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By Alameda County Environmental Health 9:39 am, Jun 04, 2015

May 29, 2015

Ms. Dilan Roe
Site Cleanup Program Manager
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94501-6577

Subject: **Review of Ground Improvement Submittal**
Former Crown Chevrolet North Parcel
7544 Dublin Boulevard
Dublin, California
Site Cleanup Program Case No. RO0003014

Dear Ms. Roe:

Enclosed please find a letter entitled *Review of Ground Improvement Submittal* for the Crown Chevrolet Cadillac Isuzu site at 7544 Dublin Boulevard, in Dublin, California (Site Cleanup Program Case No. RO0003014, GeoTracker Global ID T10000001616). This letter was prepared by Amec Foster Wheeler Environment & Infrastructure, Inc., on behalf of BWD Dublin LLC.

I declare under penalty of perjury that the information and/or recommendations contained in the attached document or report is true and correct to the best of my knowledge.

Please contact me at (408) 680-4938 or Avery Whitmarsh of Amec Foster Wheeler at (415) 378-3912 if you have any questions regarding this letter.

Sincerely yours,

Pete Beritzhoff
BWD Dublin LLC

Attachment: Review of Ground Improvement Submittal

May 29, 2015

Project OD14170800

Ms. Dilan Roe
Site Cleanup Program Manager
Alameda County Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94501-6577

Subject: Review of Ground Improvement Submittal
Former Crown Chevrolet North Parcel
7544 Dublin Blvd
Dublin, California

Dear Ms. Roe:

On behalf of BWD Dublin, LLC, Amec Foster Wheeler Environment & Infrastructure, Inc. ("Amec Foster Wheeler") has reviewed the package of design-build documents submitted by Farrell Design-Build, Inc. ("Farrell") describing their proposed methods for improving (i.e., densifying) the ground beneath the proposed garage to be installed at the Dublin Apartments at the former Crown Chevrolet North Parcel (the "site"; Attachment 1). During a May 22, 2015 teleconference, the Alameda County Department of Environmental Health requested that Amec Foster Wheeler review these documents for environmental conformance.

Farrell proposes installation of 16- to 17-inch-diameter columns of controlled low-strength material (CLSM) to densify soil under the proposed garage. Their plan includes installation of 576 such columns to depths of 28 to 35 feet below ground surface.

The columns are installed by first advancing a "displacement tool" to the full design depth of the column. The displacement tool has a tapered auger head/bit which is advanced under heavy "crowd" (i.e., the tool is forcefully pushed into the subsurface) and high torque, is intended to densify the soil around the hole, producing minimal spoils. The displacement tool is then withdrawn about 1 foot and CLSM is introduced through the tool head to fill the resulting cavity. The displacement tool is then withdrawn as CLSM is added under pressure into the cavity, causing it to expand slightly. The construction documents specify that sufficient CLSM be injected to fill 110% of the calculated volume of the cavity created by the displacement tool. If these procedures are followed during construction, there is never an open borehole that could allow for downward migration of potentially impacted groundwater.

If the permeability of the CLSM were significantly higher than the surrounding native soil, the columns could provide a vertical conduit for shallow groundwater containing contaminants of concern to migrate to deeper water-bearing units. However, falling-head permeability tests were performed by Farrell on samples of CLSM that were prepared according to a mix design that is substantially similar to that proposed for this project. These results (included in Attachment 2) indicate that the measured permeability of the CLSM samples ranged from 6.4 x 10^{-9}

Amec Foster Wheeler Environment & Infrastructure, Inc.
180 Grand Avenue, Suite 1100
Oakland, California 94612-3066
USA
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centimeters per second (cm/sec) to 1.5 x 10^{-8} cm/sec. These measured values are likely substantially less that the permeability of the native soil below the proposed garage, which we estimate to be around 1 x 10^{-6} cm/sec based on soil descriptions in site boring logs. The construction drawings include a requirement that states that the "CLSM permeability shall be less than 1x10^{-6} cm/sec."

We believe that, based on Farrell's design, the CLSM columns will not create a vertical conduit that allows migration of shallow groundwater containing contaminants of concern, either during or after installation.

Sincerely yours,
Amec Foster Wheeler Environment & Infrastructure, Inc.

REGISTERED PROFESSIONAL ENGINEER
FRANK S. SZERDY
No. 43037
Exp. 3/31/16
CIVIL
STATE OF CALIFORNIA

Frank Szerdy, Ph.D., PE
Principal Engineer

Avery Whitmarsh, PG
Associate Geologist

AW/FS/dc
x:\17000s\170800\4000_regulatory\2015_05_foundation letter\crown chevrolet - foundation letter - 5-28-2015.docx

Attachments: Attachment 1—Design-Build Submittal and Drawings
Attachment 2—Permeability Tests for Similar Mixture

ATTACHMENT 1

Design-Build Submittal and Drawings

DESIGN-BUILD SUBMITTAL

DRILL DISPLACEMENT COLUMN™
DISPLACEMENT GROUND ANCHOR

DUBLIN APARTMENTS GARAGE
DUBLIN, CA

JOB NO.: C14-329
MAY 22, 2015

Submittal Prepared for:

Pete Beritzhoff
Bay West Development
2 Henry Adams Street, Suite 450
San Francisco, CA 94103

In accordance with our agreement, Farrell Design-Build Companies, Inc. (Farrell) prepared this Drill Displacement Column™ (DDC) and Displacement Ground Anchor (DGA) calculation submittal for settlement control and increased bearing capacity for the proposed new foundations for the subject project. This submittal includes the following attachments:

A) Project Background, DDC Method of Support, DDC and DGA Properties, Load Testing, DDC and DGA Construction, Special Conditions, References, and Limitations
B) Summary of Structural Information by the Structural Engineer or Record (SEOR)
C) Summary of Geotechnical Information by the Geotechnical Engineer of Record (GEOR)
D) DDC and DGA Calculations
E) Specification: DDC 31 66 20 and DGA 31 68 20
F) Distribution

Submittal Prepared by:
Sam Warren
Project Engineer

Submittal Reviewed by:
Tom Farrell, MS, GE
President

REGISTERED PROFESSIONAL ENGINEER
TOM FARRELL
No.2484
GEOTECHNICAL
STATE OF CALIFORNIA

2015-05-22

PROJECT BACKGROUND

Based on information provided by Bay West Development, FBA Structural Engineers, and Rockridge Geotechnical, we understand that Drill Displacement Column™ (DDC) has been selected to provide improved settlement performance and increased bearing capacity for the proposed structure.

The DDC ground improvement has been proposed to:

1. Increase the strength and stiffness of the native soils,
2. Limit static total and differential settlement,

Table 1. Project Specific Information Summary

Jobsite Address:	7544 Dublin Blvd Dublin, CA 94568
Jobsite Coordinates:	Latitude: 37.7037N, Longitude: 121.9283W
Customer	Bay West Development Contact: Pete Beritzhoff
Geotechnical Engineer of Record - GEOR	Rockridge Geotechnical Contact: Logan Medeiros, GE
Structural Engineer of Record - SEOR	FBA Structural Engineers Contact: Chris Bane, SE
General Subsurface Conditions (Refer to Geotechnical Report for detailed soil and groundwater description)	Soil Conditions: • Stiff clay to 8 feet below ground surface (bgs) • Followed by medium stiff clay at 8-13 feet bgs • Followed by stiff clay at 13-55 feet bgs • Followed by a dense layer of sandy silt to silty sand to the maximum depth of geotechnical exploration. • Ground water was observed at 13 to 16 feet bgs.
Expected Top of Footing Elevation	Within 2 feet of finished floor
New FILL on pad or CUTS from PAD	Up to 2 feet cut or fill typical
Depth of Ground Improvement	Refer to the ground improvement plan

DDC METHOD OF SUPPORT

Drill Displacement Column™ (DDC) system is a deep, displacement, grout column, ground improvement method used to improve any soft or loose soil or contaminated soil for the support of heavy foundation loads on shallow footings. The DDC offers a well-defined, full displacement, grout column, with reliable, high vertical capacity in soft and loose soil. The large cavity expansion effect in the displaced soil produces the increased strength and ground improvement of the system. DDC construction produces low noise and no vibration with low spoil from the displacement tool. DDC ground improvement emulates compaction grouting on a large scale with a well-defined grout column. DDC ground improvement increases the bearing capacity of weak soil, increases soil stiffness and reduces soil compressibility, increases loose soil resistance to liquefaction, and increases composite soil shear strength to resist lateral spread and slope instability.

DDC AND DGA PROPERTIES

The layout of DDC shown on the approved drawings will provide the following composite allowable bearing capacity for DDC-improved soil supported foundations:

Table 2. Allowable Bearing and Tension Capacities

General Properties	Maximum DDC Cell Capacity =	100 kips (ASD) for 4' x 4' Cell
	DDC Shaft Length =	28 to 32 feet
	f'c =	1,200 psi at 56 days
DDC Bearing	D + L Bearing Capacity =	6,250 psf (ASD) for 4' x 4' Spacing
	D + L + E/1.4 Bearing Capacity =	8,333 psf (ASD) for 4' x 4' Spacing
	Spring Stiffness used for Ground Improvement Foundation Model	100 kips/in (Static) Bearing Only 200 kips/in (Seismic) Bearing Only
DGA Bearing and Tension	Maximum DGA Cell Capacity =	(Equivalent to DDC)
	DGA Shaft Length =	35 feet
	f'c =	(Equivalent to DDC)
	D + L Bearing Capacity =	(Equivalent to DDC)
	D + L + E/1.4 Bearing Capacity =	(Equivalent to DDC)
	Allowable Tension Capacity =	52½ kips x1.33 = 70 kips (ASD) Short-term
	Tension Capacity Design Strength =	105 kips (LRFD)
	Spring Stiffness used for Ground Improvement Foundation Model	100 kips/in (Static) Bearing and Tension 200 kips/in (Seismic) Bearing and Tension

Table Notes:

1. Refusal is less than 6 inches downward penetration within 30 seconds during drilling.

Table 3. Estimated Settlements

Settlement Type	Vertical Settlement	Differential Settlement
Static Settlement	Less than 1½ inch	Less than ½ inch over 30 feet
Liquefaction Induced Settlement (Per Geotechnical Report)	Less than ½ inch	Less than ¼ inch over 30 feet

Table Notes:

1. DDCs and DGAs for this project are not designed to mitigate slab settlement potential.
2. Differential settlement between the parking structure and adjacent apartment building may be greater than the estimated values. Elevations of passage ways between structures should be checked and/or adjusted after the majority of both structures have been constructed (50%-100% dead load).

Bearing loads: Resisted by the improved soil, DDCs, and DGAs.

Lateral loads: Resisted by friction at the bottom of the footings and passive resistance as provided by the geotechnical engineer.

Tension load test: Resisted by the dead weight of the foundation and additional tension resistance from DGAs.

LOAD TESTING

Bearing load test: The maximum load of 100 kips at 100% load and up to 200 kips at 200% load will be applied to a 4ft x 4ft footing over an installed DDC to confirm design assumptions by a full-scale load test in general accordance with the specification 31 66 20 and the ground improvement drawings. Due to the variability in soil conditions, the construction of DDCs may need to be modified and additional modulus tests performed prior to the beginning of construction.

Tension load test: The maximum load of 52.5 kips at 100% and up to 70 kips at 150% will be applied to an installed DGA to confirm design assumptions by a full-scale load test in general accoradance with the specification 31 68 20 and the ground improvement drawings.

DDC AND DGA CONSTRUCTION

DDCs and DGAs shall be constructed in general accordance with the specification 31 66 20, specification 31 68 20, and the ground improvement drawings. The general contractor shall identify and expose the DDCs aggregate topping with smooth bucket backhoe or hand shovel. DDCs shall be separated from the foundation concrete by crushed rock as defined in the approved drawing details.

Compaction of the footing bottoms prior to placing reinforcing steel is necessary for the successful performance of the ground improvement foundation system. Please review the ground improvement details and specification regarding related work and preparation of footing bottoms.

SPECIAL CONDITIONS

1. DDC construction requires a minimum of 4 feet lateral clearance from adjacent obstructions, such as existing buildings or temporary shoring.

REFERENCES

Geotechnical Documents	Geotechnical Investigation by Rockridge Geotechnical Title: Proposed Mixed-Use Development, 7544 Dublin Blvd, Dublin, CA Project Number: 14-723 Date: March 17, 2015
Structural Documents	*Soil Improvement Loads* by FBA Structural Engineers dated May 18, 2015. Foundation CAD background by FBA Structural Engineers received May 6, 2015.

LIMITATIONS

DDC and DGA supported foundations will not mitigate expansion of subgrade soil. DDCs and DGAs will not resist slab heaving deformations, which can cause floor slab damage.

Farrell based the DDC and DGA layout on information provided by Bay West Development, the SEOR, and the GEOR. If the existing construction and soil condition are not consistent with this information, engineering and construction changes may be required. If any site or soil conditions have changed from what is presented in this document or the reference documents, Farrell must be asked to review the changed conditions and make the appropriate modifications where necessary.

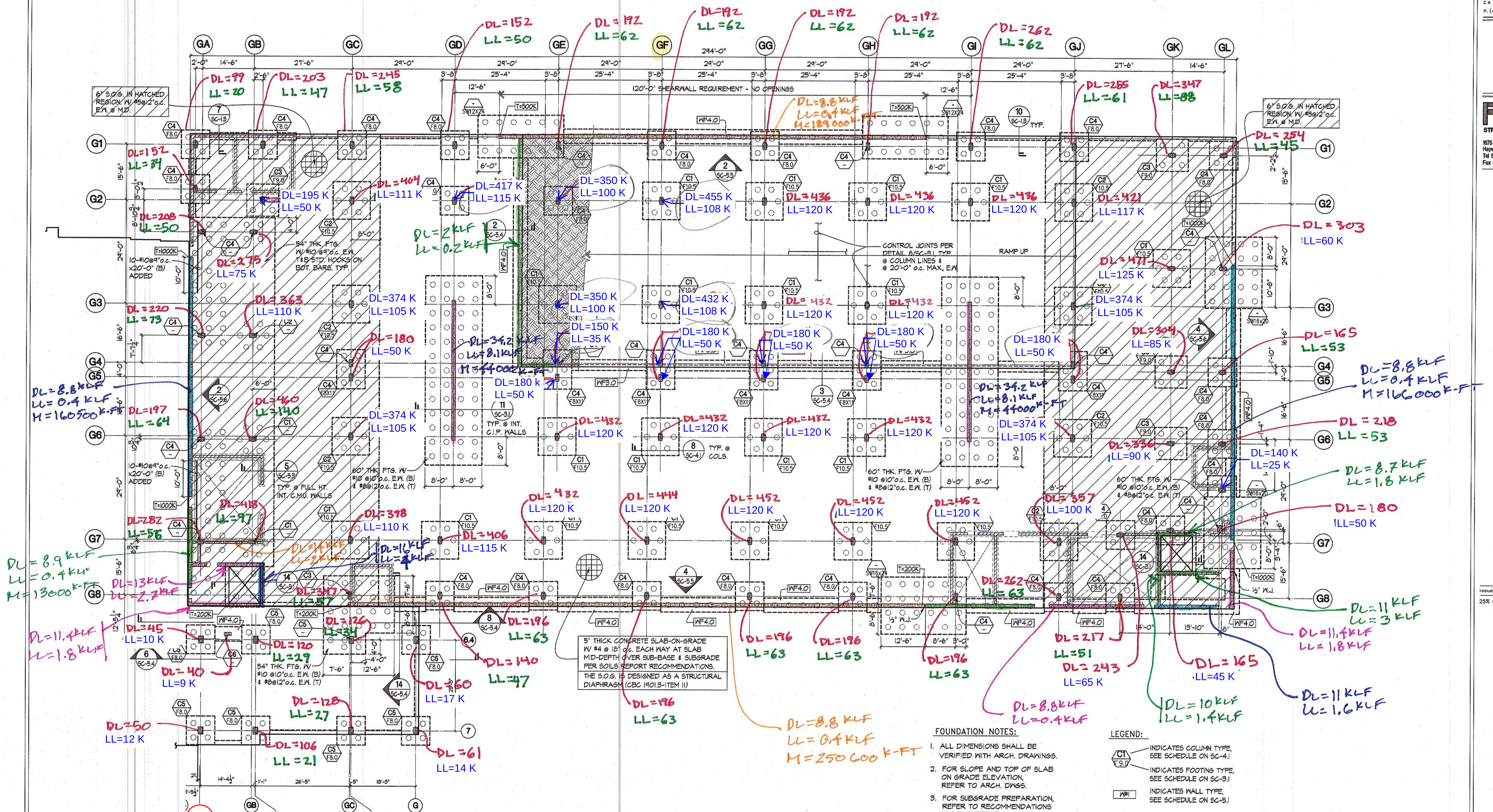
This Design-Build Submittal is the private and proprietary property of Farrell Design-Build Inc. The owner and contractor are granted a limited use license to this submittal for purposes of structural foundation design, contract documents, and agency submittals. Farrell's design and engineering work are expressly provided and conditioned on Farrell installing the design work. Under no circumstance shall this Design-Build Submittal be provided to any other contractor to perform the designed work contained herein.

END ATTACHMENT A

ATTACHMENT B

Summary of Structural Information by SEOR

SOIL IMPROVEMENT LOADS REVISED 5-18-15



FIRST FLOOR FOUNDATION PLAN

SCALE: 3/32" = 1'-0"

ALL LOADS ARE IN KIPS OR KIP-FT

MOMENTS ARE FACTORED

DL & LL ARE AT SERVICE LEVEL (NOT FACTORED)

FOUNDATION NOTES:

1. ALL DIMENSIONS SHALL BE VERIFIED WITH ARCH. DRAWINGS.
2. FOR SLOPE AND TOP OF SLAB ON GRADE ELEVATION, REFER TO ARCH. DWGS.
3. FOR SUBGRADE PREPARATION, REFER TO RECOMMENDATIONS IN SOILS REPORT.
4. SOILS ENGINEER TO REVIEW & APPROVE FOUNDATION PLANS PRIOR TO ANY SITE WORK.
5. ANY REQ'D S.O.G. OR CONTINUOUS FTG. CONSTRUCTION JOINTS ARE TO BE AS SHOWN ON DETAILS 7&8/SC-3.1.
6. ALL FOOTINGS ARE TO BE CENTERED UNDER WALLS OR COLUMNS, EACH WAY, U.N.O.
7. FOR ADDITIONAL NOTES AND TYPICAL DETAILS, SEE SHEETS SC-1.3, SC-3.1 & SC-3.2.
8. WALL CONTROL JOINTS SHALL BE PROVIDED AT 20' ON CENTER (MAX.) PER DETAIL 16/SC-5.2.
9. REFER TO SHEET SC-5.2 FOR TYPICAL WALL INTERSECTION & CONRNER DETAILS

LEGEND:

C1	INDICATES COLUMN TYPE, SEE SCHEDULE ON SC-4.1
F9.0	INDICATES FOOTING TYPE, SEE SCHEDULE ON SC-3.1
W#1	INDICATES WALL TYPE, SEE SCHEDULE ON SC-5.1
WF2.5	INDICATES WALL FTG. TYPE, SEE SCHEDULE ON SC-3.1
▩	INDICATES FULL HT. CONC. WALL
═	INDICATES PARTIAL HT. C.I.P. WALL
▨	INDICATES FULL HT. C.M.U. WALL
½" W.J.	INDICATES WALL JOINT PER 14/SC-5.2
T=1000K	SERVICE LEVEL TENSION LOAD FOR GEOPIER DESIGN SEE DETAIL 16/SC-3.1 & GROUND IMPROVEMENT PLANS
○	INDICATES D.D.C. SOIL IMPROVEMENT BY OTHERS

FOOTING WEIGHT IS INCLUDED IN TENSION LOAD SHOWN ON PLAN

BDE ARCHITECTURE
950 Howard Street
San Francisco
CA 94103
P. (415)677-0966

CLIENT

CONSULTANT

FBA INC
STRUCTURAL ENGINEERS
1675 Sabre St.
Hayward, CA 94545
Tel 510.265.1888
Fax 510.265.1891

DUBLIN APARTMENTS GARAGE
7544 DUBLIN BOULEVARD
DUBLIN, CA 94568

ISSUE	DATE
25% CD Set	11.14.14

STAMP

FIRST FLOOR FOUNDATION PLAN

SHEET TITLE

SCALE —

PROJECT NO. 2014-40 DRAWN BY

SHEET SIZE: 30 x 42

NOT FOR CONSTRUCTION

SC-2.1

ATTACHMENT C

Summary of Geotechnical Information by GEOR

For complete boring and CPT information, refer to the geotechnical report for this project:

Go Vertical with Confidence®
FARRELL
DESIGN-BUILD

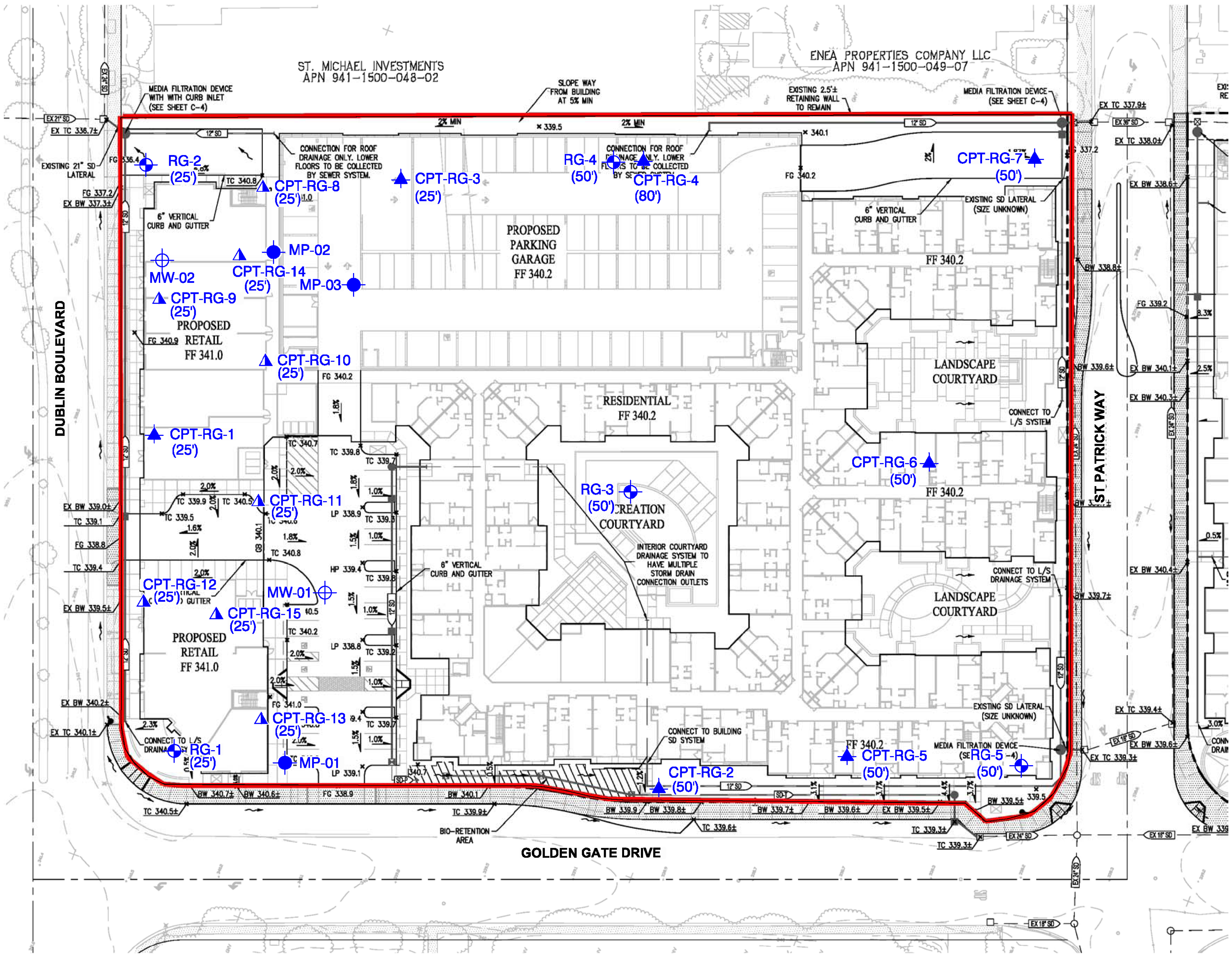
SITE SOIL PROFILE

Boring/CPT Summary

Project: Dublin Apartments Parking Structure
Job No: C14-329
Address: 7544 Dublin Boulevard, Dublin, CA
Geotech: Rockridge Geotechnical
Date: Borings from 7/17/14 and 7/18/14

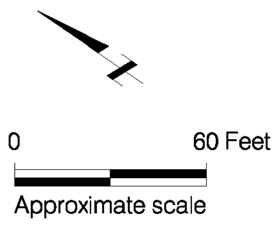
Notes:

Depth (feet)	**Ground Improvement**	**RG-1**			**RG-2**			**RG-3**			**RG-4**			**RG-5**						**Depth (feet)**
		USCS Classification	**Groundwater**	**SPT N-Value**	**USCS Classification**	**Groundwater**	**SPT N-Value**	**USCS Classification**	**Groundwater**	**SPT N-Value**	**USCS Classification**	**Groundwater**	**SPT N-Value**	**USCS Classification**	**Groundwater**	**SPT N-Value**	**USCS Classification**	**Groundwater**	**SPT N-Value**	
1		AC			AC			AC			AC			AC						1
2		CL		9	CL		20	CL		20	CL		14	CL		19				2
3																				3
4	▨			14	CL		22	CL		22			18	CL		19				4
5	▨																			**5**
6	▨			21			11			22			20			11				6
7	▨																			7
8	▨																			8
9	▨			14			8			7			9			5				9
10	▨																			**10**
11	▨			20			18									9				11
12	▨									13			8	GC						12
13	▨											▽		CL						13
14	▨														▽					14
15	▨																			**15**
16	▨		▽																	16
17	▨						13													17
18	▨																			18
19	▨																			19
20	▨																			**20**
21	▨				CL															21
22	▨																			22
23	▨																			23
24	▨			15			20			13			13			11				24
25	▨																			**25**
26		EOB = 25 ft			EOB = 25 ft															26
27																				27
28														CL						28
29									▽	15			18			17				29
30																				**30**
31																				31
32																				32
33																				33
34										17	CL		13			21				34
35																				**35**
36																				36
37																				37
38														CL						38
39										14			11			32				39
40																				**40**
41																				41
42																				42
43								CL												43
44										21			17			29				44
45																				**45**
46																				46
47																				47
48											CL									48
49										24			16	CL		20				49
50														CL						**50**
51								EOB = 50 ft			EOB = 50 ft			EOB = 50 ft						51
52																				52
53																				53
54																				54
55																				**55**



EXPLANATION

RG-1 ⊕ (50')	Approximate location and depth of hollow-stem auger exploratory boring for geotechnical investigation by Rockridge Geotechnical, Inc., July 2014
CPT-RG-1 ▲ (50')	Approximate location and depth of cone penetration test (CPT) for geotechnical investigation by Rockridge Geotechnical Inc., July 2014
MP-01 ●	Approximate location of multi-port monitoring well by AMEC (installed August 2012)
MW-01 ⊕	Approximate location of monitoring well by AMEC (installed August 2012)
CPT-RG-8 △ (25')	Approximate location and depth of supplemental CPT by Rockridge Geotechnical Inc., November 2014



7544 DUBLIN BOULEVARD
Dublin, California

SITE PLAN

Date 01/17/15	Project No. 14-723	Figure 2

ROCKRIDGE GEOTECHNICAL

Reference: Base map from a drawing titled "Preliminary Grading & Drainage Plan", by Carlson, Barbee & Gibson, Inc., dated March 5, 2013.

PROJECT: **7544 DUBLIN BOULEVARD**
Dublin, California

Log of Boring RG-1

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 7/18/14
Date finished: 7/18/14
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Down Hole Wireline
Sampler: Sprague & Henwood (S&H), Shelby Tube (ST)
Logged by: P. Wildvine

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA: Fines %	LABORATORY TEST DATA: Natural Moisture Content, %	LABORATORY TEST DATA: Dry Density Lbs/Cu Ft
0						2 inches Asphalt Concrete (AC)						
1						CLAY with SAND (CL) dark brown, stiff, moist						
2	S&H		4 5 8	9								
3						olive-brown						
4	S&H		6 8 12	14							20.2	108
5						very stiff						
6	S&H		7 14 16	21								
8						stiff						
9	S&H		10 10 10	14								
10						very stiff						
11	S&H		7 11 17	20								
12					CL	mottled gray						
13	ST		100 psi				PP		2,250			
16						⊽ (07/18/14; 1:16 PM)						
17	ST		75 psi									
24	S&H		7 9 12	15		stiff to very stiff						
25–30												

Boring terminated at a depth of 25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 16 feet during drilling.

[1] S&H blow counts for the last two increments were converted to SPT N-Values using a factor of 0.7 to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 14-723
Figure: A-1

ROCKRIDGE 14-723.GPJ TR.GDT 8/26/14

PROJECT: **7544 DUBLIN BOULEVARD**
Dublin, California

Log of Boring RG-2

PAGE 1 OF 1

Boring location: See Site Plan, Figure 2
Date started: 7/18/14
Date finished: 7/18/14
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Down Hole Wireline
Sampler: Sprague & Henwood (S&H), Shelby Tube (ST)
Logged by: P. Wildvine

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						4 inches Asphalt Concrete (AC)						
2	S&H		9 13 16	20	CL	CLAY (CL) dark brown, very stiff, moist						
4	S&H		7 14 17	22	CL	CLAY with SAND (CL) olive-brown, very stiff, moist						
6	S&H		6 7 8	11		stiff, dry to moist, trace fine gravel						
9	S&H		5 5 6	8		dark brown, moist						
11	S&H		7 11 14	18		gray-brown, very stiff						
13	ST		100 psi			mottled gray/yellow, medium stiff to stiff	PP		700			
17	S&H		7 8 10	13		olive-brown, stiff						
21	ST		200 psi		CL	CLAY (CL) gray-brown, medium stiff to stiff, wet	PP		800			
24	S&H		11 14 15	20		very stiff						

Boring terminated at a depth of 25 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

[1] S&H blow counts for the last two increments were converted to SPT N-Values using a factor of 0.7 to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 14-723
Figure: A-2

PROJECT: **7544 DUBLIN BOULEVARD**
Dublin, California

Log of Boring RG-3

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 7/18/14
Date finished: 7/18/14
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Down Hole Wireline
Sampler: Sprague & Henwood (S&H), Shelby Tube (ST)
Logged by: P. Wildvine

	SAMPLES						LABORATORY TEST DATA					
DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						4 inches Asphalt Concrete (AC)						
1												
2	S&H		7 11 17	20	CL	CLAY with SAND and GRAVEL (CL) yellow-brown, very stiff, moist LL = 46, PI = 21, see Appendix B					22.6	101
3						CLAY with SAND (CL) dark brown, very stiff, moist						
4	S&H		9 15 17	22								
5												
6	S&H		10 14 18	22								
7												
8												
9	S&H		5 5 5	7		olive-brown, medium stiff TxUU Test, see Appendix B	TxUU	600	1,450		25.0	98
10												
11						stiff						
12	S&H		7 9 10	13		mottled gray/yellow						
13												
14	ST		150 psi			TxUU Test, see Appendix B Consolidation Test, see Appendix B	TxUU	1,000	670		24.8 26.6	95 95
15												
16					CL							
17						soft to medium stiff						
18	ST		125 psi				PP		500			
19												
20												
21												
22												
23												
24	S&H		7 9 10	13		olive-brown, stiff						
25												
26												
27												
28												
29	S&H		7 10 11	15		∇ (07/18/14; 8:58 AM) stiff to very stiff						
30												

ROCKRIDGE GEOTECHNICAL

Project No.: 14-723
Figure: A-3a

PROJECT: **7544 DUBLIN BOULEVARD**
Dublin, California

Log of Boring RG-3

PAGE 2 OF 2

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA: Fines %	LABORATORY TEST DATA: Natural Moisture Content, %	LABORATORY TEST DATA: Dry Density Lbs/Cu Ft
						CLAY with SAND (CL) (continued)						
31												
32												
33												
34	S&H	▨	10 11 13	17		very stiff						
35												
36					CL							
37												
38												
39	S&H	▨	7 9 11	14		stiff, trace fine gravel						
40												
41												
42						SANDY CLAY (CL) gray, very stiff, moist						
43												
44	S&H	▨	9 14 16	21								
45												
46					CL							
47												
48												
49	S&H	▨	11 16 18	24		olive-brown						
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 50 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 29 feet during drilling.

[1] S&H blow counts for the last two increments were converted to SPT N-Values using a factor of 0.7 to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 14-723

Figure: A-3b

ROCKRIDGE 14-723.GPJ TR.GDT 8/26/14

PROJECT: **7544 DUBLIN BOULEVARD**
Dublin, California

Log of Boring RG-4

PAGE 1 OF 2

Boring location: See Site Plan, Figure 2
Date started: 7/17/14
Date finished: 7/17/14
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Down Hole Wireline
Sampler: Sprague & Henwood (S&H), Shelby Tube (ST)
Logged by: P. Wildvine

LABORATORY TEST DATA

DEPTH (feet)	SAMPLES Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						5 inches Asphalt Concrete (AC)						
1						CLAY with SAND (CL) dark brown, stiff, moist, trace fine gravel						
2	S&H		7 9 11	14		LL = 43, PI = 24, see Appendix B					24.5	99
3												
4	S&H		9 10 16	18		very stiff						
5												
6	S&H		9 13 16	20								
7												
8												
9	S&H		7 7 6	9		olive-brown, stiff						
10												
11												
12	S&H		4 5 6	8		medium stiff to stiff						
13						▽ (07/17/14; 12:57 PM)						
14												
15					CL							
16												
17	ST		125 psi			TxUU Test, see Appendix B	TxUU	1,300	770		29.9	89
18						LL = 48, PI = 31, see Appendix B Consolidation Test, see Appendix B					29.9	92
19												
20												
21												
22												
23												
24	S&H		7 8 10	13		stiff						
25												
26												
27												
28												
29	S&H		8 11 15	18		very stiff						
30												

ROCKRIDGE GEOTECHNICAL

Project No.: 14-723

Figure: A-4a

PROJECT: **7544 DUBLIN BOULEVARD**
Dublin, California

Log of Boring RG-4

PAGE 2 OF 2

DEPTH (feet)	SAMPLES: Sampler Type	SAMPLES: Sample	SAMPLES: Blows/ 6"	SAMPLES: SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	LABORATORY TEST DATA: Confining Pressure Lbs/Sq Ft	LABORATORY TEST DATA: Shear Strength Lbs/Sq Ft	LABORATORY TEST DATA: Fines %	LABORATORY TEST DATA: Natural Moisture Content, %	LABORATORY TEST DATA: Dry Density Lbs/Cu Ft
						CLAY with SAND (CL) (continued)						
31												
32					CL							
33						SANDY CLAY (CL) olive-gray, stiff, moist						
34	S&H	▨	8 9 10	13								
35						(07/17/14; 2:17 PM)						
36												
37												
38												
39	S&H	▨	5 7 9	11		TxUU Test, see Appendix B	TxUU	2,200	1,640		27.4	97
40					CL							
41												
42												
43												
44	S&H	▨	9 10 14	17		gray, very stiff						
45												
46												
47						CLAY (CL) gray, very stiff, moist						
48					CL							
49	S&H	▨	9 11 12	16								
50												
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 50 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 13 feet during drilling.

[1] S&H blow counts for the last two increments were converted to SPT N-Values using a factor of 0.7 to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 14-723

Figure: A-4b

PROJECT: **7544 DUBLIN BOULEVARD**
Dublin, California

Log of Boring RG-5

Boring location: See Site Plan, Figure 2
Logged by: P. Wildvine
Date started: 7/17/14
Date finished: 7/17/14
Drilling method: Hollow Stem Auger
Hammer weight/drop: 140 lbs./30 inches
Hammer type: Down Hole Wireline
Sampler: Sprague & Henwood (S&H), Shelby Tube (ST)

	SAMPLES						LABORATORY TEST DATA					
DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value^1	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						6 inches Asphalt Concrete (AC)						
1	S&H	▨	7 12 15	19	CL	CLAY (CL) dark brown, very stiff, moist, trace fine sand and fine gravel LL = 40, PI = 22, see Appendix B					16.6	108
3	S&H	▨	9 14 13	19	CL	SANDY CLAY (CL) olive-brown, stiff, moist, trace fine gravel						
5	S&H	▨	5 7 8	11		LL = 37, PI = 17, see Appendix B					22.2	98
8	S&H	▨	3 3 4	5		medium stiff						
10	S&H	▨	5 6 7	9		stiff						
11					GC	CLAYEY GRAVEL with SAND (GC) olive-brown, loose, moist						
12.5	ST	▨	75 psi		CL	∇ CLAY (CL) olive-gray, soft to medium stiff, moist (07/17/14; 9:19 AM) Consolidation Test, see Appendix B LL = 42, PI = 24, see Appendix B	PP		500		30.8	88
16.5	ST	▨	150 psi			medium stiff	PP		600			
24	S&H	▨	5 7 9	11								
25.5						olive gray, stiff, moist						
28					CL	CLAY (CL) dark gray, very stiff, moist, trace fine sand						
29	S&H	▨	10 11 13	17								
30												

ROCKRIDGE GEOTECHNICAL

Project No.: 14-723
Figure: A-5a

PROJECT: **7544 DUBLIN BOULEVARD**
Dublin, California

Log of Boring RG-5

PAGE 2 OF 2

DEPTH (feet)	Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						CLAY (CL) (continued)						
31												
32												
33												
34	S&H	■	10 13 17	21	CL	olive-gray						
35												
36												
37												
38						SANDY CLAY (CL) olive-gray, hard, moist						
39	S&H	■	16 22 24	32								
40												
41												
42												
43					CL							
44	S&H	■	13 19 22	29		very stiff to hard						
45												
46												
47												
48						CLAY (CL) olive-gray, very stiff, moist						
49	S&H	■	7 14 14	20	CL							
50					CL	SANDY CLAY (CL) olive-gray, very stiff, moist						
51												
52												
53												
54												
55												
56												
57												
58												
59												
60												

Boring terminated at a depth of 50 feet below ground surface.
Boring backfilled with cement grout.
Groundwater encountered at a depth of 13.5 feet during drilling.

[1] S&H blow counts for the last two increments were converted to SPT N-Values using a factor of 0.7 to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 14-723

Figure: A-5b

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size	**Gravels** (More than half of coarse fraction > no. 4 sieve size)	**GW**	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	**SW**	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	**Silts and Clays** LL = < 50	**ML**	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	**MH**	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		**PT**	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	**Grain Size in Millimeters**
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel	3" to No. 4	76.2 to 4.76
coarse	3" to 3/4"	76.2 to 19.1
fine	3/4" to No. 4	19.1 to 4.76
Sand	No. 4 to No. 200	4.76 to 0.075
coarse	No. 4 to No. 10	4.76 to 2.00
medium	No. 10 to No. 40	2.00 to 0.420
fine	No. 40 to No. 200	0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

▽	Unstabilized groundwater level
▼	Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

⬒	Sample taken with Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter. Darkened area indicates soil recovered
◩	Classification sample taken with Standard Penetration Test sampler
◨	Undisturbed sample taken with thin-walled tube
☒	Disturbed sample
⊡	Sampling attempted with no recovery
◫	Core sample
▣	Analytical laboratory sample
▥	Sample taken with Direct Push sampler
▦	Sonic

SAMPLER TYPE

C	Core barrel
CA	California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter
D&M	Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube
O	Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube
PT	Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube
S&H	Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter
SPT	Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter
ST	Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

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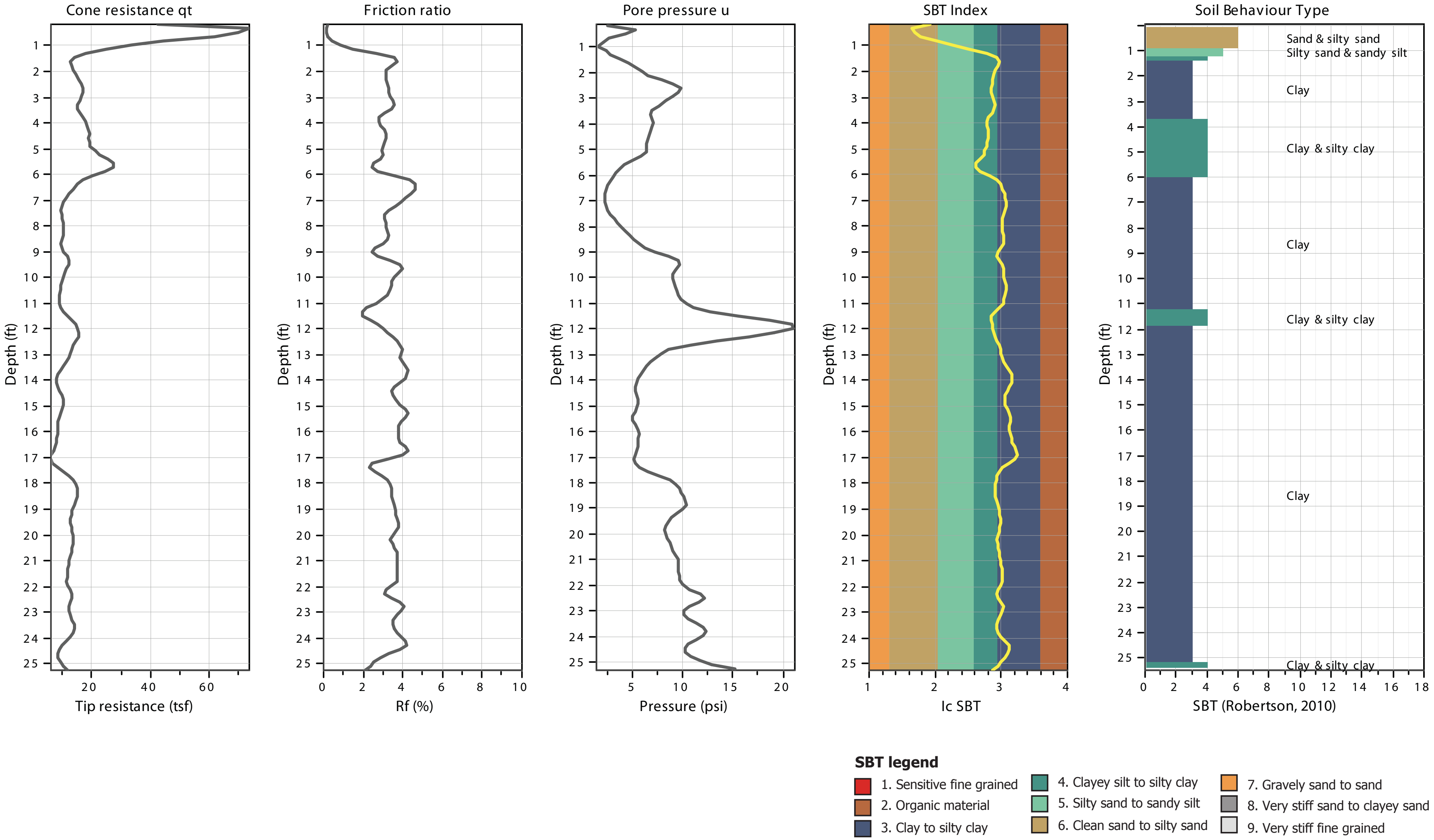
CLASSIFICATION CHART

Date 08/19/14 | Project No. 14-723 | Figure A-6



Total depth: 25.26 ft, Date: 7/15/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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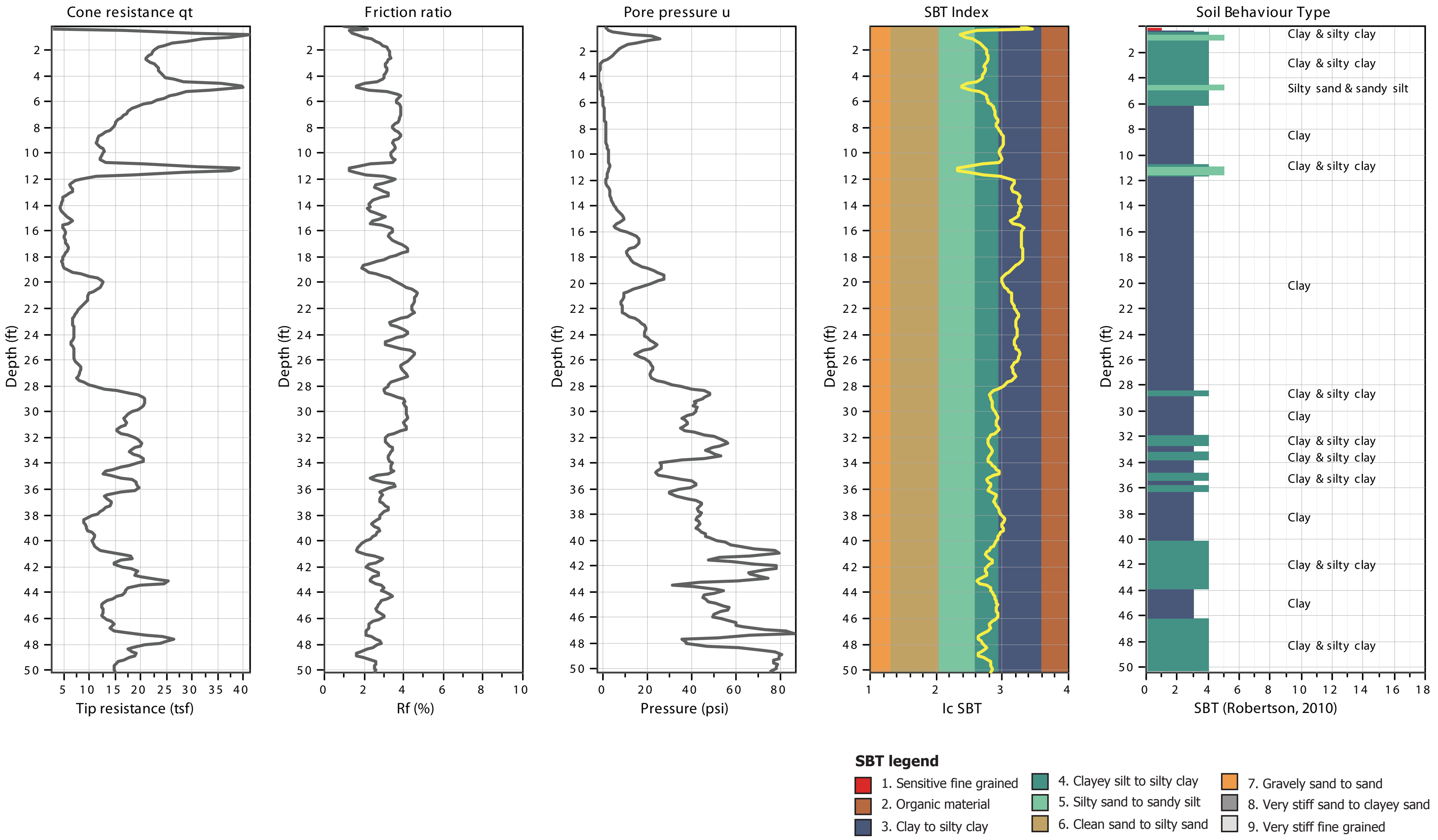
CONE PENETRATION TEST RESULTS
CPT-RG-1

Date 07/23/14	Project No. 14-723	Figure A-7



Total depth: 50.20 ft, Date: 7/14/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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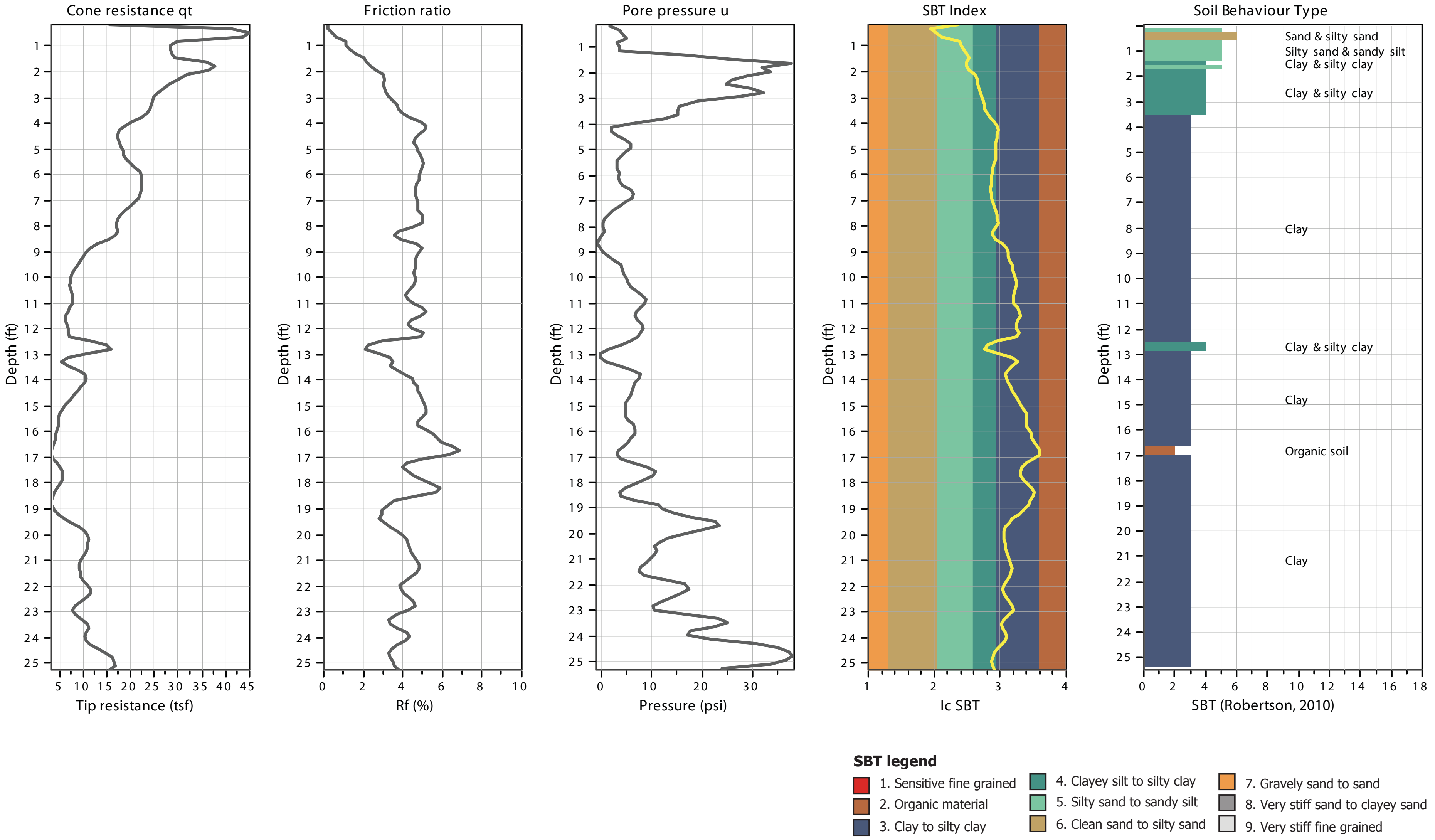
CONE PENETRATION TEST RESULTS
CPT-RG-2

Date 07/23/14	Project No. 14-723	Figure A-8



Total depth: 25.26 ft, Date: 7/14/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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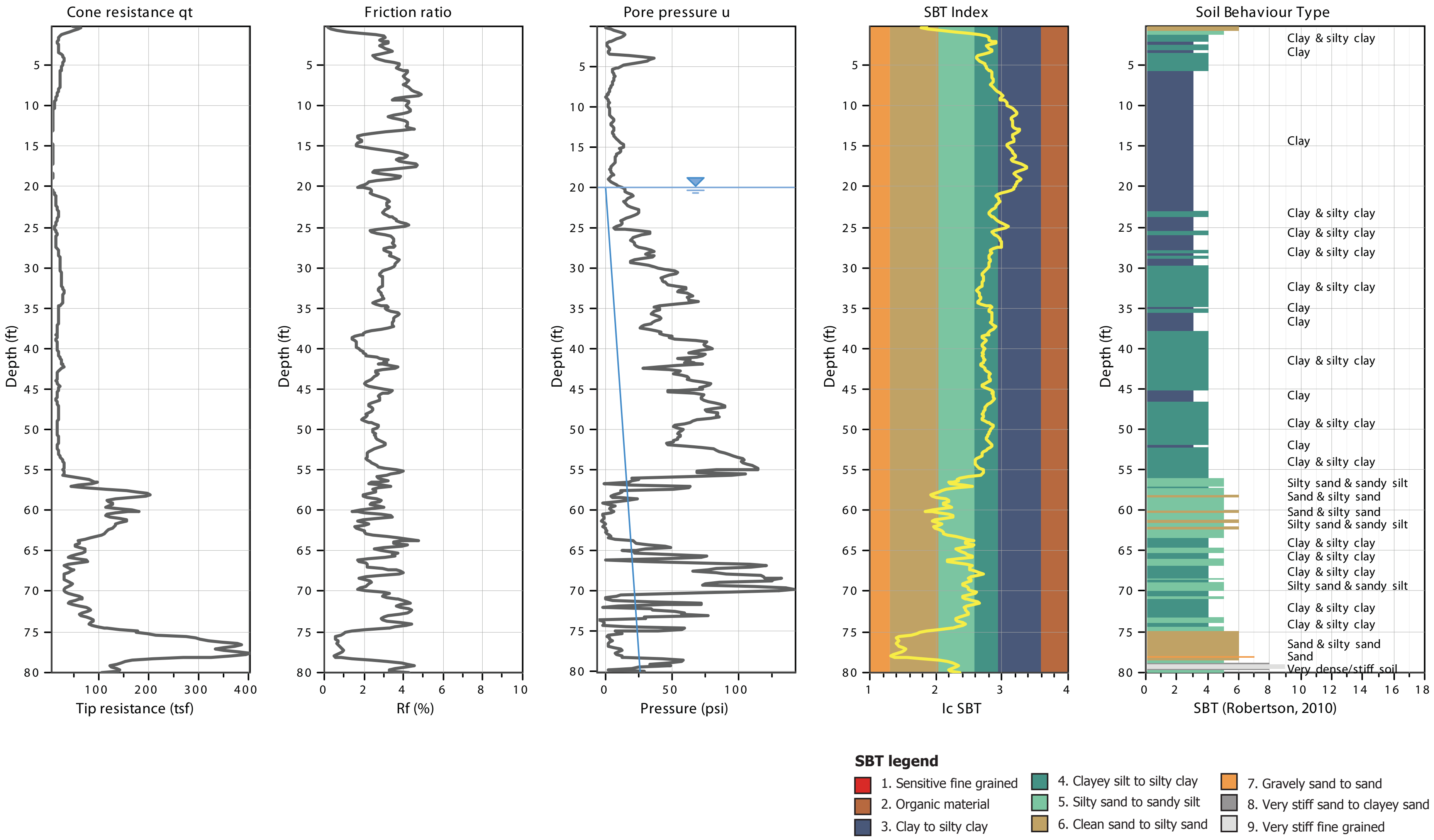
CONE PENETRATION TEST RESULTS
CPT-RG-3

Date 07/23/14	Project No. 14-723	Figure A-9



Total depth: 80.05 ft, Date: 7/15/2014
Groundwater estimated at 20 feet using pore pressure dissipation test results.
Cone Operator: Gregg Drilling & Testing, Inc.

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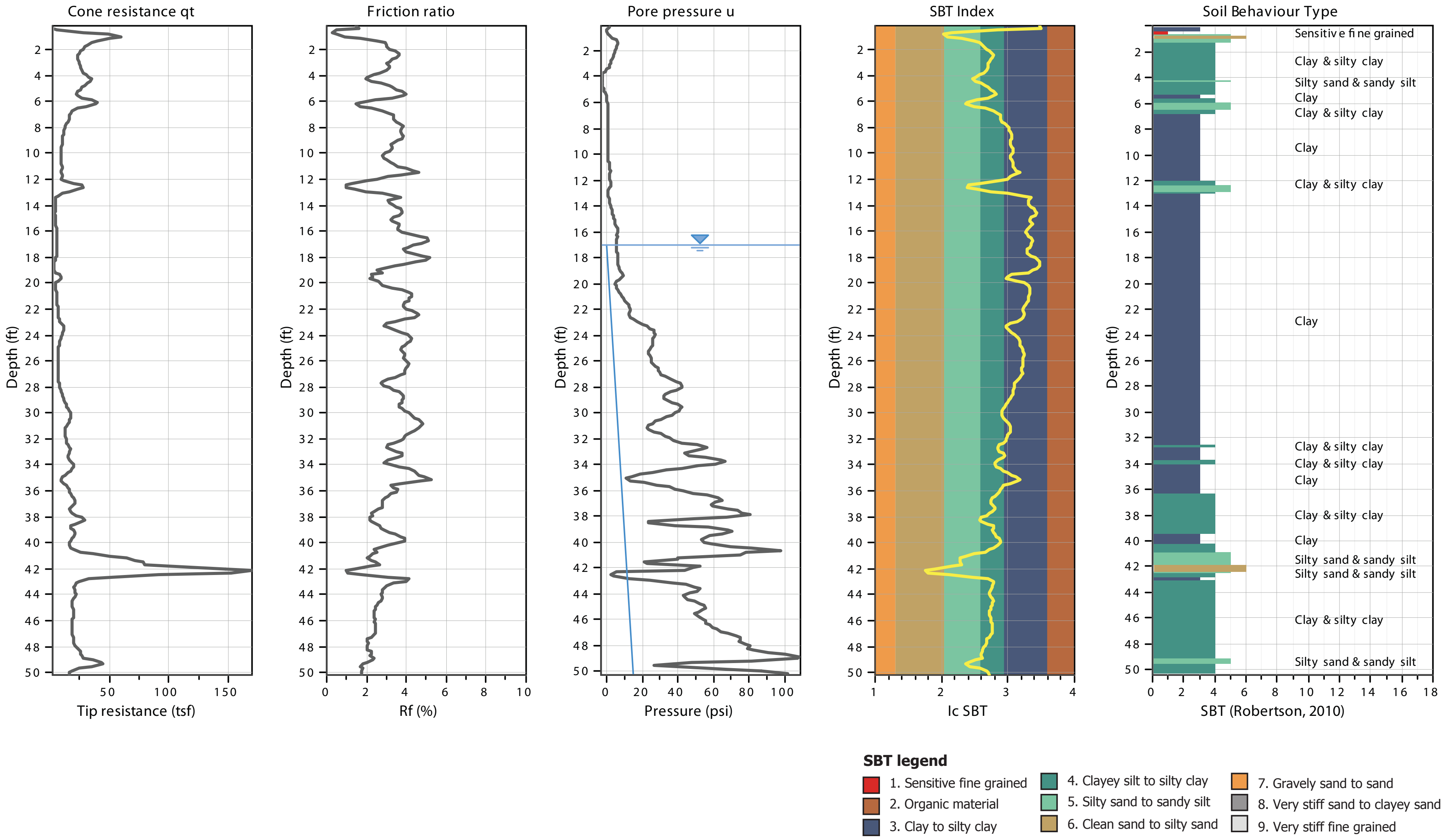
CONE PENETRATION TEST RESULTS
CPT-RG-4

Date 07/23/14	Project No. 14-723	Figure A-10



Total depth: 50.20 ft, Date: 7/14/2014
Groundwater estimated at 17 feet using pore pressure dissipation test results.
Cone Operator: Gregg Drilling & Testing, Inc.

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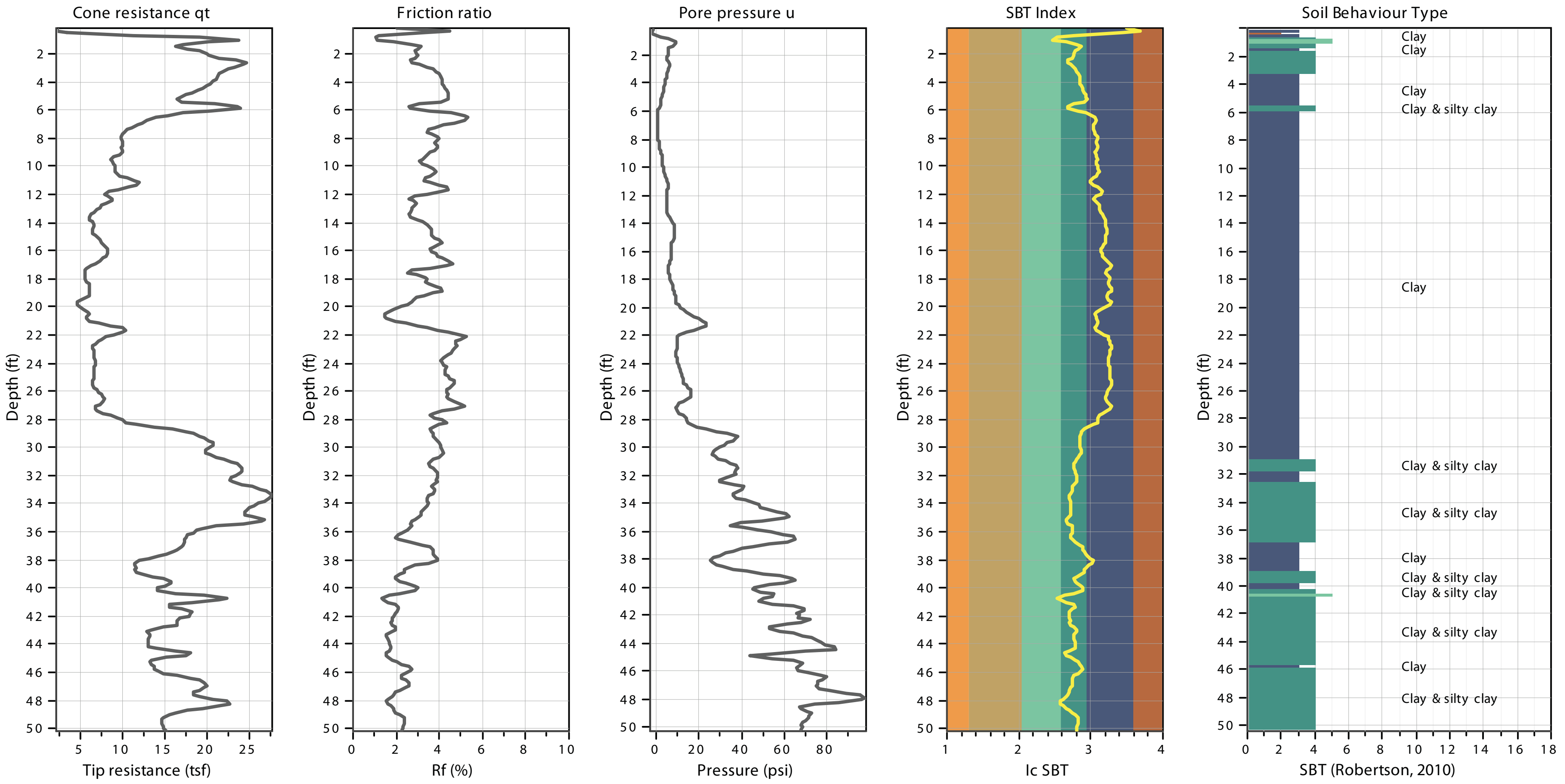
CONE PENETRATION TEST RESULTS

CPT-RG-5

Date 07/23/14 | Project No. 14-723 | Figure A-11



SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬜ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Total depth: 50.20 ft, Date: 7/14/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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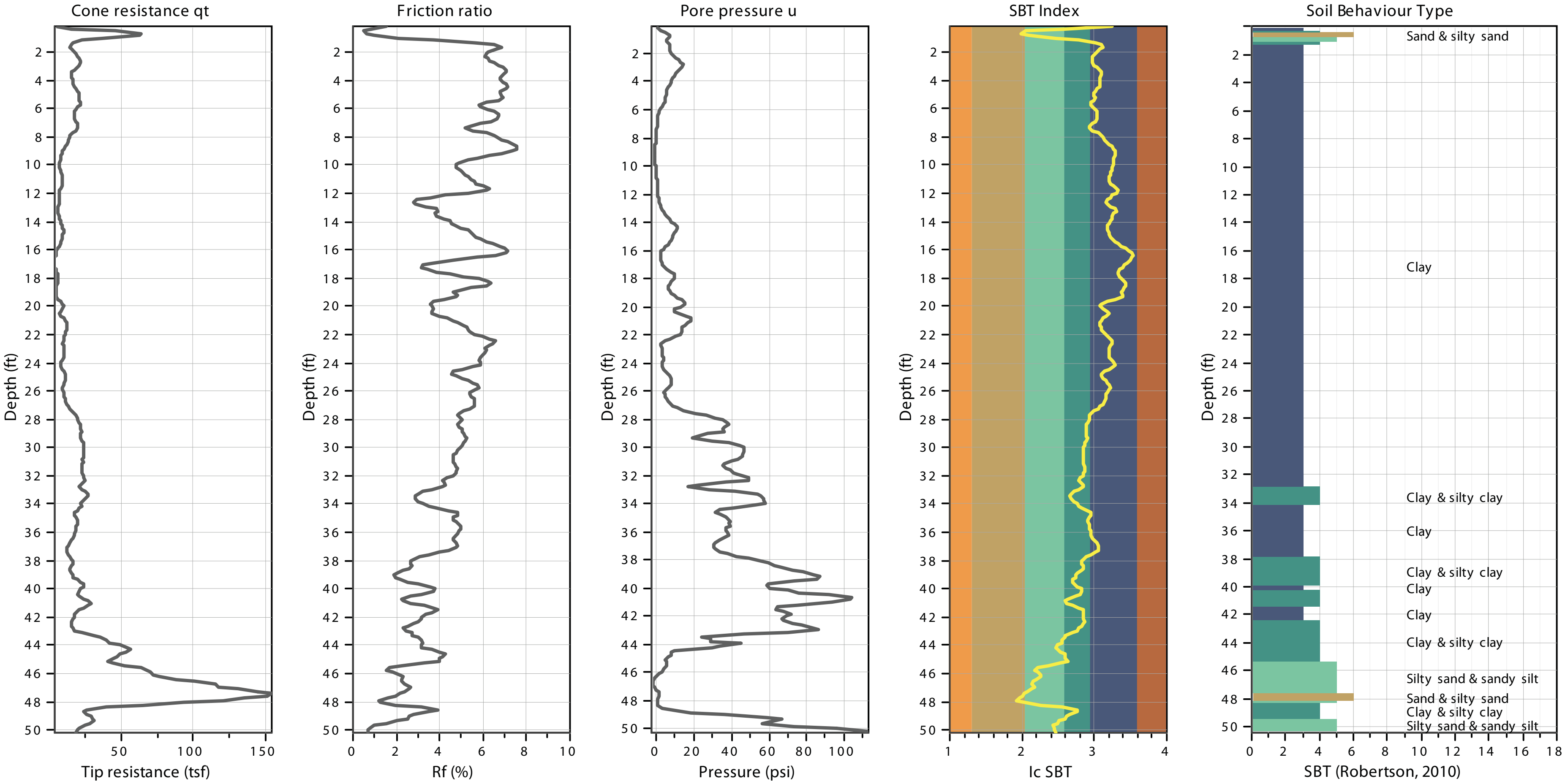
CONE PENETRATION TEST RESULTS
CPT-RG-6

Date 07/23/14	Project No. 14-723	Figure A-12



SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟨 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

Total depth: 50.20 ft, Date: 7/14/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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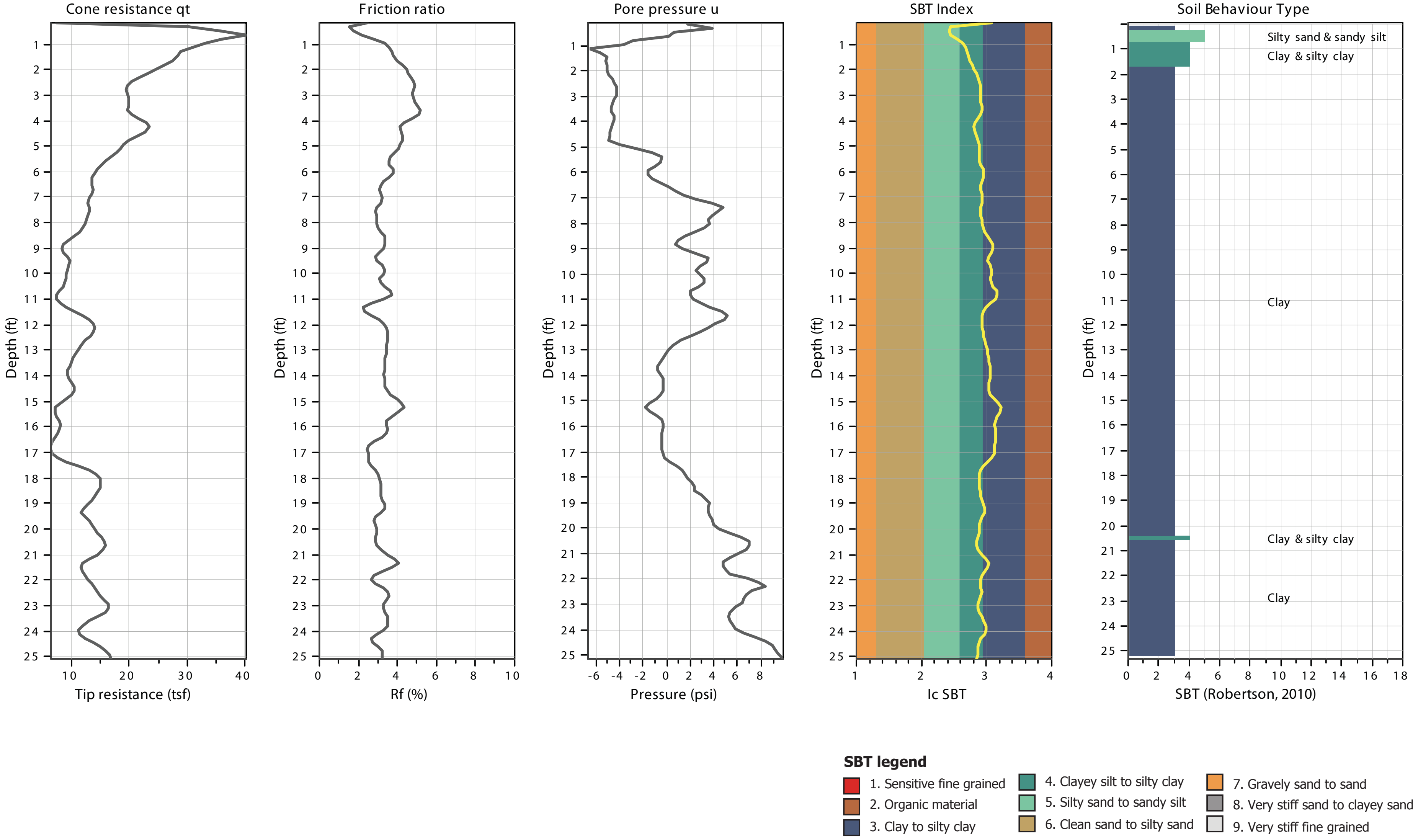
CONE PENETRATION TEST RESULTS
CPT-RG-7

Date 07/23/14	Project No. 14-723	Figure A-13



Total depth: 25 ft, Date: 11/19/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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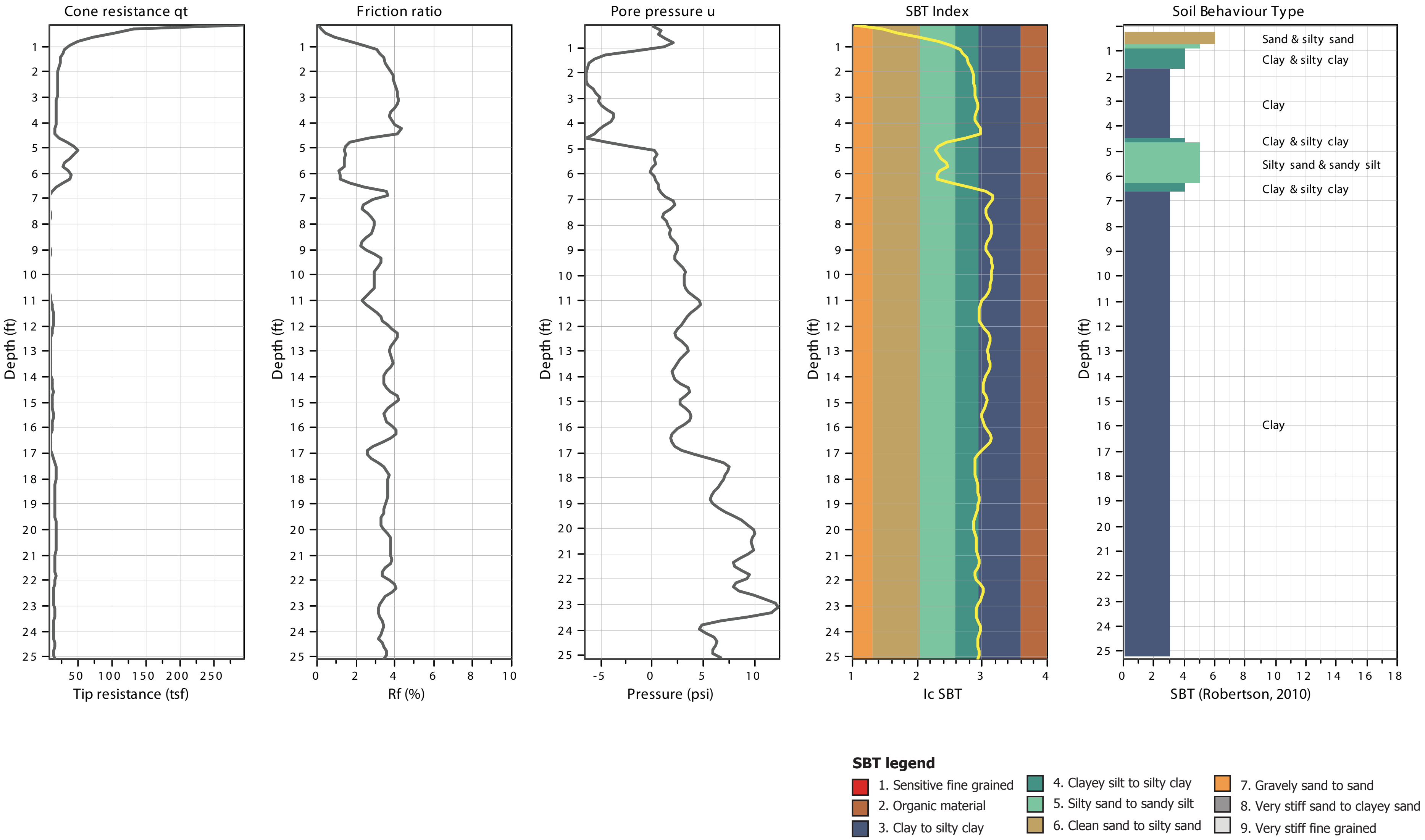
CONE PENETRATION TEST RESULTS
CPT-RG-8

Date 01/17/15	Project No. 14-723	Figure A-14



Total depth: 25 ft, Date: 11/19/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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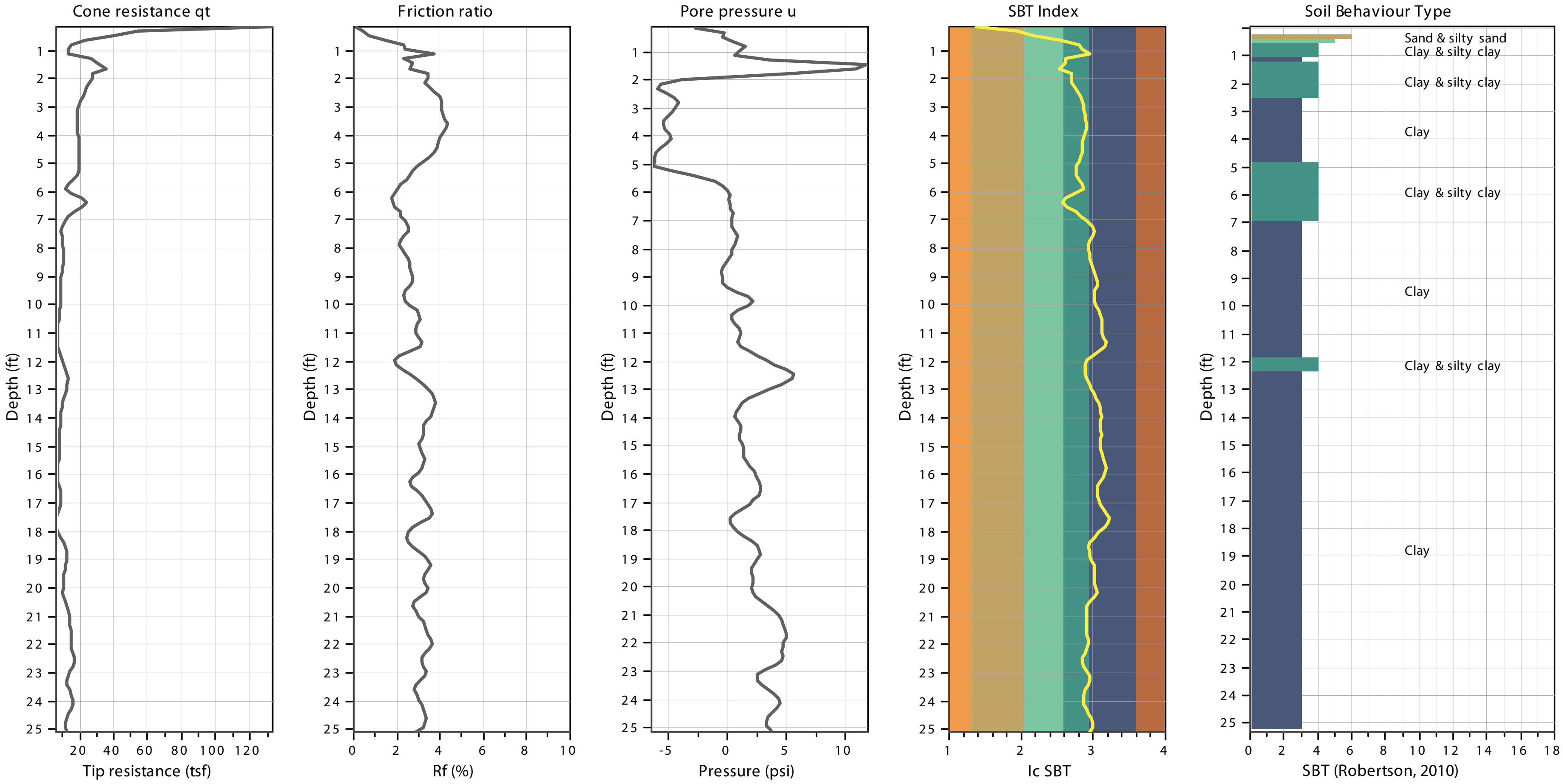
CONE PENETRATION TEST RESULTS
CPT-RG-9

Date 01/17/15	Project No. 14-723	Figure A-15



SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟫 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Total depth: 25 ft, Date: 11/19/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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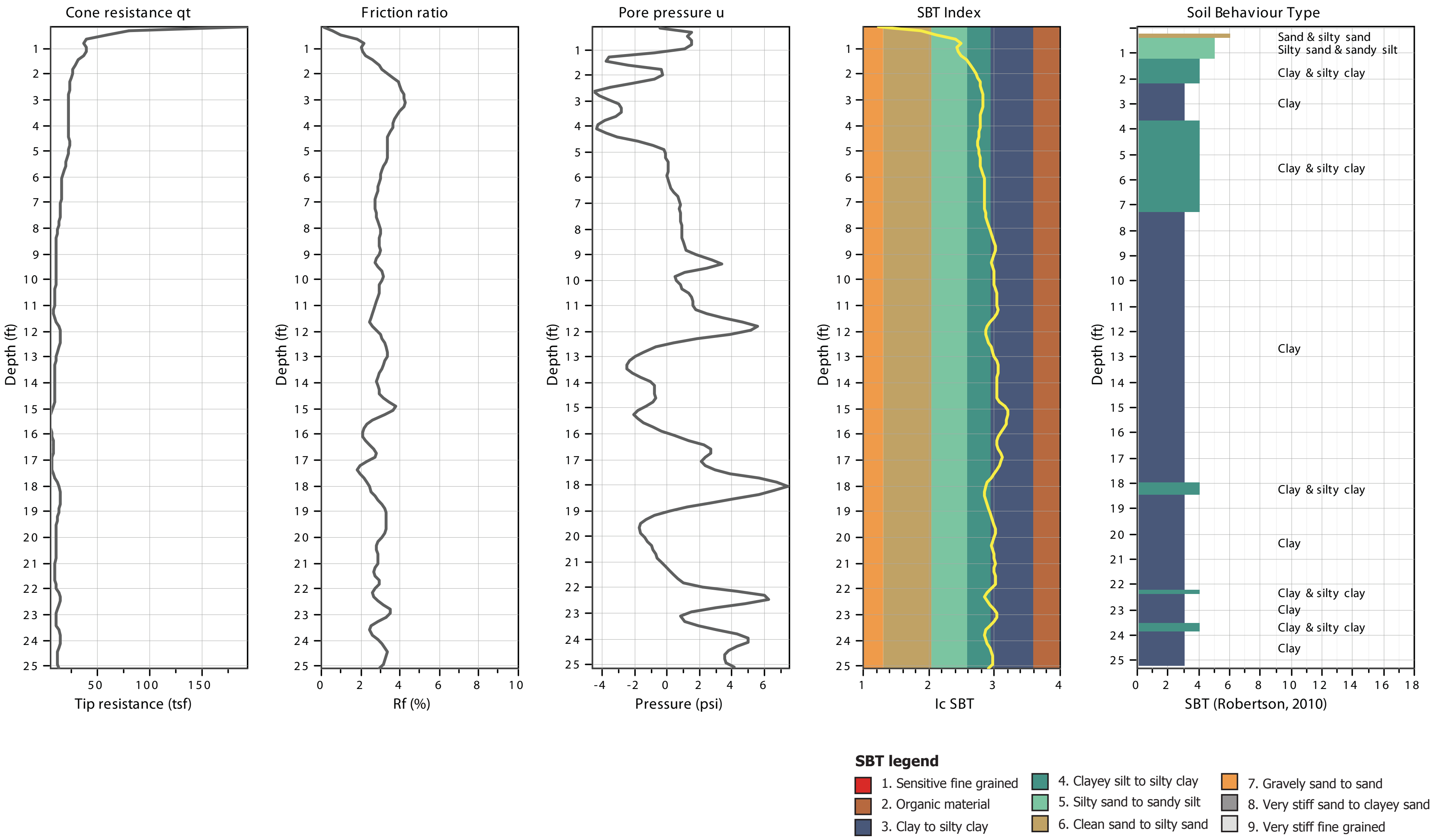
CONE PENETRATION TEST RESULTS
CPT-RG-10

Date 01/17/15	Project No. 14-723	Figure A-16



Total depth: 25 ft, Date: 11/19/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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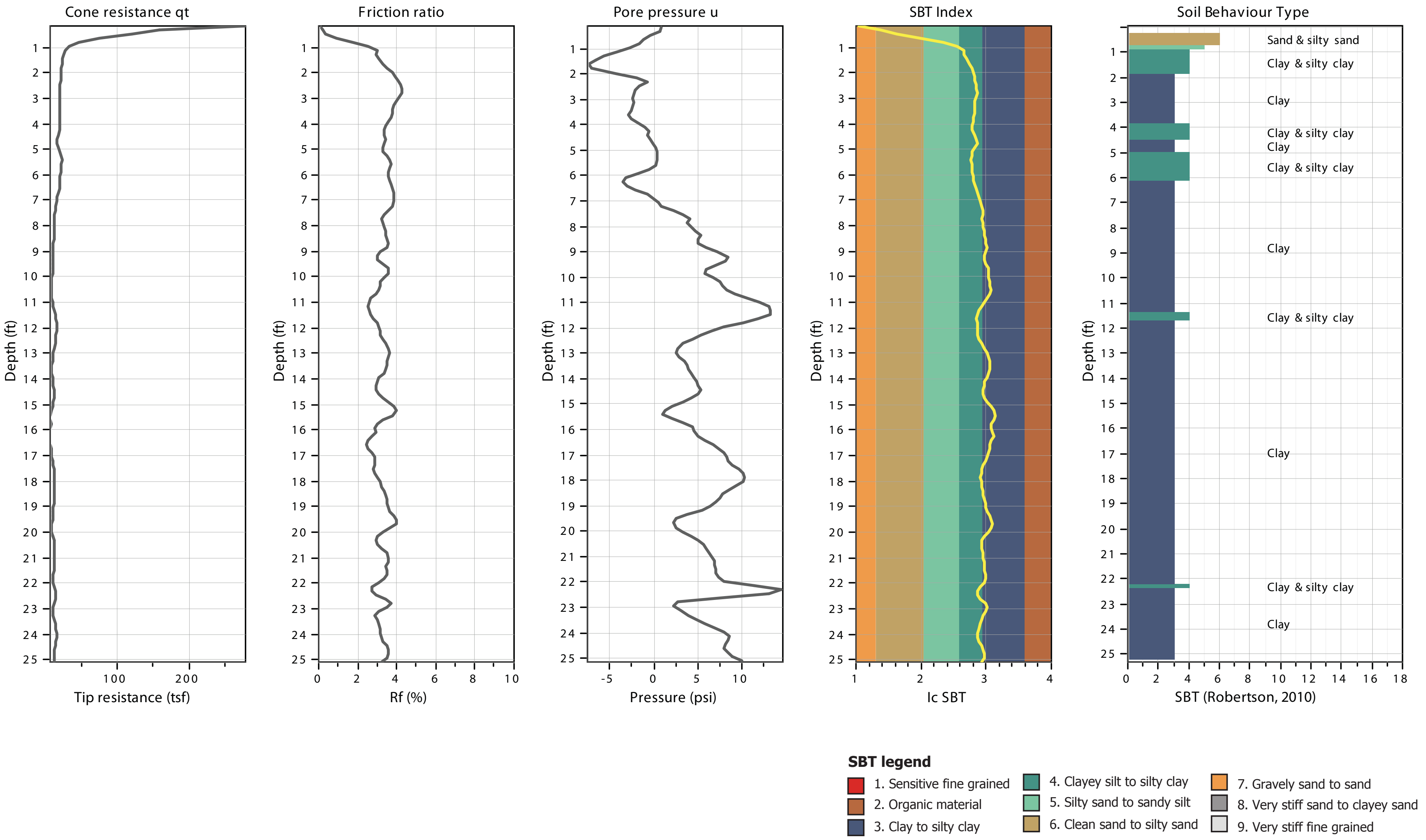
CONE PENETRATION TEST RESULTS
CPT-RG-11

Date 01/17/15	Project No. 14-723	Figure A-17



Total depth: 25 ft, Date: 11/19/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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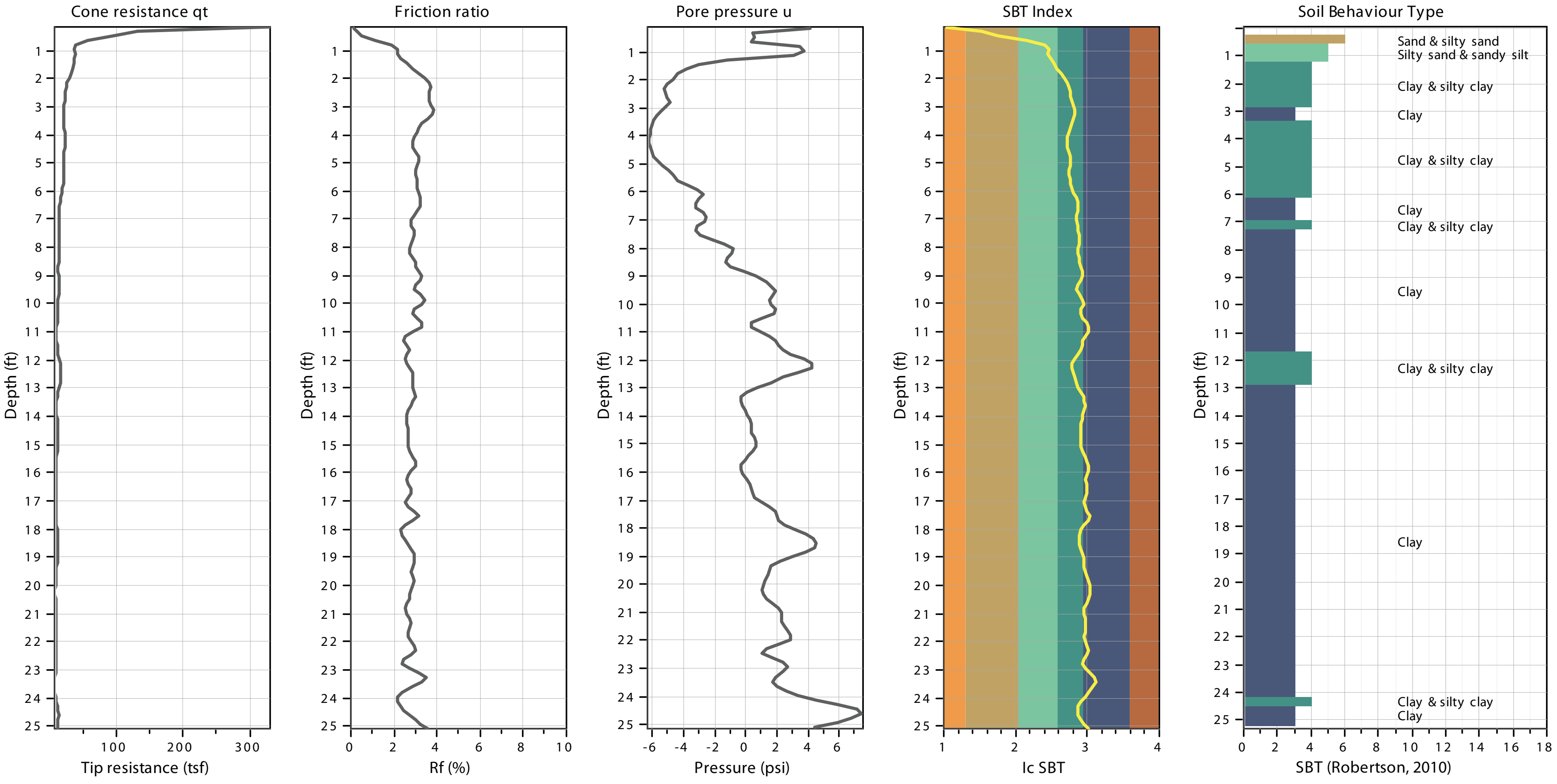
CONE PENETRATION TEST RESULTS
CPT-RG-12

Date 01/17/15	Project No. 14-723	Figure A-18



SBT legend

- 🟥 1. Sensitive fine grained
- 🟫 2. Organic material
- 🟦 3. Clay to silty clay
- 🟩 4. Clayey silt to silty clay
- 🟩 5. Silty sand to sandy silt
- 🟨 6. Clean sand to silty sand
- 🟧 7. Gravely sand to sand
- ⬛ 8. Very stiff sand to clayey sand
- ⬜ 9. Very stiff fine grained

Total depth: 25 ft, Date: 11/19/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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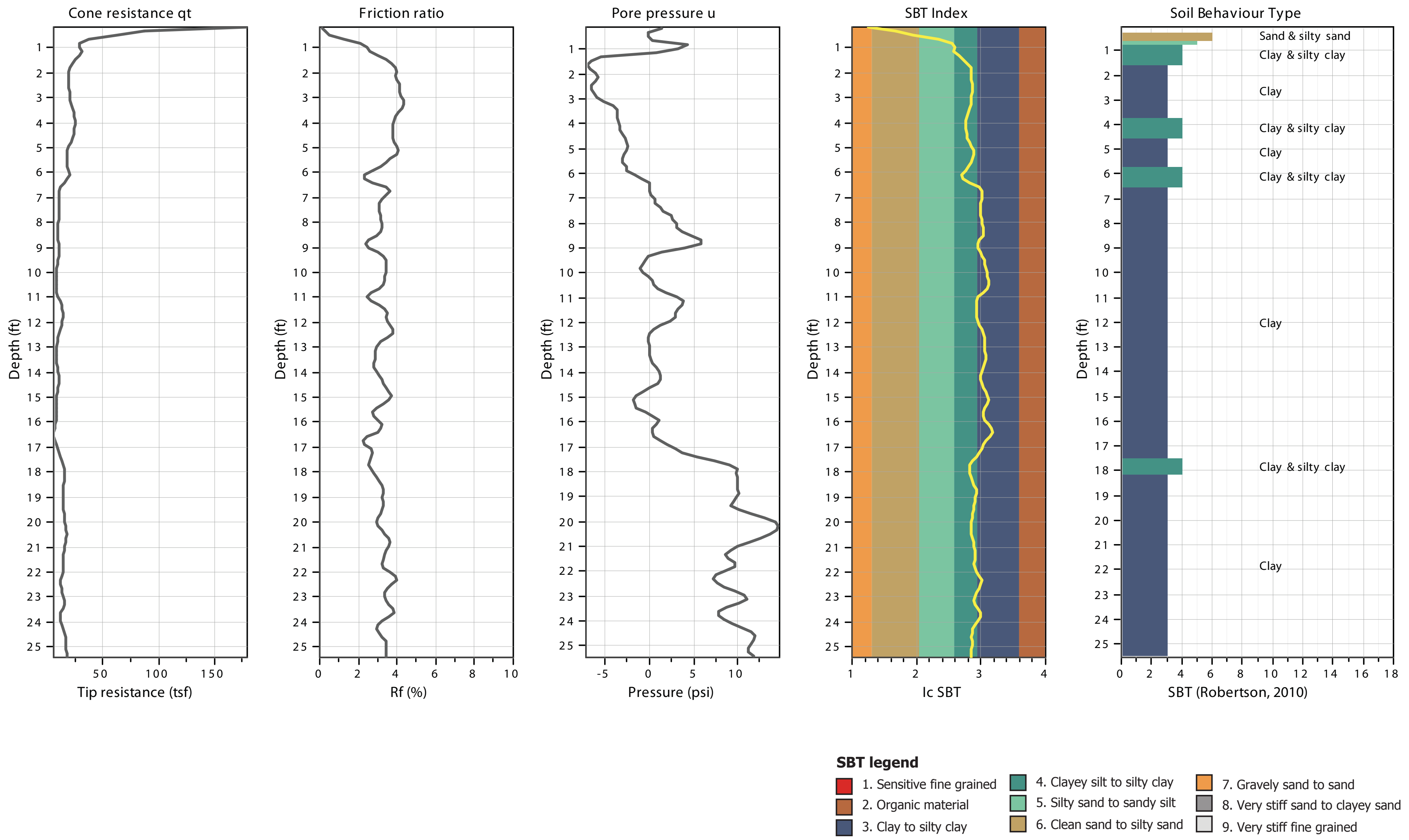
CONE PENETRATION TEST RESULTS
CPT-RG-13

Date 01/17/15	Project No. 14-723	Figure A-19



Total depth: 25 ft, Date: 11/19/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

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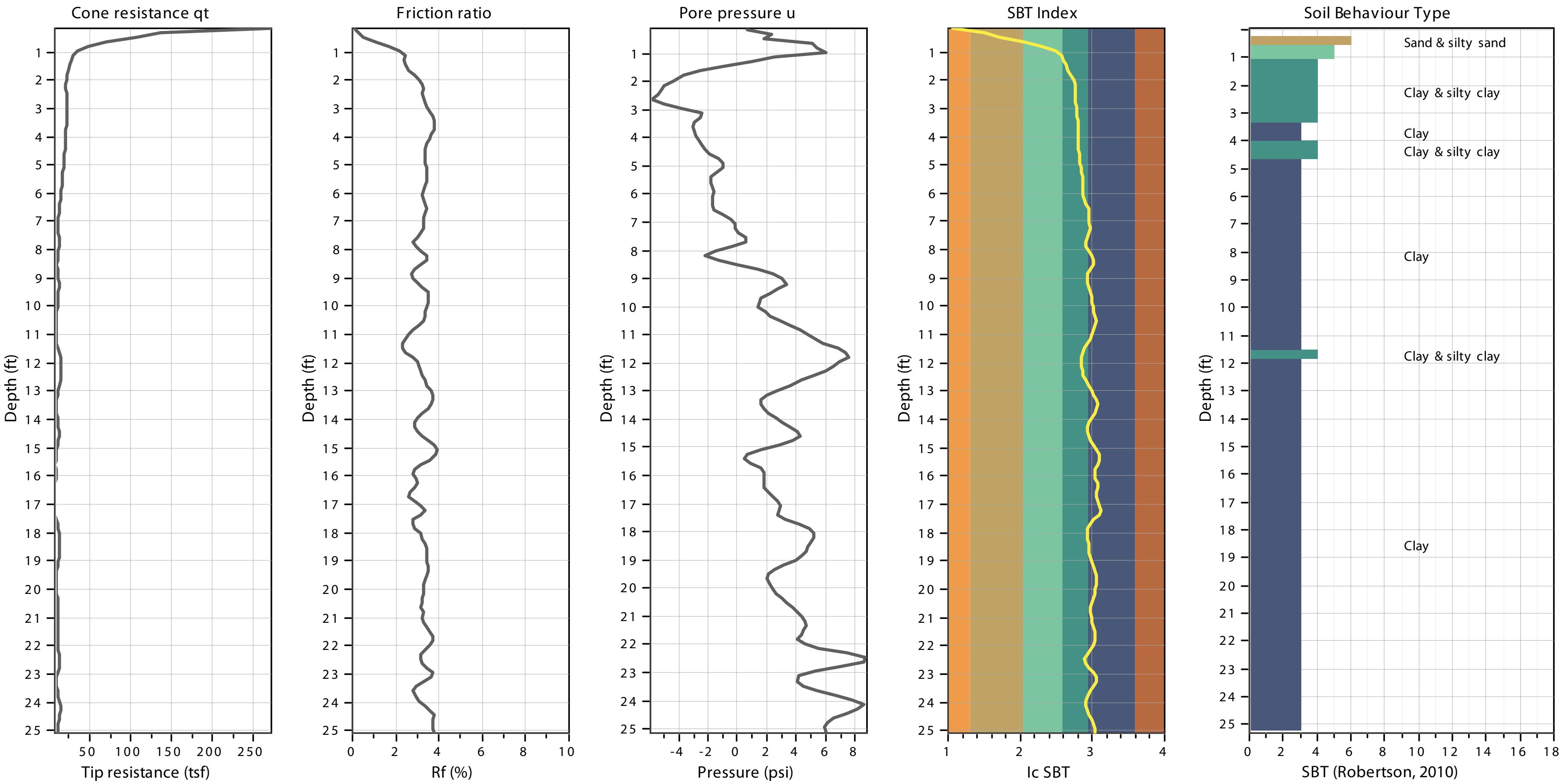
CONE PENETRATION TEST RESULTS
CPT-RG-14

Date 01/17/15	Project No. 14-723	Figure A-20



SBT legend

🟥 1. Sensitive fine grained
🟫 2. Organic material
🟦 3. Clay to silty clay
🟩 4. Clayey silt to silty clay
🟩 5. Silty sand to sandy silt
🟫 6. Clean sand to silty sand
🟧 7. Gravely sand to sand
⬛ 8. Very stiff sand to clayey sand
⬜ 9. Very stiff fine grained

Total depth: 25 ft, Date: 11/19/2014
Groundwater depth not measured.
Cone Operator: Gregg Drilling & Testing, Inc.

7544 DUBLIN BOULEVARD
Dublin, California

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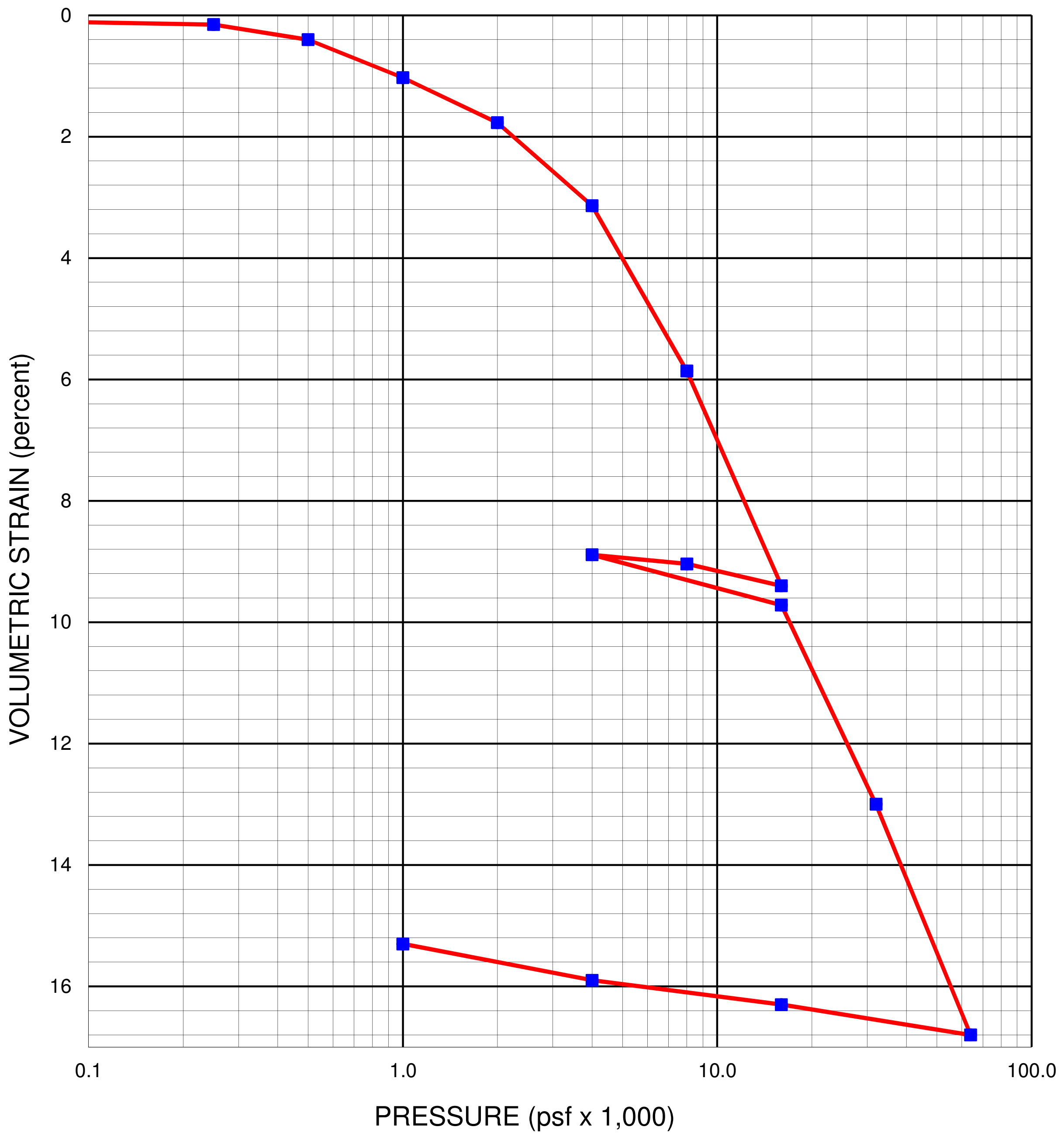
CONE PENETRATION TEST RESULTS
CPT-RG-15

Date 01/17/15 | Project No. 14-723 | Figure A-21



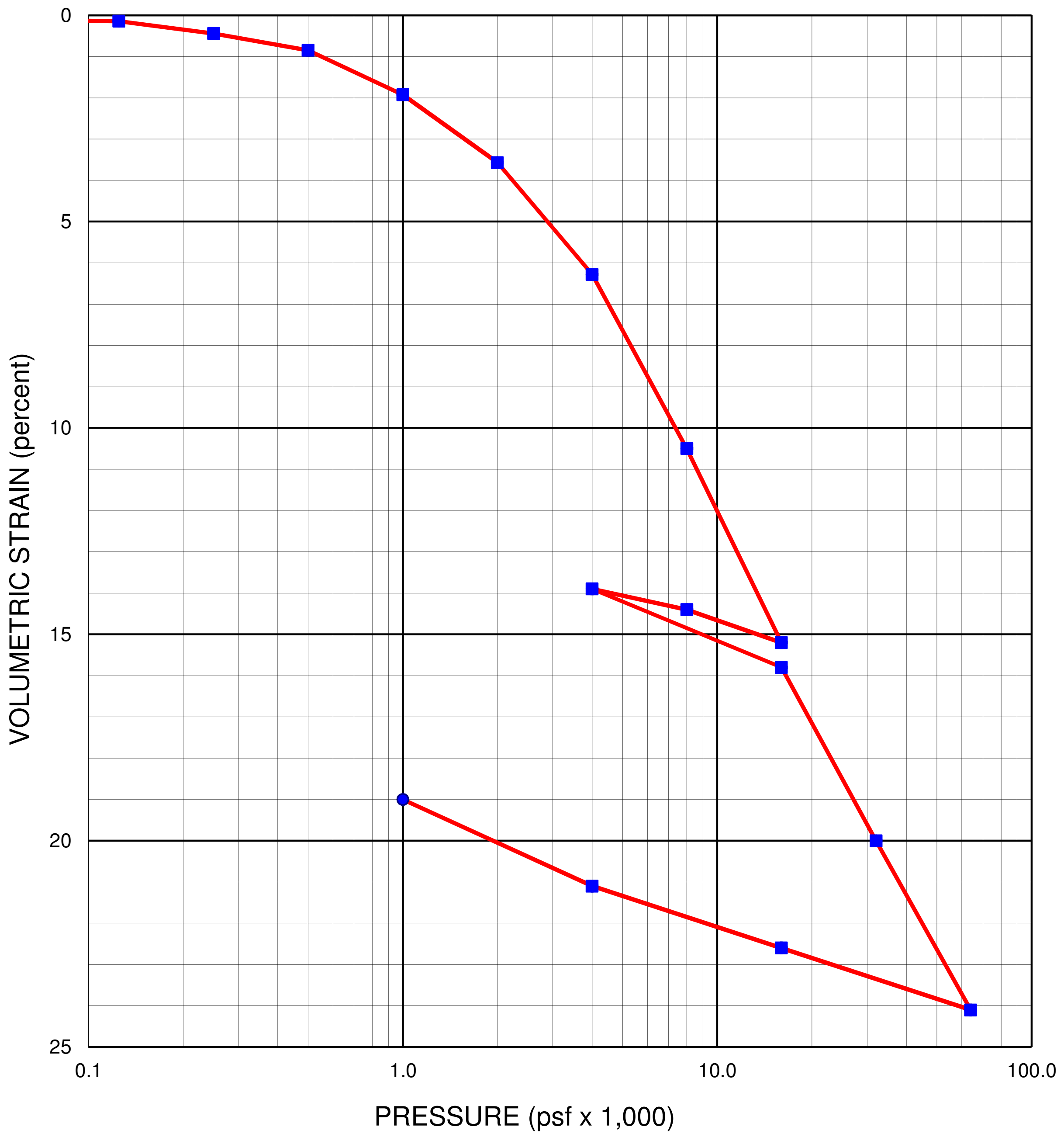
Sampler Type:	Shelby Tube			Condition		Before Test			After Test	
Diameter (in)	2.42	Height (in)	1.00	Water Content	w_o	26.6	%	w_f	18.4	%
Overburden Pressure, p_o	1,500	psf		Void Ratio	e_o	0.77		e_f	0.50	
Preconsol. Pressure, p_c	4,100	psf		Saturation	S_o	92.8	%	S_f	99	%
Compression Ratio, $C_{\varepsilon c}$	0.13			Dry Density	γ_d	95	pcf	γ_d	112	pcf
Recompression Ratio, $C_{\varepsilon r}$	0.014	LL	--	PL	--	PI	--	G_s	2.70	(assumed)
Description:	CLAY with SAND (CL), mottled gray/yellow			Source:	RG-3 at 14.0 feet					

7544 DUBLIN BOULEVARD
Dublin, California

CONSOLIDATION TEST REPORT

ROCKRIDGE
GEOTECHNICAL

Date 07/28/14 Project No. 14-723 Figure B-6



Sampler Type:	Shelby Tube			Condition	Before Test		After Test	
Diameter (in)	2.49	Height (in)	1.00	Water Content	w_o	29.9 %	w_f	19.1 %
Overburden Pressure, p_o	1,700	psf		Void Ratio	e_o	0.88	e_f	0.53
Preconsol. Pressure, p_c	2,300	psf		Saturation	S_o	93.3 %	S_f	100 %
Compression Ratio, $C_{\varepsilon c}$	0.17			Dry Density	γ_d	92 pcf	γ_d	113 pcf
Recompression Ratio, $C_{\varepsilon r}$	0.025	LL	48	PL 17	PI	31	G_s	2.76 (assumed)

Description: CLAY with SAND (CL), olive-brown

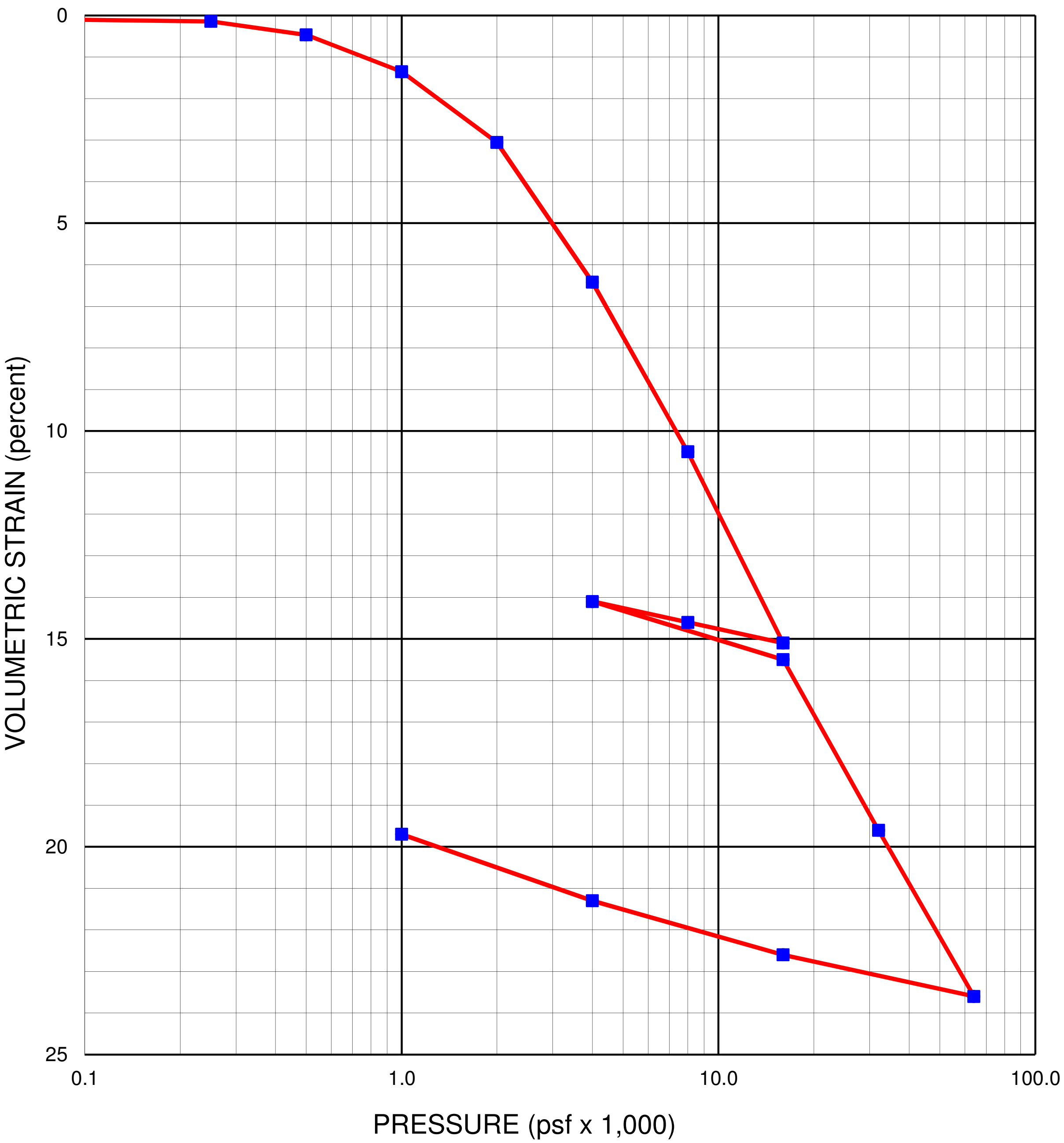
Source: RG-4 at 18.0 feet

7544 DUBLIN BOULEVARD
Dublin, California

ROCKRIDGE
GEOTECHNICAL

CONSOLIDATION TEST REPORT

Date 07/28/14 Project No. 14-723 Figure B-7



Sampler Type:	Shelby Tube		Condition	Before Test			After Test		
Diameter (in)	2.42	Height (in) 1.00	Water Content	w_o	30.8	%	w_f	20.4	%
Overburden Pressure, p_o	1,400	psf	Void Ratio	e_o	0.94		e_f	0.56	
Preconsol. Pressure, p_c	2,000	psf	Saturation	S_o	89.4	%	S_f	100	%
Compression Ratio, $C_{\varepsilon c}$	0.16		Dry Density	γ_d	88	pcf	γ_d	109	pcf
Recompression Ratio, $C_{\varepsilon r}$	0.022	LL 42	PL 18	PI	24		G_s	2.72	(assumed)

Description: CLAY (CL), olive-gray

Source: RG-5 at 13.5 feet

7544 DUBLIN BOULEVARD
Dublin, California

CONSOLIDATION TEST REPORT

ROCKRIDGE
GEOTECHNICAL

Date 07/30/14 Project No. 14-723 Figure B-8

ATTACHMENT D

DDC and DGA Calculations

Load Combinations

C14-329 Dublin Apartments Garage

Load Combinations:

The following load combinations are used in the ground improvement foundation model.
Maximum DDC and DGA reactions are noted on the following pages.

🟩 = Values Used for Ground Improvement Foundation Model Analysis

ASCE 7-10 Section 2.4.1 Basic Combinations					
Load Combination Designation	**Load Factor**				**Load Combination**
			E		
	D	**L**	No reduction	25% reduction[Note 1]	
LC 2	**1.0**	**1.0**	---	---	**1.0D + 1.0L**
LC 5	**1.0**	---	±0.7	±0.7 x 75% = **±0.525**	**1.0D ± 0.525E**
LC 6b	**1.0**	**0.75**	±0.525	±0.525 x 75% = **±0.39375**	**1.0D + 0.75L ± 0.39375E**
LC 8	**0.6**	---	±0.7	±0.7 x 75% = **±0.525**	**0.6D ± 0.525E**

Notes:

1. Overturning effects at the soil-foundation interface have been reduced by 25% per ASCE 7-10 section 12.13.4.

DGA Reinforcement

C14-329 Dublin Apartments Garage

WF Grade 75 Ground Anchor Tension Capacity							Soil Cap.
Bar Size ---	Bar Diam. (in)	Thread Diam. (in)	Net Area (in^2)	Nominal Weight (lb/ft)	LRFD ϕT_n (kip)	ASD T_a (kip)	ASD 75% (T_a) (kip)
#6	0.750	0.875	0.44	1.50	29.7	19.8	14.8
#7	0.875	1.000	0.60	2.00	40.5	26.9	20.2
#8	1.000	1.125	0.79	2.70	53.0	35.3	26.4
#9	1.128	1.250	1.00	3.40	67.5	44.9	33.7
#10	1.270	1.375	1.27	4.30	85.7	57.0	42.8
#11	1.410	1.500	1.56	5.30	105	70.1	52.5
#14	1.693	1.875	2.25	7.65	152	101	75.8
#18	2.257	2.438	4.00	13.6	270	180	135

Static Capacity

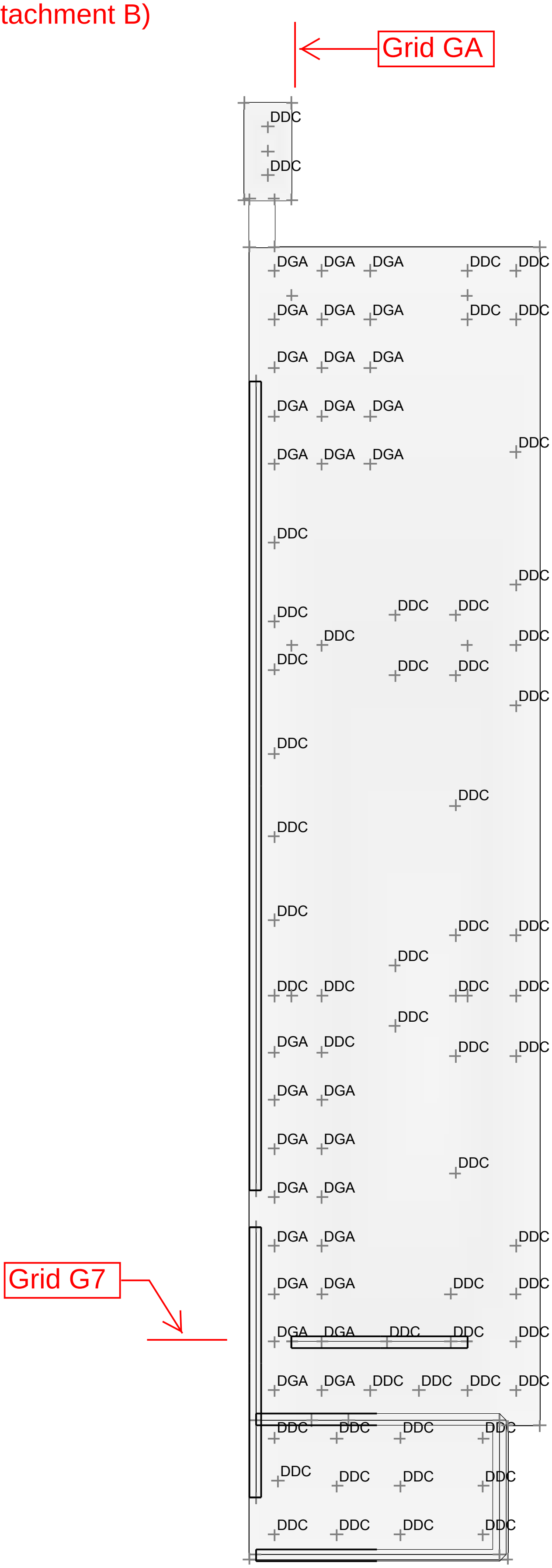
Short-term Capacity (1/3 Increase on Static Capacity)

LRFD Factors		ASD Factors		A615-75 Steel	
ϕ_y	ϕ_u	Ω_y	Ω_u	F_y (ksi)	F_u (ksi)
0.90	0.75	1.67	2.00	75	100

Note:

1. No 1/3 increase permitted for short-term loading for steel.
2. Net area = root area.
3. ϕy = Resistance Factor for yielding (LRFD).
4. ϕu = Resistance Factor for yielding (LRFD).
5. $\phi_y F_y$ governs over $\phi_u F_u$ for all cases with A615.
6. T_n is tension design strength -- compare with factored load combinations.
7. T_a is allowable tension strength -- compare with "working" service load combinations.
8. Code Reference: AISC 360-05 D.2 and ACI 318-08 9.3.2.
9. $\phi T_n = \phi_y * F_y * A$ [Eq D2-1]
10. $T_a = F_y * A / \Omega_y$ [Eq D2-1]
11. Soil Capacity is permitted 1/3 increase for load combinations that include seismic.

Loading per SEOR (Attachment B)



Maximum DDC and DGA Static Bearing Reaction < 100 k (Typical)
OK

Maximum DDC Short-term Bearing Reaction < 133 k (Typical)
OK

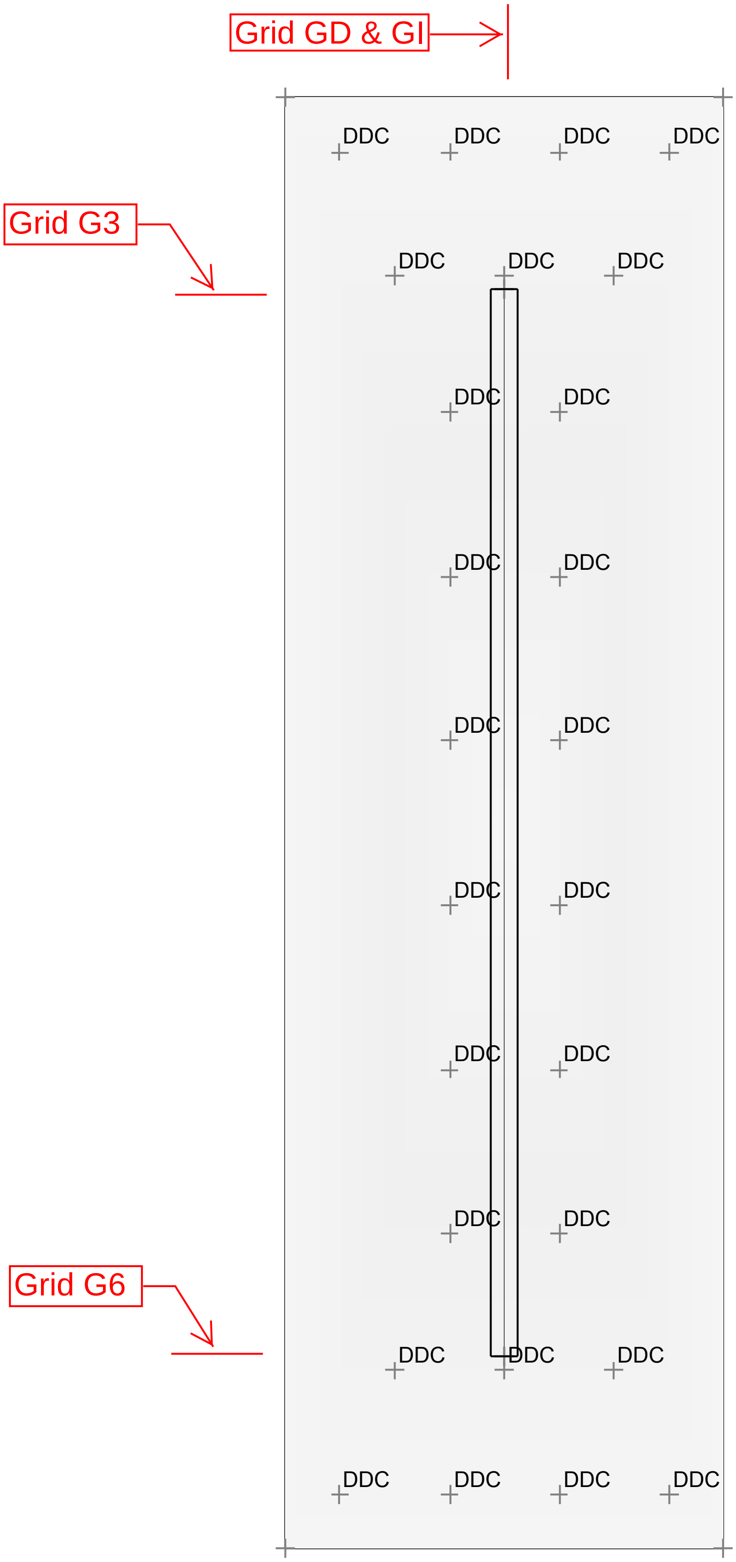
Maximum DGA Short-term Tension Reaction < 70 k (Typical)
OK

Loading per SEOR (Attachment B)

Maximum DDC and DGA Static Bearing Reaction < 100 k (Typical)
OK

Maximum DDC Short-term Bearing Reaction < 133 k (Typical)
OK

Maximum DGA Short-term Tension Reaction < 70 k (Typical)
OK

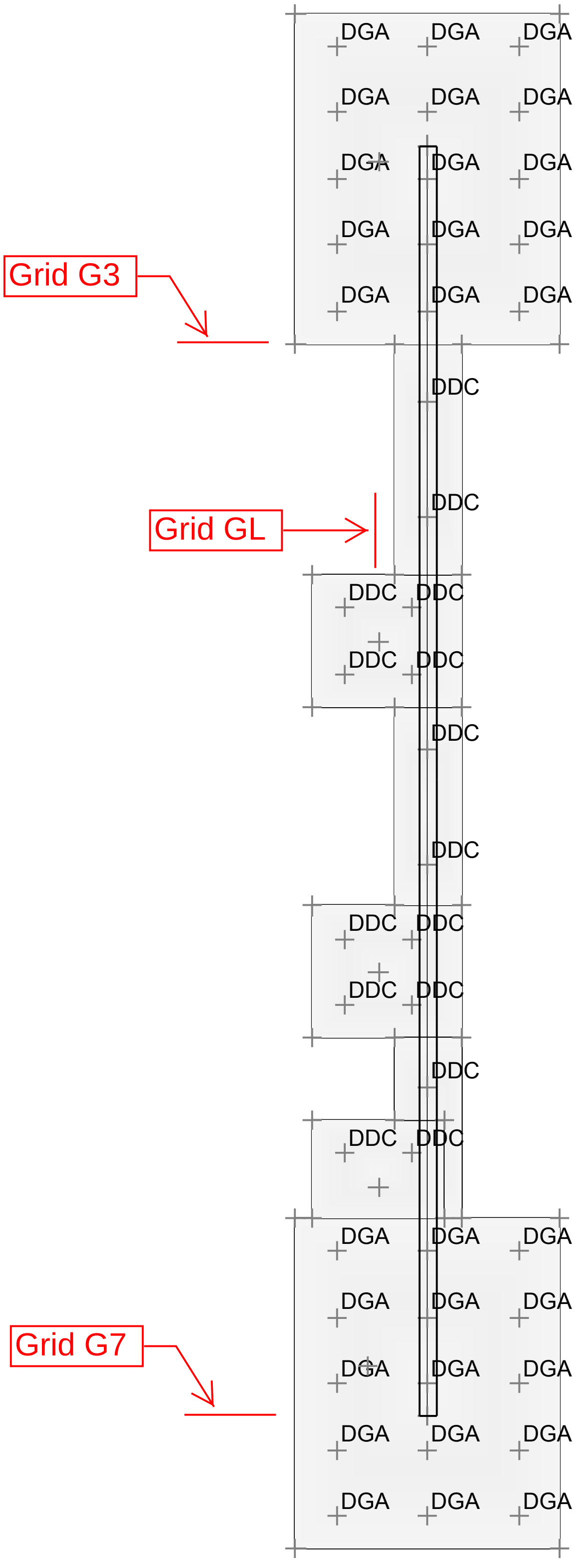


Loading per SEOR (Attachment B)

Maximum DDC and DGA Static Bearing Reaction < 100 k (Typical)
OK

Maximum DDC Short-term Bearing Reaction < 133 k (Typical)
OK

Maximum DGA Short-term Tension Reaction < 70 k (Typical)
OK



2015-05-22 2:46 PM

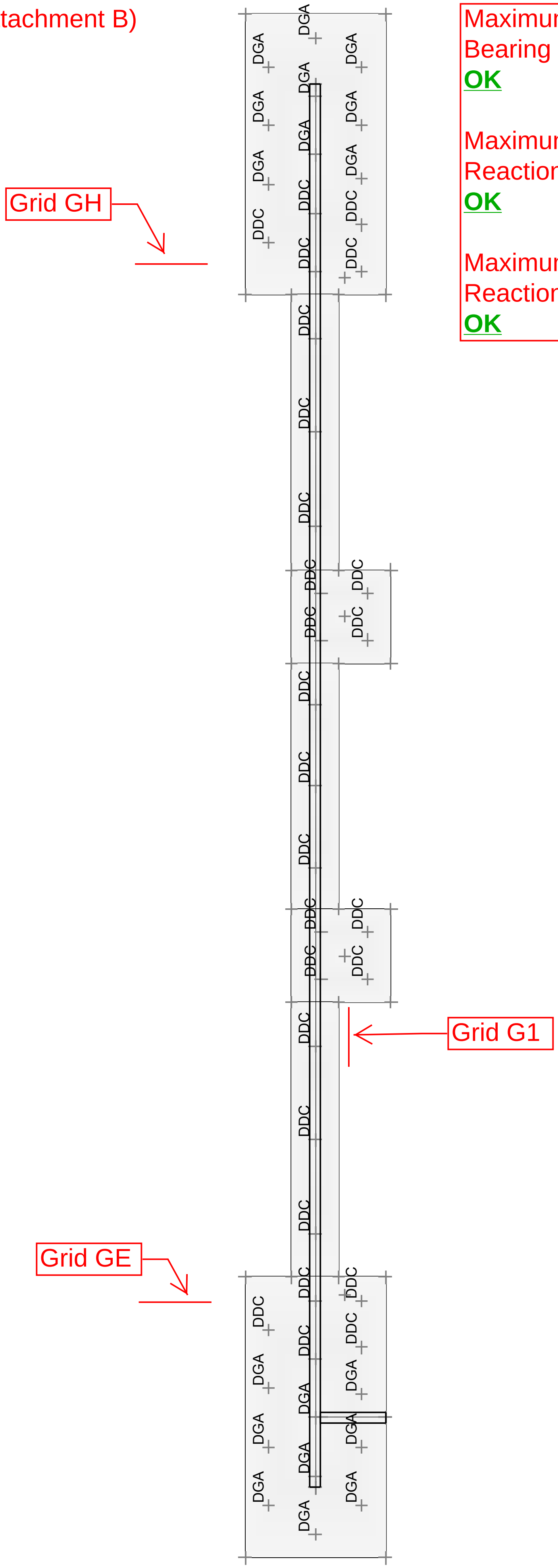
C14-329 7544 Dublin - SW Grid G1

Loading per SEOR (Attachment B)

Maximum DDC and DGA Static Bearing Reaction < 100 k (Typical)
OK

Maximum DDC Short-term Bearing Reaction < 133 k (Typical)
OK

Maximum DGA Short-term Tension Reaction < 70 k (Typical)
OK



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Plan View

SAFE 2014 14.0.0

C14-329 7544 Dublin - SW Grid G8

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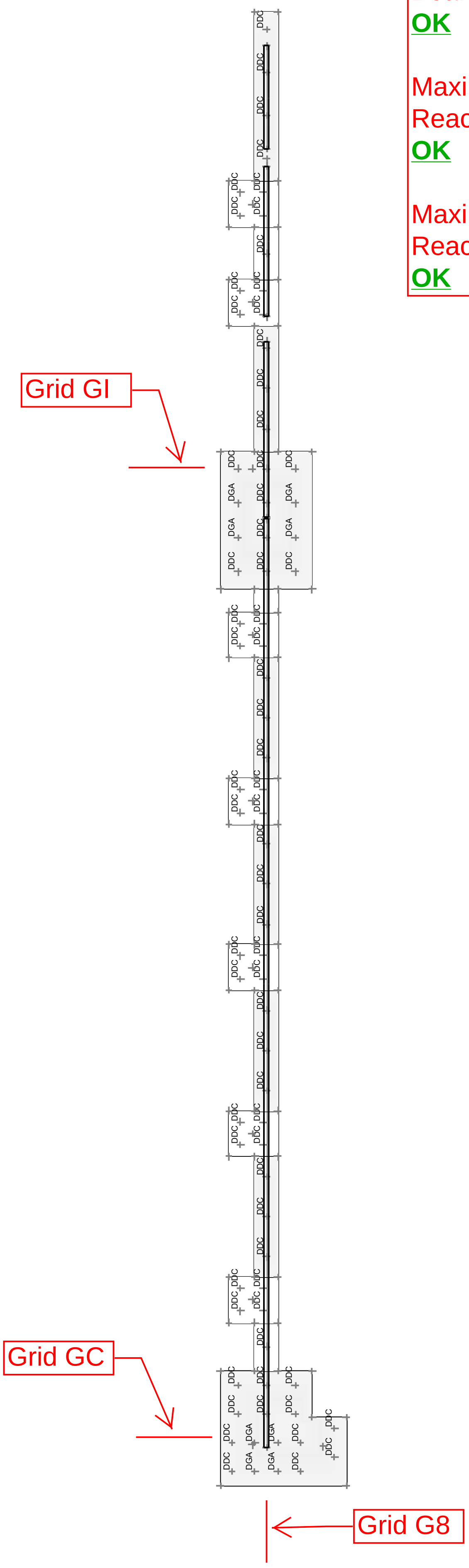
Loading per SEOR (Attachment B)

Maximum DDC and DGA Static Bearing Reaction < 100 k (Typical)
OK

Maximum DDC Short-term Bearing Reaction < 133 k (Typical)
OK

Maximum DGA Short-term Tension Reaction < 70 k (Typical)
OK



kip - ft

Plan View

SAFE 2014 14.0.0

Settle3d Model: Dublin Apartments Garage

Total Static Settlement Estimate

Go Vertical with Confidence®

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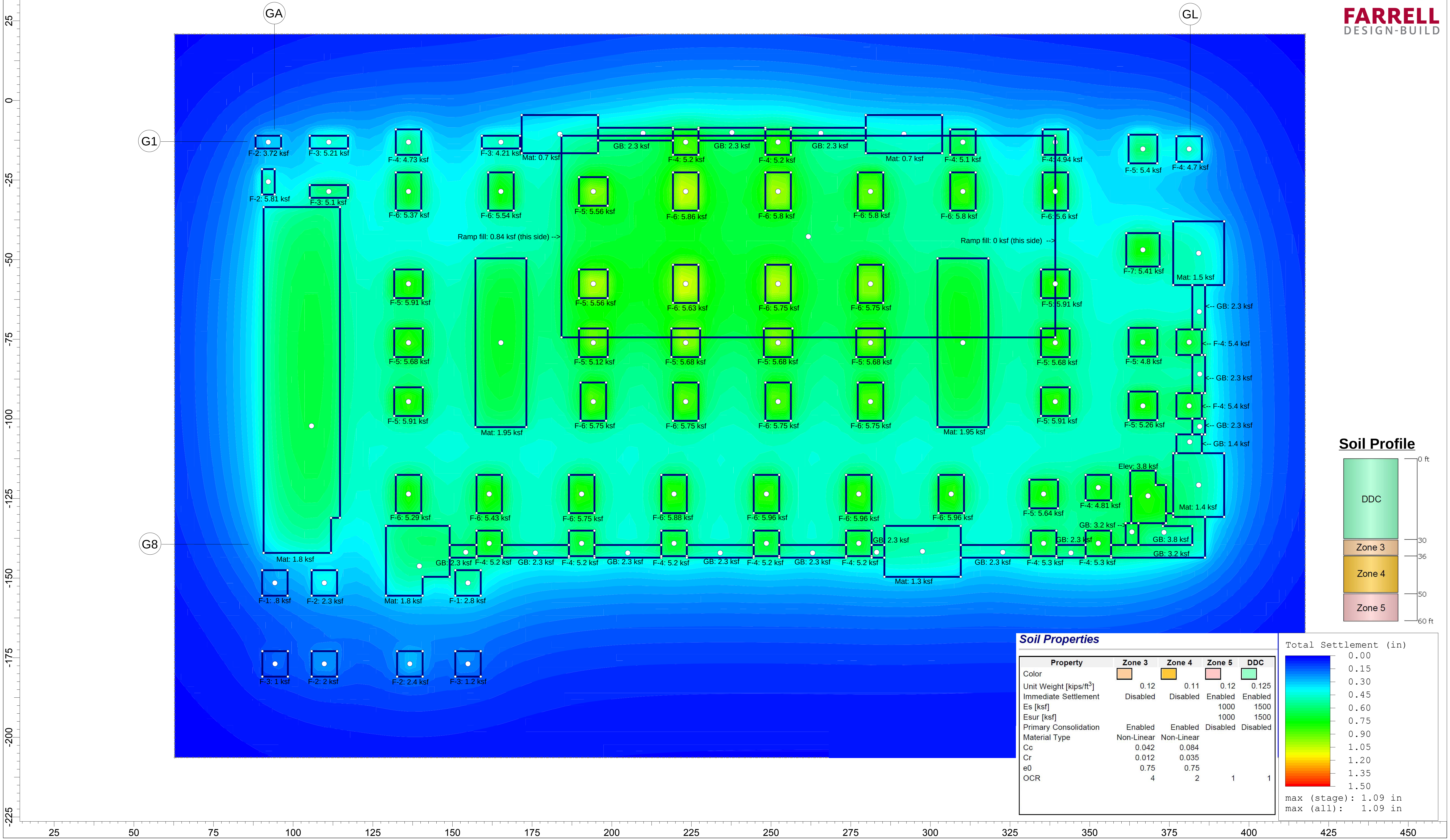


Soil Properties

Property	Zone 3	Zone 4	Zone 5	DDC
Color	🟧	🟨	🟥	🟩
Unit Weight [kips/ft^3]	0.12	0.11	0.12	0.125
Immediate Settlement	Disabled	Disabled	Enabled	Enabled
Es [ksf]			1000	1500
Esur [ksf]			1000	1500
Primary Consolidation	Enabled	Enabled	Disabled	Disabled
Material Type	Non-Linear	Non-Linear		
Cc	0.042	0.084		
Cr	0.012	0.035		
e0	0.75	0.75		
OCR	4	2	1	1

ATTACHMENT E

DDC and DGA Specifications

SECTION 31 66 20

DRILL DISPLACEMENT COLUMN GROUND IMPROVEMENT

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Section 31 66 20 includes all material, layout, and construction for the Drill Displacement Column ground improvement (DDC) to meet the performance criteria defined in this specification.

B. A Specialty GeoContractor shall provide all equipment, material, labor, and supervision to design and install DDC to meet the performance criteria defined for the project. Design shall rely upon information presented in the contract documents, geotechnical report, and Contract Drawings.

C. Drill Displacement Column ground improvement is a specialized technique used for controlled compaction, densification, stiffening and strengthening, of loose and soft soil. This method comprises the injection of Controlled Low Strength Material (CLSM) into a compatible soil mass to achieve controlled compaction, densification, cementation, and increased strength of the soil mass by displacing the soil mass and replacing the displaced soil with cement/sand CLSM. The method physically moves the soil particles into a closer arrangement radially from the drill displacement tool and a pressured column of injected CLSM.

D. Related Sections include the following:

    1. Drawings and general provisions of the Contract, including Contract General Conditions and Supplementary General Conditions and Division 1 specification sections, apply to this section.

1.02 REFERENCES

A. Geotechnical Report for the site.

B. State of California Department of Transportation (Caltrans) Standard Specification and Test Methods (Latest Edition).

C. California Building Code (CBC), Title 24 Part 2, Volume 1 and 2 (Latest Edition).

D. ACI 229 Controlled Low Strength Materials.

E. ACI 232 Fly Ash/Other Pozzolans in Concrete.

F. ASTM D4832 Method for Prep./Testing of Controlled Low Strength Material Test Cylinders.

G. ASTM D-1143 Guide specification for bearing load testing

H. ASTM C94 Specification for Ready-mixed Concrete.

I. ASTM C150 Specification for Portland Cement.

J. ASTM C260 Specification for Air-Entraining Admixtures for Concrete.

K. ASTM C494 Specification for Chemical Admixtures for Concrete.

L. ASTM C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan - Concrete.

M. ASTM C937 Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete

1.03 DEFINITIONS

A. CLSM: controlled low strength material – a well-defined, controlled, composite material composed of aggregate, sand, cement, fly-ash, water and admixtures.

B. Drill Displacement Column: DDC - a ground improvement method of installing premixed CLSM under pressure in a displaced cavity that compacts and stiffens the soil and increases the density of the soil/CLSM composite. The installed DDC results in a reduction of soil compressibility and related foundation settlement, and liquefaction potential and related post seismic settlement.

C. Engineer: the Geotechnical Engineer of Record GEOR or Structural Engineer of Record SEOR.

D. Testing Agency: the special inspector and material testing company selected and retained by the Owner. The GEOR commonly acts as the Testing Agency for drill displacement column work.

E. Specialty GeoContractor: The specialist subcontractor responsible for the design, construction, and performance of DDC ground improvement outlined in these specifications.

   1. Farrell Design-Build Companies Inc. of Placerville, CA (530) 621-4867 is the Specialty GeoContractor for this work.

1.04 SUBMITTALS

A. The Specialty GeoContractor shall submit the following documents for the Engineer's approval:

B. DDC Design Drawings: Shall clearly indicate but not be limited to:

   1. DDC layout drawing referenced to the structural plans including a numbering system capable of identifying each individual DDC.

C. Records

   1. DDC design report with construction methods and materials that will be utilized to install DDC. The design report shall be prepared and sealed by a California licensed Professional Engineer.
   2. DDC installation record to the GEOR for each DDC not later than 3 working days after installation is completed. The Specialty GeoContractor's crew shall include a quality control (QC) inspector to observe installation operations and prepare the installation records.

D. Load Test Data:

   1. Load test report with description of the installation equipment, installation records, load test data, analysis of the test data, and recommended allowable design bearing pressure based on load test results. The report shall be prepared and sealed by a California licensed Professional Engineer.

E. CLSM field and lab tests shall be provided by the Engineer or Testing Agency.

F. Upon acceptance of the work, the Specialty GeoContractor shall submit a full size drawing showing the as-built locations, diameters, and depths of all completed DDC.

1.05 QUALITY ASSURANCE

A. The DDC work shall be performed by a Specialty GeoContractor and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

B. Inspection and Testing will be performed by the GEOR and/or the Testing Agency in accordance with the governing code, and shall include the following:

   1. Review submittals for conformance with the requirements of this Section.
   2. Monitor DDC installation continuously for conformance with requirements.
   3. Keep records of each DDC installed. The record shall include as-built DDC locations provided by the Contractor.

C. The presence of the GEOR or Testing Agency shall in no way relieve the Specialty GeoContractor of its obligation to perform the DDC installation in accordance with the Contract Drawings and these specifications.

D. The Engineer or Testing Agency to perform material testing of the CLSM including but not limited to:

   1. Slump Tests
   2. CLSM sample preparation and testing per ASTM D4832 methods. A minimum of one set of samples shall be obtained for every 100 cubic yards placed or at least once a day.
      a. One set of samples shall consist of 8 test cylinders. The test cylinders shall be 6x12 inch.
      b. The break schedule shall be:
         1. One Test Cylinder tested at 7-days
         2. Three Test Cylinders tested at 28-days
         3. Three Test Cylinders tested at 56-days

        4. One Test Cylinder held in reserve
    c. ASTM D4832 sample preparation **<u>excludes</u>** rodding material during sample preparation.
    d. It is important that CLSM samples be handled with care to achieve correct test results.

1.06 DDC SYSTEM REQUIREMENTS

A. The DDC system shall be constructed by the drill-displacement, bottom-feed method. DDC shall be used to reinforce, compact, and increase the density of the soil/CLSM composite for increased stiffness to control static settlement and increase composite bearing capacity.

B. The DDC system shall be spaced to support footing and slab loads as approved by the Engineer.

C. Construction of the DDC ground improvement shall be in accordance with this specification and the Contract Drawings unless otherwise approved by the Engineer.

PART 2 - PRODUCTS

2.01 CONTROLLED LOW STRENGTH MATERIAL - CLSM

A. CLSM shall be a flowable, excavatable mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water which has been mixed in accordance with ASTM C 94.

B. CLSM shall be batched either by a ready mix grout plant and delivered to the WORK by means of standard transit mixing trucks or an onsite mixing system. The mixture shall produce a flowable material.

C. The actual mix proportion and slump shall be as determined by the approved mix design.

D. CLSM Properties:
    1. Density shall be between 100 pcf and 145 pcf.
    2. Slump shall be 6 to 11 inches.
    3. Compressive strength at 56 days shall be in accordance with the approved drawings.

E. CLSM Composition: The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.
    1. Mix proportions shall be approved by the Engineer.
    2. Cement: Cement shall be Type II in accordance with the requirements of ASTM C150.
    3. Pozzolan: Pozzolan shall be Type F in accordance with the requirements of ASTM C618.
    4. Aggregate: Aggregate shall consist of a well graded mixture of crushed rock, soil, or sand with a maximum size aggregate of 3/4 inch. 100 percent shall pass the 3/4 inch sieve.
    5. Admixtures: Air entraining may be added as approved by the Engineer not to exceed 10% and as required in ASTM C260. Retarding admixture may be added as approved by the Engineer not to exceed 8 hour retarding time and as required in ASTM C494.
    6. Water: Water shall be clean and free from objectionable quantities of silt and clay, organic matter, alkali, salts, and other impurities.

PART 3 - EXECUTION

3.01 GENERAL

A. The Specialty GeoContractor shall determine the method of DDC treatment and construction procedures, the specific equipment to be used, and the size and spacing of the DDC. Such procedures and related information shall be subject to review by the Engineer during the submittal phase.

B. Horizontal Tolerance: All DDC shall be located within 3 inches of the drawing positions shown on the approved drawings unless otherwise approved by the Engineer.

C. Vertical Tolerance: All DDC shall be plumb within 2 degrees of vertical, which is about 1 inch horizontal in 28 inches vertical.

3.02 DDC CONSTRUCTION

A. A pre-drill hole can be pre-drilled below the bottom of footing or slab prior to constructing the DDC.

B. CLSM shall be delivered into each DDC by pumping. The grout pump shall be a positive displacement pump of an approved design. The pump discharge capacity shall be calibrated in strokes per cubic foot or revolutions per cubic foot by a method approved by the Engineer. Oil or other rust inhibitors shall be removed from mixing drums and pressure grout pumps prior to mixing and pumping.

C. The volume of CLSM per linear foot of DDC shall be not less than the theoretical neat volume. All volume measurements shall be made in the presence of the GEOR or the Testing Agency.

D. DDC installation and pressure injection shall continue without interruption.

  1. Upon reaching the design depth or bottom of each DDC, the displacement tool shall be rotated a minimum of 6 turns to compact drill spoil at the bottom.
  2. Then the tool shall be raised 12 inches and the drill stem and bottom shall be charged with CLSM prior to DDC installation, to begin the bottom pressure bulb.
  3. After installation of bottom pressure bulb, the tool shall be withdrawn at a rate to maintain a minimum average CLSM pumped replacement volume equal to (110%) the drill displaced volume in the pressurized zone as shown on the approved drawings, or
  4. Pressurized pumping may be stopped at a depth as noted on the approved drawings OR after a heave at the adjacent ground of 0.05 feet is observed.

E. Adjacent DDC

  1. Adjacent DDC within ten feet (10'), center-to-center, shall not be installed within twelve (12) hours of each other.
  2. Within footings, DDC adjacent within four (4) DDC diameters center-to-center, shall not be installed within twelve (12) hours of each other.

F. CLSM shall be directed in place to ensure that voids, crevices, and pockets are filled with CLSM. Care shall be taken to avoid over-consolidation of the material separating the large and fine aggregate.

G. CLSM shall be continuously placed against undisturbed in-situ earth material under pressure unless otherwise approved by the Engineer.

H. Where an unforeseen obstruction is encountered below the ground the Engineer shall be informed immediately. Should any obstruction be encountered during installation of DDC work, the General Contractor shall be responsible for removing such obstruction or the DDC shall be relocated or abandoned as approved by the Engineer.

I. The finished DDC element shall be “post-drilled” to establish the final top elevation of the DDC.

3.03 QUALITY CONTROL TESTING

A. All DDC operations shall be performed under the observation of the GEOR and in accordance with CBC Section 18.

B. All DDC load test results shall be submitted to the GEOR for review and approval.

C. Monitoring and logging of DDC operations shall be done by Specialty GeoContractor’s QC inspector.

D. The Specialty GeoContractor shall provide access to the Engineer or Testing Agency to observe the work and take samples, measurements and tests as necessary for quality assurance purposes.

E. All testing during the work shall be performed by the Engineer or Testing Agency.

F. In case the tests of the DDC show non-compliance with the specifications the Specialty GeoContractor shall accomplish such remedy as may be required to insure compliance.

G. Compressive strength shall be determined by laboratory compression tests ASTM D4832.

H. DDC Load Test

1. A load test shall be performed to verify the parameter values selected for design. The DDC load test shall be of the type and installed in a manner specified herein. The location of the DDC load test shall be coordinated with the Geotechnical Engineer. ASTM D-1143 Procedure A shall be used as a guide to establish load increments, load duration, and load decrements except that the maximum load shall be 200% of the design maximum load on the DDC cell and the load increments will be 10% of the design load.
2. The load test shall be performed as shown on the approved plans.
3. A seating load equal to 5 percent of the total load shall be applied prior to application of load increments.
4. An optional creep test can be performed prior to the load test described above.
5. The creep test shall be loaded in increments of 20% of the design load to a maximum load of 115%. During each load interval, keep the load constant for a time interval of not less than 4 min and not more than 8 min. At load interval 120%, keep the load constant for a time interval of not less than 1 hour and not more than 4 hours. Maintain the load increment until the rate of deflection reduces to 0.01 inches per hour or a deflection of less than 0.0025 inches per 15-minutes. Once the rate of deflection has reduced to 0.0025-inches, remove the load in decrements of 20%, keeping the load constant for a time interval of not less than 2 min and not more than 4 min.

I. Construction Records: The Specialty Geotechnical Contractor shall keep written, daily records of the completed DDC installation and shall submit copies of the records to the General Contractor and Engineer within 3 working days. The records shall show:

1. Identification number and date of installation for each DDC,
2. DDC drill tool diameter,
3. Elevation of bottom of each DDC,
4. Volume of CLSM placed in cubic feet,
5. DDC pump pressures (where applicable),
6. Concrete truck ticket ID associated with each DDC, and
7. Added reinforcement (if required),
8. Documentation of obstructions, placement delays, any unusual ground conditions, and any unusual occurrences observed during DDC installation.

3.04 PROTECTING DDC

A. DDC shall be protected from running water, rain, freezing or other conditions that could damage the material.

B. No equipment, traffic, or backfill shall be allowed on the DDC until the surface of the DDC is able to withstand a 20 psi load without displacement or damage. If necessary, the General Contractor shall provide steel trench plates that span the work area impacted by traffic until the DDC has reached the required strength.

PART 4 - MEASUREMENT AND PAYMENT

A. The amount of completed and accepted DDC work shall be paid for at the Contract sum price per job and/or adjusted for price per linear foot required by contract. This price shall be full compensation for design and for furnishing all materials, and for all labor, equipment, tools, and incidentals necessary to complete the work.

END OF SECTION

SECTION 31 68 20

DISPLACEMENT GROUND ANCHOR

PART 1 - GENERAL

1.01 SCOPE OF WORK

A. Section 31 68 20 includes all material, layout, and construction for the Displacement Ground Anchor shown on the Contract Drawings and defined in this specification.

B. A Specialty GeoContractor shall provide all equipment, material, labor, and supervision to design and install DGAs to meet the performance criteria defined for the project. Design shall rely upon information presented in the contract documents, geotechnical report, and Contract Drawings.

C. Unless otherwise directed, the Specialty GeoContractor shall select the DGA type, drilling method, grouting method, grouting pressures, and subject to the minimum capacities in the contract documents, determine the bond length, free-stressing (unbounded) length, and anchor diameter. The Specialty GeoContractor shall be responsible for installing DGAs that will develop the load-carrying capacity indicated on the Contract Drawings in accordance with the testing subsection of this Specification.

D. Related Sections include the following:

   1. Drawings and general provisions of the Contract, including Contract General Conditions and Supplementary General Conditions and Division 1 specification sections, apply to this section.

1.02 REFERENCES

A.	Geotechnical Report for the site.	
B.	California Building Code (CBC), Title 24 Part 2, Volume 1 and 2 (Latest Edition).	
C.	ASTM A53	Standard Specification for Steel Pipe
D.	ASTM D3689	Standard Test Methods for Deep Foundations Under Static Axial Tensile Load
E.	ASTM A615	Grade 75 ksi All Thread Rebar Specification
F.	ASTM A36	Structural Steel
G.	ASTM A108	Heavy Duty Hex Nut
H.	ASTM F436	Hardened Washers
I.	ASTM A153	Hot Dip Galvanizing
J.	ACI 229	Controlled Low Strength Materials.
K.	ACI 232	Fly Ash/Other Pozzolans in Concrete.
L.	ASTM D4832	Method for Prep./Testing of Controlled Low Strength Material Test Cylinders.
M.	ASTM C94	Specification for Ready-mixed Concrete.
N.	ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
O.	ASTM C33	Standard Specification for Concrete Aggregates
P.	ASTM C937	Standard Specification for Grout Fluidifier for Preplaced-Aggregate Concrete
Q.	ASTM C150	Specification for Portland Cement.
R.	ASTM C260	Specification for Air-Entraining Admixtures for Concrete.
S.	ASTM C494	Specification for Chemical Admixtures for Concrete.
T.	ASTM C618	Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

1.03 DEFINITIONS

A. Grout: a well-defined, controlled, composite material composed of aggregate, sand, cement, fly-ash, water and admixtures. Grout can be concrete or CLSM (controlled low strength material) for the purpose of DGA.

B. Displacement Ground Anchor: DGA - a foundation method of installing grout under pressure in a displaced cavity and installing vertical steel bar(s) or tendon(s) to provide tension capacity to resist uplift forces at the foundation from transient wind and seismic forces. A system used to transfer uplift forces from the foundation to the soil or rock at depth below the foundation, which includes steel bar or tendons, anchorage, spacers, centralizers, and concrete or grout.

C. Engineer: the Geotechnical Engineer of Record GEOR or Structural Engineer of Record SEOR.

D. Testing Agency: the special inspector and material testing company selected and retained by the Owner. The GEOR commonly acts as the Testing Agency for DGA work.

E. Specialty GeoContractor: The specialist subcontractor responsible for the design, construction, and performance of DGA outlined in these specifications.

   1. Farrell Design-Build Companies Inc. of Placerville, CA (530) 621-4867 is the Specialty GeoContractor for this work.

1.04 SUBMITTALS

A. The Specialty GeoContractor shall submit the following documents for the Engineer’s approval:

B. Shop Drawings and Specification: Shall clearly indicate but not be limited to:

   1. DGA layout plan referenced to the structural plans including a numbering system capable of identifying each individual DGA and indicating tip elevations.

C. Records

   1. DGA design report with construction methods and materials that will be utilized to install DGA. The design report shall be prepared and sealed by a California licensed Professional Engineer.
   2. DGA installation record to the GEOR for each DGA not later than 3 working days after installation is completed. The Specialty GeoContractor’s crew shall include a quality control (QC) inspector to observe installation operations and prepare the installation records.

D. Load Test Data:

   1. Load test report with description of the installation equipment, installation records, load test data, analysis of the test data, and recommended allowable design bearing pressure based on load test results. The report shall be prepared and sealed by a California licensed Professional Engineer.

E. Grout, concrete or CLSM field and lab tests shall be performed by Engineer or Testing Agency.

F. Upon acceptance of the work, the Specialty GeoContractor shall submit a full size drawing showing the as-built locations, diameters, and depths of all completed DGA.

1.05 QUALITY ASSURANCE

A. The DGA work shall be performed by a Specialty GeoContractor and shall be performed by skilled workmen thoroughly experienced in the necessary crafts.

B. Inspection and Testing will be performed by the GEOR and/or the Testing Agency in accordance with the governing code, and shall include the following:

   1. Review submittals for conformance with the requirements of this Section.
   2. Monitor DGA installation continuously for conformance with requirements.
   3. Keep records of each DGA installed. The record shall include as-built DGA locations provided by the Contractor.

C. The presence of the GEOR or Testing Agency shall in no way relieve the Specialty GeoContractor of its obligation to perform the DGA installation in accordance with the Contract Drawings and these specifications.

D. The Engineer or Testing Agency to perform material testing of the CLSM including but not limited to:
   1. Slump Tests
   2. CLSM sample preparation and testing per ASTM D4832 methods. A minimum of one set of samples shall be obtained for every 100 cubic yards placed or at least once a day.
      a. One set of samples shall consist of 8 test cylinders. The test cylinders shall be 6x12 inch.
      b. The break schedule shall be:
         1) One Test Cylinder tested at 7-days
         2) Three Test Cylinders tested at 28-days
         3) Three Test Cylinders tested at 56-days
         4) One Test Cylinder held in reserve
      c. ASTM D4832 sample preparation excludes rodding material during sample preparation.
      d. It is important that CLSM samples be handled with care to achieve correct test results.

1.06 DISPLACEMENT GROUND ANCHOR SYSTEM REQUIREMENTS

A. The DGA system shall be constructed by the drill-displacement, bottom-feed pumped method with placement by wet stabbing steel tendons/anchors into fresh Grout or CLSM.

B. The anchor system shall be placed into the fluid Grout OR CLSM within 20 minutes after the auger is removed from the ground.

C. The DGA shall meet the requirements in these specifications and as shown on the approved shop drawings with regards to type, load capacity, and placement.

PART 2 - PRODUCTS

2.01 GROUT, CLSM OR CONCRETE

A. Grout or CLSM shall be a flowable, excavatable mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water which has been mixed in accordance with ASTM C 94.

B. Grout or CLSM shall be batched by a ready mix concrete plant and delivered to the WORK by means of standard transit mixing trucks. The mixture shall produce a flowable material.

C. The actual Grout or CLSM mix proportion and slump shall be as determined by the approved mix design.

D. Grout or CLSM fluidifier shall conform to ASTM C937, except that expansion shall not exceed 4 percent. The fluidifier shall be a compound possessing characteristics which will increase the flowability of the mixture, assist in the dispersal of cement grains, and neutralize the setting shrinkage of the high-strength cement mortar.

E. Composition: The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.
   1. Mix proportions shall be approved by the Engineer.
   2. Cement: Cement shall be Type II in accordance with the requirements of ASTM C150.
   3. Pozzolan: Pozzolan shall be Type F in accordance with the requirements of ASTM C618.
   4. Aggregate: Aggregate shall consist of a well graded mixture of crushed rock, soil, or sand with a maximum size aggregate of 3/4 inch. 100 percent shall pass the 3/4 inch sieve.
   5. Admixtures: Air entraining may be added as approved by the Engineer not to exceed 10% and as required in ASTM C260. Retarding admixture may be added as approved by the Engineer not to exceed 8 hour retarding time and as required in ASTM C494.
   6. Water: Water shall be clean and free from objectionable quantities of silt and clay, organic matter, alkali, salts, and other impurities.

2.02 ANCHOR STEEL AND CONNECTIONS

A. Steel materials: steel anchor tendons shall be furnished complete with all accessories, and shall be a standard product of a company regularly engaged in their manufacture.

B. Approved manufacturer: Williams Form, 280 Ann Street, Grand Rapids, MI 49510.

C. Corrosion Protection System:

  1. The DGA steel assembly shall be isolated from all footing rebar and steel. If necessary, the uplift anchorage in the footing shall be covered with plastic tape or other method for isolating the steel from the footing rebar steel.

D. Steel Anchor Tendons, Bearing Plates, Hex Nuts, Washers, and Couplers:

  1. All steel tendons shall be Grade 75 All-Thread Rebar conforming to ASTM A615. Steel tendons shall have a continuous concentric rolled thread deformation pattern that ensures a consistent cross sectional area and strength at all points along the steel. The diameter, lengths, and required strengths shall be as noted on the DGA drawings.
  2. Bearing (Anchor) Plates shall be steel conforming ASTM A36 with a minimum yield strength of 36 ksi. The size and thickness shall be as shown on the DGA drawings.
  3. Hex Nuts shall be the manufacturer's heavy duty, hexagonal pattern, machined from steel conforming to ASTM A108 and designed for use with the Grade 75 All-Thread Rebar. The hex nuts will be tapped oversize when additional corrosion protection of epoxy coating or hot dip galvanizing is specified. The hex nuts shall develop in excess of 125% of the yield strength of the rebar and an ultimate strength of not less of than 100% of the guaranteed ultimate tensile strength of the Grade 75 All-Thread Rebar tendon.
  4. Washers shall be a hardened steel washer conforming to ASTM F436. Washers will be used between the hex nut and bottom and top bearing plates (where applicable).
  5. Mechanical Couplings when required may be used to splice the steel tendons and shall be capable of developing 100 % of the guaranteed ultimate tensile strength of the Grade 75 All-Thread Rebar. Couplings will provide a positive internal threaded connection to the rebar and shall be machined from steel conforming to ASTM A108. The couplings will be tapped oversize when additional corrosion protection or hot dip galvanizing is specified.

2.03 ANCHOR ASSEMBLY

A. Unless otherwise directed, the GeoContractor shall select the type of steel anchor assembly to be used for tension in the DGA.

B. Anchors shall be handled and stored in a manner as to avoid damage. A light coating of rust on the steel is acceptable. If heavy corrosion or pitting is observed, the Engineer shall reject the affected steel.

C. GeoContractor shall supply bearing plate and hardware for anchor assembly (where applicable). Cutting and installation of bearing plate and hardware shall be performed by the General Contractor.

PART 3 - EXECUTION

3.01 GENERAL

A. The Specialty GeoContractor shall determine the type and method of DGA, construction procedures, the specific equipment to be used, and the size and spacing of the DGAs. Such procedures and related information shall be subject to review by the Geotechnical Engineer of Record during the submittal phase.

B. Horizontal Tolerance: All DGAs shall be located within 3 inches of the plan positions shown on the approved shop drawings unless otherwise approved by the Engineer.

C. Vertical Tolerance: All DGAs shall be plumb within 2 degrees of vertical, which is about 1 inch horizontal in 28 inches vertical. The vertical elevation shall be within 6 inches of planned.

3.02 DISPLACEMENT GROUND ANCHOR CONSTRUCTION

A. A pre-drill hole can be pre-drilled below the bottom of footing or slab prior to constructing the DGA.

B. Grout or CLSM shall be delivered into each DGA by pumping. The Grout or CLSM pump shall be a positive displacement pump of an approved design. The pump discharge capacity shall be calibrated in strokes per cubic foot or revolutions per cubic foot by a method approved by the Engineer. Oil or other rust inhibitors shall be removed from mixing drums and pressure Grout or CLSM pumps prior to mixing and pumping.

C. The volume of Grout or CLSM per linear foot of DGA shall be not less than the volume of per foot of the test elements. All volume measurements shall be made in the presence of the Geotechnical Engineer or the Testing Agency.

D. DGA installation and pressure injection shall continue without interruption.

   1. Upon reaching the design depth or bottom of each DGA, the displacement tool shall be rotated a minimum of 6 turns to compact drill spoil at the bottom.
   2. Then the tool shall be raised 12 inches and the drill stem and bottom shall be charged with Grout or CLSM prior to installation, commonly 7 to 12 pumps strokes to begin the pressurized bottom bulb.
   3. After installation of pressurized bottom bulb, the tool shall be withdrawn at a rate to maintain a minimum average Grout or CLSM pumped replacement volume equal to (110%) the drill displaced volume in the pressurized zone as shown on the approved drawings, or
   4. Pressurized pumping may be stopped at a depth as noted on the approved drawings OR after a heave at the adjacent ground of 0.05 feet is observed.

E. Adjacent DGA

   1. Adjacent DGA within ten feet (10'), center-to-center, shall not be installed within twelve (12) hours of each other.
   2. Within footings, DGA adjacent within four (4) DGA diameters center-to-center, shall not be installed within twelve (12) hours of each other.

F. Grout or CLSM shall be directed in place to ensure that voids, crevices, and pockets are filled with Grout or CLSM. Care shall be taken to avoid over-consolidation of the material separating the large and fine aggregate.

G. Grout or CLSM shall be continuously placed against undisturbed in-situ earth material under pressure unless otherwise approved by the Engineer.

H. Where an unforeseen obstruction is encountered below the ground the Engineer shall be informed immediately. Should any obstruction be encountered during installation of DGA work, the General Contractor shall be responsible for removing such obstruction or the DGA shall be relocated or abandoned as approved by the Engineer.

I. Centralizers shall be used to maintain the required Grout or CLSM cover. Centralizers shall be fabricated from plastic or material which is non-detrimental to the steel anchorage. Wood shall not be used. The centralizer shall be able to support the anchorage in the drill hole and position the bar so a minimum 3-inches of cover is provided and shall permit Grout or CLSM to freely flow around the bar.

J. The finished DGA element may be “post-drilled” to establish the final top elevation of the DGA.

3.03 QUALITY CONTROL TESTING

A. All DGA operations shall be performed under the observation of the Engineer or Testing Agency and in accordance with CBC (current edition) Section 18.

B. All DGA load test results shall be submitted to the GEOR for review and approval.

C. Monitoring and logging of DGA operations shall be done by Specialty GeoContractor’s QC inspector.

D. The Specialty GeoContractor shall provide access to the Engineer or Testing Agency to observe the work and take samples, measurements and test as necessary for quality assurance purposes.

E. All testing during the work shall be performed by the Engineer or Testing Agency.

F. In case the tests of the DGA show non-compliance with the specifications the Specialty GeoContractor shall accomplish such remedy as may be required to insure compliance.

G. Compressive strength shall be determined by laboratory compression tests ASTM D4832.

H. DGA Load Test

   1. A load test shall be performed to verify the design capacity. The DGA load test shall be of the type and installed in a manner specified herein. The location of the DGA load test shall be coordinated with the Geotechnical Engineer of Record. ASTM D3689 general test procedures shall be used as a

guide to establishing load increments, load duration, and load decrements except that the maximum load shall be as shown on the DGA drawings.

2. A seating load equal to 5 percent of the total load shall be applied prior to application of load increments.

I. Construction Records: The Specialty GeoContractor shall keep written, daily records of the DGA installation completed and shall submit signed copies of the records to the General Contractor and Engineer within 3 working days. The records shall show:

1. Identification number and date of installation for each DGA,
2. DGA drill diameter,
3. Elevation of bottom of each DGA,
4. Volume of Grout or CLSM or Concrete placed in cubic feet within the pressurized zone,
5. Grout or CLSM or Concrete pump pressures (where applicable),
6. Total time to install each DGA,
7. Concrete truck ticket ID associated with each DGA, and
8. Documentation of obstructions, placement delays, any unusual ground conditions, and any unusual occurrences observed during DGA installation.

3.04 PROTECTING DGA

A. DGA shall be protected from running water, rain, freezing or other conditions that could damage the material.

B. No equipment, traffic, or backfill shall be allowed on the DGA until the surface of the DGA is able to withstand a 20 psi load without displacement or damage. If necessary, the General Contractor shall provide steel trench plates that span the work area impacted by traffic until the DGA has reached the required strength.

PART 4 - MEASUREMENT AND PAYMENT

A. The amount of completed and accepted DGA work shall be paid for at the Contract sum price per job. This price shall be full compensation for design and for furnishing all materials, and for all labor, equipment, tools, and incidentals necessary to complete the work.

END OF SECTION

ATTACHMENT F

Submittal Distribution

CUSTOMER	
Pete Beritzhoff Bay West Development 2 Henry Adams Street, Suite 450 San Francisco, CA 94103 408.680.4938 pete@baywestdevelopment.com	PDF
GEOR – Geotechnical Engineer	
Logan Medeiros, GE Rockridge Geotechnical 270 Grand Avenue Oakland, CA 94610 510.420.5738 ldmedeiros@rockridgegeo.com	PDF
SEOR – Structural Engineer	
Chris Bane, SE FBA Structural Engineers 1675 Sabre Street Hayward, CA 94545 510.265.1888 chris@fbaengineers.com	PDF
Architect	
Ian Murphy BDE Architecture 950 Howard Street San Francisco, CA 94103 417.967.6813 imurphy@bdearch.com	PDF

GENERAL NOTES FOR DRILL DISPLACEMENT COLUMN™

SCOPE & DESIGN CRITERIA

1. SCOPE: THESE DRAWINGS REPRESENT THE DESIGN–BUILD CONSTRUCTION OF DRILL DISPLACEMENT COLUMN™ (DDC) GROUND IMPROVEMENT. FARRELL IS THE GEOCONTRACTOR FOR THE DDC GROUND IMPROVEMENT WORK. THE GEOCONTRACTOR'S SCOPE OF CONSTRUCTION IS THE DDC ONLY, AND EXCLUDES DESIGN AND/OR CONSTRUCTION OF FOUNDATIONS, TEMPORARY CONSTRUCTION PAD GRADING, AND FINAL PAD GRADING.

STRUCTURAL CODES:	SEISMIC:
CBC 2013	SITE CLASS = D
ASCE 7–10	SEISMIC DESIGN CATEGORY = E
	SDS = 1.58g
	I = 1.0

DDC GROUND IMPROVEMENT OVERVIEW

1. THIS GROUND IMPROVEMENT WORK CONSISTS OF IMPROVING THE DENSITY, STRENGTH AND STIFFNESS OF WEAK AND LOOSE SOIL FOR FOUNDATION SUPPORT USING DRILL DISPLACEMENT COLUMN™ (DDC) IN ACCORDANCE WITH THESE PLANS, THE DDC SPECIFICATION, AND IN GENERAL CONFORMITY WITH THE LINES, GRADES AND DIMENSIONS SHOWN ON THE PLANS OR ESTABLISHED BY THE ENGINEERS.
2. GROUND IMPROVEMENT IS ACHIEVED BY DISPLACING SOIL WITH A DRILL DISPLACEMENT TOOL AND BACKFILLING THE CAVITY UNDER PRESSURE WITH CONTROLLED LOW–STRENGTH MATERIAL (CLSM).
3. DDCs ARE INTENDED FOR GROUND IMPROVEMENT FOR THIS PROJECT AT FOOTINGS AND MATS.
4. DDC GROUND IMPROVEMENT CONSTRUCTION IS DEFINED BY SPECIFICATION 31 66 20 AND DETAIL SHEET GI–3.1.
5. DGA GROUND IMPROVEMENT CONSTRUCTION IS DEFINED BY SPECIFICATION 31 68 20 AND DETAIL SHEET GI–3.1.

PROJECT SPECIFICS	
PROJECT NAME	DUBLIN APARTMENTS GARAGE
PROJECT ADDRESS	7544 DUBLIN ROAD DUBLIN, CA 94568
PROJECT LOCATION	LAT/LON: 37.7037N, 121.9283W

DDC DESIGN PARAMETERS	
INDIVIDUAL DDC ALLOWABLE CAPACITIES	BEARING ONLY: 100 kips (ASD) STATIC FOR 4'x4' CELL 133 kips (ASD) SHORT–TERM
ALLOWABLE FOOTING BEARING PRESSURE	6,250 psf (ASD) STATIC FOR 4'x4' SPACING 6,250 psf (ASD) SHORT–TERM
INDIVIDUAL DGA ALLOWABLE CAPACITIES	BEARING: SIMILAR TO DDC ALLOWABLE CAPACITIES TENSION: 52.5 kips (ASD) STATIC 70 kips (ASD) SHORT–TERM
SHORT TERM INCREASE	1/3 INCREASE PERMITTED ON STATIC ASD CAPACITIES FOR LOAD COMBINATIONS THAT INCLUDE SEISMIC AND WIND
DDC/DGA DIAMETER	NEAT DIAMETER: 16" EFFECTIVE DIAMETER: 17"
GROUT FACTOR	TARGET: 110% MINIMUM: 100%
GROUT PRESSURE	TARGET: 4–6 bars @ BTM, 1 bar ABOVE MINIMUM: 1 bar @ BTM, ½ bars ABOVE
DDC/DGA SHAFT LENGTH	SEE SCHEDULE ON SHEET GI–2.1
ESTIMATED SETTLEMENT	SEE DESIGN–BUILD SUBMITTAL

LOAD TESTING	
REQUIRED FULL–SCALE LOAD TESTING	(1) BEARING LOAD TEST AND (1) TENSION LOAD TEST PER DETAIL SHEET GI–3.1

DRILLING	
DRILL RIG	APPROXIMATE WEIGHT: 140,000 lbs MIN TORQUE: 150,000 ft–lbs MIN CROWD: 30,000 lbs
REFUSAL CRITERIA	LESS THAN ½ ft OF VERTICAL PROGRESSION IN 30 SECONDS

CLSM MATERIAL PARAMETERS	
COMPRESSIVE STRENGTH	TARGET: 1,500 psi AT 56 DAYS MINIMUM: 1,200 psi AT 56 DAYS
SLUMP RANGE	6" MIN, 11" MAX

CLSM NOTES:

1. CLSM PERMEABILITY SHALL BE LESS THAN 1×10^{-6} cm/sec.

DESIGN NOTES

1. THE DDC METHOD OF GROUND IMPROVEMENT IS PROPRIETARY. FARRELL DESIGN–BUILD INC. IS RESPONSIBLE FOR THE DESIGN OF THE DDC GROUND IMPROVEMENT SYSTEM AND OBTAINING THE PERFORMANCE CRITERIA SPECIFIED HEREIN. FARRELL'S ENGINEERING AND DESIGN WORK ARE EXPRESSLY PROVIDED AND CONDITIONED ON FARRELL INSTALLING THE DESIGNED WORK SHOWN ON THESE PLANS. UNDER NO CIRCUMSTANCE SHALL THIS PLAN BE PROVIDED TO ANY OTHER CONTRACTOR TO PERFORM THE DESIGNED WORK SHOWN HEREIN.
2. ALL DDC MUST BE CONSTRUCTED IN ACCORDANCE WITH THE DDC PLANS AND SPECIFICATION. REFER TO THE REFERENCES TABLE FOR THE DESIGN–BUILD SUBMITTAL.
3. GEOTECHNICAL BASIS: GEOTECH REPORT NOTED IN REFERENCES.
4. FARRELL SHALL BE NOTIFIED IMMEDIATELY IF SUBSURFACE SOIL OR STRUCTURAL LOADS CHANGE OR VARY FROM THOSE USED FOR DESIGN.

LOAD TESTING

1. FULL–SCALE LOAD TESTING IS REQUIRED. REFER TO LOAD TESTING TABLE FOR TEST TYPE AND QUANTITY.
2. VERTICAL BEARING LOAD TEST SHALL BE CONDUCTED SUBSTANTIALLY IN ACCORDANCE WITH ASTM D1143–07 (PROCEDURE A).

GENERAL CONTRACTOR CONSTRUCTION NOTES

1. THE GENERAL CONTRACTOR SHALL EXCAVATE AND PREPARE THE BOTTOM OF DDC & DGA SUPPORTED FOUNDATIONS AS NOTED IN THE SPECIFICATION.
2. EACH DDC SHALL BE PROTECTED FROM TRAFFIC, INCLUDING ALL CONSTRUCTION EQUIPMENT, FOR 48 HOURS AFTER INSTALLATION.
3. SEE DETAIL SHEET GI–3.1 FOR TEMPORARY EXCAVATIONS.
4. ALL DDC & DGA SUPPORTED FOUNDATIONS SHALL BE EXCAVATED PER DETAIL SHEET GI–3.1.

QUALITY ASSURANCE AND TESTING

1. THE OWNER OR GENERAL CONTRACTOR IS RESPONSIBLE FOR RETAINING AN INDEPENDENT COMPANY TO PROVIDE QUALITY ASSURANCE SERVICES AND MATERIALS TESTING. THE TESTING AGENCY MAY BE THE PROJECT GEOTECHNICAL ENGINEER OF RECORD.
2. THE TESTING AGENCY SHALL:
   - A. MONITOR ALL PRE–PRODUCTION TESTING.
   - B. MONITOR THE INSTALLATION OF DDC ELEMENTS TO VERIFY THAT THE PRODUCTION INSTALLATION PRACTICES ARE SIMILAR TO THOSE USED DURING THE INSTALLATION OF THE TEST ELEMENTS.
   - C. PERFORM ALL TESTING REQUIRED IN THE SPECIFICATIONS.
   - D. OBSERVE AND PROVIDE A WRITTEN REPORT OF ALL FOOTING EXCAVATION AND FOOTING BOTTOM PREPARATION.

QUALITY CONTROL

1. THE GEOCONTRACTOR SHALL HAVE A CONTINUOUS QUALITY CONTROL REPRESENTATIVE (QCR) TO REPORT INSTALLATION PROCEDURES. THE QCR SHALL IMMEDIATELY REPORT ANY UNUSUAL CONDITIONS ENCOUNTERED DURING INSTALLATION TO THE GEOCONTRACTOR AND THE GENERAL CONTRACTOR. THE GEOCONTRACTOR WILL COMMUNICATE ANY UNUSUAL CONDITIONS TO THE PROJECT STRUCTURAL ENGINEER, GEOTECHNICAL ENGINEER, ARCHITECT, AND OWNER.

SPECIAL INSPECTIONS

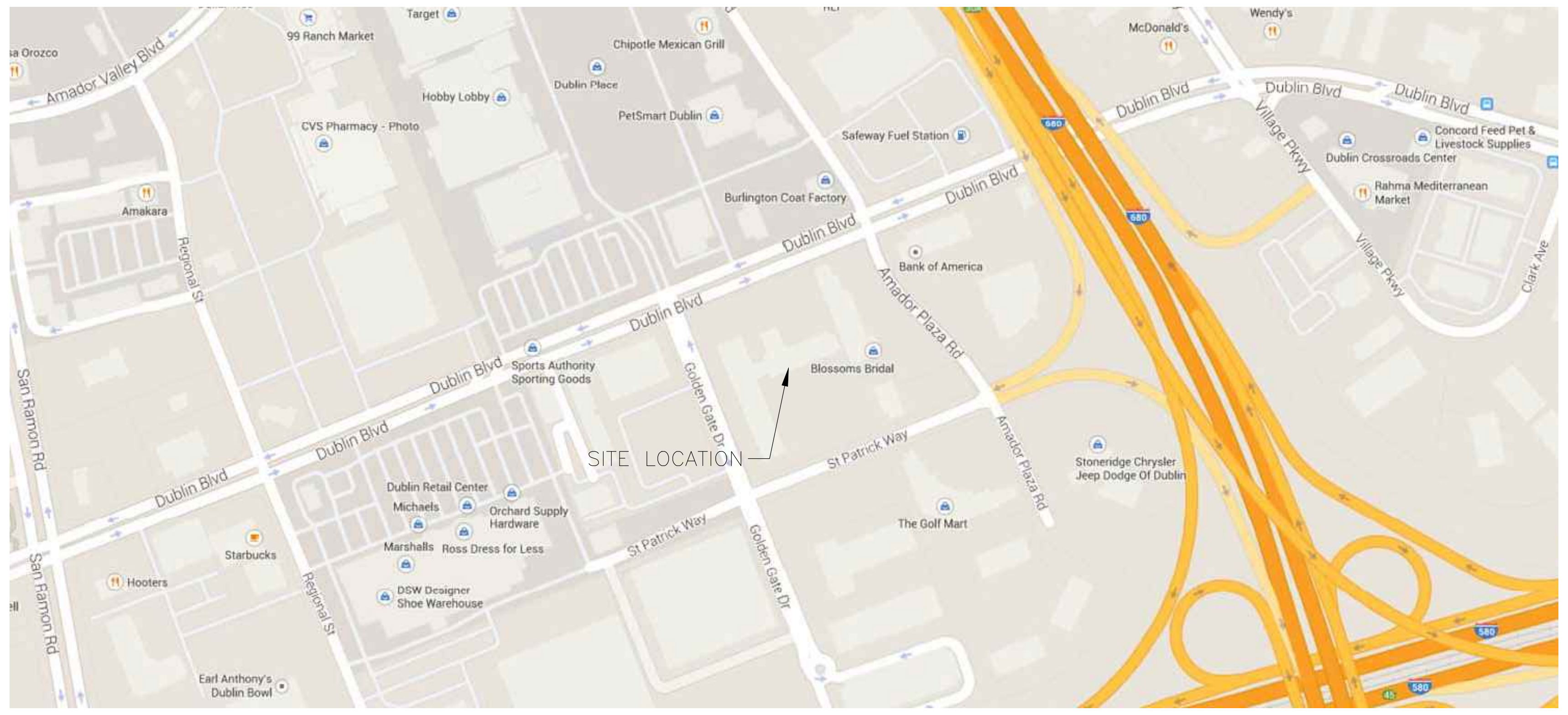
1. SPECIAL INSPECTIONS SHALL BE PERFORMED IN ACCORDANCE WITH CALIFORNIA BUILDING CODE CHAPTER 17. ALL INSPECTION IS FULL–TIME.
2. DAILY INSPECTION REPORTS SHALL BE MADE OF ALL TESTING AND PRODUCTION.
3. THE GEOTECHNICAL ENGINEER SHALL MAKE OBSERVATIONS OF SOIL CONDITIONS ENCOUNTERED DURING CONSTRUCTION OF THE DDCs AND REPORT ANY CHANGES IN THE EXPECTED SOIL CONDITIONS TO DDC INSTALLER.
4. REQUIRED SPECIAL INSPECTION ITEMS FOR DDC GROUND IMPROVEMENT:
   - A. DDC LOCATIONS (ID NUMBER)
   - B. DDC INSTALLATION DATE AND TIME
   - C. DDC TOOL DIAMETER
   - D. DRILL DEPTH OF DDC
   - E. CLSM VOLUME PER DDC
   - F. DDC PUMP PRESSURE (WHERE APPLICABLE)
   - G. READY–MIX TRUCK TICKET ID ASSOCIATED WITH CLSM
   - H. ADDED WATER TO CLSM (IF ANY)
   - I. ADDED REINFORCEMENT (FOR DGAs)
   - J. AMBIENT TEMPERATURE
   - K. CLSM TEMPERATURE
   - L. CLSM MATERIAL SAMPLING
     - i. SLUMP
     - ii. STRENGTH

LIMITATIONS

1. FARRELL BASED THE DESIGN AND LAYOUT ON INFORMATION PROVIDED BY THE GENERAL CONTRACTOR, THE SEOR, AND THE GEOR AS NOTED IN THE REFERENCES TABLE. IF THE EXISTING SITE CONSTRAINTS OR SOIL CONDITIONS ARE NOT CONSISTENT WITH THIS INFORMATION, ENGINEERING AND CONSTRUCTION CHANGES MAY BE REQUIRED. IF ANY SITE OR SOIL CONDITIONS HAVE CHANGED FROM WHAT IS PRESENTED IN THIS DOCUMENT OR THE REFERENCE DOCUMENTS, FARRELL MUST BE ASKED TO REVIEW THE CHANGED CONDITIONS AND MAKE THE APPROPRIATE MODIFICATIONS WHERE NECESSARY.

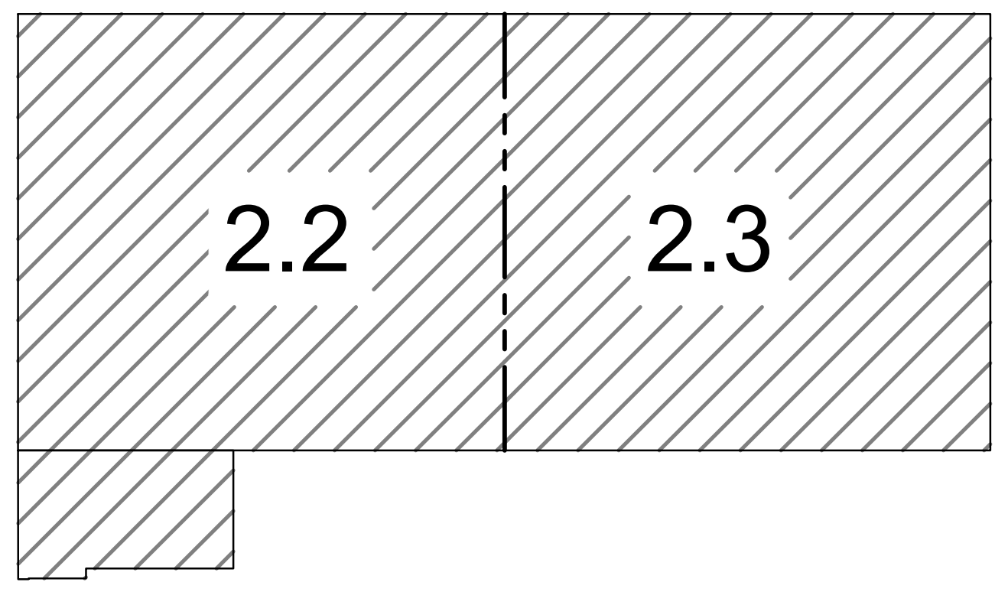
ABBREVIATIONS

APPRX	APPROXIMATE	GI	GROUND IMPROVEMENT
ASD	ALLOWABLE STRESS DESIGN	OC	ON–CENTER
BTM	BOTTOM	STRUCT	STRUCTURAL
DIA	DIAMETER	TYP	TYPICAL
EW	EACH WAY	w/	WITH
FTG	FOOTING		



① VICINITY MAP
NOT TO SCALE

TRUE NORTH
PLAN NORTH



② KEY MAP
NOT TO SCALE

TRUE NORTH
PLAN NORTH

REFERENCES				
PRIMARY DESIGN DOCUMENTS	DESCRIPTION	DOCUMENT BY	DATE RECEIVED	DOCUMENT DATE
GROUND IMPROVEMENT	DESIGN–BUILD SUBMITTAL: DUBLIN APARTMENTS GARAGE	FARRELL DESIGN–BUILD	–	2015May22
STRUCTURAL	CAD DRAWING: 2014–40 GAR SC–2.1.dwg	FBA INC. STRUCTURAL ENGINEERS	2015May06	–
	PDF DRAWING: DUBLIN GARAGE SOIL IMPROVEMENT LOADS 5–18–15F.pdf		–	2015May18
GEOTECHNICAL	GEOTECHNICAL INVESTIGATION PROPOSED MIXED–USE DEVELOPMENT 7544 DUBLIN BLVD, DUBLIN, CA PROJECT NUMBER: 14–723	ROCKRIDGE GEOTECHNICAL	–	2015Mar17
ARCHITECTURAL	–	–	–	–

SHEET INDEX			
REVISED	ORDER	SHEET	DESCRIPTION
2015MAY22	1	GI–1.0	GROUND IMPROVEMENT NOTES
2015MAY22	2	GI–2.1	GROUND IMPROVEMENT OVERALL PLAN
2015MAY22	3	GI–2.2	GROUND IMPROVEMENT PARTIAL PLAN
2015MAY22	4	GI–2.3	GROUND IMPROVEMENT PARTIAL PLAN
2015MAY22	5	GI–2.4	GROUND IMPROVEMENT SECTIONS
2015MAY22	6	GI–3.1	GROUND IMPROVEMENT DETAILS

Go Vertical with Confidence®
FARRELL
DESIGN-BUILD
farrellinc.com 530.621.4867

CLIENT

CONSULTANT

DUBLIN APARTMENTS
GARAGE
7544 DUBLIN BOULEVARD
DUBLIN, CA 94568

ISSUE	DATE
DB SUBMITTAL	2015MAY22

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TOM FARRELL
No.2484
2015May27

STAMP

GROUND
IMPROVEMENT
NOTES

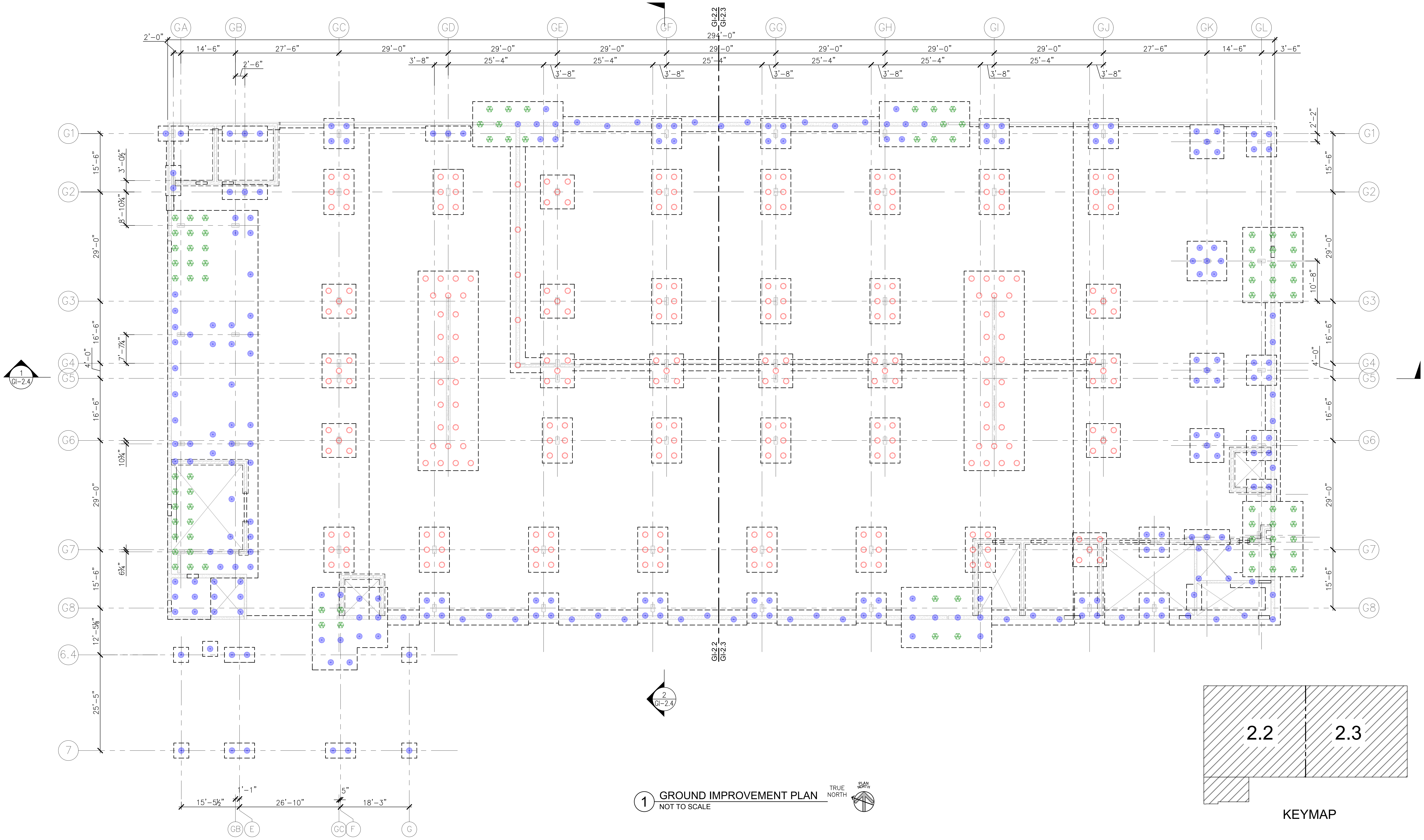
SHEET TITLE
SCALE AS NOTED
PROJECT NO. C14-329 DRAWN BY MK
SHEET SIZE: 30 x 42

GROUND IMPROVEMENT SCHEDULE

SYMBOL	QTY	SHAFT LENGTH	TYPE
◎	252	28ft	16"ø DDC BEARING ONLY
○	240	32ft	16"ø DDC BEARING ONLY
△	84	35ft	16"ø DGA BEARING AND TENSION
TOTAL:	576		

PLAN NOTES:

1. ALL GRID LINES AND DIMENSIONS MUST BE VERIFIED WITH THE APPROVED ARCHITECTURAL AND STRUCTURAL CONSTRUCTION DRAWINGS.
2. FOUNDATION LAYOUT SHALL BE IN ACCORDANCE WITH THE STRUCTURAL ENGINEER'S FOUNDATION PLAN SHEET. ALL GROUND IMPROVEMENT LAYOUT SHALL BE IN ACCORDANCE WITH THE GROUND IMPROVEMENT PLAN. ANY DISCREPANCIES DISCOVERED SHALL BE IMMEDIATELY REPORTED TO FARRELL.
3. DDCs SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE NOTES SHOWN ON SHEET GI-1.0, DETAILS SHOWN ON SHEET GI-3.1, AND THE DDC DESIGN-BUILD SUBMITTAL.
4. DDC CONSTRUCTION REQUIRES A MINIMUM OF 5 FEET LATERAL CLEARANCE FROM ANY UTILITY.



1 GROUND IMPROVEMENT PLAN
NOT TO SCALE

KEYMAP

Go Vertical with Confidence®
FARRELL
DESIGN-BUILD
farrellinc.com 530.621.4867

Client

Consultant

DUBLIN APARTMENTS
GARAGE
7544 DUBLIN BOULEVARD
DUBLIN, CA 94568

Issue	Date
DB SUBMITTAL	2015MAY22

TOM FARRELL
No.2484
2015May27

Stamp

GROUND
IMPROVEMENT
OVERALL PLAN

Sheet Title

Scale as noted

Project No. C14-329 Drawn By MK

Sheet Size: 30 x 42

GI-2.1

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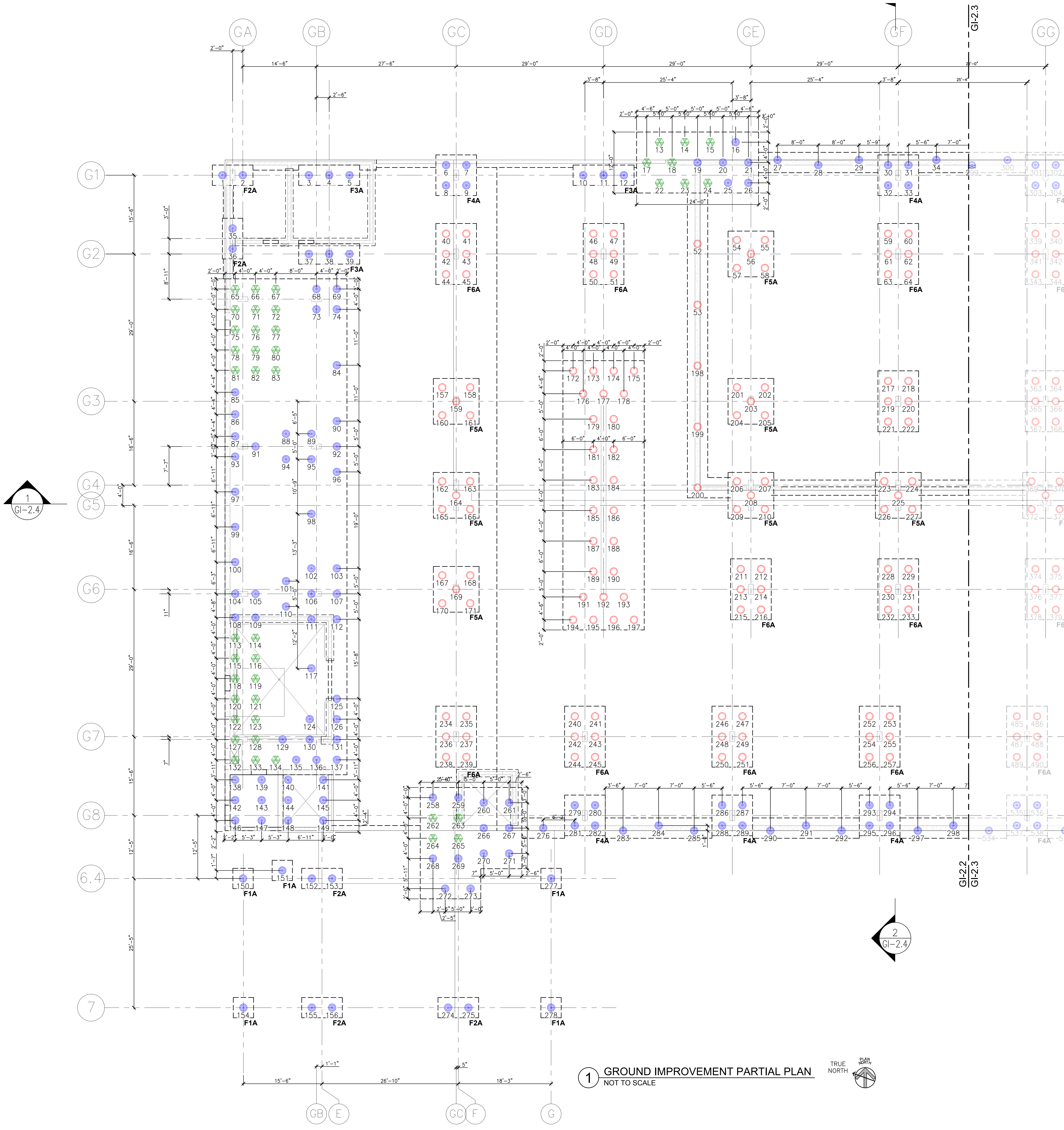

1 GROUND IMPROVEMENT PARTIAL PLAN
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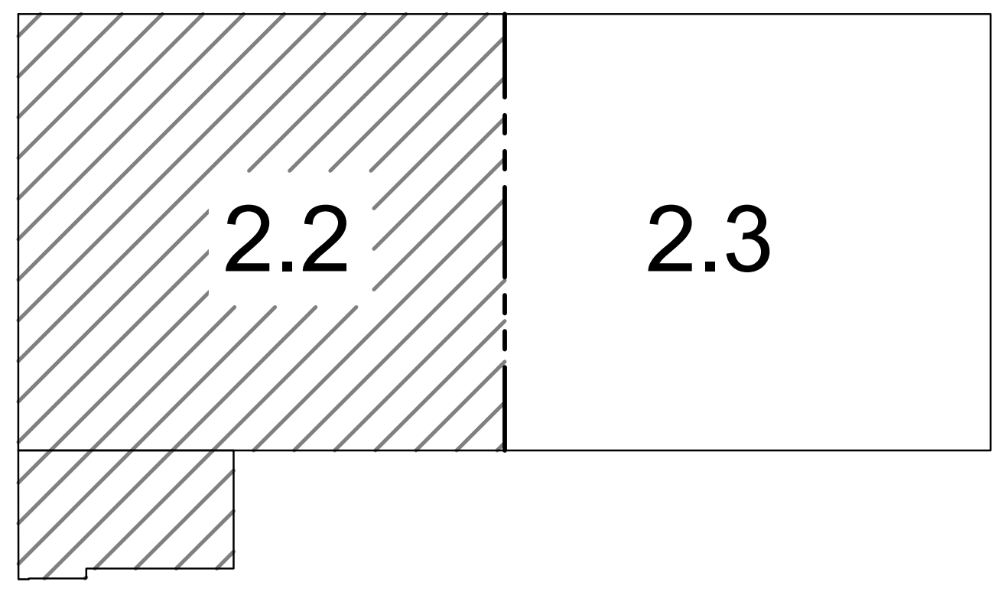

KEYMAP

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DUBLIN, CA 94568

Issue	Date
DB SUBMITTAL	2015MAY22

TOM FARRELL
No.2484
2015May27

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GROUND IMPROVEMENT PARTIAL PLAN

Sheet Title

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Project No. C14-329 Drawn By MK

Sheet Size: 30 x 42

GI-2.2

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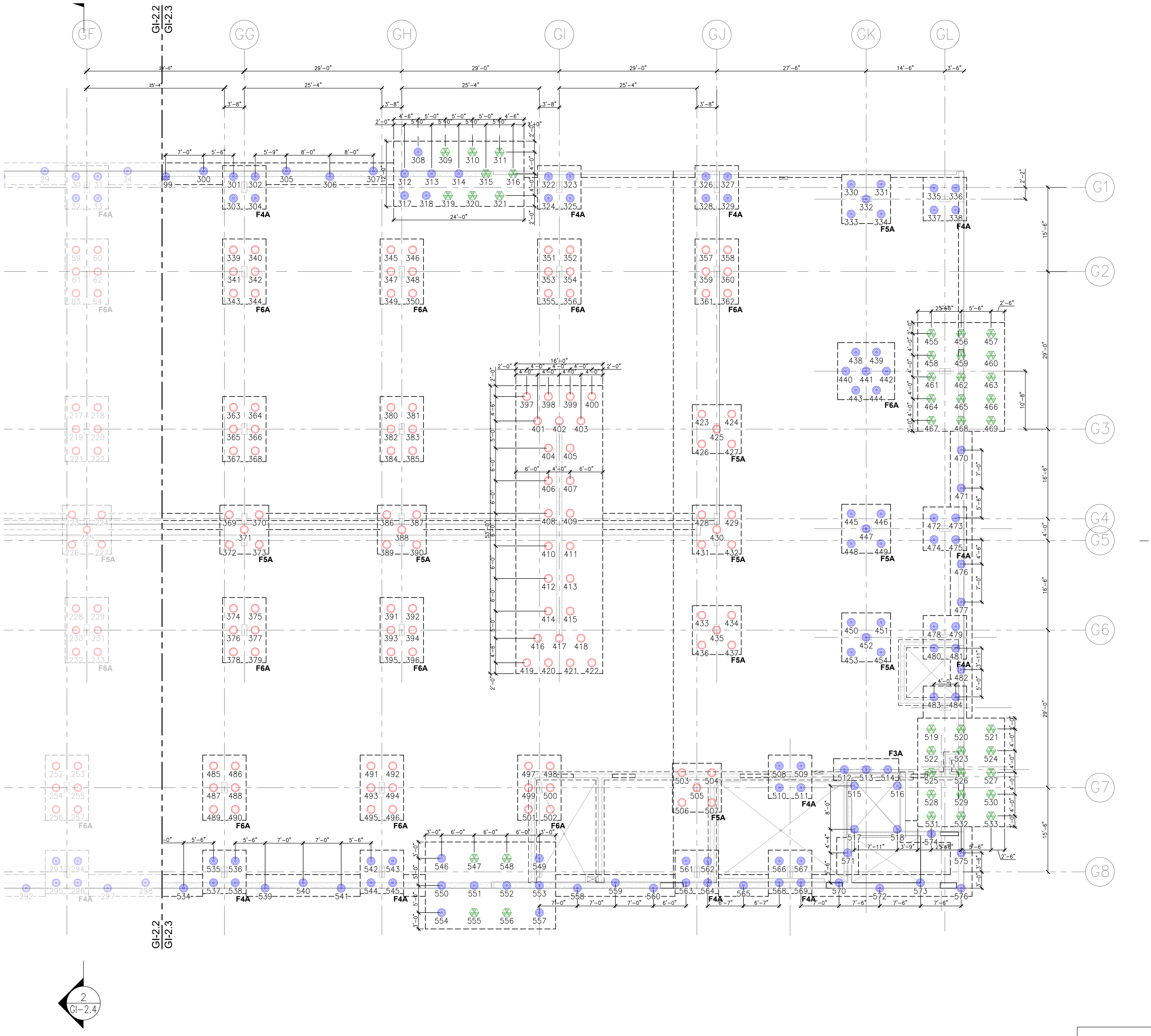
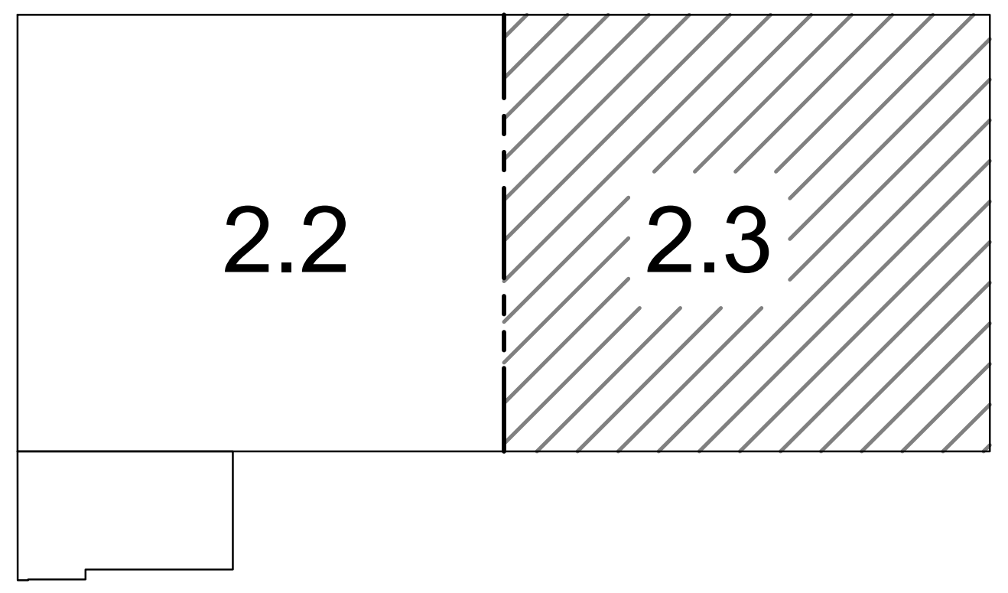


1 GROUND IMPROVEMENT PARTIAL PLAN

NOT TO SCALE

TRUE NORTH

PLAN NORTH



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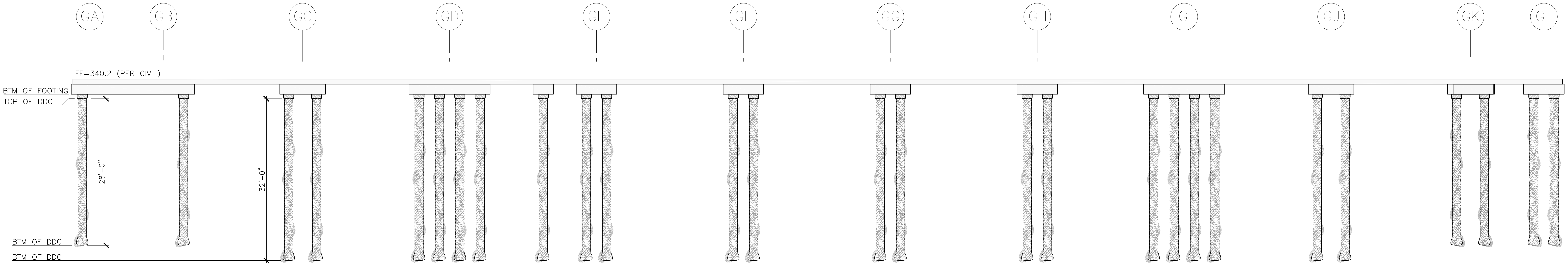

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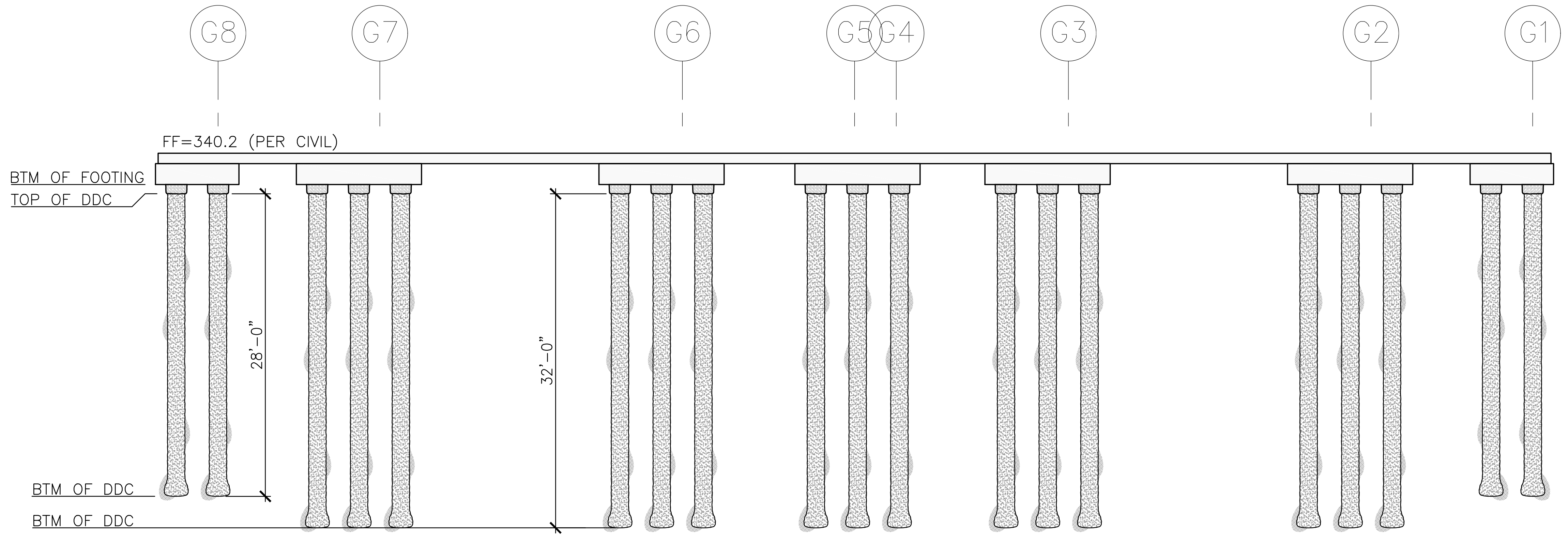

2 GROUND IMPROVEMENT SECTION
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SECTIONS

SHEET TITLE

SCALE AS NOTED

PROJECT NO. C14-329 DRAWN BY MK

SHEET SIZE: 30 x 42

GI-2.4

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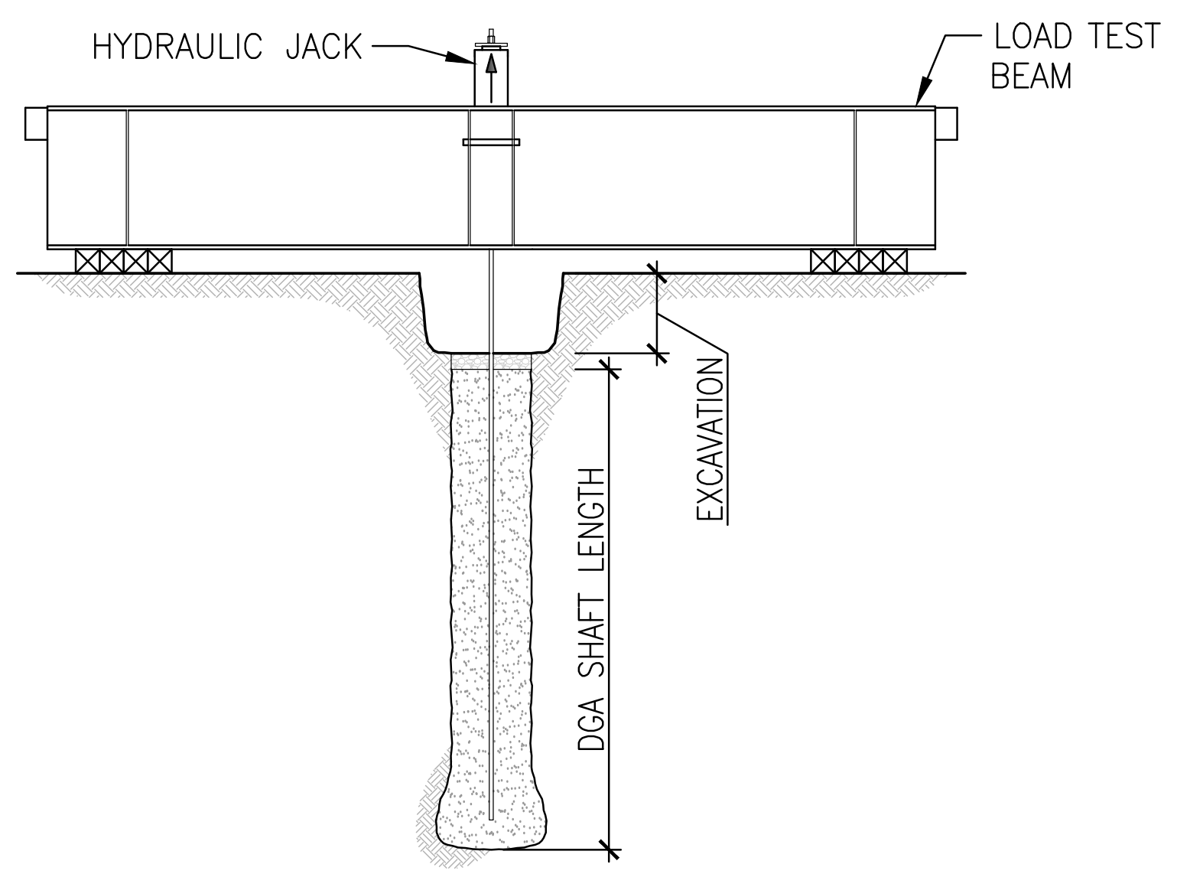
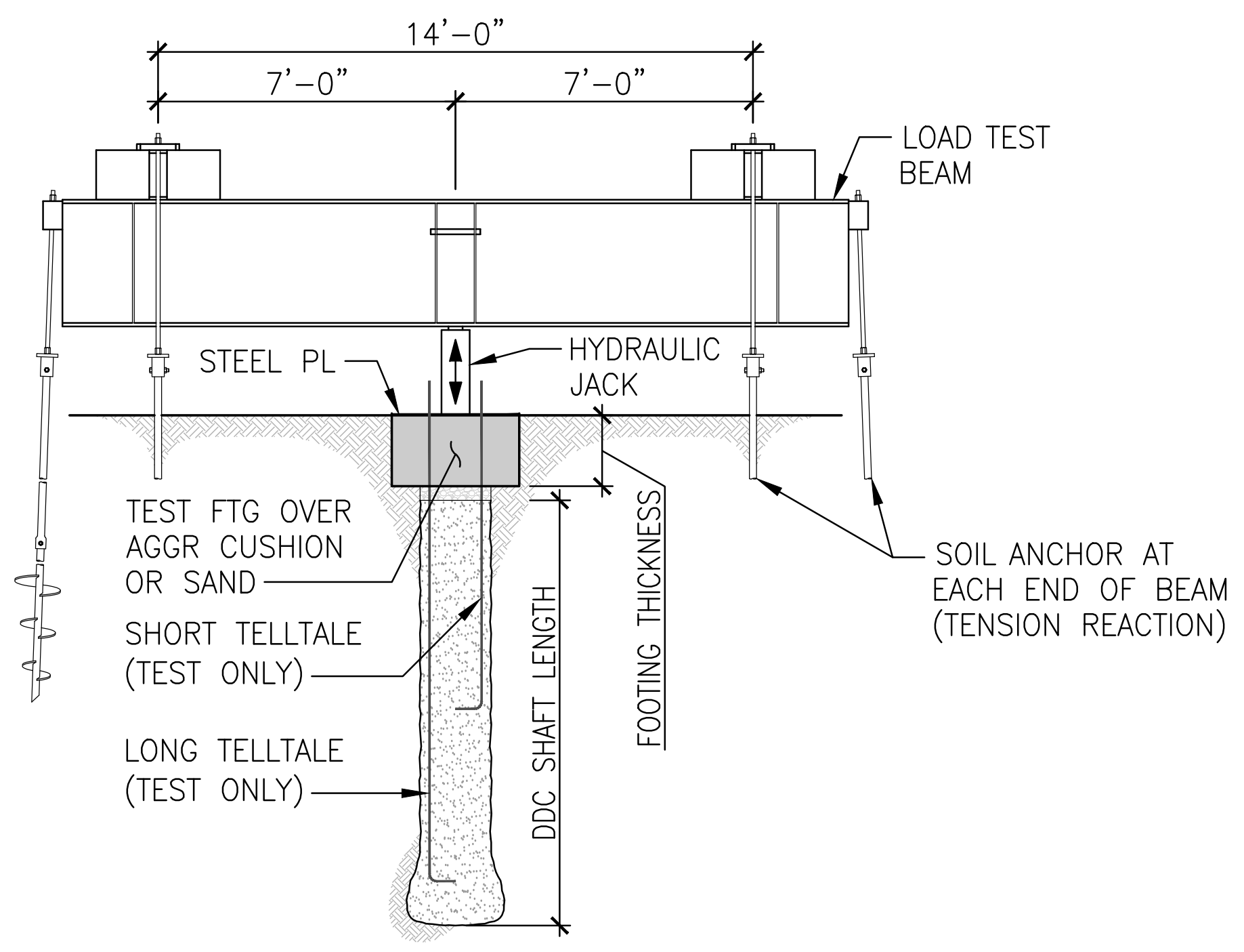


DGA TENSION LOAD TEST	
TARGET SHAFT LENGTH	35 ft
NEAT DDC DIAMETER	16 in
FOOTING EXCAVATION	4x4 ft
APPRX EXCAVATION DEPTH	2 ft
TEST LOAD (100%)	52.5 kips
TEST LOAD (150%)	70 kips

10 DGA TENSION LOAD TEST

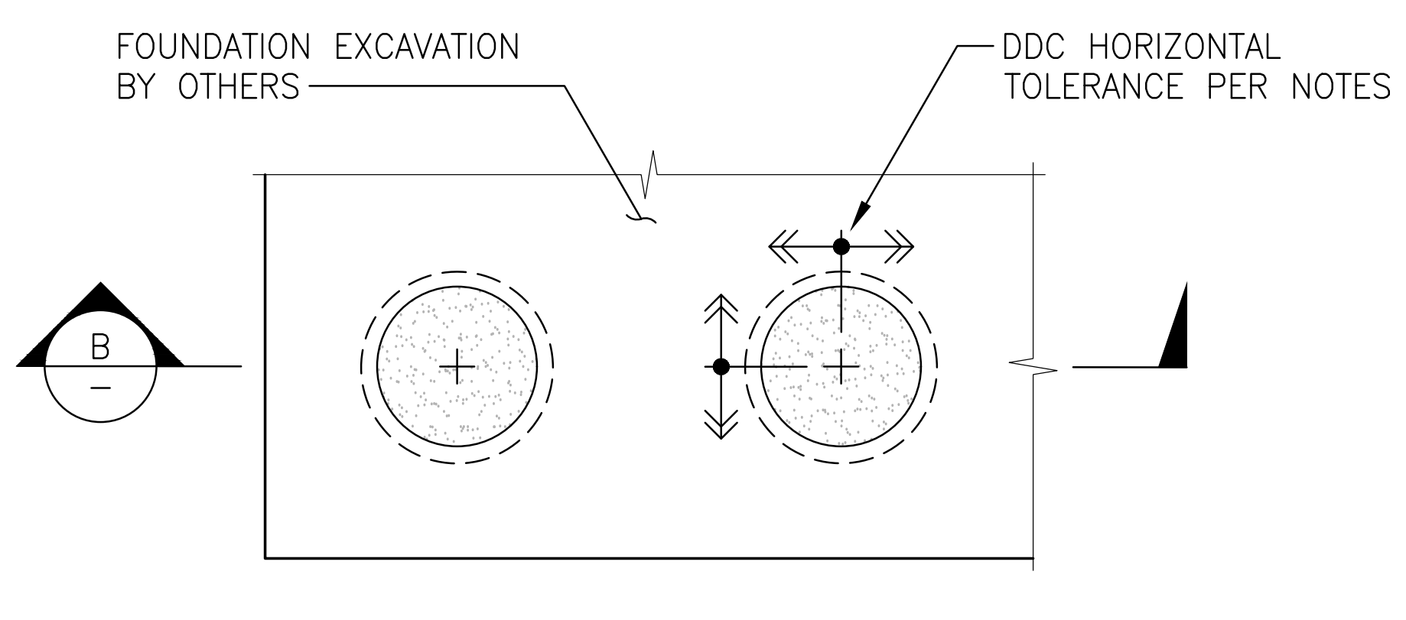
NOT TO SCALE



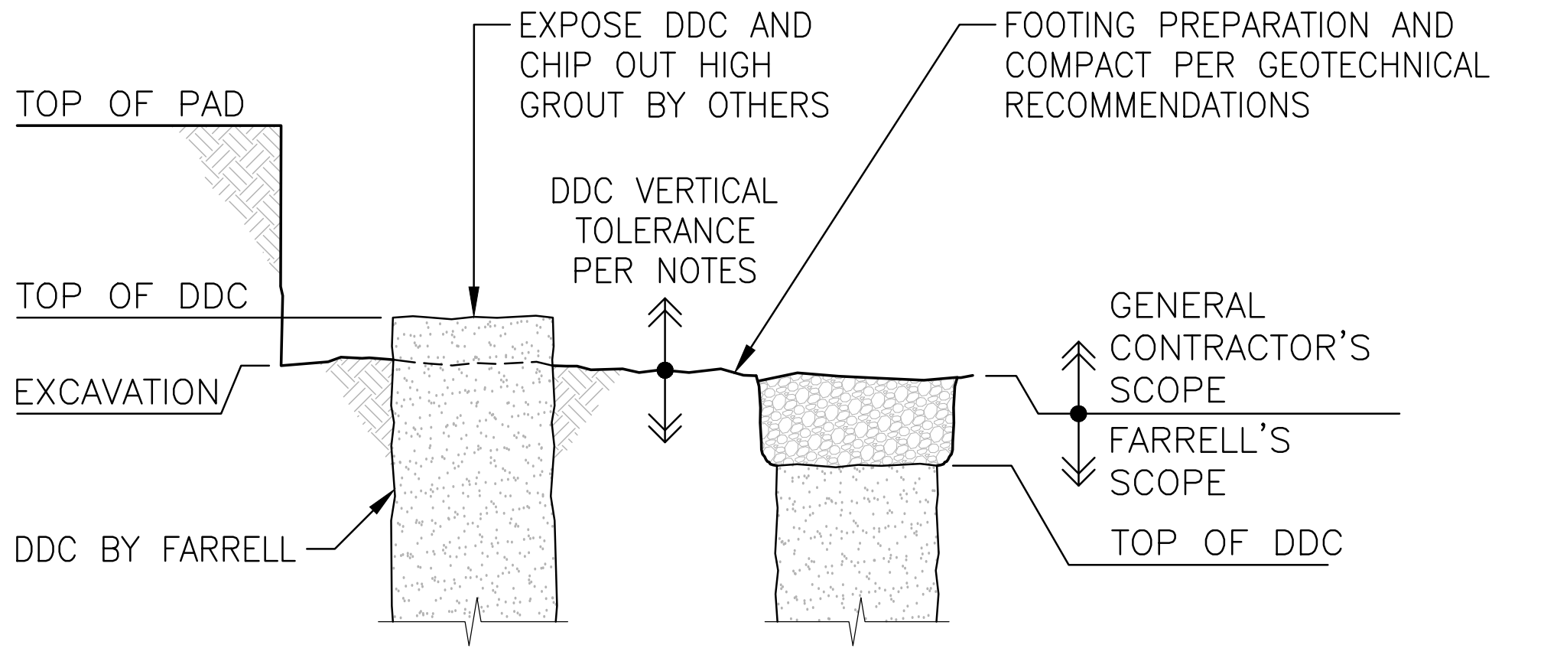
DDC BEARING LOAD TEST	
TARGET SHAFT LENGTH	28 ft
NEAT DDC DIAMETER	16 in
FOOTING PLAN DIMENSIONS	4x4 ft
APPRX FTG THICKNESS	2 ft
DESIGN LOAD (100%)	100 kips
TEST LOAD (200%)	200 kips

7 DDC BEARING LOAD TEST

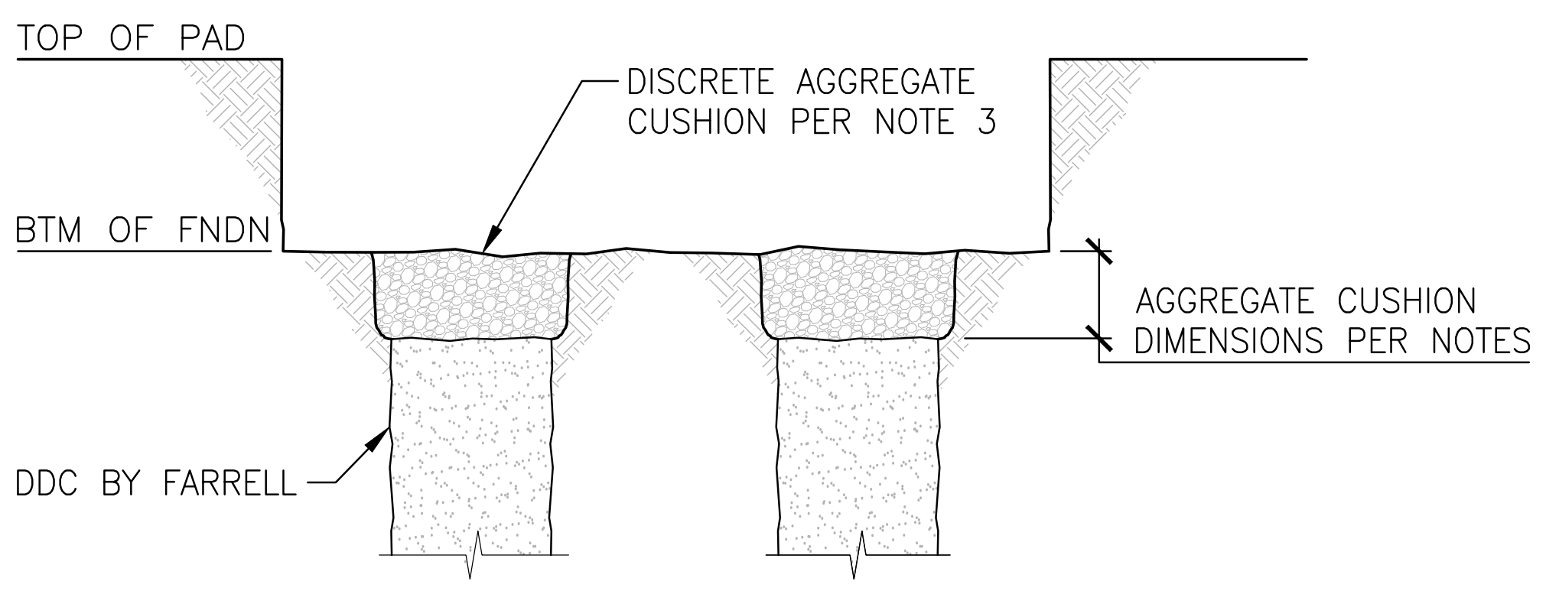
NOT TO SCALE



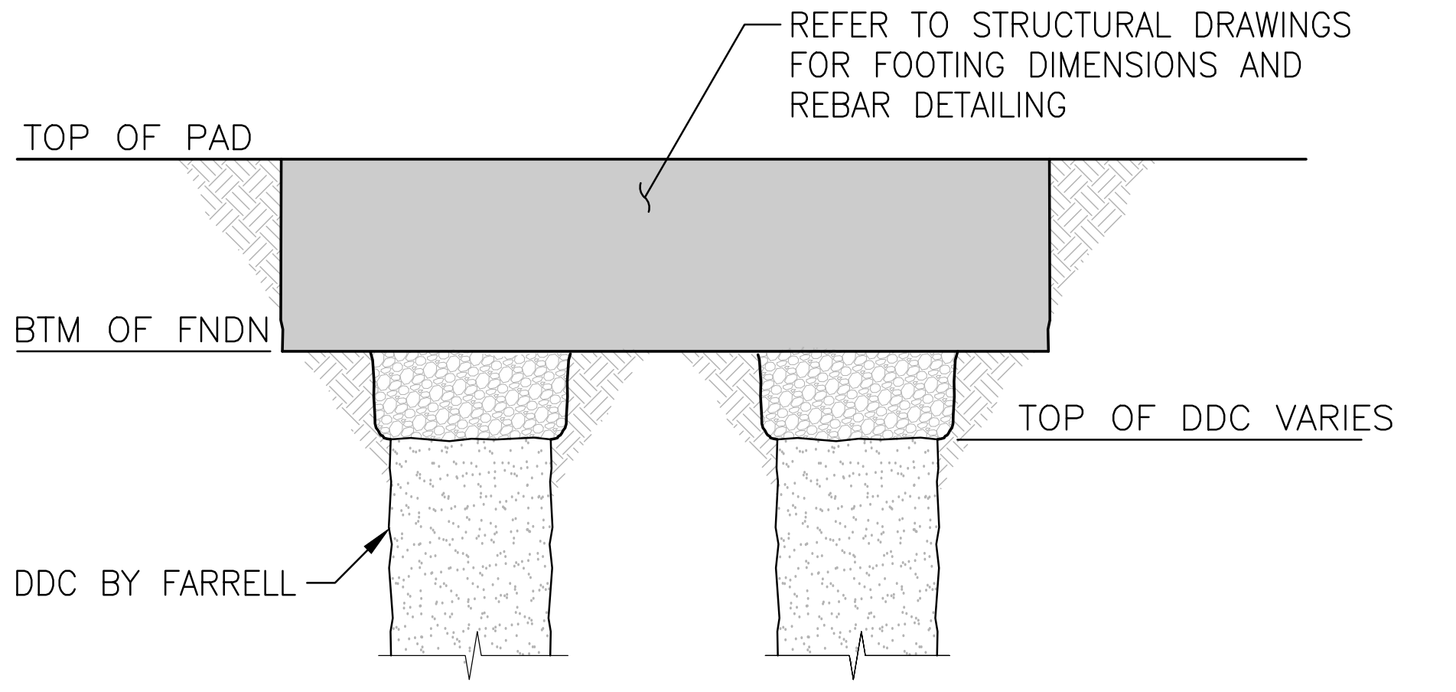
A FOOTING EXCAVATION
PLAN VIEW



B FOOTING EXCAVATION
SECTION VIEW



C AGGREGATE CUSHION
SECTION VIEW



D COMPLETED FOOTING
SECTION VIEW

CONSTRUCTION NOTES

1. IDENTIFY AND EXPOSE TOP OF DDC OR AGGREGATE CUSHION w/ SMOOTH BUCKET OR BLADE.
2. CLEAR OFF LOOSE SOIL FROM TOP OF DDC OR AGGREGATE CUSHION.

MATERIAL NOTES

AGGREGATE CUSHION:

OPTION 1: ⅜-INCH TO ¾-INCH CRUSHED ROCK COMPACTED WITH AT LEAST 2 PASSES USING A "JUMPING JACK" OR VIBROPLATE.

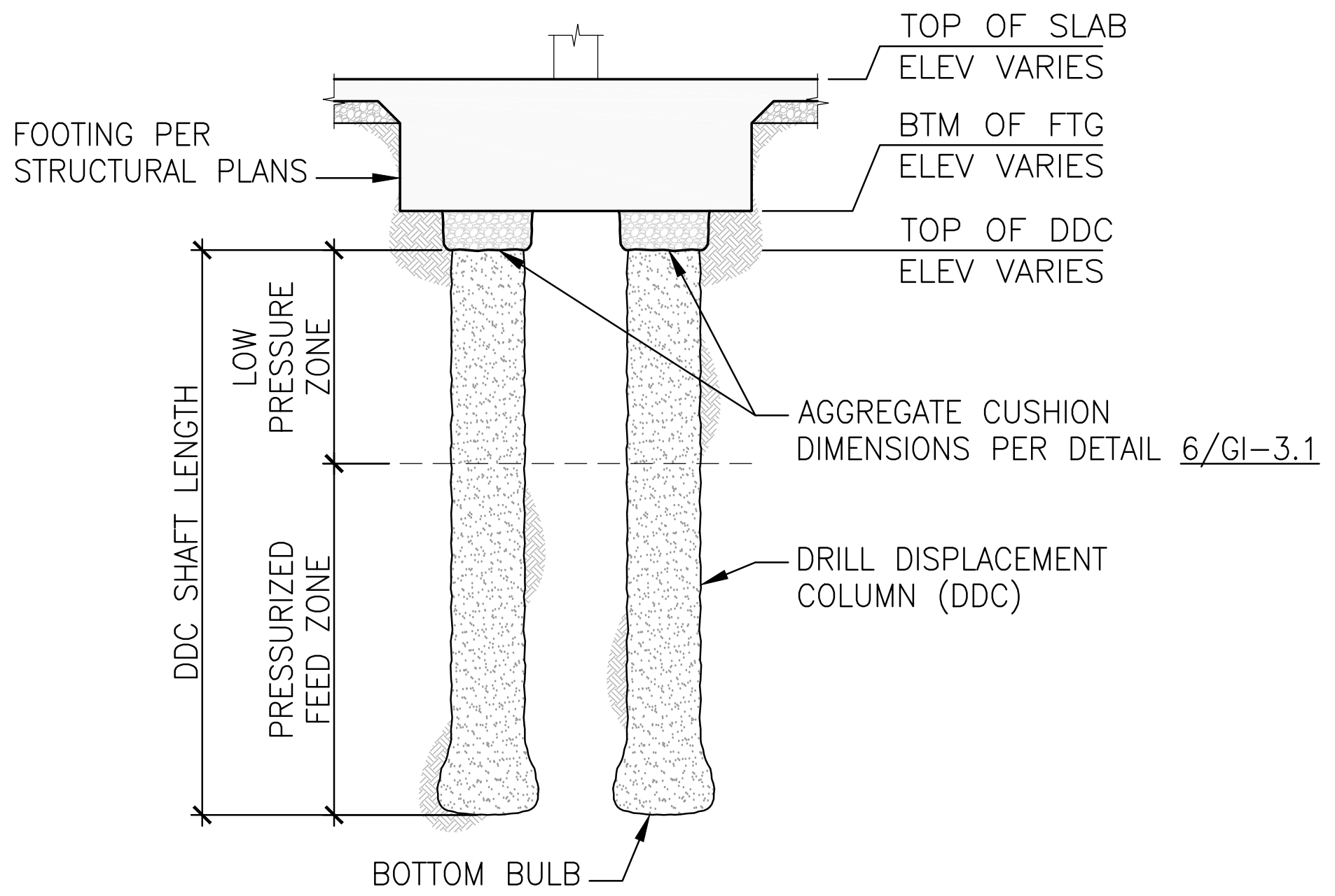
OPTION 2: ¾-INCH CLASS II AGGREGATE BASE COMPACTED TO AT LEAST 90% RELATIVE COMPACTION USING HAND OPERATED EQUIPMENT ("JUMPING JACK") IN ACCORDANCE WITH ASTM D1557 METHODS OR PER GEOTECHNICAL ENGINEER RECOMMENDATIONS. THE MOST STRINGENT COMPACTION REQUIREMENT SHALL GOVERN.

DIMENSIONS & TOLERANCES

DISCRETE AGGREGATE CUSHION:	4" MIN TO 6" MAX THICK, 18"–24"ø
DDC HORIZONTAL TOLERANCE:	±3" OC IN EACH DIRECTION
DDC VERTICAL TOLERANCE:	±3" OC IN EACH DIRECTION

6 FOUNDATION EXCAVATION & AGGREGATE CUSHION

NOT TO SCALE

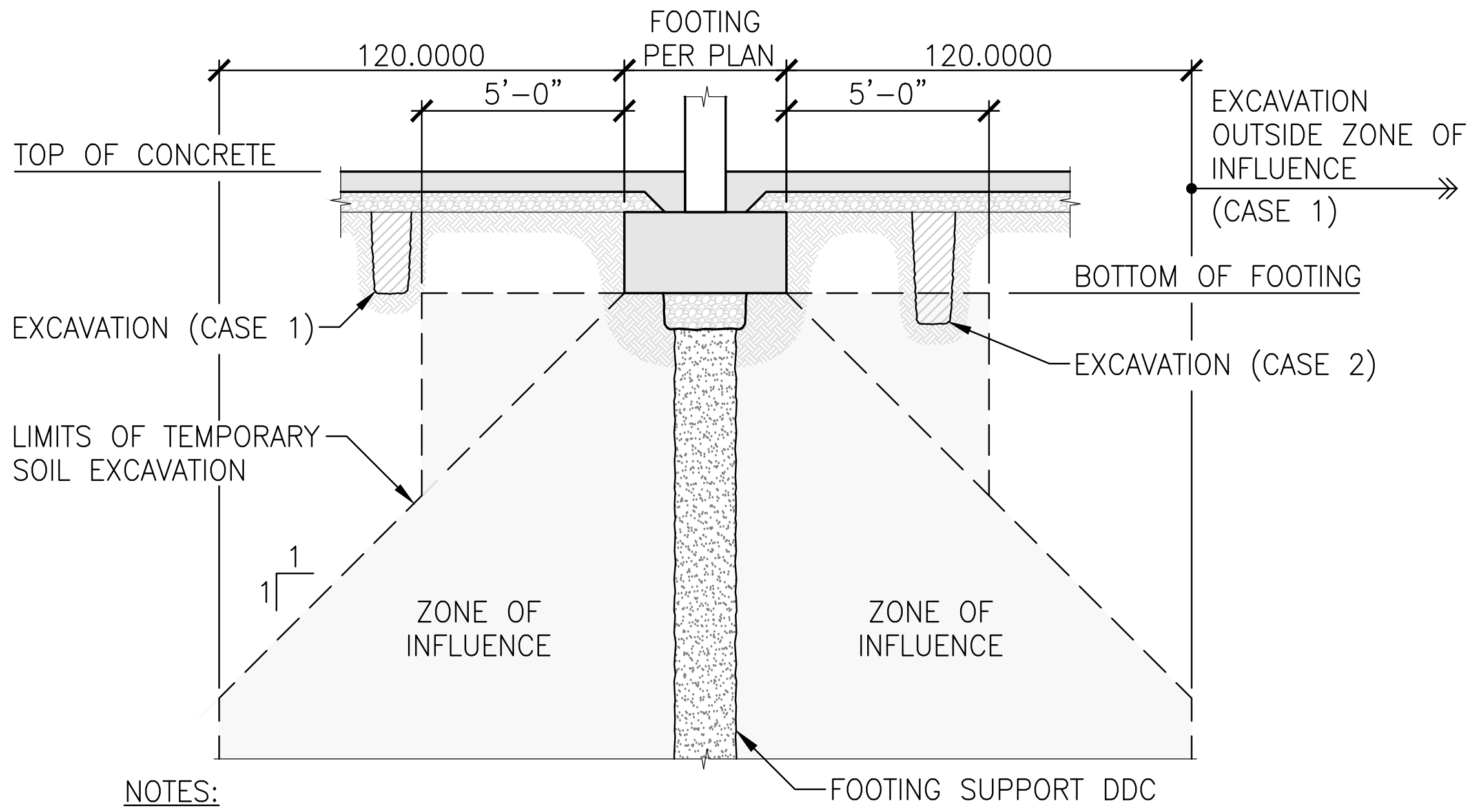


DDC PROPERTIES	
DDC SHAFT LENGTH	PER PLAN
AGGREGATE LAYER	PER DETAIL 6/–.
LOW PRESSURE ZONE	0 ft - 10 ft BELOW WORKING PAD

1 DDC SECTION

NOT TO SCALE

11



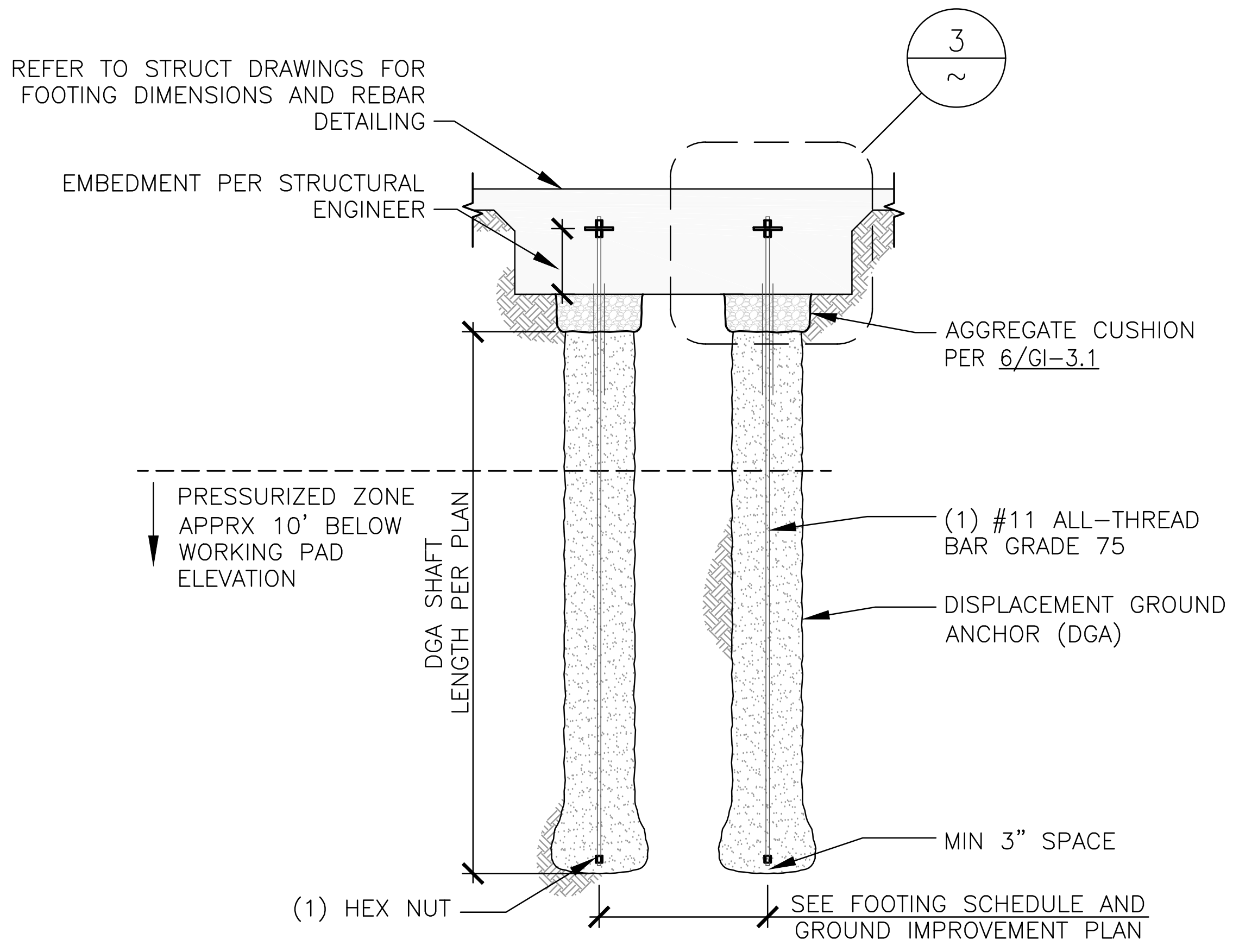
NOTES:

CASE 1: WHERE TRENCH DOES NOT ENCROACH INTO THE ZONE OF INFLUENCE, SEE GEOTECH REPORT FOR BACKFILL REQUIREMENTS.

CASE 2: TRENCH BACKFILL SHALL BE COMPACTED TO A MINIMUM 90% RELATIVE COMPACTION PER ASTM D1557 WHERE TRENCH ENCROACHES INTO THE ZONE OF INFLUENCE OR PER GEOTECHNICAL ENGINEER RECOMMENDATION. THE MOST STRINGENT COMPACTION REQUIREMENT SHALL GOVERN.

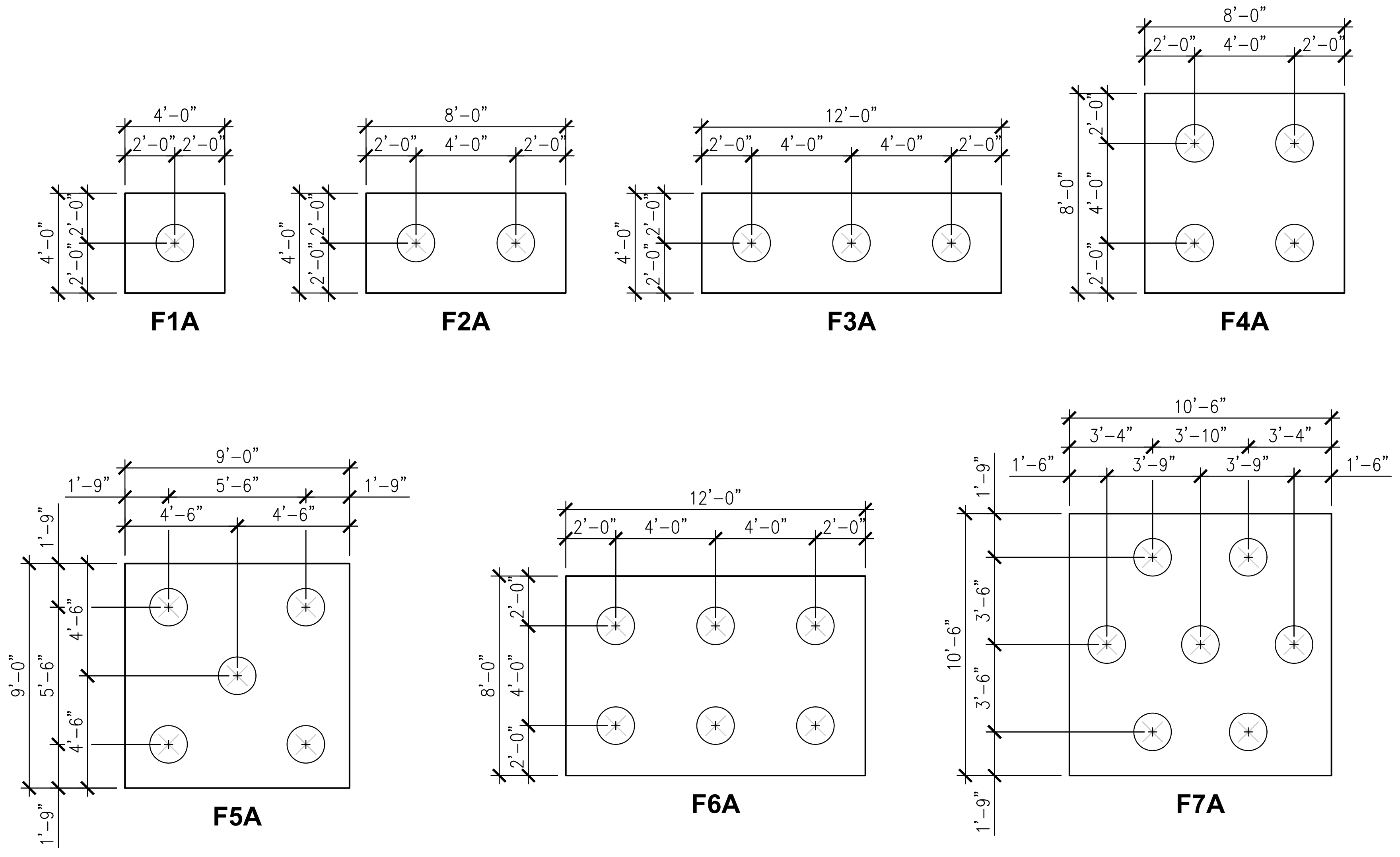
8 EXCAVATION COORDINATION

NOT TO SCALE



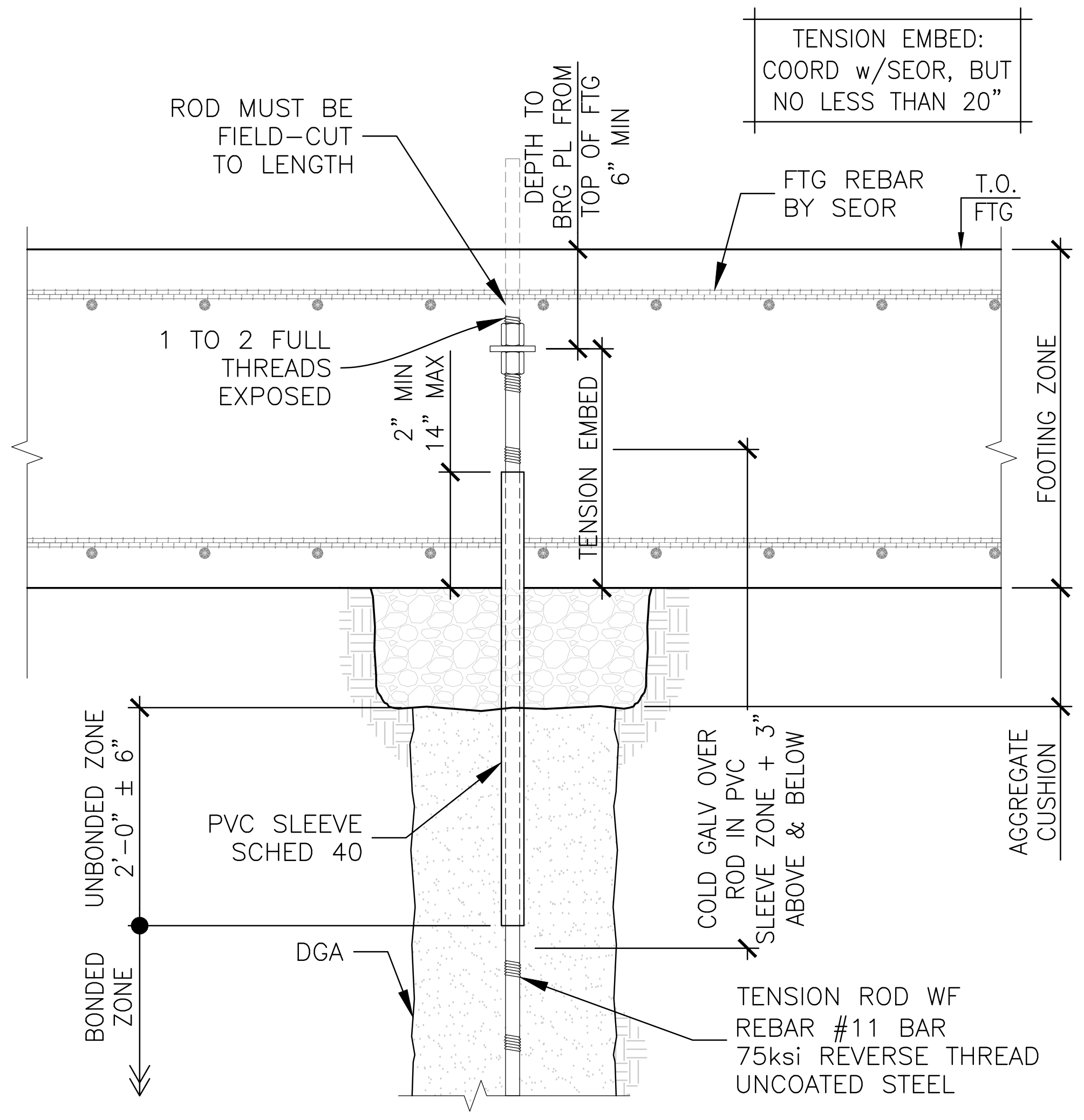
2 DGA SECTION

NOT TO SCALE



12 FOOTING SCHEDULE

NOT TO SCALE



NOTES:
1. GENERAL CONTRACTOR TO EXERCISE CARE DURING FOOTING EXCAVATION AROUND TENSION RODS.
2. HARDWARE PROVIDED BY FARRELL FOR GENERAL CONTRACTOR INSTALLATION.
3. DO NOT PERMIT DIRECT CONTACT BETWEEN TENSION ROD AND FOOTING REBAR.

3 DGA FOUNDATION INTERFACE

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GROUND IMPROVEMENT DETAILS

Sheet Title

Scale as noted

Project No. C14-329 Drawn By MK

Sheet Size: 30 x 42

GI-3.1

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ATTACHMENT 2

Permeability Tests for Similar Mixture

Hydraulic Conductivity
ASTM D 5084
Method C: Falling Head Rising Tailwater

Job No: 568-092 **Boring:** **Date:** 07-29-14
Client: CTS **Sample:** 95470-1 **By:** MD/PJ
Project: LAM Research Campus - 9822 **Depth, ft.:** **Remolded:** Cast-6/10/14
Visual Classification: Gray Soil Cement

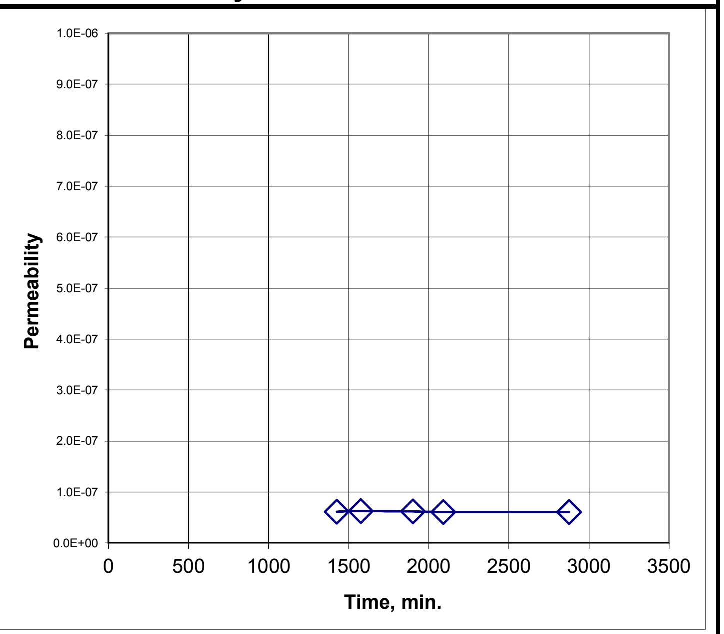
B: = >0.95 ("B" is an indication of saturation)

Max Hydraulic Gradient: = 12

Max Sample Pressures, psi:

Cell:	Bottom	Top	Avg. Sigma3
73.5	70	67	5

Date	Minutes	Head, (in)	K,cm/sec
2014-07-22	0.00	98.07	Start of Test
2014-07-23	1427.00	91.77	6.2E-08
2014-07-23	1575.00	91.12	6.3E-08
2014-07-23	1901.00	89.82	6.2E-08
2014-07-23	2091.00	89.07	6.1E-08
2014-07-24	2876.00	85.97	6.1E-08



Average Hydraulic Conductivity: 6.E-08 cm/sec

Sample Data:	Initial (As-Received)	Final (At-Test)
Height, in	7.98	7.98
Diameter, in	4.00	4.00
Area, in2	12.57	12.57
Volume in3	100.28	100.28
Total Volume, cc	1643.3	1643.3
Volume Solids, cc	1163.3	1163.3
Volume Voids, cc	480.0	480.0
Void Ratio	0.4	0.4
Total Porosity, %	29.2	29.2
Air-Filled Porosity (θa),%	6.8	1.5
Water-Filled Porosity (θw),%	22.4	27.8
Saturation, %	76.6	95.0
Specific Gravity	2.70 Assumed	2.70
Wet Weight, gm	3508.6	3597.0
Dry Weight, gm	3140.9	3140.9
Tare, gm	0.00	0.00
Moisture, %	11.7	14.5
Wet Bulk Density, pcf	133.2	136.6
Dry Bulk Density, pcf	119.3	119.3
Wet Bulk Dens.ρb, (g/cm^3)	2.13	2.19
Dry Bulk Dens.ρb, (g/cm^3)	1.91	1.91

Remarks: CLSM from On-Site Reimer Mixer

COOPER TESTING LABORATORY

Hydraulic Conductivity
ASTM D 5084
Method C: Falling Head Rising Tailwater

Job No: 640-547 **Boring:** 1 **Date:** 06/03/13
Client: Cornerstone Earth Group **Sample:** 7 Day Break #1 of 2 **By:** MD/PJ
Project: SWS Warehouse - 474-2-4 **Depth, ft.:** 40 **Remolded:** Precast-5/7/13
Visual Classification: Controlled Low Strength Material (7 Day Perm)

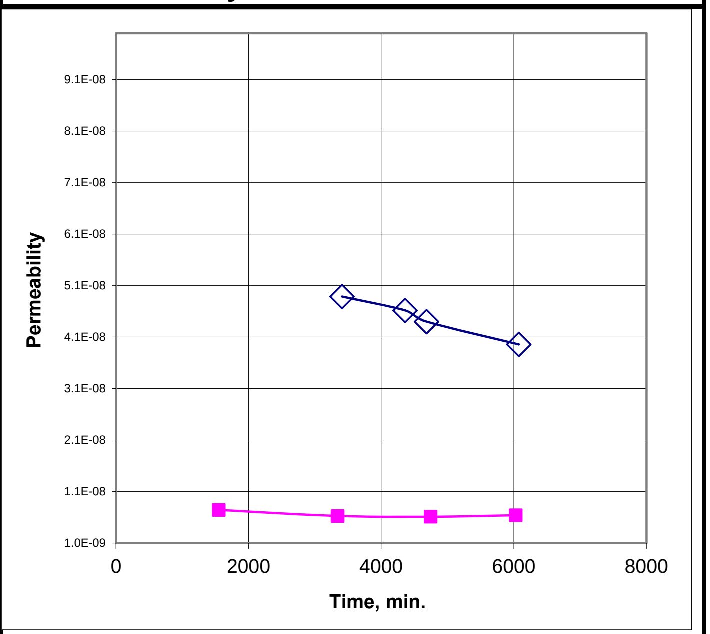
Max Sample Pressures, psi:

Cell:	Bottom	Top	Avg. Sigma3
73.5	70	67	5

B: = >0.95 **("B" is an indication of saturation)**

Max Hydraulic Gradient: = 16

Date	Minutes	Head, (cm)	K,cm/sec
5/17/2013	0.00	167.66	**Start of Test**
5/19/2013	3410.00	156.16	4.9E-08
5/20/2013	4360.00	153.96	4.6E-08
5/20/2013	4684.00	153.56	4.4E-08
5/21/2013	6075.00	151.76	4.0E-08
5/25/2013	1549.00	236.89	7.4E-09
5/26/2013	3341.00	235.89	6.3E-09
5/27/2013	4747.00	235.09	6.1E-09
5/28/2013	6030.00	234.29	6.4E-09



Average Hydraulic Conductivity: **<1X10-8** **cm/sec**

Sample Data:	**Initial (As-Received)**		**Final (At-Test)**
Height, in	5.95		5.95
Diameter, in	2.99		2.99
Area, in2	7.02		7.02
Volume in3	41.74		41.74
Total Volume, cc	684.0		684.0
Volume Solids, cc	486.3		486.3
Volume Voids, cc	197.8		197.8
Void Ratio	0.4		0.4
Total Porosity, %	28.9		28.9
Air-Filled Porosity (θa),%	7.8		1.3
Water-Filled Porosity (θw),%	21.2		27.6
Saturation, %	73.2		95.6
Specific Gravity	2.70	Assumed	2.70
Wet Weight, gm	1457.6		1502.0
Dry Weight, gm	1312.9		1312.9
Tare, gm	0.00		0.00
Moisture, %	11.0		14.4
Wet Bulk Density, pcf	133.0		137.0
Dry Bulk Density, pcf	119.8		119.8
Wet Bulk Dens.ρb, (g/cm^3)	2.13		2.19
Dry Bulk Dens.ρb, (g/cm^3)	1.92		1.92

Remarks: Permeabilities in the range of 10-9 cm/sec are difficult to measure accurately. Therefore, a permeability of less than 1 x 10-8 cm/sec is reported instead of the average of the actual readings as is normally done.

COOPER TESTING LABORATORY

Hydraulic Conductivity
ASTM D 5084
Method C: Falling Head Rising Tailwater

Job No:	640-547	**Boring:**	1	**Date:**	06/03/13
Client:	Cornerstone Earth Group	**Sample:**	7 Day #2 of 2	**By:**	MD/PJ
Project:	SWS Warrehouse - 474-2-4	**Depth, ft.:**	40	**Remolded:**	Precast-5/7/13

Visual Classification: Controlled Low Strength Material (7 Day Perm)

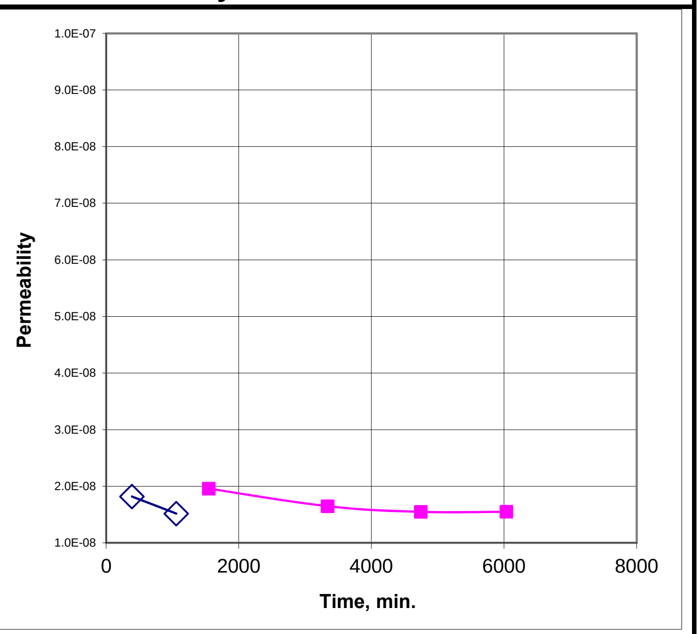
Max Sample Pressures, psi:

Cell:	Bottom	Top	Avg. Sigma3
84	80.5	77.5	5

B: = >0.95 **("B" is an indication of saturation)**

Max Hydraulic Gradient: = 16

Date	Minutes	Head, (cm)	K,cm/sec
5/23/2013	0.00	167.66	**Start of Test**
5/23/2013	389.00	167.16	1.8E-08
5/24/2013	1057.00	166.56	1.5E-08
5/25/2013	1548.00	235.09	2.0E-08
5/26/2013	3339.00	232.49	1.6E-08
5/27/2013	4745.00	230.69	1.5E-08
5/28/2013	6037.00	229.09	1.5E-08



Average Hydraulic Conductivity: **2.E-08** **cm/sec**

Sample Data:	**Initial (As-Received)**		**Final (At-Test)**
Height, in	5.92		5.92
Diameter, in	2.99		2.99
Area, in2	7.02		7.02
Volume in3	41.57		41.57
Total Volume, cc	681.2		681.2
Volume Solids, cc	485.2		485.2
Volume Voids, cc	196.0		196.0
Void Ratio	0.4		0.4
Total Porosity, %	28.8		28.8
Air-Filled Porosity (θa),%	7.9		1.4
Water-Filled Porosity (θw),%	20.9		27.3
Saturation, %	72.5		95.0
Specific Gravity	2.70	Assumed	2.70
Wet Weight, gm	1452.1		1496.2
Dry Weight, gm	1310.0		1310.0
Tare, gm	0.00		0.00
Moisture, %	10.8		14.2
Wet Bulk Density, pcf	133.0		137.1
Dry Bulk Density, pcf	120.0		120.0
Wet Bulk Dens.pb, (g/cm^3)	2.13		2.20
Dry Bulk Dens.pb, (g/cm^3)	1.92		1.92

Remarks: