Case Study: Trench Screening During Vibratory Pile Driving

Rick Sadler

ICE® - International Construction Equipment

Reason and Purpose for Trench Screening

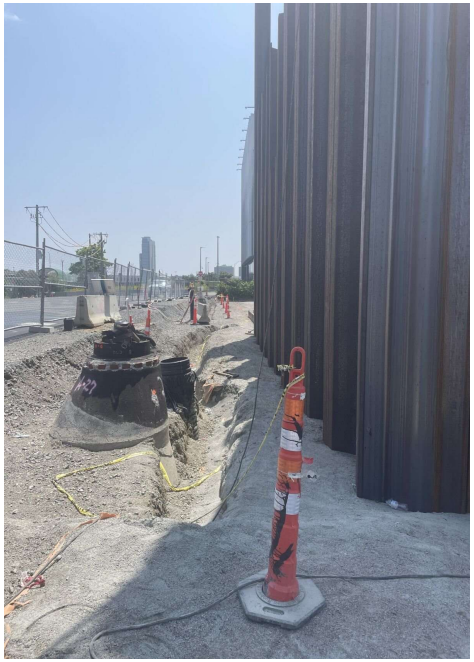
- Under the premise that construction in general has noise and ground disturbances that can be a nuisances to the public.
- To remove or at least damper the human sensitivity factor from Vibratory Pile Driving sites.
- To help facilitate the already proven safety factors around Vibratory Pile Driving by providing a dampening solution for the contractor to assist with the public perception.

Equipment to Accomplish Trench Screening

Nothing Technical

These tests used an irrigation trencher in Springfield, MA and larger excavators in other locations

Trench install approximately 3ft off the driven sheets



Sites Utilizing Trench Screening

Random Selection by Availability

Sites Utilizing Trench Screening

Location #1 – Springfield, MA - Not Equipment Monitored

Dug Open Trench (no support- dry soil)
- 4” wide x 18” deep
- Approx. 3 feet from the sheet pile wall

Over time, the open trench began to refill with dirt from the site making the trench less useful but even the soil disturbance as it refilled the trench provided a good outcome.

Outcome - overall perception
Every person on this site could feel less to zero vibration “at their feet” on the opposite side of this small trench.

** There was no tangible data collected during this exercise.*

Overview - Springfield, MA

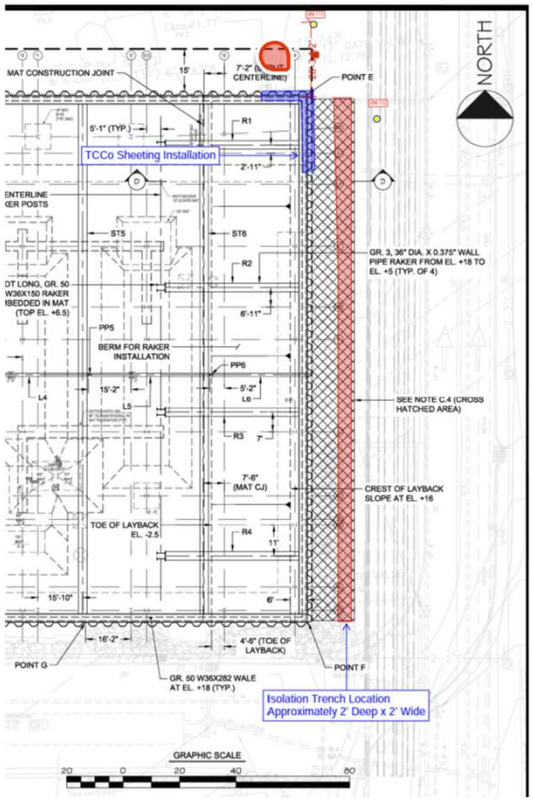
Sites Utilizing Trench Screening
Location #2 - Boston, MA
- *G*eophone & Seismograph *Monitored* -

ICE® Model 44 Variable Moment Vibratory Hammer
ICE® Model 580T - Tier 4F Power Unit

Dug <u>Open</u> Trench (no support- dry soil)
- 20” wide x 18” deep
- Approx. 3 feet from the sheet pile wall
- 300 feet in length (full sheet wall length)

ICE® 44 Variable Moment (VM) Vibratory Hammers installed over 1000 pairs of 13 sections of AZ-18 to AZ-42 with sheets ranging 35’-45’ in length.

Sites Utilizing Trench Screening
Location #2 - Boston, MA
- *G*eophone & Seismograph *Monitored* -



This project was well planned and executed with monitoring program from the start.

The ICE® 44 Variable Moment Vibratory Hammer was selected for its ability to begin the drive already in sync without extra startup or shutdown energy.

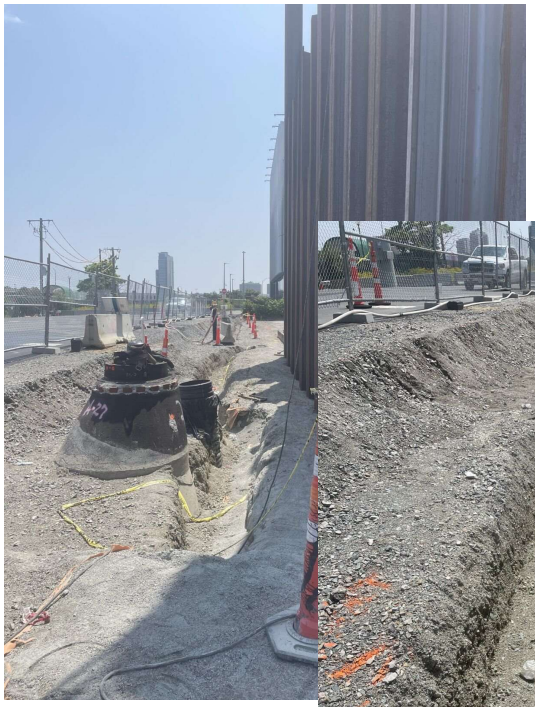
Choices were made to monitor both trenched and non-trenched driving

Seismograph Monitoring was also utilized on the Underground Utilities with both trench and non-trenched driving

2 Methods were selected for monitoring based on the underground utilities running within 2 feet of the projects driving.

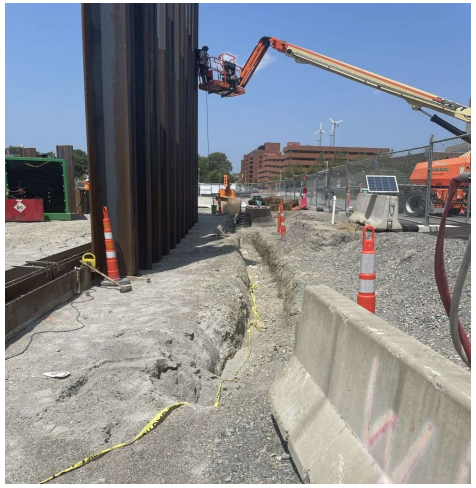
PDCA 25TH ANNUAL CONFERENCE & EXPO

Sites Utilizing Trench Screening
Location #2 - Boston, MA
- *G*eophone & Seismograph *Monitored* -

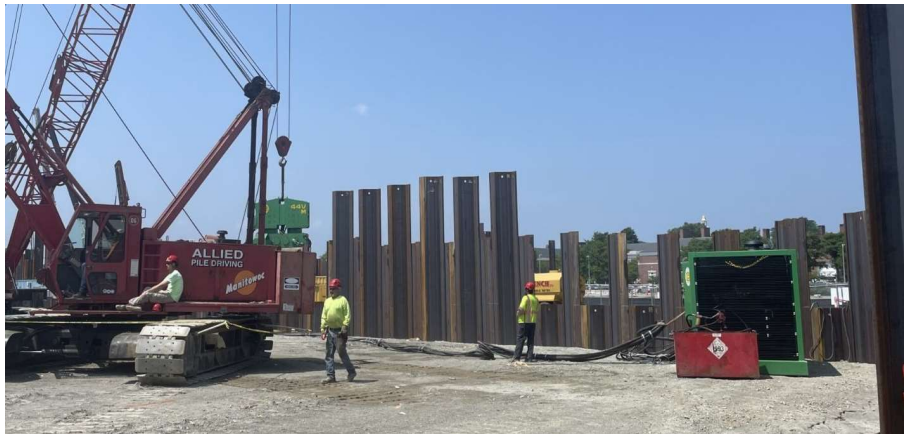


Trench Screening occurred for 300 Linear Feet
and between the buried utility and sheet pile wall.
The trench was cut with an onsite excavator.

Trenching ended at corner before the sheets turn 90⁰ and continue



Sites Utilizing Trench Screening
Location #2 - Boston, MA
- *G*eophone & Seismograph *Monitored* -



There was zero issue with trench decomposition as the soil conditions were extreme.

Due to extreme hard soils, Contractor choose to switch from pairs to single sheets as we got close to final tip elevation.

Sites Utilizing Trench Screening
Location #2 - Boston, MA
- *G*eophone VM-111 Placement-

*G*eophone - VM-111

This geophone (VM-111) is monitoring the area without the trench.

It is protected by orange cones.

Sites Utilizing Trench Screening
Location #2 - Boston, MA
- *G*eophone VM-112 Placement-

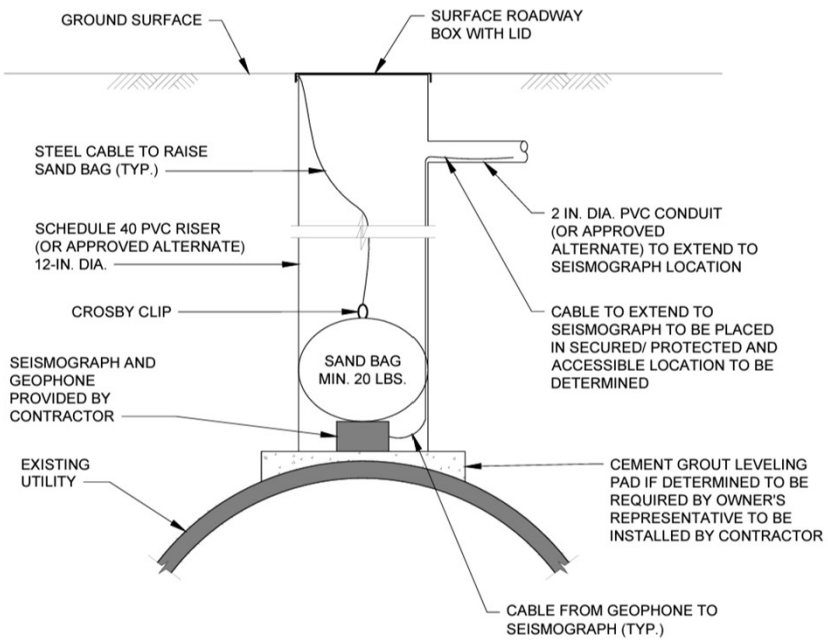
Trench

*G*eophone - VM-112

This geophone (VM-112) is monitoring the area with the trench.

It is protected by orange cones.

Sites Utilizing Trench Screening
Location #2 - Boston, MA
- Seismograph Placement-



FIXED LOCATION SEISMOGRAPH INSTALLATION OVER UTILITIES
SCHEMATIC DETAIL
NOT TO SCALE

This Seismograph was placed to monitor the public utilities.

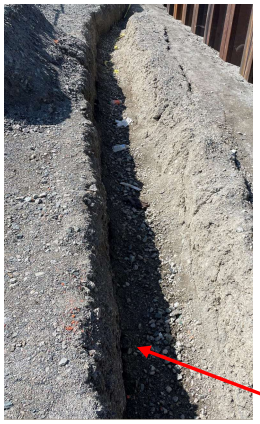
The utilities were a main focus for the Trench Screen to protect.

Trench Screen was dug between the utility and the sheet pile wall install.

Sites Utilizing Trench Screening
Location #2 - Boston, MA

- Visual Results & Human Factors -

Trench side away from driving.



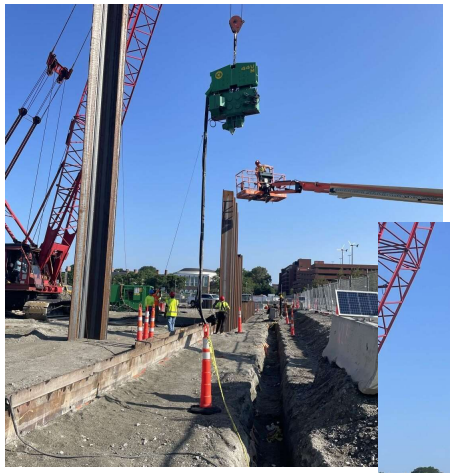
No physical signs of vibration
Nothing felt by the onsite team on this side of trench

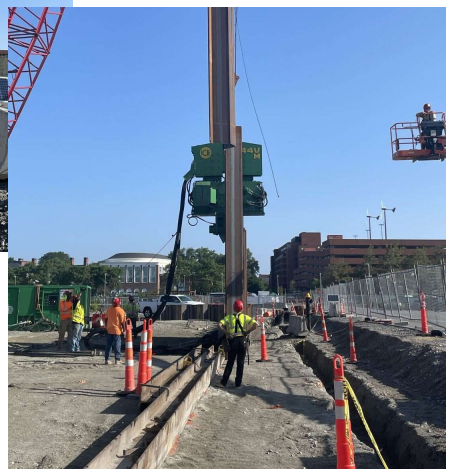
Trench side next to driving.

Physical surface signs of vibration/ earth penetration
Did not cross over the 18” deep trench
Did not show effects past few inches on surface

Sites Utilizing Trench Screening
Location #2 - Boston, MA

- Visual Results & Human Factors -



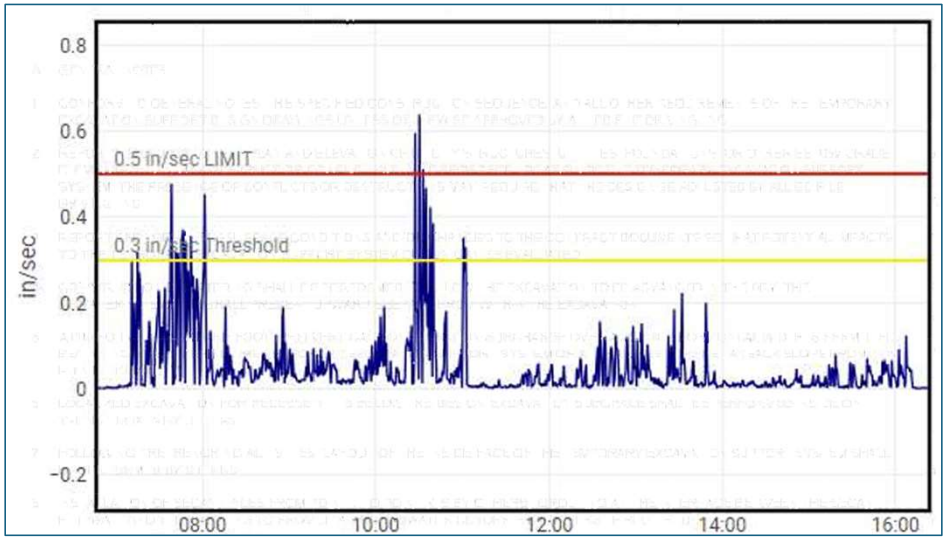


As the drive continued, we saw less and less disruption to the top layers of soil where there was trenching.

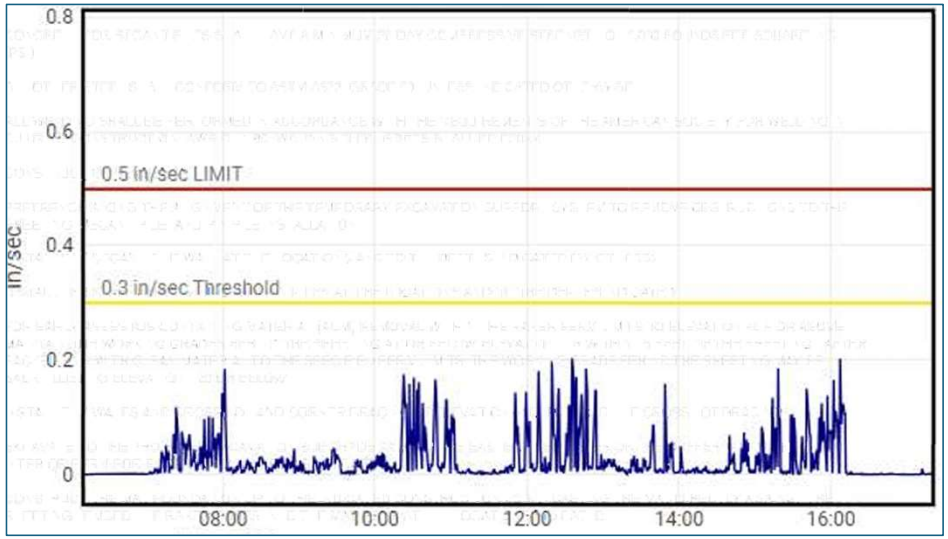
In all areas without trenching, we did see more surface disruption but nothing more then 3” of superficial disruption – most likely from hard soil penetration.

Sites Utilizing Trench Screening
Location #2 - Boston, MA
- Geophone Results-

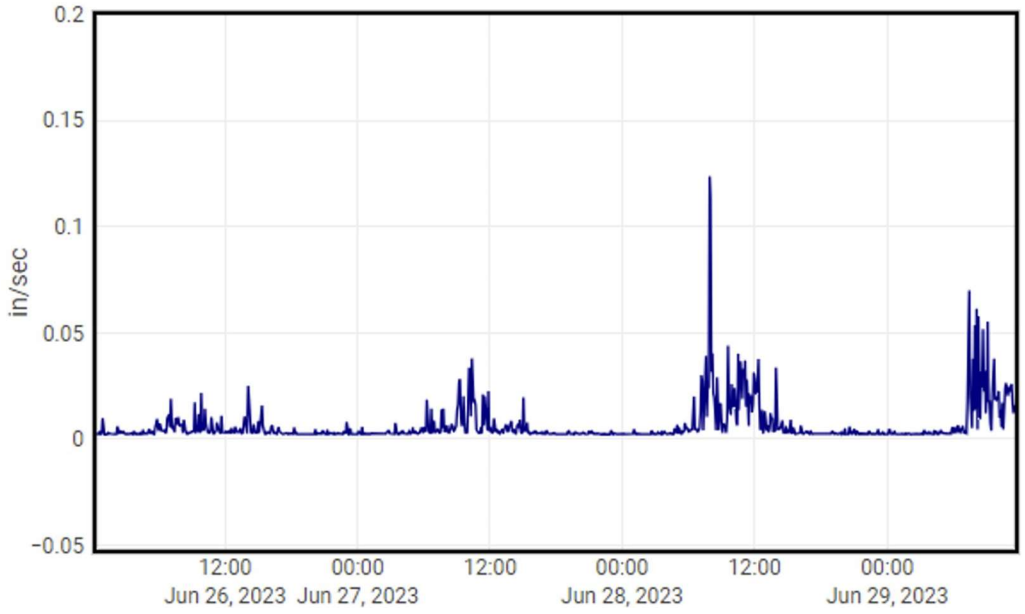
Geophone VM-111 – NO TRENCH



Geophone VM-112 – TRENCH SCREEN



Sites Utilizing Trench Screening
Location #2 - Boston, MA
- Seismograph Results-



Seismograph placed on underground utility

Thresholds of .5 never reached…

Trench screen readings never advanced past 0.122

Job owner and onsite crews thrilled with what a simple trench could do…

TEST BORING REPORT

HALEY ALDRICH

Boring No. TB21-H8(OW)

Project	HARVARD ENTERPRISE RESEARCH CAMPUS (ERC)-PHASE A, ALLSTON, MA
Client	TISHMAN SPEYER ERC DEVELOPER, LLC
Contractor	NORTHERN DRILL SERVICE, INC.

File No.	134042-003
Sheet No.	1 of 2
Start	August 6, 2021
Finish	August 6, 2021
Driller	J. Stevens
H&A Rep.	C. Romero
Elevation	15.7
Datum	Boston City Base
Location	See Plan N 2957461.7049 E 755718.4914

	Casing	Sampler	Barrel
Type	HW	S	
Inside Diameter (in.)	4	1.4	
Hammer Weight (lb)	140	140	-
Hammer Fall (in.)	30	30	-

Drilling Equipment and Procedures
- Rig Make & Model: Mobile Drill B-59
- Bit Type: Roller Bit
- Drill Mud: None
- Casing: Wash and Drive
- Hoist/Hammer: Winch / Automatic hammer
- PID Make & Model: Tiger 10.6 eV

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Reading (ppm)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Toughness	Plasticity	Strength
0	15 13 6 10	S1 7	0.0 2.0	0.4	SM		Medium dense gray silty SAND with gravel (SM), no odor, dry	20	25	15	15	15	10				
	14 15 16 13	S2 16	2.0 4.0	0.0	SM		Medium dense gray to brown silty SAND with gravel (SM), no odor, moist -FILL-	15	10	15	25	20	15				
5	7 6 4 4	S3 11	4.0 6.0	0.4	SM		Loose gray to dark brown silty SAND with gravel (SM), no odor, wet, brick and ash fragments	15	25	15	20	10	15				
	5 7 6 2	S4 15	6.0 8.0	0.7	SM		Medium dense brown to dark brown silty SAND with gravel (SM), no odor, wet	10	20	15	15	25	20				
	WOH WOH 1 2	S5 23	8.0 10.0	3.1	OL/OH	7.7 / 8.0	Very soft dark brown to black ORGANIC SOIL (OL/OH), no odor, moist - ORGANIC DEPOSITS -						100				
10	WOH WOH WOH 5	S6 21	10.0 12.0	8.7	SW-SM	5.7 / 10.0	Very loose brown to dark brown well-graded SAND with silt (SW-SM), chemical-like odor, moist	20	10	25	25	15	10				
	13 17 21 24	S7 17	12.0 14.0	11.6	SW		Dense gray well-graded SAND with gravel (SW), no odor, moist	10	10	20	25	20	15				
15	16 32 31 38	S8 11	14.0 16.0	0.7	GW-GM		Very dense gray well-graded GRAVEL with silt and sand (GW-GM), no odor, moist	10	15	15	25	20	15				
							Note: Laboratory grain size analysis performed.	29	19	11	21	11	10				
	35 30 26 31	S9 23	16.0 18.0	0.6	SW		Very dense gray well-graded SAND with gravel (SW), no odor, moist - FLUVIAL DEPOSITS -	10	15	20	25	20	10				
	12 13 15 15	S10 10	18.0 20.0	0.7	SW		Medium dense gray to light-brown well-graded SAND with gravel (SW), no odor, wet	15	25	15	20	15	10				
20																	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
08/06/21	11:54	5.0	28.0	26.0	3.8

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split-spoon Sample
- G - Geoprobe

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary
- Overburden (ft) 30.0
- Rock Cored (ft) -
- Samples S16

Boring No. TB21-H8(OW)

Field Tests: Dilatancy: R - Rapid S - Slow N - None; Toughness: L - Low M - Medium H - High; Plasticity: N - Nonplastic L - Low M - Medium H - High; Dry Strength: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

HALEY ALDRICH

Boring No. TB21-H8(OW)
File No. 134042-003
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	PID Reading (ppm)	USCS Symbol	Stratum Change Elev/Depth (ft)	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	Gravel % Coarse	Gravel % Fine	Sand % Coarse	Sand % Medium	Sand % Fine	% Fines	Field Test Dilatancy	Toughness	Plasticity	Strength
20	12 20 20 25	S11 12	20.0 22.0	0.6	SW		Dense gray well-graded SAND with gravel (SW), no odor, wet	15	25	20	10	15	15				
	24 21 19 17	S12 18	22.0 24.0	0.8	SW		Dense gray to orange well-graded SAND with gravel (SW), no odor, wet	15	25	15	20	15	10				
25	5 12 14 15	S13 6	24.0 26.0	0.0	SW		Medium dense gray well-graded SAND with gravel (SW), no odor, wet	15	20	15	25	15	15				
	10 14 17 19	S14 22	26.0 28.0	0.0	SW		Dense gray well-graded SAND with gravel (SW), no odor, wet - FLUVIAL DEPOSITS -	15	20	15	25	15	10				
	10 13 9 10	S15 7	28.0 30.0	0.0	SW	-12.3 / 28.0	Medium dense gray well-graded SAND with gravel (SW), no odor, wet	15	25	15	20	15	10				
30						-14.3 / 30.0	BOTTOM OF EXPLORATION 30.0 FT										

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. TB21-H8(OW)

PDCA 25TH ANNUAL CONFERENCE & EXPO

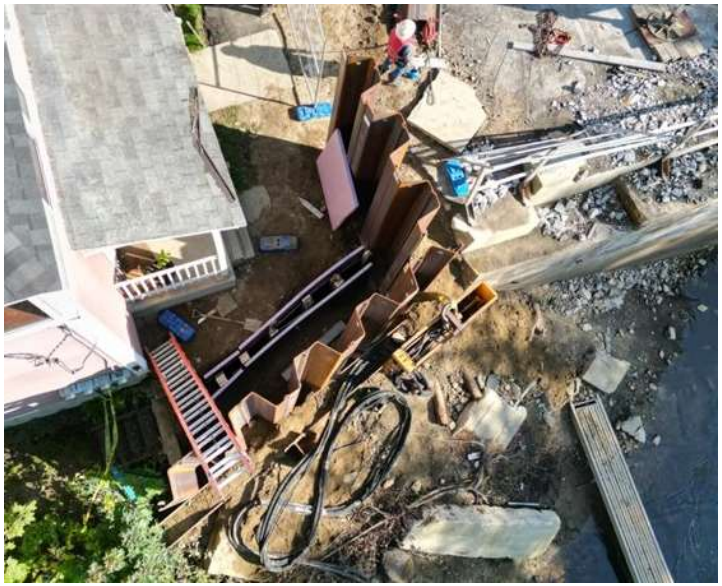
Sites Utilizing Trench Screening
Location #3 – Keene, NH - *Not Equipment Monitored*

Overview

- Extreme necessarily for a Trench Screen
- House is located only 5 feet, 6 inches from steel sheet wall and water's edge
- 50' (Ft) PZ-27 are necessary to be installed to support earth excavations for new bridge and save house in the process
- A 12" wide 36" deep trench was hand dug with shovels
- 2" thick foam insulation boards used to support trench walls.
- Trench placed between the sheet pile and the house, approximately 12" from the sheet pile wall.

Sites Utilizing Trench Screening
Location #3 – Keene, NH - *Not Equipment Monitored*

This was so effective that everyone standing on site was surprised by the noticeable reduction in the vibrations felt.



Aerial image #1

Aerial image #2

Sites Utilizing Trench Screening
Location #3 – Keene, NH – *HUMAN Monitored*

LAST THOUGHT…. Going the extra mile or in this case 12” is always the right move.

One of the crew on-site stated, “You don’t need a geo-phone to tell you that this trench is effective.”

Thank you – Rick Sadler

Sites Utilizing Trench Screening

Questions…

Rick Sadler
ICE® Regional Sales Manager

RSADLER@ICEUSA.COM