GEOTECHNICAL DESIGN MEMORANDUM

TO:	Metropolitan Transportation Authority (MTA), Metro-North Railroad (MNR) Structures Department
CC:	Michael Moskowitz, P.E.
FROM:	Robert D. Bunting, P.E.
RE:	MTA MNR, Scarsdale and Hartsdale Train Station Elevator Pits Scarsdale and Hartsdale, New York
DATE:	01.16.2020

Introduction

This memorandum summarizes the subsurface field exploration and provides geotechnical engineering recommendations for the design and construction of the proposed elevator pits to be constructed at the Metro-North Railroad's (MNR) Scarsdale and Hartsdale Train Stations. Elevations noted herein are in feet and referenced to the North American Vertical Datum of 1988 (NAVD88).

Existing Conditions

Hartsdale Train Station

The site at Hartsdale Train Station is relatively flat with paved parking areas, the Bronx River and wooded areas adjacent to the outbound platform and paved parking areas, wooded areas, a 1 story train station building and a multilevel parking garage adjacent to the inbound platform. An overhead pedestrian overpass bisects the platforms. Pedestrian stairways only are located at the pedestrian overpass.

The Hartsdale Station is underlain by metamorphic, Middle Proterozoic, biotite and/or hornblende-quartz-feldspar Yonkers Gneiss and Precambrian-Middle Proterozoic, Fordham Gneiss containing amphibolite, granulite and quartzite. The soil deposits overlying the bedrock consist of sandy glacial till. The geology at the station is described as presented in the Mineral Resources On-line Spatial Data website maintained by the U.S. Department of the Interior, U.S. Geological Survey (2015) and as presented in the Geotechnical Design Manual published by the New York State Department of Transportation (2013).

Scarsdale Train Station

The tracks at Scarsdale were constructed in a cut with a 14 to 20-foot high slope on the outboard platform side. One-story structures are along the top of the slope with a retaining wall near the Popham Road Bridge. The inbound side platform is generally flat with a parking lot, a 1 story structure for the train station and a 1 story commercial property between a

pedestrian overpass and the Popham Road Bridge. The overhead pedestrian overpass bisects the platforms. Pedestrian stairways only are located at the pedestrian overpass.

Bedrock is exposed along the slope adjacent to the outbound platform roughly 100 to 175 feet from the north end of the platform.

The Scarsdale Station is underlain by metamorphic, Precambrian-Middle Proterozoic, Fordham Gneiss containing amphibolite, granulite and quartzite and Early Cambrian-Lower Ordovician, Inwood Marble containing calc-schist, granulite and quartzite. The soil deposits overlying the bedrock consist of sandy glacial till.

Proposed Construction

The proposed construction will include additions of elevators to the pedestrian overpasses. Two elevators are required for the Hartsdale Train Station overpass and one elevator is required for the Scarsdale Train Station overpass. The elevator pits to support the elevators will be approximately 10.3 feet wide by 10.7 feet long by 6 feet deep. A cross section of the proposed elevator pits is shown in **Figure 1**.





Subsurface Exploration Program

A subsurface exploration program was conducted with a boring performed adjacent to the proposed elevator pit at Scarsdale Train Station on June 21, 2019, and one boring performed within the proposed footprint of the southern elevator pit for the Hartsdale Train Station on December 13, 2019. Previous borings were drilled at the Hartsdale Train Station in February 2018. These borings were used to supplement the recent information. Boring Location Plans are included as Attachment A.

The soil borings were drilled using 4-inch inside diameter casing and mud rotary techniques. The upper 5-feet of each boring was hand augered to clear utilities. Split spoon sampling was then conducted continuously from 5 to 17 feet bgs and then at 5-foot intervals in accordance with ASTM D1586 (using a 2-inch outside diameter sampler, driven 24 inches by blows from a 140-pound automatic hammer falling freely for 30-inches). The number of blows required to drive the sampler each 6-inch increment was recorded, and the Standard Penetration Test (SPT) resistance (N-value) was determined as the sum of the blows over the middle 12 inches of penetration. An STV representative visually classified the soil samples recovered in the field in general accordance with the Burmister classification system. Representative soil samples from each split spoon were collected and stored in jars for subsequent review and laboratory testing.

The groundwater level at the soil boring locations were estimated by the observed water levels within the borehole at the completion of drilling. The soil borings were backfilled upon completion with soil cuttings.

Soil borings were located in the field by taping and line of sight from existing site features. The soil boring logs, prepared by STV, are included in Attachment B.

Subsurface Conditions

Soil and Bedrock

Table 1 summarizes the STV borings and provides the coordinates and elevations of the as-drilled locations.

The boring performed at Scarsdale Train Station (STV-SB-1) consisted of approximately 9feet of medium dense to dense (SPT N-values of 17 and 40 blows per foot, bpf) coarse to fine sand with various amounts of gravel and silt. Underlying the sand approximately 1-foot of decomposed bedrock overlaid Grey Gneiss bedrock. The Gneiss bedrock was cored 5feet and 100% of the rock was recovered with the Rock Quality Designation (RQD) reported as 86% which is considered good. The boring was terminated 15 feet below ground surface.

Doring	Coord	inates	Data	Ground	As Drilled	Water Depth	Depth To
No.	Northing	Easting	Drilled	(ft)	(ft)	(ft)	Rock (ft)
STV-SB-1	786270	683002	6/21/19	143.5	15.0	Dry	10.0
STV-HB-1	794028	686607	12/13/19	164.4	51.8	13.0	N.E.
HB-2	793985	686444	2/13/18	165.0	45.1	7.2	N.E.
HB-3	794084	686633	2/15/18	166.0	51.5	-	N.E.
HB-4	794321	686694	2/14/18	167.0	23.0	-	18.0

Table 1 – STV Boring Summary

Note N.E. = Not Encountered

The soil encountered at Hartsdale Train Station in Borings HB-2 through HB-4 was generally described as silty gravelly sand with the soil having SPT N-values ranging from 4 to 53 bpf with an average of 20 bpf. This soil is generally considered medium dense, however, Boring HB-3 encountered loose material in the upper 15 feet of the boring. Gneiss was cored at 18 feet below the ground surface in Boring HB-4.

The soil encountered at Hartsdale Train Station in Boring STV-HB-1 was generally described as loose, coarse to fine sand with varying amounts of silt and gravel in the upper 32 feet of the soil profile which is within the depth of the influence of the elevator shaft. SPT N-values ranged from 3 to 18 bpf with an average of 7 bpf in this upper layer. The boring was terminated at a depth of 51.8 feet below ground surface in medium dense sand.

Laboratory Tests

Representative soil and bedrock samples were tested on samples taken from the Hartsdale Station in February 2018. Index testing consisting of water content (ASTM D2216) and particle size distribution (ASTM D422) were performed to verify visual descriptions and determine soil parameters. Point load tests (ASTM D5731) on bedrock samples were performed to determine rock compressive strength. Corrosivity testing consisting of resistivity (AASHTO T288), pH (AASHTO T289), chloride content (AASHTO T291) and sulfate content (AASHTO T290) were performed. Existing soils are considered non-corrosive to steel and concrete structures. Laboratory test results are presented in Appendix C.

Groundwater

Groundwater was not encountered in Boring STV-SB-1.

Groundwater was measured in Boring STV-HB-1 at the completion of drilling and HB-2 24hours after the boring was completed. The groundwater elevation was recorded at El. 151.4 feet in Boring STV-HB-1 and El. 157.8 feet in Boring HB-2.

Variation in Subsurface Conditions

Interpretation of general subsurface conditions presented herein is based on soil and groundwater conditions observed at the exploration locations. However, subsurface conditions may vary between exploration locations. If conditions are found to be different than assumed, recommendations contained in this memorandum should be reevaluated by STV and confirmed in writing.

Water levels measured in the borings should not necessarily be considered to represent stabilized groundwater levels. Groundwater levels are expected to fluctuate with rainfall, season, and construction activities in the area. Therefore, actual conditions at the time of construction may be different from those observed at the time of exploration.

Foundation Recommendations

General

Geotechnical engineering evaluations and design recommendations have been made as they relate to the proposed elevator pits at the Scarsdale and Hartsdale Elevator Pits. In general, these evaluations have been based on the results of field testing programs conducted for the design, published correlations with soil properties, and the design standards of AREMA, AASHTO and FHWA. In addition, recommended design criteria are based on performance tolerances, such as allowable settlement and horizontal deflection as set forth by MNR.

Design Requirements

The foundations for the elevators must be designed for a 1 tsf applied load. A resistance factor of 0.45 was used to determine the factored bearing resistance at each elevator pit. Allowable vertical settlement needs to remain less than 1-inch. The design groundwater was assumed to be at the ground surface.

Elevator Pit Foundation Design

Based on the poorest subsurface conditions encountered at each site, it was determined that the factored bearing resistance at each pit would be above the 1 tsf (2 ksf) required for the design. A factored bearing resistance of 4 ksf was calculated for the Hartsdale elevator pits and 8 ksf for the Scarsdale elevator pit. In addition, the maximum vertical settlement calculated at any of the elevator test pits was approximately 1-inch of immediate settlement. It is anticipated that the majority of this settlement will occur during construction.

Construction Considerations

Excavation and Excavation Support

Anticipated excavation depths will be approximately 6-feet below grade. Based on the subsurface exploration data, it is anticipated that foundation excavations can typically be made using conventional earth moving equipment.

Existing structures are in the vicinity of the proposed structures. Excavations shall not extend into the zone of influence of any existing building, utilities of other structures. The zone of influence is defined as extending 2-feet beyond the bottom exterior edge of the existing foundation and then down and away at a one horizontal to 1 vertical (1H:1V) slope. Undermining of existing foundations must not occur. Where open excavations are feasible, the side slopes should be designed in accordance with OSHA regulations.

The selection of the type of excavation support system should be performed by the Contractor. The Contractor should be required to retain a registered Professional Engineer licensed in the State of New York to design the excavation support systems. Where applicable, the design of the excavation support systems should be performed in conjunction with the design of the dewatering systems. Excavation support systems that are installed within the zone of influence of structures should be left-in-place. Any sheeting or soldier piles left in place should be cut-off at least 5-feet below the adjacent finished grade.

Dewatering

Based on the available groundwater information, the excavations are not anticipated to extend below the existing groundwater level at any of the proposed structures. However, due to seasonal changes in groundwater, the Contractor should be required to design and implement a dewatering system that maintains a dry, undisturbed subgrade. It is anticipated that a sump and pump system may be utilized for this purpose. To avoid disturbance to the subgrade, water elevation should be maintained at least 2-feet below the subgrade level during the entire period of excavation.

If wet weather is encountered during construction, the Contractor shall take care to schedule excavations to limit the duration of open cuts, slope the bottoms of the excavations to facilitate drainage and provide berms to limit runoff into the excavations.

Excavated material to be reused as fill should be stockpiled in such a manner that promotes run off and limits saturation of the materials.

Preparation and Protection of Foundation Subgrades

Care should be taken to avoid excess traffic on the excavated subgrades prior to placement of structural fill or concrete foundations. Final excavation including any over excavation should be made using a smooth edged bucket where possible. Any unsuitable material present at the subgrade level should be removed and replaced with compacted structural fill. Soil subgrades should be proofrolled with at least four coverages of a vibratory compactor prior to placement of fill. the exposed subgrade should be protected against precipitation, and the subgrade should not be allowed to freeze.

Attachments

Attachment A – Boring Location Plans

Attachment B – Soil Boring Logs

Attachment C – Geotechnical Laboratory Test Results

ATTACHMENT A BORING LOCATION PLANS



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ATTACHMENT B TEST BORING LOGS

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5	P		1										moist. (SP)				
- -	$ \varphi$		1	3		9.0 - 11.0	3	3	4	8	7		Dark brown	CM SAND	and MF Gr	avel little S	ilt
– 10													moist. (SP)	CIVI 0/ 11 1D,		arei, nuie B	,
				4		11.0 12.0				10	~						
				4		11.0 - 13.0	0	6	8	10	/		Dark gray C	M SAND, so	ome M Grav	vel, trace Silt	t,
			1										moist. (SP)				
5 -	$ \mathcal{V} $			5		13.0 - 15.0	12	10	13	14	17		Dark oray C	M SAND 18	ttle M Grov	el little Silt	
	$ \varphi $												moist. (SP)	עווהט ווים, וו	uie ivi OldV	er, mute Sill,	
15						150 150	10	1.2		10							
	9			6		15.0 - 17.0	12	13		13	21		Light brown	CM SAND	some M G	ravel, trace S	Silt,
	6		1										moist. (SP)				
			$\left \right $														
-	$ \rangle$																
	٩																
ļ																	
Rev01											-	Bor	ring No.	HB-2	Shee	t 1 c	of 3

			_			1						BORING NUMBER: HB-2
•)	S	Γ	V	1	7,10	00	BC	RII	NG	LO	SHEET NUMBER: 2 of 3
					E	Jear.	r	_ •	(cor	ntinuec	i)	CONTRACT NUMBER:
PROJ	ECT:	MN	R-2	26 \$	Sta	tions Rep	airs					CONTRACTOR: Jersey Boring & Drilling
LOCA	TION	: Ha	rtsd	lal	eТ	Frain Stat	ion					DRILLER: Roberto Santiago
	IT. NA	latre	N		հո	Doilwood						INCRECTOR: Comon Arrido arri
		letro	10	rti	n F	Callroad						INSPECTOR: Canan Ozudogru
					SAI	MPI F		SOII	(Blows/	(6 in)		
eet)	LOG	s/ft) (ft)	\vdash				0/6	6/12	12/18	18/24	REC.	
TH (f	PHIC	(Blows (Min./		Ъ		(feet)	0/0	0/12		10/24	(in.)	FIELD CLASSIFICATION AND REMARKS
DEF	GRA	SING	ЪЕ	JMBE	YMBO	EPTH	RUN	REC.	REC.	, L>4"	RQD	
	٥	55	F	ž 7	Ś	<u>ā</u> 20.0 - 22.0	(in.) 15	(in.) 14	% 15	(in.) 21	% 7	Drown M CD AVEL and ME Cond little Silt maint
╞	000		$\left \right $					GP)				
-	\circ											
F			11									
-	0		1									
	25			8		25.0 - 27.0	10	10	14	24	11	Black/Dark gray CM SAND, some F Gravel, trace Silt moist (SP)
-												
-			$\left \right $									
-	Q		$\left \right $									
- 30	Ö		$\left\{ \right\}$	9		30.0 - 32.0	15	12	8	8	13	Dark grav CM SAND and CM Gravel trace (-) Silt
F	5		$\left\{ \right\}$									moist. (SP)
-	6		11									
-			1									
25	000											
- 55				10		35.0 - 37.0	12		10	10	7	Gray CM GRAVEL, little(-) MF Sand, moist. (GP)
-	000		$\left \right $									
-			$\left \right $									
-			$\left \right $									Rig chattered at 37' to 39'
- 40			$\left \right $	11	\vdash	40.0 - 42.0	20	24	22	20	13	Gray CM GRAVEL and CM Sand. (Decomposed
-			$\left \right $									Rock)
-			1		\vdash							
Rev01 Notes:												Boring No. <u>HB-2</u> Sheet <u>2</u> of <u>3</u>

•	^)	S	Γ	V		Year.)0	BC)RII (con	NG ntinued	LO	G S	ORING NUMBER: HB-2 HEET NUMBER: <u>3</u> of <u>3</u> CONTRACT NUMBER:
PROJE	ECT:	MN	R-2	26 \$	Sta	tions Rep	oairs					С	ONTRACTOR: Jersey Boring & Drilling
LOCA	TION	Hai	rtsd	lale	eТ	rain Stat	ion					D	RILLER: Roberto Santiago
CLIEN	IT: M	letro	No	ortł	h R	Railroad						11	NSPECTOR: Canan Ozudogru
it)	g	æ		5	SAN	MPLE		SOIL	. (Blows/	6 in.)			
ГН (fee	HIC LO	3lows/ft Min./ft)				eet)	0/6	6/12	12/18	18/24	REC. (in.)	F	FIELD CLASSIFICATION AND REMARKS
DEP	BUN BUN BUN REC. L24" BUN RUN REC. L24" RQI										RQD		
		30	ſ_ S	N 12	S	45.0 - 45.1	(in.) 100/1	(in.) -	-	(in.) -	% 0	No	Recovery.
- - 50 - - -												End	d of Borehole at 45.1 ft.
												Borine	1No HB-2 Sheet 3 of 3

_						1							BORING	NUMBE	R: HB-3		
	>	S	Г	V	I	7.10)()		SUE	тг	າເດ		SHEET	UMBER	k: 1	of	1
	$\overline{}$		1		E	Mear	5		501	1 L							
						9							CONTRA	ACT NUM	IBER:		
PROJE	CT:	MN	R-2	6 S	ta	tions Rep	airs						LOCATIO	ON: Hart	sdale Tr	ain Statio	n
	ION T·M/	(City	y/St N∽	tate	e): I P	Hartsdale	/ NY						COORD	· N• 794	084 1	E• 686 62	3
			140. : . Je	r ul rse	v I	anı vau Boring &	Drillin	ig Co	mpanv	Inc.			SURFAC	CE ELEV	: 166.0 f	2. 000,03. Teet	0
DRILLE	ER: R	Robe	rto	Sa	nti	ago		8 20					DATUM:				
INSPE	CTO	R: C	ana	n (Dzi	udogru											<u>.</u>
DRILLI	NGN	/ETI	HO	D: I	Ha	nd Auger									14/18 T	IME: 1:20	0 pm
RIG TY	′PE: ′	<u>l'ruc</u>	<u>k</u>	₹ig		On lith C	01-11	T . 4	Danai			Da		JATE: 2/			o hu
T		. –	Ca	sing	_	Split Spoon	Shelby		Dennison	Grat				GROUI	NDWATER		Hole
liype/S	ymbo	י -			\dashv	5			υŊ		<u> </u>	し目	Η	T :	Depth	Depth	Depth
					-								Date	Time	(ft)	(11)	(ft)
		\vdash			-			-+									
Hamme	or 1/1		140	lhe	-	140 lbs	Drill Ro	d Size	/ D (O D)		1 875"	(2.65")					
Hamm	er Fa	" -	3(0"	+	30"			TVDP		omatic L	Lammer					
											omane r		1	I			
t)	$ \begin{array}{c c} \hline \\ \hline $																
(fee	CLC	ws/ft ì./ft)	1			f	0/6	6/12	12/18	18/24	REC. (in)						
HT	HH((Blo (Mir		2		(fee		1			()	1	FIELD CL	ASSIFICAT	ION AND I	REMARKS	
DEF	GRA	DN NG	Щ	ABE	ABO	H											
		CAS	TYF	NN N	SYN	DEF	RUN (in.)										
	₩ 3		G	1		0.0 - 5.0	. ,			. /			Brown CM SAND, and CM Gravel, trace roots,				
F			1		\mathbb{N}								moist, COBI	BLES. (FILI	.)	· · ····,	
ŀ			-		V												
F	°¥°₽				M												
L					$\left \right $												
5													(Start Boring	g at 5ft, see E	Boring Log)		
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Rev01		1	1		1	1		1			l	Bor	ina No.	HB-3	Shee	t 1 c	of 1

						1							BORING		R: HB-3		
<	>	S	Г	V	I	7.10)()	R		JC	10	G	SHEET	NUMBER	: 1	of	3
	\checkmark			•	E	/fear.	5			U	LU	U					
						9							CONTR/	ACT NUM	IBER:		
PROJE	ECT:]	MNI	R-2	6 S	ta	tions Rep	airs						LOCATI	ON: Hart	sdale Tra	ain Statio	n
	HON T: Ma	(City	//S1 No	iate rth	:): I P	Hartsdale ailroad	/ N Y						COORD	· N• 794.	084 1	E• 686 63	3
CONTI		OR	Je	rse	v l	Boring &	Drillin	ig Co	mpany I	nc.			SURFAC	CE ELEV.	: 166.0 f	2. 000,00. Teet	, ,
DRILLI	ER: R	lobe	rto	Sa	nti	ago	211111	500	<u> </u>				DATUM:	-			
INSPE	CTO	R: Ca	ana	ın (Dz	udogru											
DRILLI	ING N	/ETł	10	D:N	Лu	ıd Rotary								DATE: 2/1	15/18 T	IME: 8:00	0 am
RIGIN	(PE:	Truc	k h	lig		On lith On a serie	01	T Is	Denniser	0							o pm
Turnel) una la c	. –	Cas	sing	_	Split Spoon	Sneiby		Dennison	Grai				GROUN	Water		Hole
Type/S	sympo	" -	St		_	1 275"			DD			し <u>日</u> 1 772"	- Data	Time	Depth	Depth	Depth
		⊢	4	75"	_	1.575					_	2 080"	Date	11.20 om	(π)	(π)	(π) 52.0
Length		\vdash	+.3	5"	-	2 24"						2.700 60"	2/13/18	11.30 am	4.3	-	52.0
Hamm	، er ۱۸/۴		140) he	\dashv	140 lbs	Drill Ro	d Size	<u>(10)</u>	Δ	<u> </u> / 1 875"	(2.65")					
Hamm	er Fa	-	30	0"	\neg	30"	H				omatic I	Lammer					
			Τ	-					· · · · · · · · · · · · · · · · · · ·				1			I	
l 🗊	g	()		;	SAI			50	יור (Blows/6	o in.)	-	4					
(fee	CLC	ws/ft n./ft)				Ŧ	0/6	6/12	2 12/18	18/24	REC.						
PTH	HH	(Blo (Mii		к	2	(fee					()	1	FIELD CL	ASSIFICAT	ION AND F	REMARKS	
DEI	GRA		Щ	MBE	MBC	L H				1 . 41		-					
		CAS	Ţ	R	SΥI	DEI	(in.)	(in.)	. REC. 8	L>4 (in.)	RQD %						
- G I O.O - 5.0 Previously hand cleared to 5' below ground surright See Soft Dig Log for HB-3.															ground surfa	ce.	
-	G 1 0.0 - 5.0 Previously hand cleared to 5' below ground surface. See Soft Dig Log for HB-3.																
-	See Soft Dig Log for HB-3.																
-																	
_					$ \rangle$												
	0		S	1		5.0 - 7.0	3	3	2	2	4		Brown CM S	SAND, little	MF Gravel	, wet. (SP)	
F			1														
F	0		s	2		7.0 - 9.0	3	3	2	2	7		Brown CM	SAND little	MF Gravel	trace Silt	<i>v</i> et
₂⊢	\mathbf{b}		$\left \right $										(SP)	, iittie	In Glavel	, and one, w	
107/7	$\left[\phi \right]$			2		0.0 11.0	2	<u>`</u>		n							
) S	5		9.0 - 11.0				Z			No Recovery	/.			
	0																
			S	4		11.0 - 13.0	12	12	11	5	15		Brown CM S	SAND, some	e M Gravel.	little Clayev	Silt,
	ρ												wet. (SP)	,	. ,	5-5	ŕ
- -	Din		s	5		13.0 - 15.0	3	3	5	5	7		0 0		ma i		
PAOE						10.0				·			Gray Silty C	LAY, and M	IF Sand, we	et. (CL)	
	0		S	6		15.0 - 17.0	6	6	5	5	4		Brown CM S	SAND, and I	MF Gravel,	little Silt, we	et.
≥⊢ 9			1										(SP)				
	0		$\left \right $														
	\mathbb{N}																
Rev01												Bor	ing No.	HB-3	Shee	t_1_0	of <u>3</u>

		~		_	_							BORING NUMBER: HB-3			
•	_ >	S	Γ	V	1	7,10	0	BC	RII	NG	LO	G SHEET NUMBER: 2 of 3			
_					C	Jear.	2		(cor	itinued	l)	CONTRACT NUMBER:			
PROJ	ECT:	MN	R- 2	26 \$	Sta	itions Rep	oairs					CONTRACTOR: Jersey Boring & Drilling			
LOCA		Hai	rtso	dal	eТ	rain Stat	ion					DRILLER: Roberto Santiago			
		r ,	NT												
	NI: M	letro	N	orti	h R	Kailroad						INSPECTOR: Canan Ozudogru			
								501	(Plows)	G in)					
eet)	LOG	r/ft) ft)	h				0/0			40/24	REC.				
TH (fe	HIC	(Blows (Min./f		٨		(feet)	0/6	6/12	12/18	18/24	(in.)	FIELD CLASSIFICATION AND REMARKS			
DEP	GRAF	SING (RING	Ш	MBEF	MBOL	PTH (RUN	REC		; \/"	ROD				
		S O C Č	<u>ך</u>		SY	Ш 200-220	(in.)	(in.)	% 5	(in.)	% 4				
-				,		20.0 22.0	2	5	5			Brown CM SAND, and Silt, some CM Gravel, wet. (SM)			
-															
-															
-															
- 25	00		s	8		25.0 - 27.0	5	5	6	9	15	Top 4": Gray CM GRAVEL, wet. (GP)			
-												Bottom 11": Brown CM SAND, and CM Gravel, trace (-) Silt, wet. (SP)			
-															
-	000		1												
30	000														
	000		S	9		30.0 - 32.0	4	6	6	4	0	No Recovery.			
-	000														
<u>o</u> –	\circ														
10717			$\left \right $												
- 35			s	10		35.0 - 37.0	3	4	4	5	13	Top A": Grav ME CD AVEL wat (CD)			
	000		$\left \right $									Bottom 9": Brown/Gray CF SAND, trace Silt, wet. (SM)			
			$\left \right $												
			$\left \right $												
	0		1												
≏ <u>⊢</u> 40	Ö.		s	11		40.0 - 42.0	5	5	5	7	16	Gray CM SAND, and CM Gravel, wet. (SP)			
	Б														
Notes:												Boring No. <u>HB-3</u> Sheet <u>2</u> of <u>3</u>			

	• •	S	Γ	V		Year.)0	BC	ORII (cor	NG ntinued		G BORING NUMBER: HB-3 SHEET NUMBER: <u>3</u> of <u>3</u> CONTRACT NUMBER:
PROJI	ECT:	MN	R- 2	26	Sta	ations Rep	oairs					CONTRACTOR: Jersey Boring & Drilling
LOCA	TION:	Ha	rtso	dal	eТ	Frain Stat	ion					DRILLER: Roberto Santiago
CLIEN	IT: M	letro	No	ortl	h F	Railroad						INSPECTOR: Canan Ozudogru
£	b				SAI	MPLE		SOIL	(Blows/	'6 in.)		
H (feel	IIC LC	lows/ft) /in./ft)				set)	0/6	6/12	12/18	18/24	REC. (in.)	FIELD CLASSIFICATION AND REMARKS
DEPT	SRAPH	ING (B	ш	ABER	ABOL	TH (fe			CORING			
		CAS	TYP		SΥΝ		RUN (in.)	REC. (in.)	REC. %	L>4" (in.)	RQD %	
-			S	12		45.0 - 47.0	8	10	13	Top 3": Gray MF GRAVEL, moist. (GP) Bottom 10": Brown CF SAND, little Silt, moist. (SM)		
- 50			S	13		50.0 - 51.5	33	100/6	38	100/6	19	Brown/Gray CM GRAVEL, and CM Sand, moist. (GP)
50 5 5 5 5 60 60 60 60 60 60 60 60 60 60 60 60 60												
Rev01			-									Boring No. HB-3 Sheet 3 of 3

						1							BORING	NUMBE	R: HB-4		
<	>	S	Γ	V	I	7.10)()		SOF	тг	າເດ		SHEET	NUMBER	1	of	1
	\checkmark	N	1		E	Mean	s		501								
						9							CONTRA	ACT NUN	IBER:		
PROJE	ECT:	MN	R-2	6 S	ta	tions Rep	airs							ON: Hart	sdale Tr	ain Statio	n
	ΠΟΝ Τ∙ΜΩ	(Cit	y/Si N∩	tate rth	:): P	Hartsdale ailroad	/ NY							: N: 794	321 1	E: 686.694	4
CONT		TOR	140 : Je	rse	v l	Boring &	Drillin	ig Ca	ompany]	Inc.			SURFAC	CE ELEV	167.0 1	2. 000,09. Teet	•
DRILLI	ER: R	Robe	rto	Sa	nti	ago		80	punj l	**			DATUM:				
INSPE	СТО	R: C	ana	an (Dzu	udogru								- /			
DRILL	ING N	ЛЕТ	HO	D:1	Ha	nd Auger									13/18 T	IME: 1:0	0 pm 5
RIG T	YPE:	<u>Fru</u>	ck I	Rig		0.111.0		.	<u> </u>					DATE: 2/			5 pm
T			Ca	sing	_	Split Spoon	Shelby	Tube ⊓	Dennison	Grat				GROUI	NDWATER Water		Hole
Type/S	sympo	ᄓᄂ			_	5			DD	G		し目		-	Depth	Depth	Depth
		-			_								Date	Lime	(π)	(π)	(π)
Longth		┝			+					+	_						
Hamm	ا ۵۲ ۱۸/۱	,	140) lhe	-	140 lbc		d Size			1 875"	(2.65")					
Hamm		" -	3	0"	-	30"			r Type		omatic L	Lammer					
			T	-							sinant I		1	1	I	I	
Ę.	g			;	SAI			so	JIL (Blows/	6 in.)							
(fee	C LO	ws/ft				f	0/6	6/1:	2 12/18	18/24	REC. (in)						
TH	H	(Blo		м		(fee				<u> </u>	()	1	FIELD CL	ASSIFICAT	ION AND I	REMARKS	
DEF																	
		CAS	궠	D Z	SΥΛ	DEF	RUN (in.)	REC (in.									
	Å.		G	1		0.0 - 5.0				Light brown	CM SAND	, little (-) F	Gravel. (FIL)	L)			
-					\mathbb{N}												
-			-		IV												
-			4		M												
					$ \rangle$												
- 5													(Start Boring	g at 5ft, see E	Boring Log)		-
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<u>_</u> _			4														
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15			1														
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			4														
Rev01												Bor	ing No.	HB-4	Shee	t <u>1</u> c	of 1

													BORING	NUMBE	R: HB-4		
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	\checkmark		1	V	E	Mean.	2	D		J.	LU	J					
						J							CONTRA	ACT NUM	IBER:		
PROJE	CT:	MN	R-2	6 S	ta	tions Repa	airs						LOCATIO	ON: Hart	sdale Tra	ain Statio	n
	ION	(City	y/Si ™≏	tate):] P	Hartsdale	/ NY							· N• 794	321 I		4
		nr0 CR	180 • Je	rtn rse	к v I	anroad Boring &	Drillin	o Ca	omnany I	ne			SURFAC	1 1. 794, DE ELFV	: 167.0 f	2. 000,094 eet	•
DRILL	ER: R	lobe	rto	Sa	<u>,</u> nti	ago		50	pany I				DATUM:	/.			
INSPE	СТО	<u>R:</u> C	ana	n ()zi	udogru											
DRILLI	NGN	/ET	HO	D:N	Au	d Rotary								DATE: 2/	13/18 T	IME: 1:2	0 pm
RIG TY	′PE: ′	<u>Fruc</u>	ck I	Rig			.			-				JATE: 2/	14/18 ⊺		45 am
 		. –	Ca	sing	-	Split Spoon	Shelby	Tube	Dennison	Grat		re Barrel		GROU		DATA	Hala
lype/S	ymbo	µ ⊢	St	eel	-	S 📕	U		DN	G 🛛			4		Depth	Depth	Depth
I.D.		\vdash	4	+"	\downarrow	1.375"					_	1.772"	Date	Time	(ft)	(ft)	(ft)
U.D.		\vdash	4.3	75"	\downarrow	2"						2.980"	2/14/18	8:40 am	-	10.0	11.0
Length		\vdash	1	5"		24"			/			60"	2/15/18	1:15 pm	9.4	15.0	23.0
Hamm	er Wt	. ⊢	140	lbs	-	140 lbs	Drill Ro	d Size	e/ I.D.(O.D.)		1.875"	(2.65")	2/15/18	2:00 pm	10.2	-	23.0
Hamm	er Fa		30	ט"		30"	Ha	mme	r Type	Aut	omatic I	Hammer					
_	(7)			S	SAI	MPLE		SC	DIL (Blows/6	6 in.)							
feet)	Ľ	's/ft) /ft)				_	0/6	6/13	2 12/18	18/24	REC.	1					
EH (1 E	Min.				eet)		0/11		10/21	(in.)		FIELD CL	ASSIFICAT	ION AND F	REMARKS	
EP.	CORING USANIAC DONNAC																
	Image: Second																
	\breve{S} \breve{S} \breve{L} \breve{C} \breve{L} \breve{C} \breve{L} \breve{C} \breve{L} \breve{C} \breve{L} \breve{C} \breve{L} \breve{C} \breve{C} \breve{L} \breve{L} \breve{C} \breve{L} \breve{C} \breve{L} \breve{L} \breve{C} \breve{L}																
\mathbf{F}	$\begin{array}{c c c c c c c c c c c c c c c c c c c $																
L	Previously hand cleared to 5' below ground surface. See Soft Dig Log for HB-4.																
	See Soft Dig Log for HB-4.																
F			1														
ŀ	` ₩₽		-														
- 5			- -			50-70	4	7	15	21	21						
L						5.0 - 7.0	-		1.5	£ 1	<u>~1</u>		Brown CM S	SAND, and	C Gravel me	oist. (SP)	
F			S	2		7.0 - 9.0	13	17	35	24	16		Light brown	/ gray CM S	AND, and	CM Gravel.	
0			-										moist. (SP)	0,	,		
7170			- -	3		90-110	17	17	36	50	20						
						7.0 - 11.0	1/		50	50	20		Dark brown moist (Deco	/ gray CM S mposed Roo	AND, some	e CM Gravel	l,
	Ň		s	4		11.0 - 11.0	100/3	-	-	-	2		MF GRAVE	L.			
			-														
5-			- c	5		13.0 - 13.1	100/6	100/	4		Q						
ADE						13.0 - 13.1	100/0	100/	-	-	0		MF GRAVE	L.			
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<u>ا</u> لآ			-														
			S	6		18.0 -18.0	100/0	-		-	0		No Recov	ery.			
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			1														
Rev01			_				1				I	L Ror	ing No	HR-4	Shee	t 1 c	of 1
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	<u> </u>						BORING	NUM	BER:	HB-4			
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DRILLIN	G ME	ETHOD: Diar	nond '	Tip			START	DATE:	2/14/	/ 18 T	IME:	11:0	0 am
RIG TYP	E: Ti	ruck Rig		•			FINISH I	DATE:	2/14/	18 T	IME:	1:00	pm
CORE B	ARRE	EL DATA:				NOTES:		GR	OUND	WATEF	R DATA	<u>،</u>	
										Water	Cas	ing	Hole Depth
TYPE: D	ouble l	Barrel, Split Inne	r Tube v	with W	<i>ireline</i>		Date	Time	e	(ft)	(ft	:)	(ft)
CORE S	IZE:	NQ2											
O.D.: 2.	.980"												
I.D.: 1.77	72"												
CASING	SIZE	E I.D. (O.D.):	4" (4.3	375")									
	J/ft)		-	_						DIS	CONTI	NUITY	DATA
et)	(mi	Ō€	(in)	(%)				NG	Ŧ				~
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B	SIN(ND I	SEC SEC	SEC	^{LL}			WE	SI	DNG			ED.
	co	δĀ											
	6					GNEISS, gray, soft, highly weathered, med	lium spaced	11/111	R2	10	1.0	4	18.31
F						jointo.				12	1.0	2	18.82 -
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<u>⊢</u> 20		R-1								5	1.0	3	19.75-
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			Ca	sing		Split Spoon	Shelby	Tube D	ennison	Grat	o C	ore Barrel		GROUI	DWATER	DATA	
Type/S	Symbo	» [_	Ste	eel		S 🖊	U[D	G 🛛]	C			Water Depth	Casing Depth	Hole Depth
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O.D.						1 5 in.						2 in.	6/21/19	4:00 pm	Dry	10	10
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[₩] − 5			S	1	1	5.0 - 7.0	3	5	12	15	10		Grev cf SAN	ND. trace f (Gravel, trac	e (-) silt.	
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			s	3	\geq	9.0 - 9.3	100/4"				4		DECOMPO	SED ROCK			
<u>5</u> – 10	K//X	6 75	С	1		9.3 - 10.0	60	60	100	52	86		Could not ac	dvance split	spoon thro	ugh decomp	osed
5		0.73											GNEISS, wl	hite-grey, m	edium, slig	htly weathe	red,
		6.50											RQD = 86%).			
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<u>ا</u> ر		6.00															
15	¥///>	0.30														-	
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Notes:

Boring No. <u>STV-SB-1</u> Sheet <u>1</u> of <u>1</u>

ATTACHMENT C

GEOTECHNICAL LABORATORY TEST RESULTS

STV #18.005 MNR Hartsdale and Scarsdale Stations LABORATORY SOIL TESTING DATA SUMMARY

BORING	SAMPLE	DEPTH	IDENTI	FICATION T	ESTS	REMARKS
			WATER	USCS	SIEVE	
NO.	NO.		CONTENT	SYMB.	MINUS	
				(1)	NO. 200	
		(ft)	(%)		(%)	
HB-2	S-3	9-11	17.5	GP-GM	6.8	See corrosion summary
HB-2	S-9	30-32	11.5	SP-SM	8.4	
HB-3	G-1	0-5	16.0	SP-SM	10.0	See corrosion summary
HB-3	S-2	7-9	16.4	SM	21.5	
HB-3	S-5	13-15	33.7	CL	64.8	
HB-4	S-1	5-7	5.2	SP-SM	9.1	See corrosion summary
HB-4	S-3	9-11	7.6	SM	12.8	

Note: (1) USCS symbol based on visual observation and Sieve reported.

TerraSense, LLC 45H Commerce Way Totowa, NJ 07512

STV #18.005 MNR Hartsdale and Scarsdale Stations Summary of Corrosion Testing

	SAMPLE ID)	RESISTI	VITY TESTS		CHEM	ICAL TESTS		REMARKS
Boring	Sample	Depth	Test	Minimum		pН	Leachable	Leachable	
No.	No.		Date	Resistivity	AASH	ITO T289	Chloride (1)	Sulfate(1)	
				AASHTO T288	pН	Temperature	AASHTO T291	AASHTO T290	
		(ft)		(kΩ - cm)	(pH units)	(°C)	(ppm)	(ppm)	
HB-2	S-3	9-11	2/27/18	1.3	7.1	20.8	206	133	
HB-3	G-1	0-5	2/27/18	2.4	7.1	20.8	103	56	
HB-4	S-1	5-7	2/27/18	6.9	7.3	20.8	15	<5	

Prepared by: RT Reviewed by: GET Date: 3/20/2018 TerraSense, LLC

45H Commerce Way Totowa, NJ 07512 (973) 812-1818 Project No. 8123-18002 File: Corrosion2.xlsx Page 1 of 1

COLUME COLUME INVE Description HB-2 HB-2 100 111 100 100 100 100 100 100 100 100 100 100 100 100 100 100 111 100 100 100 111 100 100	COBB	LES		GRA	VEL				SAND			SILT	or CLAY		Symbol			0
1 1			COARS	E	FIN	IE (COARSE	E MED	IUM	FINE					Boring	HB-2	HB-2	
100 100 100 100 100 100 13.8 80.0 100 100 100 10.1 10.1 10.0 100.0 100.0 10.			_												Sample	S-3	S-9	
100 11.5 100.0 11.7 100.0 100.0 11.7 100.0 100.0 11.7 20.3 20.2 86 68.4 40 36.6 68.4 40 36.6 68.4 40 36.6 68.4 40 36.6 68.4 40 36.7 16.6 20.2 11.5 11.5 11.5 12.7 </td <td></td> <td></td> <td>2</td> <td>Ę</td> <td>+ 5</td> <td>n</td> <td></td> <td>0 0</td> <td></td> <td>. 8</td> <td>64 O</td> <td></td> <td></td> <td></td> <td>Depth</td> <td>9-11</td> <td>30-32</td> <td></td>			2	Ę	+ 5	n		0 0		. 8	64 O				Depth	9-11	30-32	
100 100 100 100 100 100 13.6 90 00 00 13.6 13.6 13.6 100 100 13.6 13.6 13.6 100 100 13.6 13.6 13.6 100 100 100 100 100.0 100.0 100 100 100.1 0.01 0.01 0.00 11.5 10.5 P-SM Dark grayled grawwi with sit and grave 0226/18 11.5 11.5 SP-SM Dark grayled grawwi with sit and grave 0228/18 11.5 SP-SM Dark grayled grawwi with sit and grave 0228/18 4.4 11.5 SP-SM Dark grayled grawi with sit and grave 0228/18 4.4 11.5 SP-SM Dark grayled grawi with sit and grave 0228/18 4.4 11.5 SP-SM Dark grayled grawi with sit and grave 0228/18 4.4 100 11.7 14.8 4.4 4.4 4.4 11.5 SP-SM Dark grayled grawi with sit and grave 0228/18 4.4 4.4 </td <td></td> <td></td> <td>11</td> <td></td> <td>2/2</td> <td>5 7 7</td> <td></td> <td>#1</td> <td>#7</td> <td>#6(#1(</td> <td>#1, #2</td> <td></td> <td></td> <td></td> <td>% +3"</td> <td>0.0</td> <td>0.0</td> <td></td>			11		2/2	5 7 7		#1	#7	#6(#1(#1, #2				% +3"	0.0	0.0	
40 43.8 60.0 41 43.8 60.0 40 43.8 60.0 40 43.8 60.0 40 43.8 60.0 40 43.8 60.0 40 43.8 60.0 40 43.8 60.0 40 43.8 60.0 40 43.8 60.0 40 43.8 60.0 40 40.0 11.0 13.3 25.6 40 40.0 10.0 10.0 10.00 10.00 40 40.0 10.0 10.0 12.2 0.088 C.c. 0.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0 11/2 10.0 10.0.0 10.0 10.0 10.0 10.0 11.1 10.0 100.0 11.2 100.0 100.0 11.2 100.0 100.0 11.2 100.0 100.0 11.2 100.0 100.0 11.2 100.0 100.0 11.2 100.0 100.0 1	1	00 TT		╎╷╷				1 1							% Gravel	49.4	31.6	
90 0				Η											% SAND	43.8	60.0	
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90 0				i V											%M SAND	13.3	25.6	
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50 50 0	∧ X	60 		+	t			+	┼┼┼┼	+ + -					D ₃₀ (mm)	0.625	0.437	
Strv #11.5 GP-GM	е С	÷.		1				ار ا							D ₁₀ (mm)	0.122	0.088	
Signal Cu 78.5 31.5 Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal Signal <td>NIS</td> <td>50 🚻</td> <td></td> <td>+</td> <td></td> <td>HHÀ</td> <td></td> <td>+</td> <td>┼┼┼┼┼</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Сс</td> <td>0.300</td> <td>0.800</td> <td></td>	NIS	50 🚻		+		HHÀ		+	┼┼┼┼┼						Сс	0.300	0.800	
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No.0 Size/ID # Percent Finer Data 20 0	E E	40 🚻						ti li	NH	+ +				<u>+</u>	Sieve			
9 30 4 100.0 100.0 10 1 0.1 0.01 0.01 1 11.2 100.0 100.0 100.0 100.0 11.5 GP-GM GP-GM Gray. Poorly graded gravel with silt and sand petroleum product present 02/26/18 11.5 GP-GM GP-GM Gray. Poorly graded sand with silt and gravel 02/26/18 11.5 SP-SM Dark grayish brown . Poorly graded sand with silt and gravel 02/26/18 11.5 SP-SM Dark grayish brown . Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 9 0.00 11.7 14.8 9 0.1 0.01 0.01 0.01 11.5 SP-SM Dark grayish brown . Poorly graded sand with silt and gravel 02/26/18 #100 11.5 SP-SM Dark grayish brown . Poorly graded sand with silt and gravel 02/26/18 #100 11.7 11.5 SP-SM Dark grayish brown . Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 9 MNR Hartsdale and Scarsdale Stations PARTICLE SI	N U	H							4IN I						Size/ID #		Percent Finer Dat	a
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100 10 1 0.1 0.01 0.01 3/8" 59.8 85.2 PARTICLE SIZE -mm PARTICLE SIZE -mm #4 50.6 68.4 SYMBOL W (%) LL PL PI USCS AASHTO USCS DESCRIPTION AND REMARKS DATE #20 33.5 42.7 - 17.5 - - GP-GM Gray, Poorly graded gravel with silt and sand petroleum product present 02/28/18 #40 25.3 29.2 - 11.5 - GP-GM Dark grayish brown , Poorly graded sand with silt and gravel 02/26/18 #40 25.3 29.2 - 11.5 - GP-GM Dark grayish brown , Poorly graded sand with silt and gravel 02/26/18 #40 25.3 29.2 - 11.5 - - SP-SM Dark grayish brown , Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 0 -															1/2"	71.4	92.0	
PARTICLE SIZE -mm #4 50.6 68.4 #10 38.6 54.8 #10 38.6 54.8 #10 17.5 Image: Comparison of the state o		100			10)		1			0.1		0.01	0.001	3/8"	59.8	85.2	
SYMBOL w (%) LL PL PI USCS AASHTO USCS DESCRIPTION AND REMARKS DATE #20 33.5 42.7 □ 17.5 □ 0 GP-GM Gray, Poorly graded gravel with silt and sand petroleum product present 02/28/18 #40 25.3 29.2 • 11.5 □ Image: SP-SM Dark gravish brown , Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 · 11.5 □ Image: SP-SM Dark gravish brown , Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 · Image: SP-SM Image: Dark gravish brown , Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 · Image: SP-SM Image: Dark gravish brown , Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 · Image: SP-SM Image: Dark gravish brown , Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 · Image: SP-SM								I	PARTICL	.E SIZE -mn	n				#4	50.6	68.4	
SYMBOL w (%) LL PL PI USCS AASHTO USCS DESCRIPTION AND REMARKS DATE #20 33.5 42.7 □ 17.5 □ □ GP-GM Gray, Poorly graded gravel with silt and sand petroleum product present 02/28/18 #40 25.3 29.2 • 11.5 □ □ SP-SM Dark grayish brown , Poorly graded sand with silt and gravel 02/28/18 #100 11.7 14.8 ○ □ □ SP-SM Dark grayish brown , Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 ○ □															#10	38.6	54.8	
Image: 17.5 GP-GM Gray, Poorly graded gravel with silt and sand petroleum product present 02/28/18 #40 25.3 29.2 Image: 17.5 11.5 SP-SM Dark grayish brown, Poorly graded sand with silt and gravel 02/28/18 #40 25.3 29.2 Image: 11.5 SP-SM Dark grayish brown, Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 Image: 11.5 Image: 11.5 Image: 11.5 Image: 11.5 Image: 11.5 Image: 11.5 1mage: 11.	SYMBOL	w (%	%) LL	. P	L PI	USC	S	AASHTO		USCS D	ESCRIPTIO	N AND REM	IARKS	DATE	#20	33.5	42.7	
Image: Image		47	5				214		Gray, P	oorly graded	d gravel with	silt and sand	d	02/20/40	#40	25.3	29.2	
• 11.5 SP-SM Dark grayish brown, Poorly graded sand with silt and gravel 02/26/18 #100 11.7 14.8 O I	Ц	17.	5			GP-C	ואוכ		petrole	eum product	present			02/20/18	#60	17.7	20.9	
- 11.3 3P-SM Dark grayish brown, Poony graded sand with silt and gravel 02/20/18 #140 8.7 11.6 0 Image: Comparison of the second se	_	4.4	5			00.0	NA		Dork	oviab brown	Doorly are	dod ocod wit	th ailt and arous	02/26/40	#100	11.7	14.8	
Ο #200 5μ m 6.8 8.4 STV #18.005 MNR Hartsdale and Scarsdale Stations 2μ m 1μ m 2μ m TerraSense, LLC #8123-18002 PARTICLE SIZE DISTRIBUTION	-	11.	5			5P-5	NVI		Dark gra	ayısın brown	, Poorly gra	ued sand Wi	in siit and gravel	02/20/18	#140	8.7	11.6	
STV #18.005 MNR Hartsdale and Scarsdale Stations TerraSense, LLC #8123-18002 PARTICLE SIZE DISTRIBUTION Siev2a visx, 3/20/2018	<u> </u>														#200	6.8	8.4	
STV #18.005 Image: TerraSense, LLC #8123-18002 Image: TerraSense, LLC #8123-18002 PARTICLE SIZE DISTRIBUTION	0																	
TerraSense, LLC #8123-18002 μm 1μm		ст	<u> </u>		-	Да	0 00-	-							2µ m			
TerraSense, LLC #8123-18002		31	STV #18.005 MNR Hartsdale and Scarsdale Stations												1µ m			
	🕂 Ter	raSe	nse.		2	#812	3-180	002						5110	PART	ICLE S	IZE DISTRIF	BUTION
	TerraSonce	Analysi	File Cr		- 70\//D/	(11/17)		-	1								Siev2a vla	x 3/20/2019





STV
MNR Hartsdale and Scarsdale Stations
SUMMARY OF ROCK TESTING

SAM	PLE IDE	NTIFIC	ATION	STATE F	PROPER	TIES		ENGINEERIN	G PROPERTY T	ESTS	REMARKS
Boring	Run		Depth	WATER	TOTAL	DRY	TEST	ORIENTATION	POINT LO	DAD TEST	
				CONTENT	UNIT	UNIT	TYPE		(ASTN	l D5731)	
				(1)	WGT.	WGT.			STRENGTH	ESTIMATED (4)	
							(2)		INDEX	COMPRESSIVE	
									ls(50)	STRENGTH	
				(%)	(pcf)	(pcf)		(3)	(MPa)	(psi)	
HB-4	R-1	T-1	19.0-19.1	0.27			PL	Diametral	1.1	3772	
HB-4	R-1	T-1	19.0-19.1				PL	Axial	9.2	28995	
HB-4	R-1	T-2	19.7-19.8	0.19			PL	Diametral	5.4	18409	
HB-4	R-1	T-2	19.7-19.8				PL	Axial	7.3	22766	
HB-4	R-1	T-3	20.2-20.3	0.20			PL	Diametral	4.1	14172	
HB-4	R-1	T-3	20.2-20.3				PL	Axial	7.3	22191	
HB-4	R-1	T-4	22.05-22.15	0.21			PL	Diametral	3.9	13230	
HB-4	R-1	T-4	22.05-22.15				PL	Axial	7.6	22453	
HB-4	R-1	T-5	22.6-22.7	0.20			PL	Diametral	3.8	12758	
HB-4	R-1	T-5	22.6-22.7				PL	Axial	6.8	20569	

Notes: (1) Water contents determined after trimming and shearing.

(2) Test Type Abbreviations: PL: Point Load

(3) Diametral orientation across core along bedding plane, axial perpendicular to bedding plane.

(4) Compressive Strength determined using generalized "K" factor in ASTM D5731

TerraSense, LLC 45H Commerce Way Totowa, NJ 07512

Depth:			
Load Orientation:	Diametral		Axial
Length to nearest free end, L (mm)	27.9		25.2
Specimen Width, W (mm)	52.4		52.4
D (mm)	52.4		28.0
D' (mm)	52.4		28.0
D _e (mm)	52.4		43.2
Failure Load, P (lb)	686		4144
Point Load (N)	3051		18433
Point Load (Mpa)	1.14		9.25
Index, Is50 (psi)	160		1340
Unconfined Compressive Strength (psi)	3772		28995
Specimen /Failure Sketch			
Tare No.	P-62		
Wet + Tare (gm)	493.9		
Dry + Tare (gm)	493.39		
Tare (gm)	307.49		
Water Content%	0.27		
Comments			
	Test by: RAT Test Date:	2/21/2018 Reviewed by	GET
MNR Harts	dale and Scarsdale Station	IS	POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
STV18.005		18.005	Boring: HB-4 Run: R-1
TerraSense. LLC		8123-18002	Sample: T-1 Depth: 19.0-19.1

Depth:			
Load Orientation:	Diametral		Axial
Length to nearest free end, L (mm)	27.7		26.4
Specimen Width, W (mm)	52.5		52.5
D (mm)	52.5		27.0
D' (mm)	52.5		27.0
D _e (mm)	52.5		42.5
Failure Load, P (lb)	3244		3179
Point Load (N)	14430		14141
Point Load (Mpa)	5.35		7.28
Index, Is50 (psi)	780		1060
Unconfined Compressive Strength (psi)	18409		22766
Specimen /Failure Sketch			
Tare No.	P-63		
Wet + Tare (gm)	478.18		
Dry + Tare (gm)	477.85		
Tare (gm)	307.82		
Water Content%	0.19		
Comments			
	Test by: RAT Test Date:	2/21/2018 Reviewed by:	GET
MNR Harts	dale and Scarsdale Stations	S	POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
STV 18.005		18.005	Boring: HB-4 Run: R-1
TerraSense, LLC		8123-18002	Sample: T-2 Depth: 19.7-19.8

Depth:			
Load Orientation:	Diametral		Axial
Length to nearest free end, L (mm)	25.6		25.1
Specimen Width, W (mm)	52.6		52.6
D (mm)	52.6		25.0
D' (mm)	52.6		25.0
D _e (mm)	52.6		40.9
Failure Load, P (lb)	2508		2990
Point Load (N)	11156		13300
Point Load (Mpa)	4.13		7.26
Index, Is50 (psi)	600		1050
Unconfined Compressive Strength (psi)	14172		22191
Specimen /Failure Sketch		2	
Tare No.	W-1		
Wet + Tare (gm)	423.95		
Dry + Tare (gm)	423.63		
Tare (gm)	266.54		
Water Content%	0.20		
Comments			
	Test by: RAT Test Date:	2/21/2018 Reviewed by:	GET
MNR Harts	dale and Scarsdale Station	S	POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
STV 18.005		18.005	Boring: HB-4 Run: R-1
TerraSense. LLC		8123-18002	Sample: T-3 Depth: 20.2-20.3

Depth:			
Load Orientation:	Diametral		Axial
Length to nearest free end, L (mm)	24.3		25.1
Specimen Width, W (mm)	52.6		52.6
D (mm)	52.6		21.0
D' (mm)	52.6		21.0
D _e (mm)	52.6		37.5
Failure Load, P (lb)	2348		2719
Point Load (N)	10444		12095
Point Load (Mpa)	3.86		7.55
Index, Is50 (psi)	560		1100
Unconfined Compressive Strength (psi)	13230		22453
Specimen /Failure Sketch			
Tare No.	P-86		
Wet + Tare (gm)	421.04		
Dry + Tare (gm)	420.76		
Tare (gm)	288.84		
Water Content%	0.21		
Comments			
	Test by: RAT Test Date:	2/21/2018 Reviewed by:	GET
MNR Harts	dale and Scarsdale Station	S	POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
STV 18.005		18.005	Boring: HB-4 Run: R-1
TerraSense, LLC		8123-18002	Sample: T-4 Depth: 22.05-22.15

Depth:			
Load Orientation:	Diametral		Axial
Length to nearest free end, L (mm)	28.7		26.8
Specimen Width, W (mm)	52.6		52.6
D (mm)	52.6		23.0
D' (mm)	52.6		23.0
D _e (mm)	52.6		39.3
Failure Load, P (lb)	2282		2645
Point Load (N)	10151		11766
Point Load (Mpa)	3.75		6.85
Index, Is50 (psi)	540		990
Unconfined Compressive Strength (psi)	12758		20569
Specimen /Failure Sketch			
Tare No.	P-94		
Wet + Tare (gm)	322.78		
Dry + Tare (gm)	322.39		
Tare (gm)	131.14		
Water Content%	0.20		
Comments			
	Test by: RAT Test Date:	2/21/2018 Reviewed by:	: GET
MNR Harts	dale and Scarsdale Station	IS	POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731
STV 18.005		18.005	Boring: HB-4 Run: R-1
TerraSense. LLC		8123-18002	Sample: T-5 Depth: 22.6-22.7