2) Passive Lateral Earth Force (yielding walls)

$P_P = 0.5K_P\gamma H^2$ *(triangular distribution)*

$K_P = 4.2$ for Sandy Gravel and Pumice

3.5 for Silty Sand

(3) At-Rest Lateral Earth Force (non-yielding walls)

$P_O = 0.5K_O\gamma H^2$ (triangular distribution)

$K_O = 0.38$ for Sandy Gravel and Pumice

0.44 for Silty Sand

(4) At-Rest Lateral Earth Force Modified for Compaction (non-yielding walls)

Use if activity of mechanical compaction equipment is anticipated within a distance equal to half the wall height.

General Equations for walls less than about 8 feet high

$P_O^* = 0.5K_O\gamma H^2$ (triangular distribution)

$K_O^* = 2.8$ for Sandy Gravel and Pumice

Walls greater than 8 feet high should be considered on a case-by-case basis.
Pressures listed above may be reduced by limiting size of compaction equipment permitted within a distance equal to half the wall height.

(5) Seismic Lateral Earth Forces (yielding walls)

Probabilistic Peak Ground Accelerations

General Bridge Site Location	10% PE in 50 Years	2% PE in 50 Years
From Mill Creek North	0.22g - 0.26g	0.60g - 0.63g
South of Mill Creek	0.26g - 0.30g	0.65g - 0.73g

Equations by Okabe (1926) and Mononobe and Matsuo (1929), referenced in Kramer (1996)

Total Active Thrust

$P_{AE} = 0.5K_{AE}\gamma H^2$

K_{AE} = (see table below)

Dynamic Component

$\Delta P_{AE} = P_{AE} - P_A$

P_A has triangular distribution (resultant at H/3 above base of wall)

ΔP_{AE} acts at about 0.6H above base of wall (same direction as P_A)

(5) Seismic Lateral Earth Forces (continued from previous page)

Total Passive Thrust

$P_{PE} = 0.5K_{PE}\gamma H^2$

K_{PE} = (see table below)

Dynamic Component

$\Delta P_{PE} = P_P - P_{PE}$ P_P has triangular distribution (resultant at H/3 above base of wall)

ΔP_{PE} acts at about 0.6H above base of wall (opposite P_P)

Dynamic Earth Pressure Coefficients (for minimal wall displacement)*

Case	Friction Angle	Peak Ground Acceleration			
		0.25	0.30	0.63	0.73
Active (K_{AE})	38	0.35	0.38	0.65	0.77
	34	0.41	0.44	0.75	0.92
Passive (K_{PE})	38	3.77	3.68	3.01	2.76
	34	3.14	3.05	2.39	2.11

* Assumes k_h = 0.8PGHA. See memo dated April 18, 2006

*Dynamic Earth Pressure Coefficients (for wall displacement up to 10A inches**)*

Case	Friction Angle	Peak Ground Acceleration			
		0.25	0.30	0.63	0.73
Active (K_{AE})	38	0.31	0.32	0.44	0.49
	34	0.36	0.37	0.51	0.56
Passive (K_{PE})	38	3.94	3.89	3.51	3.38
	34	3.29	3.24	2.89	2.77

** Assumes k_h = 0.5PGHA. See memo dated April 18, 2006

(6) Seismic Lateral Earth Pressures (non-yielding walls)

Equations by Wood (1973), referenced in Kramer (1996)

Dynamic Thrust

$$\Delta P_{eq} = a_h \gamma H^2$$

a_h= Peak Ground Acceleration Coefficient (PGA/g)

Dynamic Overturning Moment

$$\Delta M_{eq} = 0.53 a_h \gamma H^3$$

Point of Application of Dynamic Thrust

$$h_{eq} = \Delta M_{eq} / \Delta P_{eq} \approx 0.53H$$

References

Kramer, S. (1996). "Geotechnical earthquake engineering," Prentice Hall, Upper Saddle River, NJ.

Mononobe, N. and Matsuo, H. (1929). "On the determination of earth pressures during earthquakes," *Proceedings, World Engineering Congress,* 9 p.

Okabe, S. (1926). "General theory of earth pressures," *Journal of the Japan Society of Civil Engineering* , Vol. 12, No. 1.

RB&G Engineering, Inc.

Memo

To: Sohail T. Khan, P.E; Larry Reasch, P.E.
From: Brad Price / Rob Johnson
CC: Steven K. Doerrer, PE; Brian Byrne, PE
Date: April 18, 2006
Re: Response to Design Criteria Questions

Responses to the questions submitted by Steven Doerrer are listed below. The email listing the questions is also attached for reference:

1) As discussed on last week's conference call (4/26/06), recommended total unit weights for fill material are as follows:

   - Regular-Weight Fill – 150 pcf for load calculations, 125 pcf for resistance calculations
   - Lightweight Fill (Pumice) – 85 pcf for load calculations, 80 pcf for resistance calculations

   It has been noted that the unit weight of regular-weight fill varies widely depending upon the source. However, it is our understanding that it is not desirable to limit the potential regular-weight borrow sources by specifying a permissible range of fill unit weight. In the interest of conservatism, we recommend using the larger unit weight to calculate soil loads, and the smaller unit weight to calculate soil resistance. The following values are recommended for fill friction angle:

   - Regular-Weight Fill – 38 degrees for load calculations, 34 degrees for resistance
   - Lightweight Fill (Pumice) – 38 degrees for load and resistance calculations

2) The Mononobe-Okabe equations are in accordance with AASHTO LRFD A11.1.1.1 and do not include inertia forces. Page 11-85 of the AASHTO LRFD states that it is not conservative to neglect inertia forces of the abutment mass. We believe it is appropriate to add seismic inertia forces of the heel backfill and concrete abutments.

3) The dynamic earth pressure coefficients provided previously, K_{AE} and K_{PE}, are for total active and passive thrust, respectively, and include both static and dynamic components. The dynamic components are ΔK_{AE} and ΔK_{PE} and are computed by subtracting the static force from the total thrust as shown on the memo. It should be noted that the equations by Wood (1973) for non-yielding walls provide only the dynamic thrust components of force and moment, and do not include static components.

4) In the memo dated 04/17/06, the horizontal acceleration coefficient k_h was assumed to be 80% of the peak horizontal ground acceleration coefficient for calculation of the Mononobe-

Okabe coefficients K_{AE} and K_{PE}. AASHTO LRFD A11.1.1.2 states that a k_h value equal to ½ the PHGA is adequate for most design purposes, provided that allowance is made for an outward displacement of the abutment of up to 10A inches (see page 11-88), where A is the maximum acceleration coefficient (PHGA). Mononobe-Okabe coefficients *for the 50% reduction* are summarized below, and may be used if allowance is made for the corresponding displacement.

Case	Friction Angle	Peak Ground Acceleration Coefficient			
		0.25	**0.30**	**0.63**	**0.73**
Active (K_{AE})	**38**	0.31	0.32	0.44	0.49
	34	0.36	0.37	0.51	0.56
Passive (K_{PE})	**38**	3.94	3.89	3.51	3.38
	34	3.29	3.24	2.89	2.77

If displacement must be minimized, we recommend that the factors shown in the initial memo (04/17/06) be used.

It should be noted that the Mononobe-Okabe factors provided to date neglect vertical acceleration. Seed and Whitman (1970) concluded that vertical accelerations can be ignored when the Mononobe-Okabe analysis is used to estimate P_{AE} for typical wall design (see Kramer, 1996). It is estimated that positive vertical accelerations, if considered, may increase the Seismic Active Thrust coefficient (K_{AE}) by as much as 30%. If desired, the coefficients on the table above can be refined to consider vertical acceleration once Peak Vertical Ground Accelerations have been determined (see Response No. 7 below).

5) We can evaluate the potential pile capacities at different depths and provide results along with uplift. It is assumed that the request of estimated pile tip elevations for compression resistance of 70, 100, and 120 tons applies only to the Pedestrian Bridge over Legacy Parkway (P-21). At any bridge we can evaluate the potential for providing a specific resistance per pile if we are provided with the desired resistance values (see also Response No. 6 below). The given extreme event capacities assume a resistance factor of 1.0, and are reduced for potential liquefaction.

6) It is possible to consider pile diameters larger than 16", although driven piles with diameters/widths greater than 16" are somewhat rare locally and local pile driving capabilities may be limited. Also, it is our understanding that a consistent pile section is preferred for the project to limit potential errors and confusion (primarily during construction). Is increased axial resistance the only reason for considering larger diameter piles? We would like to know the specific purpose for considering other diameters (such as target resistance values), as it would be inefficient to estimate capacities for an unlimited range of diameters, toe elevations, etc.

7) Kleinfelder is working on site-specific response spectra for 1250 West and State Street. It is our understanding that this data will be used to develop general response spectra (including vertical accelerations) for use at all bridge sites.

8) It was agreed at a previous meeting that the structural firms would perform the LPILE analysis using soil parameters provided by the geotechnical engineer. We recommend that p-

multipliers be used as input in LPILE or GROUP to account for group effects. As noted on the LPILE parameters sheet included with the initial recommendations for each structure, p-multipliers for laterally-loaded pile groups are outlined in AASHTO LRFD 10.7.2.4. The factors listed in the 2006 LRFD interim are in relatively good agreement with full-scale pile group lateral load tests performed at the Salt Lake City International Airport, where shallow soils are reasonably representative of the shallow soils typically encountered at the Legacy bridge sites.

Signs

RB&G Engineering, Inc.

Memo

To: Sohail T. Khan, P.E.
Larry Reasch, P.E.
Brian Byrne, P.E.

From: Rob Johnson

Reviewed by: Brad Price, P.E.

Date: October 6, 2006

Re: Legacy Parkway
Subsurface Data and Geotechnical Recommendations for Sign Foundations

---

Subsurface investigations have been performed for selected sign locations on the Legacy Parkway project. The boring locations were selected based on sign type and the proximity of other available boring logs. One boring was drilled at each of the six VMS sign locations. The other borings were performed at locations with limited available subsurface data, with priority given to the larger overhead and cantilever signs. The locations at which sign borings were performed are summarized on the table below. The borings are listed in order from south to north.

	Roadway	Location	Sign Type	Boring No.	Depth (ft)
Segment 1	LP NB	Sta 2000+50	Conventional Overhead	RSB-S-668	53.0
	LP NB	Sta 2026+90	Conventional Overhead	RSB-S-669	51.5
	LP SB	Sta 3036+75	Conventional Cantilever	RSB-S-672	43.0
	LP SB	Sta 3050+00	Conventional VMS	RSB-S-661	50.0
	LP NB	Sta 2103+00	Grass Blade VMS	RSB-S-663	51.5
	LP SB	Sta 3119+55	Grass Blade Cantilever	RSB-S-674	41.5
	LP SB	Sta 3172+35	Grass Blade Cantilever	RSB-S-675	41.5
	LP SB	Sta 3285+00	Roadside Grass Blade	RSB-S-676	31.5
Seg 2	LP NB	Sta 2350+00	Grass Blade VMS	RSB-S-664	46.5
	LP SB	Sta 3380+00	Grass Blade VMS	RSB-S-665	51.5
	LP NB	Sta 2591+50	Grass Blade VMS	RSB-S-667	62.8
Seg 3	LP NB	Sta 2613+00	Grass Blade Overhead	RSB-S-671	51.5
	LP NB	Sta 2663+00	Conventional Overhead	RSB-S-670	51.5
	LP SB	Sta 3670+00	Conventional VMS	RSB-S-662	51.5
	I-15 SB	Near Shepard Lane	Conventional Overhead	RSB-S-673	41.5

Logs for each boring are attached, along with a summary of test data for all sign borings. Miniature vane shear (torvane) tests were performed in the field on samples of cohesive soils obtained from the borings. The torvane values are noted on the boring logs in units of tons per square foot, and these values can be used as estimates of the undrained shear strength of cohesive soils. Unconfined compession tests were performed on some samples, and the unconfined compressive strengths calculated from these tests are listed on the summary of test data. The undrained shear strength can generally be conservatively estimated as fifty percent of the unconfined compressive strength.

It has been noted that site specific subsurface investigations were not performed for all sign locations. Subsurface information for sign locations can generally be estimated from other nearby investigations. Test holes and laboratory testing completed for bridge and underpass structures, walls, embankments, and roadways can be obtained from the FAK/PB Draft Geotechnical Reports submitted for the Design-Build project, as well as subsequent reports submitted by Kleinfelder and RB&G Engineering for the current Legacy Parkway project.

Foundation Recommendations

It is our understanding that major sign structures on the Legacy Project will be supported using drilled shaft foundations. Based on a review of borings throughout the project, it is anticipated that axial, lateral, and torsion resistance of drilled shafts will be controlled by the cohesive soils encountered in the upper 30 to 50 feet of the soil profile. Lateral loads and torsion loads are expected to be more critical than axial loads.

The lateral resistance of drilled shaft foundations can be estimated using Brom's method or other recognized methods. A variety of methods exist for estimating torsion resistance of drilled shafts, and a reiview of these methods is provided in the publication "Drilled Shaft Design for Sound Barrier Walls, Signs, and Signals", published by the Colorado Department of Transportaion (CDOT-DTD-R-2004-8). For the Legacy Parkway project, it is our opinion that the Florida District 7 method referenced in the CDOT publication is appropriate for calculations of torsion resistance.

A brief review of borings and testing throughout the project was performed to provide an estimate of soil parameters. Based on this review, the following generalized soil parameters may be used for drilled shafts supporting sign structures.

- Total unit weight of soil: 117 pcf
- Effective unit weight of soil below water table: 55 pcf
- Depth to water table: Assume at ground surface in absence of site-specific data
- Coefficient of friction on outside of shaft ($\tan\delta$ for torsion resistance calculations): 0.2
- Adhesion factor, α: 0.55
- Coefficient of Lateral Earth Pressure, K: 1.0
- Minimum undrained shear strength: 550 psf for locations in Segment 1
  750 psf for Segment 2 south of 1000 N Street (Centerville)
  350 psf for locations north of 1000 N Street

The parameters listed above are expected to provide conservative estimates of shear strength. Subgrade parameters may also be estimated on a site-specific basis based on a review of the nearest subsurface exploration data at each location. For estimates of axial and torsional resistance in cohesive soils, the resistance contribution of the upper five feet of soil should be considered negligible.

Some drilled shaft foundations may be installed through a significant thickness of compacted granular fill, in which case the resistance estimates for cohesive soils may be very conservative, and resistance analyses for cohesionless soils or layered soil profiles may result in more efficient foundation designs. Recommended soil parameters for use in LPILE can be provided for specific sites if needed.

Soil Chemical Analyses

Selected samples from the borings were tested to determine the pH, resistivity, and water-soluble sulfate and chloride contents. The results of these chemical tests are summarized below.

BORING NO.	DEPTH BELOW GROUND SURFACE (ft)	pH	RESISTIVITY (ohm-cm)	SULFATE (ppm)	CHLORIDE (ppm)	USCS / AASHTO CLASSIFICATION
RSB-S-661	9-10.5	8.4	1,661	157	529	CL *
	25-26.5	9.1	2,388	495	489	CL *
RSB-S-662	3-4	7.6	4,347	49	49	SM / A-4(1)
RSB-S-663	6-7.5	9.1	6,515	81	248	CL / A-6(17)
RSB-S-665	3-4.5	9.9	2,128	122	190	CL / A-7-6(32)
RSB-S-667	3-4.5	8.5	4,210	264	925	CL-ML *
	25-26.5	8.4	7,478	99	185	CL / A-6(12)
RSB-S-668	6-7.5	8.5	4,210	260	628	SM / A-2-4(0)
RSB-S-669	9-10.5	8.5	2,180	69	764	CL / A-7-6(20)
RSB-S-670	9-10.5	7.8	4,153	16	53	CL / A-6(18)
RSB-S-671	3-4.5	8.0	11,304	32	10	SC-SM / A-2-4(0)
	25-26.5	8.4	4,763	508	34	CL *
RSB-S-672	3-10.5 (combined)	9.1	3,984	58	442	SM *
	30-31.5	9.0	3,192	1,319	801	CL / A-7-6(25)
RSB-S-673	3-4.5	8.9	3,257	66	470	CL-ML / A-4(3)
RSB-S-674	6-7.5	10.1	2,673	1,381	1,758	CL / A-6(20)

* Visual Classification

The following table taken from the Bureau of Reclamation Concrete Manual indicates the amount of sulfate producing adverse effects on concrete in contact with soil containing sulfate.

Relative Degree of Sulfate Attack	Percent Water-Soluble Sulfate (as SO_4) in Soil Samples	mg/l Sulfate (as SO_4) in Water Samples
Negligible	0.00 to 0.10	0 to 150
Positive[1]	0.10 to 0.20	150 to 1,500
Severe[2]	0.20 to 2.00	1,500 to 10,000
Very Severe[3]	2.00 or more	10,000 or more

1 Use type II cement.

2 Use type V cement, or approved combination of portland cement and pozzolan which has been shown by tests to provide comparable sulfate resistance when used in concrete.

3 Use type V cement plus approved pozzolan which has been determined by tests to improve sulfate resistance when used in concrete with type V cement.

The water-soluble sulfate content in some samples was between 0.1 and 0.2 percent, and a positive degree of sulfate attack should be expected at these sites. Type II cement is strongly recommended for concrete in contact with soil at sites where soils have sulfate contents greater than 0.1 percent. In general, Type II cement is preferred for all concrete in contact with soil, due to its superior resistance to deterioration.

Construction Considerations

Care should be taken to remove any loose material from the base of the shaft excavations. Based on subsurface soil and groundwater conditions encountered throughout the project area, it may be necessary to excavate drilled shafts using temporary casing. The casing should be withdrawn during placement of concrete. Concrete should be placed by tremie in a single, relatively continuous pour to prevent cold joints from forming within the shafts.

DRILL HOLE LOG

BORING NO. RSB-S-661

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP SB STA. ~3050+00; N 348684, E 49946
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 11.2' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 6/6/06
DATE COMPLETED: 6/6/06
GROUND ELEVATION: 4222.4'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4220	0														
				5	10,18,28.(72)	CL GM	lt. brown, dry, med. dense — LEAN CLAY								
				6	9,12,8,(31)	GM (A-1-b(0))	brown, moist, loose — SILTY GRAVEL W/SAND		10.8		NP	43	38	19	
4215	5			13	Pushed 0.24	CL (A-6(11))	lt. brown, moist, soft — LEAN CLAY	105.1	22.9	32	12	0	5	95	UC
	10			13	2,2,3,(6) 0.21	CL	soft, 2" clayey sand layer		22.5						
4210				18	Pushed 0.25	ML (A-4(0))	brown, soft to firm — SILT	93.4	29.2	24	1	0	7	93	UC
	15			7	1,1,1,(2) 0.19	CL	brown, wet, soft								
4205							LEAN TO FAT CLAY								
	20			18	Pushed	CL/CH (A-7-5(32))	dk. gray, wet, soft	77.2	43.7	50	28	0	0	100	UC
4200															
	25			14	2,4,3,(6) 0.10	SP-SM	gray, wet, loose — POORLY GRADED SAND W/SILT								
						CL	dk. gray, very soft — LEAN CLAY		26.7						
4195															
	30			13	3,15,13,(24)	SM (A-4(0))	dk. gray, wet, med. dense — SILTY SAND		17.9		NP	0	51	49	
4190															
	35			12	3,3,3,(5) 0.15	CL/SM	gray, wet/moist, soft — LAYERED LEAN CLAY & SILTY SAND 2" thick layers								
4185															
	40			18	Pushed 0.56	CL (A-6(11))	gray, moist, stiff — SANDY LEAN CLAY	106.5	21.3	32	15	0	17	83	UC
4180															
	45			16	4,17,26,(32)	SM	brown-gray, wet, dense — SILTY SAND								
4175															

DH_LOGV1 S_661_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-662

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP SB STA. ~3670+00; N 403459, E 63974
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 9.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 5/26/06
DATE COMPLETED: 5/26/06
GROUND ELEVATION: 4256.1'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4255			10	8,9,9,(28)	SM	brown, moist, med. dense	SILTY SAND W/GRAVEL								
			12	Pushed	SM (A-4(1))	brown, moist, firm			13.4	36	10	16	45	39	
	5														
4250			11	6,4,4,(12)	CL	dk. brown, moist, firm	SANDY LEAN CLAY								
			11	0.27 Pushed	CL (A-6(8))	brown, moist, firm		98.8	24.4	34	14	0	30	70	UC
	10					brown, wet, loose	SILTY SAND		12.8		NP	2	75	23	
4245			16	2,2,2,(5)	SM (A-1-b(0))	brown, very moist, soft									
			16	Pushed 0.35	CL	brown, moist, firm		98.5	23.5	32	13	1	10	89	UC
	15				CL (A-6(13))										
4240			18	2,2,4,(7) 0.41	CL	brown, moist, firm	LEAN CLAY W/SILTY SAND LENSES & LAYERS UP TO 1" THICK								
	20		15	Pushed 0.61	CL (A-6(17))	gray-brown, moist, stiff			24.6	35	17	0	3	97	
4235															
	25		11	4,2,1,(3) 0.15	CL	brown, moist, soft									
4230															
	30		18	Pushed 0.46	CL (A-6(20))	brown, moist, firm	LEAN CLAY W/SILTY SAND LENSES & LAYERS UP TO 5" THICK	94.6	27.4	40	21	0	7	93	UC
4225			18	2,1,2,(3) 0.43	CL	brown, moist, firm									
	35		13	4,3,1,(3) 0.26	CL	brown, moist, firm									
4220															
	40		15	Pushed 0.40	CL (A-6(22))	gray, moist, firm	LEAN CLAY		30.6	40	22	0	4	96	
4215															
	45		18	0/18",(0) 0.23	ML	black, wet, soft/very loose	SANDY SILT slightly plastic								
4210															
	50		18	Pushed 0.42	CL	gray, moist, firm	LEAN CLAY								
4205															

DH_LOGV1 S_662_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-663

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP NB STA. ~2103+00; N 353462, E 51643
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 7.2' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 5/22/06
DATE COMPLETED: 5/23/06
GROUND ELEVATION: 4219.6'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				4	5,6,6,(19)	CL	brown, dry, stiff — LEAN CLAY								
				10	9,6,5,(17) 0.40	GM SM CL	brown — SILTY GRAVEL W/SAND; brown, med. dense — SILTY SAND; firm								
4215	5			10	Pushed 0.31	CL (A-6(17))	lt. green-brown, moist, firm — LEAN CLAY	93.2	29.6	35	17	0	3	97	UC
4210	10			18	Pushed	CL SM	brown, wet — SILTY SAND								
				16	1,1,1,(3) 0.15	CL	lt. brown, wet, soft								
				18	2,1,1,(2) 0.07	CL	very soft — LEAN CLAY								
4205	15			15	Pushed 0.35	CL (A-6(20))	firm	84.8	28.6	39	20	0	3	97	UC
				17	4,2,2,(5) 0.10	CL SM	very soft								
				8	7,2,2,(4) 0.09	SM (A-2-4(0))	dk. gray, wet, loose — SILTY SAND		21.6		NP	0	78	22	
4200	20			12	4,4,7,(11) 0.06	ML,CL ML,CL CH	soft to very soft — ALTERNATING LAYERS OF SANDY SILT & SOFT CLAY 0.5' TO 1.5' THICK								
4195	25			16	Pushed	CH (A-7-5(33))	gray, wet, soft — FAT CLAY	74.1	50	51	31	0	4	96	UC
				18	4,3,2,(5) 0.15	ML CL	gray, wet, soft — SILT; gray, wet, soft								
4190	30			18	2,1,3,(4) 0.18	CL	gray, wet, soft								
4185	35			18	Pushed 0.42	CL (A-6(20))	gray, wet, firm		34.3	40	19	0	4	96	
4180	40			18	1,2,2,(3) 0.41	CL	gray, wet, firm — LEAN CLAY								
4175	45			18	Pushed 0.35	CL (A-6(15))	gray, wet, firm		33.6	34	15	0	0	100	
4170	50			18	1,1,2,(2) 0.20	CL	gray, wet, soft								
4165															

DH_LOGV1 S_663_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6"; (N1)60 Value; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-664

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP NB STA. ~2350+00; N 375793, E 56049
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 7/28/06
DATE COMPLETED: 7/28/06
GROUND ELEVATION: 4213.2'
LOGGED BY: D. WINTERTON

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				8	2,2,2,(6)	CL	brown to gray, moist, soft								
4210				12	Pushed 0.99+	CL (A-7-6(28))	LEAN CLAY gray-brown, moist, very stiff	101.6	25.6	46	30	1	9	90	UC
	5			13	7,9,12,(33) 0.99+	CL	brown, moist, very stiff								
4205															
	10			15	Pushed 0.89	CL (A-7-6(23))	brown, moist, stiff	98.2	28.6	42	22	0	2	98	UC
				18	3,3,5,(11) 0.99+	CL	brown, moist, very stiff								
4200	15			16	Pushed 0.88	CL (A-7-6(26))	brown to gray, moist, stiff	96.2	29.7	45	26	0	7	93	UC
4195															
	20			18	2,2,3,(6) 0.64	CL	gray, moist, stiff LEAN CLAY W/SILT LENSES 0.25" TO 3" APART								
4190															
	25			16	Pushed 0.52	CL (A-7-6(30))	gray, moist, firm to stiff	88.7	34.4	49	29	0	6	94	UC
4185															
	30			18	0,2,2,(4) 0.65	CL	gray, moist, stiff								
4180															
	35			15	Pushed 0.40	CL (A-7-6(30))	gray, moist, firm		33.1	47	28	0	2	98	
4175															
	40			13	8,9,7,(13) 0.64	CL	LEAN CLAY W/SILTY SAND LAYERS TO 2.5" THICK gray, moist, stiff								
4170															
	45			11	Pushed 0.99+	CL (A-7-6(30))	SANDY LEAN CLAY dk. gray, moist, very stiff		21.7	44	28	0	19	81	
4165															

DH_LOGV1 S_664_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-665

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP SB STA. ~3380+00; N 377857, E 58129
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ N.M. **AFTER 24 HOURS:** ▼ ARTESIAN'

PROJECT NUMBER: 200601.150
DATE STARTED: 7/27/06
DATE COMPLETED: 7/28/06
GROUND ELEVATION: 4214.2'
LOGGED BY: D. WINTERTON

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				15	6,6,9,(23)	CL	brown to gray, slightly moist, stiff — organics in top 12"								
							LEAN CLAY								
4210	5			11	Pushed 0.99+	CL (A-7-6(32))	brown, moist, very stiff	98	26.4	48	30	0	2	98	UC
				17	3,4,4,(12) 0.88	CL	brown, moist, stiff — LEAN CLAY W/SILTY SAND LAYERS TO 2" THICK & UP TO 8" APART								
4205	10			12	Pushed 0.99+	CL (A-6(20))	gray-brown, moist, very stiff	101.2	26.1	39	19	0	1	99	UC
				18	2,3,3,(8) 0.99+	CL	gray, moist, very stiff								
4200	15			18	Pushed 0.31	CL (A-7-6(28))	dk. gray, moist, firm — LEAN CLAY W/SILT LENSES UP TO 5" APART	88.2	33.8	48	28	0	7	93	UC
4195	20			18	0/15",1,(1) 0.20	CL	gray, moist, soft								
4190	25			15	Pushed 0.15	MH (A-7-5(41))	dk. gray, moist, soft — PLASTIC SILT	78.9	41.7	67	33	0	1	99	UC
4185	30			18	2,2,1,(3) 0.30	CL	dk. gray, moist, firm — LEAN CLAY W/SILT & SAND LENSES UP TO 3" APART								
4180	35			17	Pushed 0.25	CL	gray, moist, firm								
				18	1,2,3,(4) 0.44	CL	gray, moist, firm								
4175	40			16	9,6,7,(11) 0.99+	CL (A-6(12))	dk. gray, moist, very stiff — SANDY LEAN CLAY		22.5	38	20	0	30	70	
4170	45			18	8,11,25,(29) 0.99+	SP (A-1-b(0))	dk. gray, wet, med. dense — SAND		21.9		NP	1	97	2	
						CL	dk. gray, moist, very stiff — LEAN CLAY W/SAND LENSES & LAYERS								
4165	50			15	4,7,8,(11) 0.46	CL	dk. gray, moist, firm								
4160															

DH_LOGV1 S_665_LOG.GPJ US EVAL.GDT 10/5/06

LEGEND:

DISTURBED SAMPLE: 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE: PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

RB&G ENGINEERING INC.
PROVO, UTAH

DRILL HOLE LOG

BORING NO. RSB-S-667

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP NB STA. ~2591+50; N 396,310, E 65,326
DRILLING METHOD: CME-55 NO. 1 / N.W. CASING
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ 0.6' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 6/12/06
DATE COMPLETED: 6/12/06
GROUND ELEVATION: 4215.7'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description		Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4215 ▽							dk. brown, slightly moist	SILTY CLAY W/ROOTS								
				12	2,8,22,(61)	CL-ML	pink-gray, dry	LEAN CLAY								
						CL	purple-brown, dry	cemented caliche								
				14	1,1,1,(4) *0.12*	CL-ML	lt. brown, wet, soft	LEAN CLAY weakly cemented								
4210	5			16	1,1,2,(6) *0.40*	CL-ML CL	lt. greenish-tan, moist-wet, firm	SILTY CLAY								
				15	Pushed	(A-6(16))	lt. greenish-tan, moist, firm		96.9	28.7	36	15	0	2	98	UC
				18	*0.45*	CL	purple-brown, moist, firm									
4205	10			18	0/9",1/3",2,(6) *0.35*	CL	lt. purple-brown, wet, very soft	LEAN CLAY W/SAND LENSES & LAYERS TO 1" THICK & 3" TO 5" APART								
				18	0/18",(0) *0.10*	CL	very soft		87.7	34.5	30	11	0	8	92	UC
				18	Pushed *0.11*	(A-6(9)) CL	gray-brown, wet, very soft									
4200	15				0,1,2,(5) *0.12*											
				8	0/16",1,(2) *0.18*	CL	dk. gray, moist, soft	INTERBEDDED LEAN CLAY & SILTY SAND LAYERS								
4195	20															
				16	Pushed *0.24*	CL (A-6(12))	gray-brown, wet, soft, w/mica flakes		87.7	34.5	31	13	0	3	97	UC
4190	25															
				18	0/18",(0) *0.10*	CL	gray-brown, wet, very soft, silty sand layers to 0.5" thick & 1" to 6" apart									
4185	30															
				18	Pushed *0.25*	CL (A-6(13))	gray-brown, wet, soft		89.1	34.4	32	14	0	6	94	UC
4180	35															
				10	0/8",1,2,(3) *0.12*	CL	soft, w/silty sand lenses	LEAN CLAY								
4175	40															
				10	0/18",(0) *0.17*	CL	gray-brown, wet, soft, silty sand layers 0.5" to 2" thick									
4170	45															
				18	Pushed *0.36*	CL (A-6(17))	brown-lt. gray, wet, firm, w/mica flakes		89.5	35.1	36	17	0	2	98	UC
4165	50															
4160	55															
				15	Pushed *0.50*	CL/CH	black, moist, firm	LEAN TO FAT CLAY								
4155	60			18	0/18",(0) *0.27*	CL/CH	gray-brown, moist, firm									

LEGEND:
DISTURBED SAMPLE: 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)
UNDISTURBED SAMPLE: PUSHED *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

RB&G ENGINEERING INC.
PROVO, UTAH

DH_LOGV1 S_667_LOG.GPJ US EVAL.GDT 10/5/06

DRILL HOLE LOG

BORING NO. RSB-S-668

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP NB STA. ~2000+50; N 343780, E 49675
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 5.2' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 5/25/06
DATE COMPLETED: 5/25/06
GROUND ELEVATION: 4217.9'
LOGGED BY: B. HORROCKS

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4215	0			5	5,8,14,(34)	CL	dk. brown, dry, very stiff — SANDY LEAN CLAY								
							SILTY SAND								
	5			14	2,2,3,(8) *0.07*	CL	dk. brown, moist, very soft — SANDY LEAN CLAY								
4210				14	2,2,5,(11)	SM (*A-2-4(0)*)	lt. gray, wet, loose — SILTY SAND		22.5		NP	12	54	35	
	10			18	2,2,6,(12) *0.17*	CL	lt. gray, wet, soft, w/two silt lenses — LEAN CLAY								
						SM	lt. gray, wet, med. dense — SILTY SAND								
4205				0	Pushed	-									
	15			7	2,1,2,(4)	CH	gray, wet, very soft								
				18	0/18",(0) *0.07*	CH (*A-7-5(40)*)	very soft		42.9	56	36	0	1	99	
4200															
	20			18	Pushed *0.19*	CH (*A-7-5(42)*)	soft — FAT CLAY	65.6	60.4	63	35	0	0	100	UC
4195															
	25			15	0/13",6,(6) *0.07*	CH	dk. gray, very soft								
4190															
	30			0	Pushed	-									
				12	1,1/12",(1) *0.05*	CH	gray, wet, very soft								
4185							gray — SAND								
	35			12	4,3,5,(7) *0.03*	CL	gray, firm — LEAN CLAY								
						ML	gray, very soft — SANDY SILT								
4180															
	40			18	0,3,7,(8) *0.11*	CL	gray, wet, very soft — LEAN CLAY								
						ML (*A-4(0)*)	gray, very soft — SANDY SILT		21.1	17	1	0	35	65	
4175															
	45			15	Pushed	ML	firm								
				18	0,2,2,(3) *0.25*	CL	dk. gray, firm — LEAN CLAY								
4170															
	50			18	Pushed	ML	gray, wet, firm — SANDY SILT								
				16	3,3,4,(5) *0.27*	CL	gray, wet, firm — LEAN CLAY								
4165															

DH_LOGV1 S_668_LOG.GPJ US EVAL.GDT 10/5/06

LEGEND:

DISTURBED SAMPLE: 2,3,2,(6) ← Blow Count per 6"; (N1)60 Value; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE: PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

RB&G ENGINEERING INC.
PROVO, UTAH

DRILL HOLE LOG

BORING NO. RSB-S-669

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS

CLIENT: UTAH DEPARTMENT OF TRANSPORTATION

PROJECT NUMBER: 200601.150

LOCATION: LP NB STA. ~2026+90; N 346420, E 49630

DATE STARTED: 6/2/06

DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT

DATE COMPLETED: 6/2/06

DRILLER: D. SAMPSON

GROUND ELEVATION: ~4224'

DEPTH TO WATER - INITIAL: ▽ 9.0' **AFTER 24 HOURS:** ▼ 11.2'

LOGGED BY: B. HORROCKS

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description		Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				12	10,37,28,(101	SP-SM (A-1-a(0))	brown, slightly moist, very dense	SAND W/GRAVEL & SILT		2.8		NP	44	45	11	
4220	5			5	8,18,25,(67)	GM	red-brown, moist, med. dense	SILTY GRAVEL W/SAND								
				13	7,9,8,(26) *0.31*	CL	lt. brown, moist, firm									
4215	10			14	Pushed *0.30*	CL (A-7-6(20))	lt. brown, moist, firm			28	41	19	0	2	98	
				16	2,1,1,(2) *0.24*	CL	lt. brown, moist, soft									
4210	15			16	Pushed *0.26*	CL (A-6(14))	lt. gray-brown, moist, firm	LEAN CLAY W/OCCASIONAL SAND LENSES	92.7	26.6	34	14	0	3	97	UC
4205	20			0	Pushed	-										
				18	0/8",1,1,(2) *0.12*	CL	gray, very moist, soft									
4200	25			14	Pushed	SM	gray to black, wet									
				13	7,12,6,(17)	SM (A-2-4(0))	gray, wet, med. dense	SILTY SAND		17.6		NP	0	78	22	
4195	30			6	3,1,2,(3)	SM	gray, wet									
						CL	gray, moist, soft									
4190	35			17	2,1,2,(3) *0.10*	CL	gray, moist, soft									
4185	40			16	Pushed *0.20*	CL (A-6(16))	gray, moist, soft	LEAN CLAY W/MANY SAND LENSES	98.1	25.6	36	18	0	8	92	UC
4180	45			18	0/13",3,(2) *0.63* *0.13*	CL	gray, moist, soft/stiff									
4175	50			16	13,17,15,(23)	SM	gray, wet, dense	SILTY SAND								
4170																

DH_LOGV1 S_669_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:

DISTURBED SAMPLE: 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)

UNDISTURBED SAMPLE: PUSHED *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-670

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP NB STA. ~2663+00; N 402748, E 64305
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 4.9' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 5/24/06
DATE COMPLETED: 5/24/06
GROUND ELEVATION: 4253.5'
LOGGED BY: B. HORROCKS

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4250	0			5	4,4,3,(11)	CL	dk. brown, slightly moist, firm								
	5			6	2,2,2,(6)	CL	soft — SANDY LEAN CLAY W/GRAVEL								
				16	1,2,2,(6) *0.20*	CL	lt. brown, moist, soft								
4245	10			15	Pushed *0.14*	CL (A-6(18))	wet	97.7	25.7	38	21	0	11	89	UC
				14	2,3,3,(8) *0.16*	CL	brown, w/0.5" sand layers every 4" — LEAN CLAY								
4240	15			14	Pushed *0.20*	CL	lt. brown-gray								
4235	20			16	2,3,2,(6) *0.30*	CL (A-6(14))	lt. brown-gray, firm, w/1" sand layer at 20.1' & 3" sand layer at 21' — LEAN CLAY W/SAND		28.6	38	18	0	18	82	
4230	25			18	Pushed *0.31*	CL (A-6(21))	gray-brown	98.2	20	40	20	0	2	98	UC
4225	30			18	0,1,1,(2) *0.11*	CL	gray, wet, soft								
4220	35			14	Pushed *0.13*	CL (A-6(19))	LEAN CLAY	93.2	31	38	19	0	2	98	UC
4215	40			18	0/14",1,(1) *0.10*	CL	dk. gray, one sand lens at 40.5'								
4210	45			14	Pushed	SM (A-4(0))	gray, wet — SILTY SAND		16.9		NP	0	62	38	
4205				2	4,7,9,(13)	ML	gray, very stiff — SANDY SILT								
4200	50			5	17,22,22,(33)	SM	gray, wet, dense — SILTY SAND W/GRAVEL								

DH_LOGV1 S_670_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6"; $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-671

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP NB STA. ~2613+00; N 397875, E 65082
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 3.2' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 6/5/06
DATE COMPLETED: 6/6/06
GROUND ELEVATION: 4220.5'
LOGGED BY: B. HORROCKS

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4220															
				5	4,5,4,(14)	CL	dk. brown, slightly moist, stiff — organics in top 9" SANDY LEAN CLAY								
				18	2,1,1,(3)	SC-SM (A-2-4(0))	brown, moist, very loose — SILTY CLAYEY SAND		21.1	24	6	0	70	30	
4215	5			18	Pushed	SM	brown-gray, wet — SILTY SAND W/CLAY LAYERS TO 4" THICK								
				18	1,2,1,(5)	SM (A-2-4(0))	brown, wet, very loose		29.3		NP	2	73	25	
4210	10			15	1,1,2,(5) 0.14	CL	brown, very moist, soft — LEAN CLAY W/SILT LENSES								
				9	2,1,2,(4)	ML (A-4(0))	brown to gray, very moist, very loose — SANDY SILT		35		NP	0	47	53	
4205	15			14	0/18",(0) 0.10	CL	brown, moist, very soft — LEAN CLAY								
				18	Pushed 0.05	SM	gray, wet — SILTY SAND								
4200	20			18	0,8,10,(21)	CL (A-6(19)) SM	gray, very moist, v. soft brown, moist, very soft — LEAN CLAY; gray, wet, med. dense — SILTY SAND		36.1	39	18	0	1	99	UC
4195	25			18	1,2,1,(3) 0.05	CL	brown, moist, very soft — LEAN CLAY W/SILT LAYERS TO 0.5" THICK & UP TO 3" APART								
4190	30			18	0/11",1,2,(3) 0.07	CL	lt. brown, very moist, very soft								
4185	35			18	Pushed 0.15	CL (A-7-6(24))	lt. gray, very moist, soft	82.2	41.6	45	24	0	3	97	UC
4180	40			18	0/9",1,2,(3) 0.15	CL	gray, very moist, soft — LEAN CLAY								
4175	45			0	Pushed	-	no recovery								
				18	0,1,2,(2)	CL	gray, very moist, soft								
4170	50			18	0,2,2,(3) 0.19	CL (A-6(11))	gray, very moist		36	34	12	1	11	88	

DH_LOGV1 S_671_LOG.GPJ US EVAL.GDT 10/5/06

LEGEND:

DISTURBED SAMPLE: 2,3,2,(6) ← Blow Count per 6" (N_1)$_{60}$ Value; 0.45 ← Torvane (tsf)

UNDISTURBED SAMPLE: PUSHED 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

RB&G ENGINEERING INC.
PROVO, UTAH

DRILL HOLE LOG

BORING NO. RSB-S-672

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP SB STA. ~3036+75; N 347408, E 49528
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 14.5' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 6/5/06
DATE COMPLETED: 6/5/06
GROUND ELEVATION: 4223.8'
LOGGED BY: B. HORROCKS

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				12	16,24,56/4"	SM (A-1-b(0))	brown, dry, very dense		2.6		NP	35	48	17	
4220				6	17,25,51	SM	brown, moist, very dense								
	5						SILTY SAND W/GRAVEL								
				2	39,55,47/3"	SM	brown, moist, very dense								
4215				7	29,34,51	SM	brown, moist, very dense								
	10														
				10	38,12,8,(22) *0.24*	ML/MH (A-7-5(7))	lt. brown, moist, soft — SANDY PLASTIC SILT		47.2	50	18	0	49	51	
4210															
	15			0	Pushed	-									
				16	1,2,3,(5) *0.18*	CL	gray, wet, soft — SANDY LEAN CLAY W/SAND LAYERS UP TO 5" THICK								
4205															
	20			13	2,2,2,(4)	ML (A-4(0))	gray, wet, very loose — SANDY SILT		31.2		NP	0	34	66	
4200															
	25			10	15,17,8,(22)	SM	gray, wet, med. dense — SILTY SAND W/SILT LAYERS UP TO 1" THICK								
4195															
	30			14	0,1,2,(2) *0.20*	CL (A-7-6(25))	gray, wet, soft — LEAN CLAY W/SAND LENSES		30.2	43	25	0	4	96	
4190							SANDY SILT								
	35			12	Pushed	ML	gray, wet								
				16	3,2,4,(5) *0.42*	CL	gray, very moist gray, very moist, firm — LEAN CLAY W/SILT LAYERS 1" THICK & 6" APART								
4185															
	40			18	Pushed	CL (A-7-6(21))	gray, very moist, stiff	90.7	30.3	41	20	0	4	96	UC
				15	4,2,4,(4)	ML	gray, wet gray, wet, loose — SANDY SILT								
4180						ML									
	45														
4175															

DH_LOGV1 S_672_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6"; (N1)60 Value
0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED
0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-673

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: I-15 SB NEAR SHEPARD LANE; N 412199, E 56636
DRILLING METHOD: CME-55 NO. 1 / N.W. CASING
DRILLER: T. KERN
DEPTH TO WATER - INITIAL: ▽ 12.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 8/3/06
DATE COMPLETED: 8/3/06
GROUND ELEVATION: ~4285.2'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
				14	12,31,34	CL-ML SM	lt. brown, dry brown, dry, very dense	SILTY CLAY W/ORGANICS SILTY SAND W/GRAVEL (fill)							
				14	6,5,5,(20)	CL-ML (A-4(3))	brown, moist, stiff	SILTY CLAY	21.45	23	6	0	11	89	
4280	5			15	*0.30* 2,5,4,(18)	CL SM	lt. brown, moist, firm lt. brown, very moist, loose	LEAN CLAY							
4275	10			13	4,6,11,(28)	SM	brown, wet, med. dense								
			▽	12	4,3,4,(10)	SM (A-4(0))	brown, wet, loose		26.1		NP	0	51	49	
4270	15			15	9,12,12,(33)	SM	brown, wet, med. dense	SILTY SAND W/CLAY LAYERS UP TO 0.5" THICK							
4265	20			15	11,18,20,(48)	SM	brown, wet, dense								
4260	25			13	9,13,11,(28)	SM (A-2-4(0))	brown, wet, med. dense		24.3		NP	0	87	13	
4255	30			13	3,3,9,(13) *0.15*	CL-ML (A-4(2))	brown, moist, soft	SANDY SILTY CLAY W/SILT & SAND LAYERS	23.1	24	5	0	20	80	
4250	35			16	6,10,13,(24)	SM	gray-brown, wet, med. dense	SILTY SAND W/OCCASIONAL CLAY LENSES							
4245	40			16	7,11,13,(24)	SM (A-2-4(0))	gray, wet, med. dense		24.1		NP	0	85	15	
4240	45														

DH_LOGV1 S_673_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-674

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP SB STA. ~3119+55: N 355112, E 51294
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 8.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 5/23/06
DATE COMPLETED: 5/23/06
GROUND ELEVATION: 4220.5'
LOGGED BY: B. HORROCKS

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	Sample USCS (AASHTO)	Material Description		Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4220																
				10	40,69,38	GM	brown, slightly moist, very dense	SILTY GRAVEL W/SAND (fill)								
				10	17,14,8,(34)	SM	brown, moist, med. dense	SILTY SAND W/GRAVEL								
4215	5			18	Pushed *0.24*	CL (*A-6(20)*)	brown, moist, soft		89.6	27.8	39	20	0	2	98	UC
				18	1,1,2,(4) *0.10*	CL	brown, moist, very soft	LEAN CLAY W/SILT LENSES UP TO 3" APART								
4210	10			15	Pushed *0.20*	CL (*A-7-6(23)*)	gray, moist, soft			31.9	41	22	0	1	99	
	15			5	7,2,1,(3)	ML	dk. gray, very moist, very loose	SANDY SILT								
4205				0	3,2,1,(3)	-	no recovery									
	20			18	0/8",2,3,(5) *0.17*	CL	gray to black, very moist, soft									
4200																
	25			19	Pushed *0.25*	CL (*A-6(19)*)	gray, moist, soft	LEAN CLAY	90.9	32.4	37	19	0	2	98	UC
4195																
	30			16	1,2,3,(4) *0.35*	CL	dk. gray, moist, firm									
4190																
	35			8	8,19,14,(28)	ML (*A-4(0)*)	dk. gray, wet, dense	SANDY SILT								
4185																
	40			15	Pushed *0.11*	CL	gray, very moist, very soft	LEAN CLAY		28.4		NP	0	42	58	
4180																
	45															
4175																

LEGEND:

DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)

UNDISTURBED SAMPLE — PUSHED; *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

RB&G ENGINEERING INC.
PROVO, UTAH

DH_LOGV1 S_674_LOG.GPJ US EVAL.GDT 10/5/06

DRILL HOLE LOG

BORING NO. RSB-S-675

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP SB STA. ~3172+35; N 360384, E 51034
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 5.0' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 7/25/06
DATE COMPLETED: 7/25/06
GROUND ELEVATION: 4220.4'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4220				9	6,7,6,(20)	CL	lt. brown to lt. green, dry, firm — organics in top 6"								
				14	Pushed 0.41	CL (A-6(21))	lt. brown, moist, firm — LEAN CLAY	88.7	34.7	39	21	0	3	97	UC
4215 ▽	5			16	Pushed 0.36	CL	gray-brown, moist, firm								
				18	1,1,2,(4) 0.10	CL	lt. brown to gray, moist, very soft								
4210	10			18	Pushed 0.31	CH (A-7-6(44))	dk. gray to black, moist, firm — FAT CLAY	65.1	63.5	62	40	0	2	98	UC
4205	15			16	2,1,2,(4) 0.40	CL	gray, moist, firm — LEAN CLAY								
4200	20			15	Pushed 0.32	CL (A-4(6))	brown-gray, moist, firm	105.8	23.7	27	7	0	5	95	UC
4195	25			13	3,5,15,(20)	SM (A-2-4(0))	gray, wet, med. dense — SILTY SAND		24.2		NP	0	88	12	
4190	30			12	8,13,17,(28)	SM	gray, wet, med. dense								
4185	35			9	0.25 Pushed	CL-ML SM	gray-brown, moist, soft — SILTY CLAY								
				12	6,6,10,(14)	SM (A-2-4(0))	gray-brown, wet, med. dense — SILTY SAND		26.7		NP	0	88	12	
4180	40			16	20,25,26,(42)	SM	gray, wet, very dense								
4175	45														

DH_LOGV1 S_675_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; 0.45 ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; 0.45 ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

DRILL HOLE LOG

BORING NO. RSB-S-676

SHEET 1 OF 1

PROJECT: LEGACY PARKWAY - SIGNS
CLIENT: UTAH DEPARTMENT OF TRANSPORTATION
LOCATION: LP SB STA. ~3285+00; N 371257, E 53020
DRILLING METHOD: CME-55 NO. 2 / N.W. CASING W/TRICONE BIT
DRILLER: D. SAMPSON
DEPTH TO WATER - INITIAL: ▽ 4.9' **AFTER 24 HOURS:** ▼ N.M.

PROJECT NUMBER: 200601.150
DATE STARTED: 5/22/06
DATE COMPLETED: 5/22/06
GROUND ELEVATION: 4217.9'
LOGGED BY: M. HANSEN

Elev. (ft)	Depth (ft)	Lithology	Sample Type	Sample Rec. (in)	Sample See Legend	USCS (AASHTO)	Material Description	Dry Density (pcf)	Moisture Content (%)	Atter. Liquid Limit	Atter. Plast. Index	Gradation Gravel (%)	Gradation Sand (%)	Gradation Silt/Clay (%)	Other Tests
4215	0			7	6,5,4,(14)	CL	dk. gray, dry, firm — organics in top 7"								
				0	4,8,10,(28)	-	no recovery								
	5			10	6,5,7,(19) *0.76*	CL	lt. brown, moist, stiff — LEAN CLAY W/OCCASIONAL SILTY SAND LENSES								
4210				17	Pushed *0.52*	CL (A-6(18))	gray-brown, moist, stiff	98.9	27.8	34	18	0	1	99	UC
	10			18	2,2,4,(8) *0.30*	ML	gray-brown, wet/moist, loose — SANDY SILT W/CLAY LAYERS								
4205						ML (A-4(0))			25.8		NP	0	46	54	
	15			14	Pushed	CL (A-6(18))	brown, moist, firm — LEAN CLAY		28.9	38	19	0	9	91	
				14	2,2,3,(6)	ML	dk. gray, wet / dk. gray, wet, loose — SANDY SILT								
4200				18	3,5,3,(9) *0.75*	ML CL	gray-brown, moist, stiff — LEAN CLAY W/SILTY SAND LAYERS UP TO 1" THICK								
	20			17	Pushed *0.65*	CH (A-7-6(34))	dk. gray, moist, stiff — FAT CLAY		29.7	55	33	0	6	94	
4195															
	25			18	4,4,6,(10) *0.52*	CL	gray-green, moist, stiff — LEAN CLAY W/SILTY SAND LAYERS UP TO 2" THICK								
4190															
	30			10	6,7,7,(13)	SM/ML	brown-gray, wet, med. dense — SILTY SAND TO SANDY SILT								
4185															
	35														
4180															
	40														
4175															
	45														
4170															

DH_LOGV1 S_676_LOG.GPJ US EVAL.GDT 10/5/06

RB&G ENGINEERING INC.
PROVO, UTAH

LEGEND:
DISTURBED SAMPLE — 2,3,2,(6) ← Blow Count per 6" / $(N_1)_{60}$ Value; *0.45* ← Torvane (tsf)
UNDISTURBED SAMPLE — PUSHED; *0.45* ← Torvane (tsf)

OTHER TESTS
UC = Unconfined Compression
CT = Consolidation
DS = Direct Shear
TS = Triaxial Shear

SUMMARY OF TEST DATA

PROJECT Legacy Parkway – Sign Structures
LOCATION Weber County, Utah
PROJECT NO. 200601-150
FEATURE Foundations

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	STANDARD PENETRATION BLOWS PER FOOT	IN-PLACE		UNCONFINED COMPRESSIVE STRENGTH (psf)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO Classification)
			DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
RSB-S-661	3-4.5	20		10.8				NP	43	38	19	GM / A-1-b(0)
	6-7.5		105.1	22.9	2290	32	20	12	0	5	95	CL / A-6(11)
	12-13.5		93.4	29.2	1548	24	23	1	0	7	93	ML / A-4(0)
	20-21.5		77.2	43.7	407	50	22	28	0	0	100	CL/CH / A-7-5(32)
	30-31.5	28		17.9				NP	0	51	49	SM / A-4(0)
	40-41.5		106.5	21.3	2377	32	17	15	0	17	83	CL / A-6(11)
RSB-S-662	3-4			13.4		36	26	10	16	45	39	SM / A-4(1)
	9-10		98.8	24.4	1307	34	20	14	0	30	70	CL / A-6(8)
	10-10.4			12.8				NP	2	75	23	SM/ A-1-b(0)
	12-13.5		98.5	23.5	1028	32	19	13	1	10	89	CL / A-6(13)
	20-21.5			24.6		35	18	17	0	3	97	CL / A-6(17)
	30-31.5		94.6	27.4	1816	40	19	21	0	7	93	CL (A-6(20))
	40-41.5			30.6		40	18	22	0	4	96	CL / A-6(22)
RSB-S-663	6-7.5		93.2	29.6	913	35	18	17	0	3	97	CL / A-6(17)
	13.5-15		84.8	28.6	2825	39	19	20	0	3	97	CL / A-6(20)
	18-19.5	4		21.6				NP	0	78	22	SM / A-2-4(0)
	25-26.5		74.1	50.0	1518	51	20	31	0	4	96	CH / A-7-5(33)
	35-36.5			34.3		40	21	19	0	4	96	CL / A-6(20)
	45-46.5			33.6		34	19	15	0	0	100	CL / A-6(15)
RSB-S-664	3-4.5		101.6	25.6	2784	46	16	30	1	9	90	CL / A-7-6(28)
	9-10.5		98.2	28.6	1911	42	20	22	0	2	98	CL / A-7-6(23)
	15-16.5		96.2	29.7	1373	45	19	26	0	7	93	CL / A-7-6(26)
	25-26.5		88.7	34.4	1756	49	20	29	0	6	94	CL / A-7-6(30)
	35-36.5			33.1		47	19	28	0	2	98	CL / A-7-6(30)
	45-46.5			21.7		44	16	28	0	19	81	CL / A-7-6(22)
RSB-S-665	3-4.5		98.0	26.4	2835	48	18	30	0	2	98	CL / A-7-6(32)
	9-10.5		101.2	26.1	3910	39	20	19	0	1	99	CL / A-6(20)
	15-16.5		88.2	33.8	1176	48	20	28	0	7	93	CL / A-7-6(28)
	25-26.5		78.9	41.7	948	67	34	33	0	1	99	MH / A-7-5(41)
	40-41.5	13		22.5		38	18	20	0	30	70	CL / A-6(12)
	45-46.5	19		21.9				NP	1	97	2	SP / A-1-b(0)

*NP = Non-Plastic

SUMMARY OF TEST DATA

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	STANDARD PENETRATION BLOWS PER FOOT	IN-PLACE		UNCONFINED COMPRESSIVE STRENGTH (psf)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO Classification)
			DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
RSB-S-667	7.5-9		96.9	28.7	1672	36	21	15	0	2	98	CL / A-6(16)
	13.5-13		87.7	34.5	538	30	19	11	0	8	92	CL / A-6(9)
	25-26.5		87.7	34.5	662	31	18	13	0	3	97	CL / A-6(12)
	30-31.5		89.1	34.4	822	32	18	14	0	6	94	CL / A-6(13)
	50-51.5		89.5	35.1	1146	36	19	17	0	2	98	CL / A-6(17)
RSB-S-668	6-7.5	7		22.5				NP	12	54	35	SM / A-2-4(0)
	15-16.5	0		42.9		56	20	36	0	1	99	CH / A-7-5(40)
	20-21.5		65.6	60.4	950	63	28	35	0	0	100	CH / A-7-5(42)
	40-41.5	10		21.1		17	16	1	0	35	65	ML / A-4(0)
RSB-S-669	0-1.5	65		2.8				NP	44	45	11	SP-SM / A-1-a(0)
	9-10.5			28.0		41	22	19	0	2	98	CL / A-7-6(20)
	15-16.3		92.7	26.6	2878	34	20	14	0	3	97	CL / A-6(14)
	26.5-28	18		17.6				NP	0	78	22	SM / A-2-4(0)
	40-41.5		98.1	25.6	1918	36	18	18	0	8	92	CL / A-6(16)
RSB-S-670	9-10.5		97.7	25.7	1101	38	17	21	0	11	89	CL / A-6(18)
	20-21.5	5		28.6		38	20	18	0	18	82	CL / A-6(14)
	25-26.5		98.2	20.0	1848	40	20	20	0	2	98	CL / A-6(21)
	35-36.5		93.2	31.0	2627	38	19	19	0	2	98	CL / A-6(19)
	45-46			16.9				NP	0	62	38	SM / A-4(0)
RSB-S-671	3-4.5	2		21.1		24	18	6	0	70	30	SC-SM / A-2-4(0)
	7.5-9	3		29.3				NP	2	73	25	SM / A-2-4(0)
	12-13.5	3		35.0				NP	0	47	53	ML / A-4(0)
	18-19.5			36.1	666	39	21	18	0	1	99	CL / A-6(19)
	35-36.5		82.2	41.6	1163	45	21	24	0	3	97	CL / A-7-6(24)
	50-51.5	4		36.0		34	22	12	1	11	88	CL / A-6(11)
RSB-S-672	0-1.5	80		2.6				NP	35	48	17	SM / A-1-b(0)
	12-13.5	20		47.2		50	32	18	0	49	51	ML/MH / A-7-5(7)
	20-21.5	4		31.2				NP	0	34	66	ML / A-4(0)
	30-31.5	3		30.2		43	18	25	0	4	96	CL / A-7-6(25)
	40-41.5		90.7	30.3	3060	41	21	20	0	4	96	CL / A-7-6(21)
RSB-S-673	3-4.5	10		21.4		23	17	6	0	11	89	CL-ML / A-4(3)
	12-13.5	7		26.1				NP	0	51	49	SM / A-4(0)
	25-26.5	24		24.3				NP	0	87	13	SM / A-2-4(0)
	30-31.5	12		23.1		24	19	5	0	20	80	CL-ML / A-4(2)
	40-41.5	24		24.1				NP	0	85	15	SM / A-2-4(0)

NP = Non-Plastic

SUMMARY OF TEST DATA

HOLE NO.	DEPTH BELOW GROUND SURFACE (ft)	STANDARD PENETRATION BLOWS PER FOOT	IN-PLACE		UNCONFINED COMPRESSIVE STRENGTH (psf)	ATTERBERG LIMITS			MECHANICAL ANALYSIS			UNIFIED SOIL CLASSIFICATION SYSTEM / (AASHTO Classification)
			DRY UNIT WEIGHT (pcf)	MOISTURE (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	PERCENT GRAVEL	PERCENT SAND	PERCENT SILT & CLAY	
RSB-S-674	6-7.5		89.6	27.8	4975	39	19	20	0	2	98	CL / A-6(20)
	12-13.5			31.9		41	19	22	0	1	99	CL / A-7-6(23)
	25-26.5		90.9	32.4	1368	37	18	19	0	2	98	CL / A-6(19)
	35-36.5			28.4				NP	0	42	58	ML / A-4(0)
RSB-S-675	3-4.5		88.7	34.7	983	39	18	21	0	3	97	CL / A-6(21)
	12-13.5		65.1	63.5	829	62	22	40	0	2	98	CH / A-7-6(44)
	20-21.5		105.8	23.7	2062	27	20	7	0	5	95	CL / A-4(6)
	25-26.5	20		24.2				NP	0	88	12	SM / A-2-4(0)
	36-37.5	16		26.7				NP	0	88	12	SM / A-2-4(0)
RSB-S-676	9-10.5		98.9	27.8	2149	34	16	18	0	1	99	CL / A-6(18)
	15-15.5			25.8				NP	0	46	54	ML / A-4(0)
	15.5-15.8			28.9		38	19	19	0	9	91	CL / A-6(18)
	21-22.5			29.7		55	22	33	0	6	94	CH / A-7-6(34)

NP = Non-Plastic