

MEMORANDUM

TO: Michael Carpenter P.E.
Director, Division of Structural Design

FROM: Adam Ross, P.E.
TEBM, Geotechnical Services Branch
Division of Structural Design

BY: Tyler Sheffield, P.E.
Structure Foundation Section
Geotechnical Services Branch

DATE: October 3, 2022

SUBJECT: **Jefferson County**
12F0 FD52 056 0264 021-023 D
I-264 WB
Mars #: 8556402D
Fed #: 00STP2641176
RECONSTRUCT THE WATTERSON EXPRESSWAY INTERCHANGE
@US 42 INCLUDING SLIP RAMP TO KY 22
Sound Barrier Wall at Northfield #2, I-264 EB Sta. 5137+90 to I-71 NB Sta.
72+51.01
Item #: 5-804.00
Geotechnical Engineering Structure Foundation Report

cc: J. Van Zee
C. Van Zee
T. Lovell
B. Nelson
M. Walls
K. Sawyer
D. McElmurray
K. Downs
D. Deitz (Palmer)
D. Lindeman (Palmer)

1.0 LOCATION AND DESCRIPTION

The geotechnical investigation for this structure has been completed. The DGN file for the subsurface data sheet has been made available on ProjectWise and through email for use in development of structure plans. The onsite geotechnical exploration for the project was performed by the contracted drilling firm of Horn and Associates.

The proposed sound barrier wall will be a part of the proposed reconstruction of the Watterson Expressway (I-264) and US 42 interchange in Jefferson County. The proposed structure is located along the east side of I-264 EB from approximate MP 22.5 to MP 22.65. The structure is located in Louisville, KY.

2.0 SITE GEOLOGIC CONDITIONS

This structure is located in the Jeffersonville, New Albany, and Charlestown Geologic Quadrangle (GQ# 1211). The geologic mapping indicates that this site consists of the Sellersburg Limestone Formation.

3.0 FIELD INVESTIGATION

Four (4) sample and core holes and one (1) mechanical rockline sounding were taken at this structure's location as part of the structural geotechnical investigation. After drilling, the soil samples and rock cores were delivered to the KYTC Geotechnical Branch in Frankfort, KY where a geologist logged the rock cores and the soil samples were classified and tested in the Branch's soils laboratory.

4.0 LABORATORY TESTING

The soil samples obtained from the borings were determined to consist of inorganic low plasticity clays and high plasticity silts. The soil samples were designated CL and MH using the Unified Soil Classification System.

5.0 SUBSURFACE CONDITIONS

Depths to rock/refusal vary from 4.0 ft. to 8.5 ft. Rock cores from this location indicated that bedrock consists mostly of light gray, very fine to fine grained, crystalline, fossiliferous limestone with few vugs and shale partings and laminations. The KY RQD values for the rock cores taken at this proposed bridge location ranged from 36% to 100% and core recoveries ranged from 76% to 100%. Core runs with lower KY RQD and recoveries shown on the attached subsurface data sheet consisted mostly of cored overburden. Top of rock/auger refusal elevations ranged from 540.0 ft to 554.4 ft.

6.0 ENGINEERING ANALYSIS

Use drilled shaft foundations socketed into bedrock for the proposed sound barrier wall. The Idealized Soil and Bedrock Profile sheet and the Drilled Shaft Axial Capacity Tables are attached for use in the design of the drilled shafts.

Because the wall will be founded on bedrock, no settlement analysis is required.

7.0 FOUNDATION RECOMMENDATIONS

- 7.1 The drilled shaft foundations shall be socketed into sound bedrock a minimum of 3 feet. Lower tip elevations may be necessary in order to satisfy lateral capacity or other structural requirements.
- 7.2 For Load & Resistance Factor Design (LRFD), evaluate the total factored axial resistances using the attached Drilled Shaft Axial Resistance Tables considering only the capacity developed in the uncased rock sockets. The total factored resistances must exceed the factored loads at the strength limit state.
- 7.3 Perform lateral load analyses using the geotechnical parameters provided in the attached Idealized Soil and Bedrock Profile. These parameters may be used to perform analyses using LPILE or other similar software. Some of the parameters may not be required to input, depending on the version of software utilized. Design the substructure units neglecting any lateral resistance derived from the top 5 feet of overburden soils.
- 7.4 The drilled shafts shall be constructed in accordance with the Special Note for Drilled Shafts, current edition, except that the subsurface exploration borings in accordance with Section 3.5 of the Special Note are not required.
- 7.5 Sound barrier walls should not be subjected to differential earth loading. Reinforced panels may shift or crack and the entire wall could potentially have an overturning failure if it is subject to earth loads. Special pane and foundation designs are required in order to safely construct a hybrid Retaining/Sound barrier wall. In walls constructed in newly placed fill areas, it should not be assumed that construction will be phased in a manner to avoid imposing earth loads. The walls should either be designed to withstand the maximum potential earth load or construction phasing must be specified to prevent differential loading conditions. Wall design loads should be determined using Soil Type 3 of Exhibit 413 in the Division of Structural Design Guidance Manual.
- 7.6 If significant voids are found while drilling for the rock socket, it may be

necessary to extend permanent casing beyond the voids to avoid excessive concrete take.

8.0 PLAN NOTES

(Include the notes below at appropriate locations in the plans, if applicable.)

- 8.1** Permanent casing is not required in the overburden. The contractor may elect to use temporary casing in deeper soil areas. Temporary casing may be omitted if the contractor can demonstrate the ability to maintain an open excavation without collapse of the side walls, fallback of material into the excavation, or fallback into and contamination of freshly placed concrete.
- 8.2** Permanent casing may be required in the rock socket if significant voids are found during drilling. If permanent casing is required, the rock socket is to be extended below the casing to provide an uncased rock socket length shown on the plans.
- 8.3** Except as permitted by special design, Sound Barrier Walls shall not be subjected to differential earth loading. Temporary or permanent soil loads placed on the sound barrier walls are only permitted as noted in the sound barrier wall plans.
- 8.4** Shafts shall have a minimum rock socket depth of 3 feet.
- 8.5** The drilled shafts shall be constructed in accordance with the Special Note for Drilled Shafts, current edition, except that the subsurface exploration borings in accordance with Section 3.5 of the Special Note are not required.

The designer should feel free to contact the Geotechnical Branch at 502-564-2374 for further recommendations or if any questions arise pertaining to this project.

Attachments:

- **Structure Location Map**
- **Subsurface Data Sheet**
- **Idealized Soil and Bedrock Profile**
- **Drilled Shaft Axial Resistance Tables**
- **Coordinate Data Sheet**

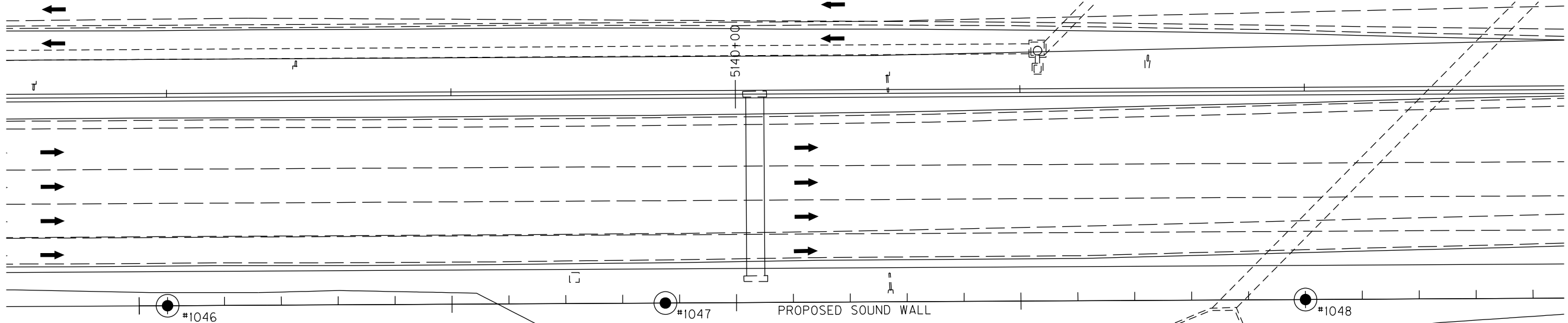
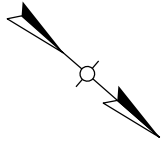
Structure Location Map:

Approximate Lat./Long: 38.286061/-85.642835



SUBSURFACE DATA

Plan Scale 1" = 20'



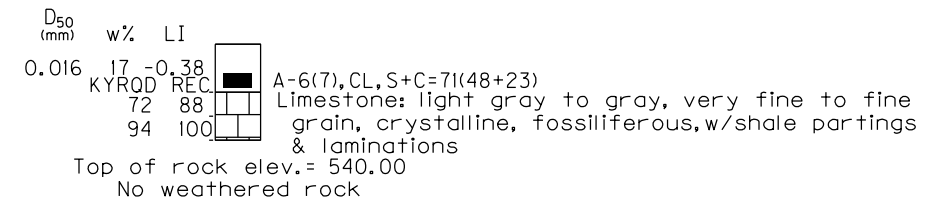
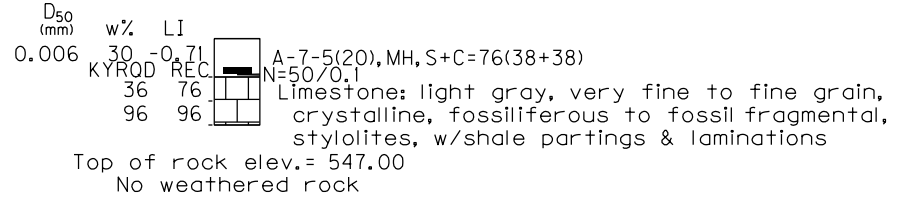
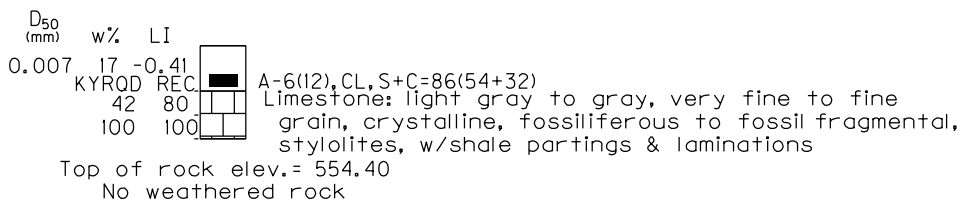
Profile Scale:
Vertical 1" = 10'
Horizontal not to scale

Hole No.
Station
Offset
Elev.
(NAVD 88
datum)

1046
638+00.00
@
559.10

1047
639+75.00
@
551.00

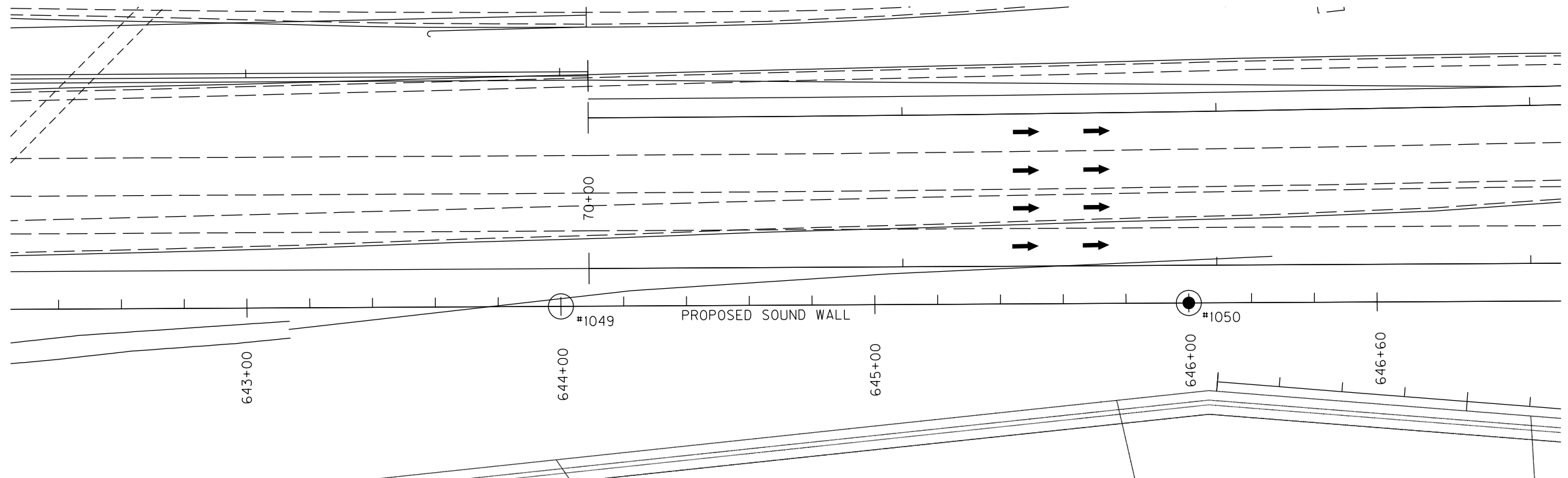
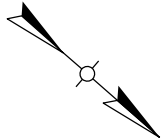
1048
643+00.00
@
545.00



Datum

SUBSURFACE DATA

Plan Scale 1" = 20'



Profile Scale:
Vertical 1" = 10'
Horizontal not to scale

Hole No.
Station
Offset
Elev.
(NAVD 88
datum)

1049
644+00.00
@
549.40

1050
646+00.00
@
556.20



R
(542.90)

D_{50} (mm) 0.013
 w% 24
 LI 0.07
 KYROD REC. N=50/0.1
 20 20
 14 16
 92 92
 86 96
 A-6(9), CL, S+C=70(42+28)
 Cored Overburden: w/limestone boulders & cobbles
 Limestone: light gray, very fine to fine grain, crystalline, fossiliferous, stylolites, w/shale partings & laminations
 Top of rock elev.= 547.70
 No weathered rock

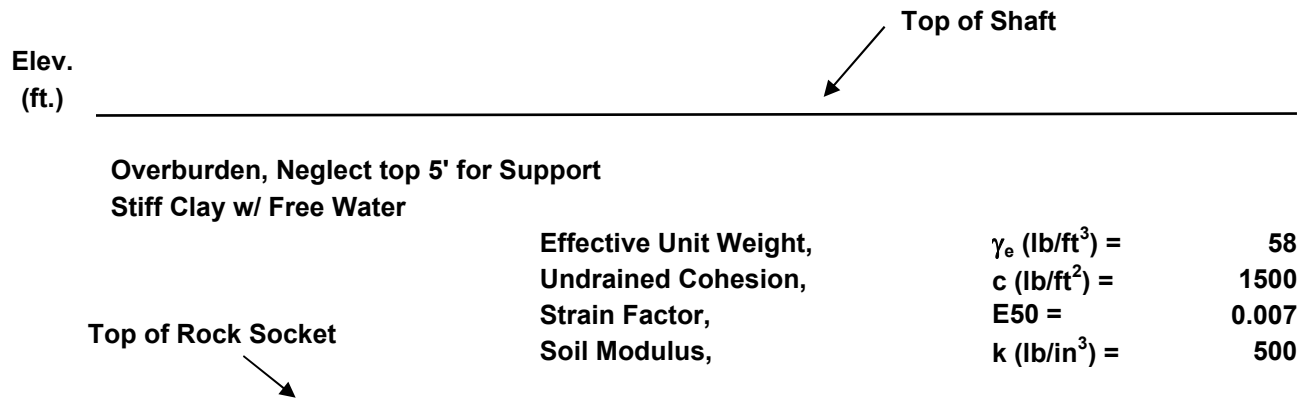
Datum

	REVISION _____ _____ _____	DATE _____ _____ _____	PREPARED BY Division of Structural Design Geotechnical Branch	DATE: 08-SEPTEMBER-2022	CHECKED BY _____ _____	ROUTE I-264	ITEM NO. 5-804.00	COUNTY OF JEFFERSON
				DESIGNED BY: E. BAILEY	DETAILED BY: T. SHEFFIELD	CROSSING Sound Wall @ Sta. 5137+90.00-72+51.01	SHEET NO. _____	DRAWING NUMBER S-089-2022

IDEALIZED SOIL AND BEDROCK PROFILE

Jefferson Co., Item# 5-804.00, I-264 and US 42 Interchange
 S-089-2022: Sound Barrier Wall at Northfield #2, I-264 EB Sta. 5137+90 to I-71 NB Sta.
 72+51.01

TQS 8/30/22



Strata

Parameters for Lateral Load Analyses

Limestone

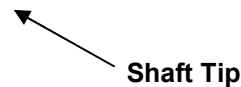
Strong Rock (Vuggy Limestone)

γ_t (lb/ft³) = 150
 q_u (psi) = 4100
 q_{eb} (ksf) = 90
 f_s (ksf) = 32.7

Effective Unit Weight,	γ_e (lb/in ³) =		0.087
Uniaxial Compressive Strength,	q_u (psi) =		4100

(Side friction limited by Concrete Strength to $f_s = 32.7$ ksf)

*



* Elevations vary and are provided in the report body.

ADDITIONAL DATA FOR GEOTECHNICAL CALCULATIONS ONLY:	
min. f'_c (psi) =	3500
p_a (psi) =	14.7

Load and Resistance Factor Design (LRFD)

DRILLED SHAFT AXIAL RESISTANCE TABLE

Jefferson Co., Item# 5-804.00, I-264 and US 42 Interchange

S-089-2022: Sound Barrier Wall at Northfield #2, I-264 EB Sta. 5137+90 to I-71 NB Sta. 72+51.01

Rock Socket Diameter = 1.5 feet

Rock Socket Diameter = 18 inches

TQS 8/30/22

Rock Socket Length (ft.)	Nominal Unit Side Shear q_{ss} (ksf)	Nominal Unit End Bearing q_{eb} (ksf)	Nominal Side Resistance R_{sr} (kips)	Nominal End Bearing Resistance R_{eb} (kips)	Factored Side Resistance ϕR_{sr} (kips)	Factored End Bearing Resistance ϕR_{eb} (kips)	Total Factored Axial Resistance ϕR_t (kips)	Total Factored Uplift Resistance ϕR_{tu} (kips)
0.0								
1.0	32.7	90	154	159	77	80	157	62
2.0	32.7	90	308	159	154	80	234	123
>>> 3.0	32.7	90	462	159	231	80	311	185
4.0	32.7	90	616	159	308	80	388	246
5.0	32.7	90	770	159	385	80	465	308
6.0	32.7	90	924	159	462	80	542	370
7.0	32.7	90	1078	159	539	80	619	431
8.0	32.7	90	1232	159	616	80	696	493
9.0	32.7	90	1386	159	693	80	773	555
10.0	32.7	90	1540	159	770	80	850	616
11.0	32.7	90	1694	159	847	80	927	678
12.0	32.7	90	1848	159	924	80	1004	739
13.0	32.7	90	2002	159	1001	80	1081	801
14.0	32.7	90	2157	159	1078	80	1158	863
15.0	32.7	90	2311	159	1155	80	1235	924
16.0	32.7	90	2465	159	1232	80	1312	986
17.0	32.7	90	2619	159	1309	80	1389	1047
18.0	32.7	90	2773	159	1386	80	1466	1109
19.0	32.7	90	2927	159	1463	80	1543	1171
20.0	32.7	90	3081	159	1540	80	1620	1232
AASHTO Table 10.5.5.2.4-1					Resistance Factor, ϕ			
					0.50	0.50		0.40
>>> = Min. Socket Length							D (ft.) =	1.5

Load and Resistance Factor Design (LRFD)

DRILLED SHAFT AXIAL RESISTANCE TABLE

Jefferson Co., Item# 5-804.00, I-264 and US 42 Interchange

S-089-2022: Sound Barrier Wall at Northfield #2, I-264 EB Sta. 5137+90 to I-71 NB Sta. 72+51.01

Rock Socket Diameter = 2.0 feet

Rock Socket Diameter = 24 inches

TQS 8/30/22

Rock Socket Length (ft.)	Nominal Unit Side Shear q_{ss} (ksf)	Nominal Unit End Bearing q_{eb} (ksf)	Nominal Side Resistance R_{sr} (kips)	Nominal End Bearing Resistance R_{eb} (kips)	Factored Side Resistance ϕR_{sr} (kips)	Factored End Bearing Resistance ϕR_{eb} (kips)	Total Factored Axial Resistance ϕR_t (kips)	Total Factored Uplift Resistance ϕR_{tu} (kips)	
0.0									
1.0	32.7	90	205	283	103	141	244	82	
2.0	32.7	90	411	283	205	141	347	164	
>>>	32.7	90	616	283	308	141	449	246	
4.0	32.7	90	822	283	411	141	552	329	
5.0	32.7	90	1027	283	513	141	655	411	
6.0	32.7	90	1232	283	616	141	758	493	
7.0	32.7	90	1438	283	719	141	860	575	
8.0	32.7	90	1643	283	822	141	963	657	
9.0	32.7	90	1848	283	924	141	1066	739	
10.0	32.7	90	2054	283	1027	141	1168	822	
11.0	32.7	90	2259	283	1130	141	1271	904	
12.0	32.7	90	2465	283	1232	141	1374	986	
13.0	32.7	90	2670	283	1335	141	1476	1068	
14.0	32.7	90	2875	283	1438	141	1579	1150	
15.0	32.7	90	3081	283	1540	141	1682	1232	
16.0	32.7	90	3286	283	1643	141	1784	1314	
17.0	32.7	90	3491	283	1746	141	1887	1397	
18.0	32.7	90	3697	283	1848	141	1990	1479	
19.0	32.7	90	3902	283	1951	141	2093	1561	
20.0	32.7	90	4108	283	2054	141	2195	1643	
AASHTO Table 10.5.5.2.4-1					Resistance Factor, ϕ	0.50	0.50		0.40
>>> = Min. Socket Length							D (ft.) =	2.0	

Load and Resistance Factor Design (LRFD)

DRILLED SHAFT AXIAL RESISTANCE TABLE

Jefferson Co., Item# 5-804.00, I-264 and US 42 Interchange

S-089-2022: Sound Barrier Wall at Northfield #2, I-264 EB Sta. 5137+90 to I-71 NB Sta. 72+51.01

Rock Socket Diameter = 2.5 feet

Rock Socket Diameter = 30 inches

TQS 8/30/22

Rock Socket Length (ft.)	Nominal Unit Side Shear q_{ss} (ksf)	Nominal Unit End Bearing q_{eb} (ksf)	Nominal Side Resistance R_{sr} (kips)	Nominal End Bearing Resistance R_{eb} (kips)	Factored Side Resistance ϕR_{sr} (kips)	Factored End Bearing Resistance ϕR_{eb} (kips)	Total Factored Axial Resistance ϕR_t (kips)	Total Factored Uplift Resistance ϕR_{tu} (kips)	
0.0									
1.0	32.7	90	257	442	128	221	349	103	
2.0	32.7	90	513	442	257	221	478	205	
>>> 3.0	32.7	90	770	442	385	221	606	308	
4.0	32.7	90	1027	442	513	221	734	411	
5.0	32.7	90	1284	442	642	221	863	513	
6.0	32.7	90	1540	442	770	221	991	616	
7.0	32.7	90	1797	442	899	221	1119	719	
8.0	32.7	90	2054	442	1027	221	1248	822	
9.0	32.7	90	2311	442	1155	221	1376	924	
10.0	32.7	90	2567	442	1284	221	1505	1027	
11.0	32.7	90	2824	442	1412	221	1633	1130	
12.0	32.7	90	3081	442	1540	221	1761	1232	
13.0	32.7	90	3337	442	1669	221	1890	1335	
14.0	32.7	90	3594	442	1797	221	2018	1438	
15.0	32.7	90	3851	442	1925	221	2146	1540	
16.0	32.7	90	4108	442	2054	221	2275	1643	
17.0	32.7	90	4364	442	2182	221	2403	1746	
18.0	32.7	90	4621	442	2311	221	2531	1848	
19.0	32.7	90	4878	442	2439	221	2660	1951	
20.0	32.7	90	5135	442	2567	221	2788	2054	
AASHTO Table 10.5.5.2.4-1					Resistance Factor, ϕ		0.50	0.50	0.40
>>> = Min. Socket Length							D (ft.) =	2.5	

Load and Resistance Factor Design (LRFD)

DRILLED SHAFT AXIAL RESISTANCE TABLE

Jefferson Co., Item# 5-804.00, I-264 and US 42 Interchange

S-089-2022: Sound Barrier Wall at Northfield #2, I-264 EB Sta. 5137+90 to I-71 NB Sta. 72+51.01

Rock Socket Diameter = 3.0 feet

Rock Socket Diameter = 36 inches

TQS 8/30/22

Rock Socket Length (ft.)	Nominal Unit Side Shear q_{ss} (ksf)	Nominal Unit End Bearing q_{eb} (ksf)	Nominal Side Resistance R_{sr} (kips)	Nominal End Bearing Resistance R_{eb} (kips)	Factored Side Resistance ϕR_{sr} (kips)	Factored End Bearing Resistance ϕR_{eb} (kips)	Total Factored Axial Resistance ϕR_t (kips)	Total Factored Uplift Resistance ϕR_{tu} (kips)	
0.0									
1.0	32.7	90	308	636	154	318	472	123	
2.0	32.7	90	616	636	308	318	626	246	
>>> 3.0	32.7	90	924	636	462	318	780	370	
4.0	32.7	90	1232	636	616	318	934	493	
5.0	32.7	90	1540	636	770	318	1088	616	
6.0	32.7	90	1848	636	924	318	1242	739	
7.0	32.7	90	2157	636	1078	318	1396	863	
8.0	32.7	90	2465	636	1232	318	1550	986	
9.0	32.7	90	2773	636	1386	318	1704	1109	
10.0	32.7	90	3081	636	1540	318	1858	1232	
11.0	32.7	90	3389	636	1694	318	2012	1356	
12.0	32.7	90	3697	636	1848	318	2167	1479	
13.0	32.7	90	4005	636	2002	318	2321	1602	
14.0	32.7	90	4313	636	2157	318	2475	1725	
15.0	32.7	90	4621	636	2311	318	2629	1848	
16.0	32.7	90	4929	636	2465	318	2783	1972	
17.0	32.7	90	5237	636	2619	318	2937	2095	
18.0	32.7	90	5545	636	2773	318	3091	2218	
19.0	32.7	90	5853	636	2927	318	3245	2341	
20.0	32.7	90	6161	636	3081	318	3399	2465	
AASHTO Table 10.5.5.2.4-1					Resistance Factor, ϕ				0.40
					0.50	0.50			
>>> = Min. Socket Length							D (ft.) =	3.0	

S-089-2022 05-0804.00 Kentucky Transportation Cabinet

ID	Latitude	Longitude	Hole	Station	Offset	Elevation(ft)	Comments
1	38.2840399	-85.6406219	1046	638+00	0	559.117	
2	38.2844505	-85.6410847	1047	639+75	0	550.977	
3	38.2848611	-85.6415475	1048	643+00	0	545	
4	38.2852717	-85.6420103	1049	644+00	0	549.435	First rock @ 6.3 ft
5	38.2856822	-85.6424731	1050	646+00	0	556.202	