Resource International, Inc.

FRA-70-13.01
FRA-70-1301R
I-70 EB OVER SR 135
PID NO. 105430
FRANKLIN COUNTY, OHIO

STRUCTURE FOUNDATION EXPLORATION REPORT

Prepared For:
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Rii Project No. W-20-025

June 2021

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June 28, 2021

Ms. Leslie Montgomery, P.E.
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2221 Schrock Road
Columbus, OH 43229

Re: Structure Foundation Exploration
FRA-70-13.01
FRA-70-1301R – I-70 EB over SR 315
PID No. 105430
Franklin County, Ohio
Rii Project No. W-20-025

Ms. Montgomery:

Resource International, Inc. (Rii) is pleased to submit this subsurface exploration report for the above referenced project. Engineering logs have been prepared and are attached to this report along with the results of laboratory testing. This report includes recommendations for the design and construction of the proposed FRA-70-13.01 project in Franklin County, Ohio.

We sincerely appreciate the opportunity to be of service to you on this project. If you have any questions regarding the preliminary structure foundation exploration or this report, please contact us.

Sincerely,

RESOURCE INTERNATIONAL, INC.

Leila Sadeghi, Ph.D., P.E.
Staff Engineer –
Geotechnical & Pavement Services

Brian R. Trenner, P.E.
Director – Geotechnical Services

Enclosure: Structure Foundation Exploration Report

TABLE OF CONTENTS

APPENDICIES

EXECUTIVE SUMMARY

Resource International, Inc. (Rii) has completed a structure foundation exploration for the design and construction of the proposed FRA-70-13.10 project in Franklin County, Ohio, which includes the FRA-70-1301R bridge structure over SR-315. Based on the information provided, it is understood that the existing bridge will be completely removed and replaced with a three-span structure, having a total length of approximately 513 feet and width of approximately 63.5 feet. It is also understood that the proposed project includes roadway improvements along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-13.21R bridge structure.

Exploration and Findings

Between April 22 and 29, 2020, five (5) soil borings, designated as B-014-1-19 through B-014-5-19, were drilled along the project alignment at the locations shown on the boring plan provided in Appendix I of the full report. Borings B-014-1-19 and B-014-5-19 were advanced to completion depths ranging from 7.3 to 7.5 feet below the exiting ground surface for the roadway approach work, and borings B-014-2-19 through B-014-4-19 were drilled to completion depths ranging from 49.7 to 94.6 feet below the existing ground surface for the proposed structure replacement.

In addition to the borings performed for the current exploration, borings B-015-1-13 and B-015-2-13 from the FRA-70-12.68 Phase 4R (PID No. 105523) project, and borings B-108-5-13 and B-108-6-13 from the FRA-71-14.36 Phase 6R (PID No. 105588) project were also referenced to further characterize the subsurface profile along the bridge alignment. The borings were advanced to depths ranging from 63.0 to 95.0 feet below the existing ground surface.

Borings B-014-1-19, B-014-2-19 and B-014-5-19 were drilled within the existing pavement of eastbound lanes of I-70 and encountered 4.5 to 5.5 inches of asphalt overlying 11.5 to 13.5 inches of concrete. Borings B-015-1-13 was drilled through the existing shoulder of I-70 eastbound and encountered 9.0 inches of asphalt overlying 6.0 inches of aggregate base. The remaining borings were drilled in the grass infield areas between the various roadways and interchange ramps and encountered 2.0 to 6.0 inches of topsoil at the ground surface.

Beneath the surface materials in borings B-015-1-13, B-014-2-19 and B-108-6-13 material identified as existing fill was encountered extending to depths ranging from 25.5 to 37.0 feet below the ground surface. The fill material consisted of grayish brown to gray, medium stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a) and brown, medium dense to dense gravel and gravel with sand and silt (ODOT A-1-a, A-2-4).

Underlying the surficial materials and existing fill, where encountered, natural soils were encountered consisting of both granular and cohesive material. The granular soils were generally described as brown, gray, grayish brown, dark brown and black, loose to very dense gravel, gravel with sand, gravel with sand and silt and gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-4, A-2-6). The cohesive soils were generally described as brown, dark brown, dark gray and gray, stiff to hard sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

Analyses and Recommendations

Design details of the proposed structure were provided by ms consultants, inc. Based on the information provided, it is understood that the proposed project includes roadway reconstruction and widening along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-1321R bridge structure. It is understood that the existing I-70 eastbound bridge will be completely removed and replaced with a three-span composite steel curved plate girder structure with stub abutments and multi-column piers on driven pile foundations, having a total length of approximately 513 feet and width of approximately 63.5 feet. The rear abutment of the proposed structure will be located in front of the existing rear abutment with an MSE wall that crosses in front of the abutment footing and wraps around to the west on the north side of I-70 eastbound. The forward abutment of the proposed structure will be located in front of the existing forward abutment and will be situated at the top of a new spill through embankment slope. A new MSE retaining wall will also be located on the south side of the spill through embankment slope at the forward abutment, which will provide grade separation for the existing pump station that is located just south of the existing bridge structure in the infield of the I-70 eastbound to SR 315 northbound ramp.

Driven Pile Recommendations

It is recommended that driven piles be utilized for foundation support at all of the substructure units for this structure. Given the depth of bedrock encountered and the required structural loading, it is recommended that steel H-piles (ODOT Item 507.06) driven to refusal on bedrock be employed for foundation support. Per Section 305.3.1.2 of the 2020 ODOT Bridge Design Manual, refusal is met during driving when the pile penetration is an inch or less after receiving at least 20 blows from the pile hammer. The following table shows the recommended pile lengths and the corresponding factored structural axial resistance ($R_{R\ max}$) of steel H-piles. For H-piles driven to refusal on bedrock, no geotechnical resistance factor should be applied to the factored structural axial resistance values presented, as the values presented account for the structural resistance factor, $\varphi_c = 0.50$, for H-piles subject to damage due to severe driving conditions. For piles subjected to downdrag loads, a structural resistance factor of $\varphi_c = 0.60$ was considered in the calculation of the factored structural resistance of the piles.

Driven Pile Recommendations

Substructure Reference	Ground Elevation [1] (feet msl)	Pile Size	Pile Elevation		Pile Length [3] (feet)	$R_{R\ max}$ [4] (kips/pile)	Sleeve / Prebore Length [5,6] (feet)	φ [7]
			Top [2]	Tip				
Rear Abutment (B-015-1-13)	746.7	HP 10x42 [8]	737.1	648.4	90	310	11.1	N/A
		HP 12x53 [8]	737.1	648.4	90	380	11.1	N/A
Pier 1 (B-014-3-19)	700.9	HP 12x53 [8]	694.8	654.9	40	380	N/A	N/A
Pier 2 (B-014-4-19)	698.8	HP 12x53 [8]	694.4	658.3	40	456 [9]	N/A	N/A
		HP 14x73 [8]	694.4	658.3	40	636 [9]	N/A	N/A
Forward Abutment (B-014-7-20)	715.5	HP 10x42 [8]	732.7	658.9	75	372 [9]	17.0	N/A
		HP 12x53 [8]	732.7	658.9	75	456 [9]	17.0	N/A

1. *Ground elevation listed is the ground elevation at the respective boring location.*
2. *The top of pile elevation corresponds to the pile cutoff elevation, which is considered to be 1.0-foot above the proposed bottom of footing elevation per Section 305.3.5.1 of the 2020 ODOT BDM.*
3. *Per Section 305.3.5.2 of the 2020 ODOT BDM, the estimated pile length was determined as the pile cutoff elevation (top) minus the pile tip elevation, rounded up to the nearest 5.0 feet.*
4. *The factored structural axial resistance for H-piles is based on the structural limit state of the steel H-pile section per Section 305.3.3 of the 2020 ODOT BDM.*
5. *Sleeve length at the rear abutment represents the required length of pile that should be sleeved within the MSE wall backfill.*
6. *Per Section 305.3.5.7 of the 2020 ODOT BDM, all piles at the forward abutment should be prebored to the bottom of the new embankment elevation at each pile location in accordance with ODOT Item 507.11.*
7. *For H-piles driven to refusal on bedrock, no geotechnical resistance factor should be applied (N/A) to the factored structural axial resistance values presented, as the values presented account for the structural resistance factor, $\varphi_c = 0.50$, for H-piles subject to damage due to severe driving conditions. For piles subjected to downdrag loads, a structural resistance factor of $\varphi_c = 0.60$ was considered in the calculation of the factored structural resistance of the piles.*
8. *A steel pile point is recommended to protect the tips of the piles during pile installation.*
9. *The total factored load should consider the factored structural load plus the factored downdrag load per pile in accordance with Section 305.3.2.2. Downdrag loads and considerations at the abutments are presented in Section 5.1.2.*

Based on the plan information provided, approximately 30.0 feet of new embankment fill will be placed at the forward abutment to achieve the proposed roadway profile grade, which will result in approximately 17.0 feet of new fill below the bottom of footing. Therefore, per Section 305.3.5.7 of the 2020 ODOT BDM, all piles at the forward abutment should be prebored to the bottom of the new embankment elevation at each pile location in accordance with ODOT Item 507.11.

The total factored load should consider the factored structural load plus the factored downdrag load per pile in accordance with Section 305.3.2.2. Downdrag loads and considerations at the abutments are presented in Section 5.1.2 of the full report.

The anticipated total settlement along the facing of Retaining Wall W4 at the rear abutment is approximately 1.83 inches. Results of the settlement analysis indicate that approximately 90 percent of the primary consolidation of the cohesive layers at the rear abutment will be complete within 33 days following the placement of the surcharge load. Therefore, if the above noted waiting period is specified following completion of construction of the retaining wall at the rear abutment, downdrag forces along the piles will be eliminated.

Total settlements up to 5.62 inches should be expected due to the weight of the new embankment fill at the forward abutment. Results of the settlement analysis indicate that approximately 90 percent of the primary consolidation of the cohesive layers will be complete within 150 days following the placement of the embankment. Since this is not a practical time period to accommodate during construction, it is recommended that a shorter wait period be specified and that the piles be designed to accommodate the downdrag loading. The depth of downdrag at the forward abutment following a 30 day hold period will be 17.0 feet. Using the calculated depth of downdrag and considering an HP 10x42 and HP 12x53 pile sizes, the unfactored downdrag load at forward abutment is 69 and 83 kips/pile, respectively.

The total anticipated settlement below the existing ground surface grade at Piers 2 is 2.05 inches, with an anticipated settlement below the bottom of footing elevation 1.26 inches due to the placement of the future embankment fill. Based on the results of the settlement analysis, downdrag loads will develop along the piles supporting Pier 2 following placement of the future embankment fill. Using the traditional method criterion, the depth of downdrag for 100 percent of primary consolidation is 18.0 feet below the bottom of footing elevation. Using the calculated depth of downdrag and considering an HP 12x53 and HP 14x73 pile size, the unfactored downdrag load at forward abutment is 74 and 104 kips/pile, respectively.

A load factor of 1.05 should be applied to the unfactored downdrag load when determining the factored downdrag load per pile at the strength limit state and should be added to the factored load per pile from the superstructure.

MSE Wall Recommendations

The bearing soils along the alignment of Wall W4 at the rear abutment are anticipated to consist of stiff to very stiff silt and clay and sandy silt (ODOT A-6a, A-4a), and the anticipated soils along the alignment of Wall W6 south of the rear abutment are anticipated to consist of very stiff silt and clay (ODOT A-6a) or loose to medium dense gravel, gravel with sand or gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-6). MSE wall foundations bearing on these soils or engineered fill, placed and compacted in accordance with ODOT Item 203, may be proportioned for a factored bearing resistance as indicated in the following table. A geotechnical resistance factor of φ_b=0.65 was considered in calculating the factored bearing resistance at the strength limit state.

FRA-70-1301R (Retaining Wall W4 and W6) MSE Wall Design Parameters

Substructure Unit (Boring)	Wall Height Analyzed (feet)	Back-slope Behind Wall	Minimum Required Reinforcement Length [1] (feet)	Bearing Resistance at Strength Limit (ksf)		Strength Limit Equivalent Bearing Pressure [3] (ksf)
				Nominal	Factored [2]	
Rear Abutment / Retaining Wall W4 (B-015-1-13)	25.2	Level	22.7 (0.90H)	17.51	5.69 [(4)]	5.37
Forward Abutment / Retaining Wall W6 (B-108-5-13, B-012-E-68)	21.4	2:1 (Broken-Back)	19.3 (0.90H)	10.76	6.99	6.23

1. *The minimum reinforcement length is based on the maximum wall height analyzed. The value in parentheses represent the required reinforcement length expressed as a percentage of the wall height, H.*
2. *A geotechnical resistance factor of φ_b=0.65 was considered in calculating the factored bearing resistance at the strength limit state.*
3. *The strength limit equivalent bearing pressure is the uniformly distributed pressure asserted by the wall over an effective base width based on the eccentricity of the wall system at the strength limit state.*
4. *The factored bearing resistance includes a reduction factor applied to the nominal resistance to account for the fore slope in front of the wall per Section 10.6.3.1.2c of the 2020 AASHTO LRFD BDM.*

Total settlements of up to 2.94 inches at the center of the reinforced soil mass and 1.83 inches at the facing of the wall are anticipated along Wall W4 at the rear abutment. Total settlements ranging from 0.63 to 3.52 inches at the center of the reinforced soil mass and 0.47 to 2.13 inches at the facing of the wall are anticipated along Wall W6 on the south side of the forward abutment. Based on the results of the analysis, 90 percent of the total settlement is anticipated to occur over a period of approximately 31 to 51 days. For Wall W4 at the rear abutment, it is estimated that less than 0.40 inches of settlement will be remaining following a period of 21 days. Based on the results of the settlement analysis, differential settlement greater than 1/100 may occur along the wall facing based on the short distance that the wall is brought down to existing grade.

Based on the results of the external and global stability analysis performed for Wall W4 (rear abutment) and Wall W6 (south side of the forward abutment), the recommended controlling strap length is 0.9 times the maximum height of the MSE wall for both walls. Sliding resistance under drained and undrained conditions and bearing resistance under undrained conditions were the controlling factors in the determination of the recommended strap lengths.

Pavement Subgrade Recommendations

The soils at the proposed subgrade elevation along the I-70 eastbound lanes between Souder Avenue (begin Sta. 128+26) and the proposed FRA-70-1321R bridge structure (end Sta. 147+63) consist of granular material comprised of medium dense gravel with sand (ODOT A-1-b) and natural or fill materials comprised of very stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a). It is understood that the existing and proposed roadway profiles will approximately match.

Per ODOT GB1, global stabilization recommendations are based upon the overall average site parameters, as noted in the table below.

Average Site Parameters from GB-1 Analysis

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Design CBR
20	8	14	12	5	8

Applying the averages in the table above, GB1 recommends the following global stabilization options, which should be evaluated based upon a cost and constructability analysis:

Option 1. **Chemically stabilize the entire subgrade with 12-inches of cement, as per ODOT Item 206. For estimating purposes, utilize a cement content of 6.0 percent by weight of soil. Actual application rates shall be verified by the contractor under Item 206.06 Mixture Design for Chemically Stabilized Soils.**

Option 2. **Stone stabilize the entire subgrade via a 12-inch undercut and replacement with ODOT Item 703.16C granular material, Type B, C or D installed over ODOT Item 712.09 Geotextile Fabric, Type D as detailed in accordance with ODOT Item 204.**

Given that this section of I-70 is being reconstructed as part of a larger corridor construction project, it is recommended that global stabilization of the subgrade shall be performed regardless of the length of the project using the global chemical stabilization option (Option 1) above. This stabilization option will provide the most uniform and durable subgrade, and will match the proposed subgrade stabilization that is being utilized along the interstate sections within this corridor in the other phases of construction.

California Bearing Ratio (CBR) values for the entire project ranged from 6 to 12 with an average of 8. If it is elected to proceed with global stabilization of the entire subgrade, it is recommended that pavement design be based on the average CBR of 8 with a corresponding natural resilient modulus, M_R, of 9,600 psi. However, since the entire subgrade will receive global chemical stabilization, the resilient modulus can be increased per Section 203.4.1 of the ODOT Pavement Design Manual, which results in an increased design resilient modulus, $M_{R\text{-}GCS}$, of 13,056 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 182 pci and a soil support value (SSV) of 5.4.

Please note that this executive summary does not contain all the information presented in the report. The unabridged subsurface exploration report should be read in its entirety to obtain a more complete understanding of the information presented.

1.0 INTRODUCTION

This report is a presentation of the structure foundation exploration performed for the design and construction of the proposed FRA-70-13.10 project in Franklin County, Ohio, which includes the FRA-70-1301R bridge structure over SR-315, as shown on the vicinity map and boring plan presented in Appendix I. The existing structure is a six-span bridge with a total length of approximately 535 feet and width of approximately 58 feet. Based on the information provided, it is understood that the existing bridge will be completely removed and replaced with a three-span composite steel curved plate girder structure with stub abutments and multi-column piers supported on driven pile foundations, having a total length of approximately 513 feet and width of approximately 63.5 feet. The rear abutment of the proposed structure will be located in front of the existing rear abutment with an MSE wall that crosses in front of the abutment footing and wraps around to the west on the north side of I-70 eastbound. The forward abutment of the proposed structure will be located in front of the existing forward abutment and will be situated at the top of a new spill through embankment slope. A new MSE retaining wall will also be located on the south side of the spill through embankment slope at the forward abutment, which will provide grade separation for the existing pump station that is located just south of the existing bridge structure in the infield of the I-70 eastbound to SR 315 northbound ramp. It is also understood that the proposed project includes roadway improvements along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-1321R bridge structure.

In addition to the borings obtained as part of the current exploration, borings from the adjacent projects for FRA-70-12.68 Phase 4R (PID No. 105523) and FRA-71-14.36 Phase 6R (PID No. 105588) were utilized to in the development of the analysis and recommendations for this report. Additionally, historic borings performed in 1968 by the Department of Highways as part of the FRA-70-12.30S project were obtained from the construction documents on record.

2.0 GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1 Site Geology

Both the Illinoian and Wisconsinan glaciers advanced over two-thirds of the State of Ohio, leaving behind glacial features such as moraines, kame deposits, lacustrine deposits and outwash terraces. The glacial and non-glacial regions comprise five physiographic sections based on geological age, depositional process and geomorphic occurrence (physical features or landforms). The project area lies within the Columbus Lowland District of the Till Plains Section. This area is characterized by flat to gently rolling ground moraine deposits from the Late Wisconsinan age. The site topography exhibits moderate to high relief. The ground moraine deposits are composed primarily of silty loam till (Darby, Bellefontaine, Centerburg, Grand Lake, Arcanum, Knightstown Tills), with smaller alluvium and outwash deposits bordering the Scioto River, its tributaries and floodplain areas. A ground moraine is the sheet of debris left after the

steady retreat of glacial ice. The debris left behind ranges in composition from clay size particles to boulders (including silt, sand, and gravel). Outwash deposits consist of undifferentiated sand and gravel deposited by meltwater in front of glacial ice, and often occurs as valley terraces or low plains. Alluvium and alluvial terrace deposits range in composition from silty clay size particles to cobbles, usually deposited in present and former floodplain areas.

According to the bedrock geology and topography maps obtained from the Ohio Department of Natural Resources (ODNR), the underlying bedrock consists predominantly of the Middle to Lower Devonian-aged Columbus Limestone Formation. This formation is further subdivided into two members in the central portion of the state, known as the Delhi and Bellepoint Members. The Delhi Member consists of light gray, finely to coarsely crystalline, irregularly bedded, fossiliferous limestone. The Bellepoint Member consists of variable brown, finely crystalline, massively bedded limy dolomite. Both of these members contain chert nodules. Just east of Scioto River, the Upper Devonian Ohio Shale Formation overlies the Columbus Limestone Formation. The Ohio Shale formation consists of brownish black to greenish gray, thinly bedded, fissile, carbonaceous shale. Regionally, the bedrock surface forms a broad valley aligned roughly north-to-south beneath the Scioto River, and the site is located within this valley. According to bedrock topography mapping, the elevation of the bedrock surface within the bedrock valley is approximately 600 feet mean sea level (msl). Just east of the Scioto River, the bedrock surface forms a knoll that slopes up to the north along the alignment of SR 315. The elevation of the knoll at the proposed structure ranges from approximately 630 to 650 feet msl. Limestone bedrock was encountered at elevations ranging from 641.9 to 657.6 feet msl along the structure alignment.

2.2 Existing Conditions

The project alignment is located along the eastbound lanes of I-70 starting from Souder Avenue and ending at the proposed FRA-70-13.21R bridge structure. The existing I-70 roadway has two driving lanes in the eastbound direction, including one exit ramp to I-71 southbound, just east of Souder Avenue, and another exit ramp to SR 135 northbound at the east end of the existing structure. The existing roadway width is 58 feet. The existing bridge structure carrying I-70 eastbound lanes over SR 135 is a six span continuous steel girder structure with non-composite reinforced concrete deck with 25 foot long approach slabs. It is understood that the existing structure was constructed in 1975. The terrain along SR-315 is lowered from the surrounding terrain, and the existing areas between the roadways are generally grass covered, with some patches of dense vegetation along the slopes. The Scioto River flows along the east side of I-71 and SR 315 northbound.

3.0 EXPLORATION

Between April 22 and 29, 2020, five (5) soil borings, designated as B-014-1-19 through B-014-5-19, were drilled along the project alignment at the locations shown on the boring plan provided in Appendix I of this report and summarized in Table 1. Borings B-014-1-19 and B-014-5-19 were advanced to completion depths ranging from 7.3 to 7.5 feet below the exiting ground surface for the roadway approach work, and borings B-014-2-19 through B-014-4-19 were drilled to completion depths ranging from 49.7 to 94.6 feet below the existing ground surface for the proposed structure replacement. On December 10 and 15, 2020, two additional borings, designated as B-014-6-20 and B-014-7-20, were performed in close proximity to the rear and forward abutment to obtain undisturbed samples within the cohesive soil layers present in these areas to further define the compressibility parameters of these layers. The borings were extended to a depth of 88.1 and 56.6 feet below existing grade, respectively.

Table 1. Test Boring Summary

Boring Number	Reference Alignment	Station	Offset	Latitude	Longitude	Ground Elevation (feet msl)	Boring Depth (feet)
B-014-1-19	BL Const. I-70 EB	130+97	21' Lt.	39.950225	-83.019864	736.5	7.5
B-014-2-19	BL Const. I-70 EB	135+82	16' Lt.	39.950298	-83.018137	744.5	94.6
B-014-3-19	BL Const. I-70 EB	139+05	31' Lt.	39.950416	-83.017000	700.9	54.8
B-014-4-19	BL Const. I-70 EB	140+65	29' Lt.	39.950496	-83.016450	698.8	49.7
B-014-5-19	BL Const. I-70 EB	145+09	10' Lt.	39.950903	-83.014979	736.1	7.3
B-014-6-20	BL Const. I-70 EB	136+40	12’ Lt.	39.950322	-83.017927	745.4	88.1
B-014-7-20	BL Const. I-70 EB	142+46	48’ Lt.	39.950764	-83.015989	715.5	56.6

The boring locations were determined and located in the field by Rii representatives. Rii utilized a handheld GPS unit to obtain northing and easting coordinates of the boring locations. Ground surface elevations at the boring locations were interpolated using topographic mapping information provided by ms consultants.

The borings were drilled using a CME 55 truck or CME 750X all-terrain vehicle (ATV) mounted rotary drilling machine, utilizing either a 3.25-inch inside diameter hollow-stem or 4.5-inch outside diameter solid flight auger to advance the holes. Standard penetration testing (SPT) and split spoon sampling were performed continuously to the boring termination depth in borings B-014-1-19 and B-014-5-19. In borings B-014-2-19 through B-014-4-19, SPT and split spoon sampling were performed at 2.5-foot increments of depth to 30.0 feet and at 5.0-foot increments thereafter to auger refusal on bedrock or boulders. In borings B-014-6-19 and B-014-7-19, SPT and split spoon

sampling were performed generally at 5.0 to 10.0-foot increments of depth to verify the material type encountered for determination of the appropriate depths to obtain undisturbed (Shelby tube) samples.

The SPT, per the American Society for Testing and Materials (ASTM) designation D1586, is conducted using a 140-pound hammer falling 30.0 inches to drive a 2.0-inch outside diameter split spoon sampler 18.0 inches. Rii utilized a calibrated automatic drop hammer to generate consistent energy transfer to the sampler. Driving resistance is recorded on the boring logs in terms of blow per 6.0-inch interval of the driving distance. The second and third intervals are added to obtain the number of blows per foot (N). Standard penetration blow counts aid in determining soil properties applicable in foundation and pavement system design. Measured blow count (N) values are corrected to an equivalent (60%) energy ratio, N_{60}, by the following equation. Both values are represented on boring logs in

$$N_{60} = N*(ER/60)$$

Where:
N = measured N value
ER = drill rod energy ratio, expressed as a percent, for the system used

The hammers for the CME 55 and CME 750X drill rigs used were calibrated on September 4, 2018, and have drill rod energy ratios of 91.2 and 79.5 percent, respectively.

In addition to the SPT sampling, relatively undisturbed (Shelby tube) samples were obtained for laboratory compressibility testing within the various cohesive soil layers encountered in borings B-014-6-20 and B-014-7-20. The samples were obtained by hydraulically pushing a 2.75-inch outer diameter thin-walled seamless steel (Shelby) tube into the soil at a constant rate of penetration. The recovered Shelby tube samples were cleaned of soil cuttings and preserved within the tubes by sealing the ends with wax. There were several instances where the down pressure exerted on the tubes was maximized and the tubes were crushed due to the inability to advance the tubes, which generally resulted in no or poor recovery of samples that would not be suitable for testing.

Hand penetrometer readings, which provide a rough estimate of the unconfined compressive strength of the soil, were reported on the boring logs in units of tons per square foot (tsf) and were utilized to classify the consistency of the cohesive soil in each layer. An indirect estimate of the unconfined compressive strength of the cohesive split spoon samples can also be made from a correlation with the blow counts (N_{60}). Please note that split spoon samples are considered to be disturbed and the laboratory determination of their shear strengths may vary from undisturbed conditions.

During drilling, Rii personnel prepared field logs showing the encountered subsurface conditions. Soil samples obtained from the drilling operation were preserved and sealed in glass jars and delivered to the soil laboratory. In the laboratory, the soil samples were visually classified and select samples were tested, as noted in Table 2.

Table 2. Laboratory Test Schedule

Laboratory Test	Test Designation	Number of Tests Performed
Natural Moisture Content	ASTM D 2216	89
Plastic and Liquid Limits	AASHTO T89, T90	29
Gradation – Sieve/Hydrometer	AASHTO T88	29
Sulfate Content in Soils (Colorimetric Method)	ODOT S1122	3
One-Dimensional Consolidation	ASTM D2435	4

The tests performed are necessary to classify existing soil according to the Ohio Department of Transportation (ODOT) classification system and to estimate engineering properties of importance in determining foundation design and construction recommendations. Results of the laboratory testing are presented on the boring logs in Appendix III. A description of the soil terms used throughout this report is presented in Appendix II.

The depth to bedrock was determined by auger refusal. Auger refusal is defined as no or insignificant observable advancement of the augers with the weight of the drill rig driving the augers.

Where borings were extended into the bedrock (after encountering auger refusal), an NQ-sized double-tube diamond bit core barrel (utilizing wire line equipment) was used to core the bedrock. Coring produced 1.85 inch diameter cores, from which the type of rock and its geological characteristics were determined.

Rock cores were logged in the field and visually classified in the laboratory. They were analyzed to identify the type of rock, color, mineral content, bedding planes and other geological and mechanical features of interest in this project. The Rock Quality Designation (RQD) for each rock core run was calculated according to the following equation:

$$\text{RQD} = \frac{\sum \text{segments equal to or longer than 4.0 inches}}{\text{core run length}} \text{x}\,100$$

At the completion of drilling, the borings were backfilled with a mixture of bentonite chips and soil cuttings or sealed with a cement-bentonite grout mix, and any pavement surfaces were patched with an equivalent thickness of either cold patch asphalt or quick set concrete.

In addition to the borings performed for the current exploration, borings B-015-1-13 and B-015-2-13 from the FRA-70-12.68 Phase 4R (PID No. 105523) project, and borings B-108-5-13 and B-108-6-13 from the FRA-71-14.36 Phase 6R (PID No. 105588) project were used for determination of the subsurface profile at Piers 1 and 2 and the forward abutment. Details regarding the subsurface explorations for these borings can be found in the FRA-70-1301A (PID No. 105523) structure foundation exploration report dated January 30, 2019, and the FRA-71-1503L (PID No. 105588) structure foundation exploration report dated April 6, 2020. The borings were advanced to depths ranging from 63.0 to 95.0 feet below the existing ground surface. The boring locations are shown on the boring plan provided in Appendix I, and the boring logs are included with the remaining project borings in Appendix III.

3.1 Historic Borings

Historic borings performed in 1968 by the Department of Highways as part of the original FRA-70-12.31S project were obtained from the construction documents on record. Two (2) borings, designated as B-003-E-68 and B-012-E-68, were obtained near the abutments of the existing I-70 eastbound bridge structure over SR 315. The borings were extended to a depth of 75.0 and 60.0 feet, respectively, below the ground surface at the time the borings were obtained. Please note that the elevations provided on the historic boring logs are referenced to the North American Datum (NAD) 27. The current design survey is referenced to NAD 83. The NAD 27 datum is 0.6 feet lower than the NAD 83 datum. **Therefore, all elevations noted in this report with respect to the historic borings are adjusted to the current NAD 83 datum.** The historic boring locations are shown on the boring plan provided in Appendix I, and the historic boring logs are provided in Appendix IV.

4.0 FINDINGS

Interpreted engineering logs have been prepared based on the field logs, visual examination of samples and laboratory test results. Classification follows the respective version of the ODOT Specifications for Geotechnical Explorations (SGE) at the time the exploration borings were performed. The following is a summary of what was found in the test borings and what is represented on the boring logs.

4.1 Surface Materials

Borings B-014-1-19, B-014-2-19, B-014-5-19 and B-014-6-20 were drilled within the existing pavement of the I-70 eastbound lanes and encountered 4.5 to 5.5 inches of asphalt overlying 11.5 to 13.5 inches of concrete. Boring B-015-1-13 was drilled through the existing shoulder of I-70 eastbound and encountered 9.0 inches of asphalt overlying 6.0 inches of aggregate base. The remaining borings were drilled in the grass infield areas between the various roadways and interchange ramps and encountered 2.0 to 6.0 inches of topsoil at the ground surface.

4.2 Subsurface Soils

Beneath the surface materials in borings B-014-2-20, B-014-6-20, B-014-7-20, B-015-1-13, and B-108-6-13 material identified as existing fill was encountered extending to depths ranging from 11.5 to 37.0 feet below the ground surface. The fill material consisted of grayish brown to gray, medium stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a) and brown, medium dense to dense gravel and gravel with sand and silt (ODOT A-1-a, A-2-4).

Underlying the surficial materials and existing fill, where encountered, natural soils were encountered consisting of both granular and cohesive material. The granular soils were generally described as brown, gray, grayish brown, dark brown and black, loose to very dense gravel, gravel with sand, gravel with sand and silt and gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-4, A-2-6). The cohesive soils were generally described as brown, dark brown, dark gray and gray, stiff to hard sandy silt, silt and clay, silty clay and clay (ODOT A-4a, A-6a, A-6b, A-7-6).

The relative density of granular soils is primarily derived from SPT blow counts (N_{60}). Based on the SPT blow counts obtained, the granular soil encountered ranged from loose ($6 \leq N_{60} \leq 10$ blows per foot [bpf]) to very dense ($N_{60} > 50$ bpf). Overall blow counts recorded from the SPT sampling within the granular soil layers ranged from 10 bpf to split spoon sampler refusal. Split spoon sampler refusal is defined as exceeding 50 blows from the hammer with less than 6.0 inches of penetration by the split spoon sampler. The shear strength and consistency of the cohesive soils are primarily derived from the hand penetrometer values (HP). The cohesive soil encountered ranged from medium stiff ($0.5 < HP \leq 1.0$ tsf) to hard ($HP > 4.0$ tsf). The unconfined compressive strength of the cohesive soil samples tested, obtained from the hand penetrometer, ranged from 0.75 to over 4.5 tsf (limit of instrument).

Natural moisture contents of the soil samples tested ranged from 5 to 24 percent. The natural moisture content of the cohesive soil samples tested for plasticity index ranged from 8 percent below to 5 percent above their corresponding plastic limits. In general, the soil exhibited natural moisture contents considered to be significantly below to moderately above optimum moisture levels.

4.2.1 Historic Borings

The natural soils encountered in historic borings B-012-E-68 and B-003-E-68 consisted of both granular and cohesive material. The granular soils were generally described as brown and gray gravel, sandy gravel, silty sandy gravel and gravelly sandy silt (ODOT A-1-a, A-1-b, A-2-4, A-4a). The cohesive soils were generally described as brownish gray, gray gravelly sandy silt, sandy silt, silt and clay (ODOT A-4a, A-7-6). In general, the subsurface conditions encountered in the historic borings matched relatively closely with the subsurface conditions encountered in the project borings.

4.3 Bedrock

Bedrock was encountered in the project and historic borings as presented in Table 3.

Table 3. Top of Bedrock Elevations

Boring Number	Ground Surface Elevation (feet msl)	Top of Bedrock (Auger Refusal)	
		Depth (feet)	Elevation (feet msl)
B-014-1-19	736.5	N/A [1]	-
B-014-2-19	744.5	N/A [1]	-
B-014-3-19	700.9	46.0	654.9
B-014-4-19	698.8	42.0	656.7
B-014-5-19	736.1	N/A [1]	-
B-014-6-20	745.4	N/A [1]	-
B-014-7-20	715.5	56.6	658.9
B-015-1-13	746.7	N/A [1]	-
B-015-2-13	700.4	58.5	641.9
B-108-5-13	700.3	54.5	645.8
B-108-6-13	714.5	57.5	657.0
B-003-E-68	718.4	70.0	648.4
B-012-E-68	704.4	58.0	646.4

1. Bedrock was not encountered in these borings.

With the exception of borings B-014-1-19, B-015-1-13, B-014-2-19, B-014-5-19 and B-014-6-20, bedrock was encountered in the remaining borings at depths ranging from 42.0 to 70.0 feet below the ground surface, which corresponds to elevations ranging from 641.9 to 658.9 feet msl. The cored bedrock consisted of limestone in all of the borings where bedrock was encountered, which was described as brown, dark brown, gray and dark grown, slightly weathered to unweathered, slightly strong to very strong and slightly to highly fractured. Boulders and cobbles consisting of limestone, dolomite, granite and siltstone fragments was encountered in boring B-014-2-19 at a depth of 82.0 to 94.6 feet, corresponding to elevations ranging from 649.9 to 662.5 feet msl.

The percent recovery, RQD values and unconfined compressive strengths of the bedrock core runs are summarized in Table 4. The rock core runs performed within the boulder zone in boring B-019-5-19 is not included in the tabulation below.

Table 4. Rock Core Summary

Boring	Core No.	Elevation (feet msl)	Recovery (%)	RQD (%)	Unconfined Compressive Strength
B-014-3-19	NQ-1	654.9 to 649.9	93	24	N/A
	NQ-2	649.9 to 646.1	93	40	N/A
B-014-4-19	NQ-1	656.7 to 651.7	97	54	N/A
	NQ-2	651.7 to 649.1	96	89	N/A
B-015-2-13	RC-1	641.9 to 640.9	100	54	N/A
	RC-2	640.9 to 635.9	87	63	N/A
	RC-3	635.9 to 631.9	96	78	q_u @ 67.6' = 5,771 psi
B-108-5-13	RC-1	645.8 to 640.8	100	79	q_u @ 56.8' = 11,933 psi
	RC-2	640.8 to 637.3	87	79	N/A
B-108-6-13	RC-1	657.0 to 652.0	100	55	q_u @ 59.6' = 8,033 psi
	RC-2	652.0 to 647.4	90	98	N/A

It should be noted that bedrock naturally experiences mechanical breaks during the drilling and coring processes. Rii attempted to account for fresh, manmade breaks during tabulation of the RQD analysis. The quality of the cored bedrock, according to the RQD value, was very poor (0% < RQD ≤ 25%) to very good (90% < RQD ≤ 100%). Three (3) unconfined compression tests were performed on the recovered limestone in borings B-015-2-13, B108-5-13 and B-108-6-13, with resulting unconfined compressive strengths ranging from 5,771 to 11,993 psi.

4.4 Groundwater

Groundwater was encountered in the project borings as presented in Table 5.

Table 5. Groundwater Levels in Borings

Boring Number	Ground Elevation (feet msl)	Initial Groundwater		Upon Completion	
		Depth (feet)	Elevation (feet msl)	Depth (feet)	Elevation (feet msl)
B-014-1-19	736.5	Dry	-	Dry	-
B-014-2-19	744.5	62.0	682.5	N/A [1]	-
B-014-3-19	700.9	12.0	688.9	N/A [1]	-
B-014-4-19	698.8	8.0	690.8	N/A [1]	-
B-014-5-19	736.1	Dry	-	Dry	-
B-014-6-20	745.4	63.5	681.9	N/A [1]	-
B-014-7-20	715.5	25.0	690.5	N/A [1]	-
B-015-1-13	746.7	68.5	678.2	N/A [1]	-
B-015-2-13	700.4	11.0	689.4	N/A [1]	-
B-108-5-13	700.3	11.5	688.8	N/A [1]	-
B-108-6-13	714.5	38.5	676.0	N/A [1]	-

1. *The groundwater level at completion could not be obtained due to the addition of mud or water as a drilling fluid.*

Groundwater was encountered initially during drilling in all of the project structure borings at depths ranging from 8.0 to 68.5 feet below the existing ground surface, corresponding to elevations ranging from 676.0 to 690.8 feet msl. The groundwater level at the completion of drilling could not be measured in any of the borings due to the addition of mud or water to counteract heaving sands or water as a circulating fluid during the rock coring process. Borings B-014-1-19 and B-014-5-19 were observed to be dry during and at the completion of drilling. Groundwater levels were not noted in borings B-003-E-68 and B-012-E-68, which were performed during the 1968 investigation.

Please note that short-term water level readings, especially in cohesive soils, are not necessarily an accurate indication of the actual groundwater level. In addition, groundwater levels or the presence of groundwater are considered to be dependent on seasonal fluctuations in precipitation.

A more comprehensive description of what was encountered during the drilling process may be found on the boring logs in Appendix III.

5.0 ANALYSES AND RECOMMENDATIONS

Data obtained from the review of existing geotechnical information have been used to determine the foundation support capabilities and the settlement potential for the soil encountered at the site. These parameters have been used to provide guidelines for the design of foundation systems for the subject bridge, as well as the construction specifications related to the placement of foundation systems and general earthwork recommendations, which are discussed in the following paragraphs.

Based on the information provided, it is understood that the proposed project includes roadway reconstruction and widening along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-1321R bridge structure. It is understood that the existing I-70 eastbound bridge over SR 315 will be completely removed and replaced with a three-span composite steel curved plate girder structure with stub abutments and multi-column piers supported on driven pile foundations, having a total length of approximately 513 feet and width of approximately 63.5 feet. It is also understood that the proposed project includes roadway improvements along the I-70 eastbound lanes between Souder Avenue and the proposed FRA-70-1321R bridge structure.

The rear abutment of the proposed structure will be located in front of the existing rear abutment with an MSE wall (Retaining Wall W4) that crosses in front of the abutment footing and wraps around to the west on the north side of I-70 eastbound. The forward abutment of the proposed structure will be located in front of the existing forward abutment and will be situated at the top of a new spill through embankment slope. A new MSE wall (Retaining Wall W6) will also be located on the south side of the spill through embankment slope at the forward abutment, which will provide grade separation for the existing pump station that is located just south of the existing bridge structure in the infield of the I-70 eastbound to SR 315 northbound ramp.

It is further understood that Pier 2 will be designed to accommodate approximately 22.0 feet of new embankment fill, which will be placed over the proposed pier foundations as part of the future realignment and profile grade changes to SR 315 northbound.

Proposed structural data was obtained from design details provided by ms consultants, inc. and are included in Table 6.

Table 6. Structure and Bridge Design Elevations

Substructure Reference	Structure Component	Elevation [1] (feet msl)	Design Maximum Factored Load
Rear Abutment / Retaining Wall W4 (B-014-2-19, B-014-6-20, B-015-1-13 & B-003-E-68)	Profile Grade	750.2	269 kips/pile
	Bottom of Footing	736.1	
	Bottom of Wall (Top of Leveling Pad)	725.0	
Pier 1 (B-014-3-19 & B-015-2-13)	Bottom of Footing	693.8	338 kips/pile
Pier 2 (B-014-4-19)	Bottom of Footing	693.4	300 kips/pile / 355 kips/pile [2]
Forward Abutment / Retaining Wall W6 (B-014-7-20, B-108-5-13, B-108-6-13 & B-012-E-68)	Bottom of Footing	731.7	303 kips/pile

1. *Proposed bottom of footing elevations and structural loading based on structure information provided by ms consultants, inc.*
2. *The first value represents the factored load for the proposed structure following the construction of this bridge structure. The second value represents the factored load considering 22 feet of embankment surcharge over the pier footings following construction of the future realignment and profile grade change to SR 315 northbound.*

5.1 Driven Pile Recommendations

It is recommended that driven piles be utilized for foundation support at all of the substructure units for this structure. Given the depth of bedrock encountered and the anticipated structural loading on the piles, it is recommended that steel H-piles (ODOT Item 507.06) driven to refusal on bedrock be employed for foundation support. Per Section 305.3.4 of the 2020 ODOT Bridge Design Manual (BDM), refusal is met during driving when the pile penetration is an inch or less after receiving at least 20 blows from the pile hammer. Table 7 shows the recommended pile lengths and the corresponding factored structural axial resistance ($R_{R\ max}$) of H-piles.

Table 7. Driven Pile Recommendations

Substructure Reference	Ground Elevation [1] (feet msl)	Pile Size	Pile Elevation		Pile Length [3] (feet)	$R_{R\ max}$ [4] (kips/pile)	Sleeve / Prebore Length [5,6] (feet)	φ [7]
			Top [2]	Tip				
Rear Abutment (B-015-1-13)	746.7	HP 10x42 [8]	737.1	648.4	90	310	11.1	N/A
		HP 12x53 [8]	737.1	648.4	90	380	11.1	N/A
Pier 1 (B-014-3-19)	700.9	HP 12x53 [8]	694.8	654.9	40	380	N/A	N/A
Pier 2 (B-014-4-19)	698.8	HP 12x53 [8]	694.4	658.3	40	456 [9]	N/A	N/A
		HP 14x73 [8]	694.4	658.3	40	636 [9]	N/A	N/A
Forward Abutment (B-014-7-20)	715.5	HP 10x42 [8]	732.7	658.9	75	372 [9]	17.0	N/A
		HP 12x53 [8]	732.7	658.9	75	456 [9]	17.0	N/A

1. *Ground elevation listed is the ground elevation at the respective boring location.*
2. *The top of pile elevation corresponds to the pile cutoff elevation, which is considered to be 1.0-foot above the proposed bottom of footing elevation per Section 305.3.5.1 of the 2020 ODOT BDM.*
3. *Per Section 305.3.5.2 of the 2020 ODOT BDM, the estimated pile length was determined as the pile cutoff elevation (top) minus the pile tip elevation, rounded up to the nearest 5.0 feet.*
4. *The factored structural axial resistance for H-piles is based on the structural limit state of the steel H-pile section per Section 305.3.3 of the 2020 ODOT BDM.*
5. *Sleeve length at the rear abutment represents the required length of pile that should be sleeved within the MSE wall backfill.*
6. *Per Section 305.3.5.7 of the 2020 ODOT BDM, all piles at the forward abutment should be prebored to the bottom of the new embankment elevation at each pile location in accordance with ODOT Item 507.11.*
7. *For H-piles driven to refusal on bedrock, no geotechnical resistance factor should be applied (N/A) to the factored structural axial resistance values presented, as the values presented account for the structural resistance factor, φ_c = 0.50, for H-piles subject to damage due to severe driving conditions. For piles subjected to downdrag loads, a structural resistance factor of φ_c = 0.60 was considered in the calculation of the factored structural resistance of the piles.*
8. *A steel pile point is recommended to protect the tips of the piles during pile installation.*
9. *The total factored load should consider the factored structural load plus the factored downdrag load per pile in accordance with Section 305.3.2.2. Downdrag loads and considerations at the abutments are presented in Section 5.1.2.*

Based on the plan information provided, approximately 30.0 feet of new embankment fill will be placed at the forward abutment to achieve the proposed roadway profile grade, which will result in approximately 17.0 feet of new fill below the bottom of footing. Therefore, per Section 305.3.5.7 of the 2020 ODOT BDM, all piles at the forward abutment should be prebored to the bottom of the new embankment elevation at each pile location in accordance with ODOT Item 507.11.

Per Section 305.3.3 of the 2020 ODOT BDM, the factored resistance of H-piles driven to refusal on bedrock is typically governed by the structural resistance of the pile element. The factored structural axial resistances listed in Table 7 consider an axially loaded pile with negligible moment, no appreciable loss of section due to deterioration

throughout the life of the structure, a steel yield strength of 50 ksi, a structural resistance factor for H-piles subject to damage due to severe driving conditions (LRFD 6.5.4.2: φ_c = 0.50) and a pile fully braced along its length. For piles subjected to downdrag loads, a structural resistance factor of φ_c = 0.60 was considered in the calculation of the factored structural resistance of the piles. **The factored structural axial resistance should not be used for piles that are subjected to bending moments or are not supported by soil for their entire length.** It is anticipated that the H-piles will be able to be driven a short distance into the surficial bedrock (approximately 3 to 6 inches) before satisfying the driving conditions that meet the refusal criterion. Settlement is estimated to be less than 0.5 inches for H-piles driven to refusal on bedrock.

The total factored load should consider the factored structural load plus the factored downdrag load per pile in accordance with Section 305.3.2.2. Downdrag loads and considerations at the abutments are presented in Section 5.1.2.

Static or dynamic pile load testing is not required for H-piles driven to refusal on bedrock. Further installation considerations are presented in Section 5.1.3.

5.1.1 Driveability

A drivability analysis was performed in accordance with Section 10.7.8 of the 2018 AASHTO LRFD Bridge Design Specifications (BDS) using the GRLWEAP software program, and the results are provided in Appendix VIII. In the driveability analysis, a Delmag 19-42 hammer with a rated energy of approximately 43,000 ft-lbs was used in conjunction with the H-pile sections.

In accordance with the comments provided by ODOT Office of Geotechnical Engineering (OGE) on the initial draft report, for the rear abutment, driveability analysis was performed in order to account for sleeved portion of the pile length by analyzing two (2) cases: Case 1 considers zero friction within the sleeved length (such as Yellow Jacket ® option); and, Case-2 considers a sleeved length consisting of PVC filled with sand with a friction angle of 28 degrees. Additionally, for the forward abutment, while the piles will be prebored through the proposed embankment, it is understood that the driveability should consider the frictional resistance through the proposed embankment with the appropriate driving strength losses (assuming embankment fill consisting of ODOT A-6a material). For the driveability analysis, the static capacity was determined using the DrivenPiles software program manufactured by Multidimensional Software Creations. An input file for the GRLWEAP driveability analysis was generated from the DrivenPiles program. The DrivenPiles analysis outputs are provided in Appendix VII.

Based on the results of this analysis, driving stresses induced on the H-piles **would not exceed** 90 percent of the yield stress of the steel (f_y = 50 ksi, 0.9f_y = 45 ksi) if driven through the overburden soils to the bedrock depths provided in Table 7. Care should be taken during pile driving operations when approaching the bedrock elevations noted

above, and when extending the piles into the surficial bedrock material, to ensure that the driving stresses induced on the pile elements do not exceed the maximum allowable value of 90 percent of the yield stress of the steel, subsequently damaging the pile elements. Pile driving should be terminated upon achieving the required 20 blows from the pile hammer with an inch or less of penetration to reduce the possibility of damaging the pile element. Per Section 202.2.3.2.a of the 2019 ODOT BDM, steel pile points should be used when the piles are driven to bear on strong bedrock (limestone or dolomite).

5.1.2 Downdrag Considerations

5.1.2.1 Rear Abutment (Retaining Wall W4)

The anticipated total settlement along the facing of Retaining Wall W4 at the rear abutment is approximately 1.83 inches. Given the anticipated amount of settlement following construction of the embankment, downdrag loads may be induced on the pile elements if installed to the final tip elevation prior to placement of the embankment fill. To reduce the amount of downdrag induced on the piles, it is recommended that the piles be pre-driven into the soil only as far as necessary to remain vertical and that the retaining wall should be constructed around the piles and then allowed to sit for a specified holding period such that a percentage of the consolidation can occur prior to driving the piles the to the design tip elevation and reduce the amount of downdrag on the piles.

In order to consolidate the underlying soil to the required settlement, consideration should be given to the placement of a surcharge load in order to preload the site under the full weight of the retaining wall heights (from the bottom of wall elevation to the profile grade). The surcharge should remain in place until approximately 90 percent of consolidation of the subsurface soils has occurred to prevent downdrag loads from developing along the pile elements. Results of the settlement analysis indicate that approximately 90 percent of the primary consolidation of the cohesive layers at the rear abutment will be complete within 33 days following the placement of the surcharge load. Therefore, if the above noted waiting period is specified following completion of construction of the retaining wall at the rear abutment, downdrag forces along the piles will be eliminated.

Settlement platforms should be installed once the embankment surcharge has been placed to monitor the settlement of the embankment over time. A shorter or longer hold period than specified may be required based on the settlement platform readings as directed by the geotechnical engineer. The required hold period may be considered complete when survey monitoring of the settlement platforms indicate that the above noted settlement has occurred for the hold period or until the survey shows less than ⅛-inch of total movement per week over a two week period **following placement of the final lifts of surcharge loading.**

5.1.2.2 Forward Abutment (Spill Through Slope)

As previously noted, approximately 29.5 feet of new embankment will be placed at the forward abutment to achieve the proposed profile grade. A settlement analysis was performed to determine the amount settlement that is anticipated due to the placement of the new embankment fill and to evaluate the potential for downdrag loads on the piles at the forward abutment (see Section 5.3 for additional details regarding the settlement analysis). Results of the settlement analysis indicate that total settlements up to 5.62 inches should be expected due to the weight of the new embankment fill at the forward abutment. Additionally, results of the settlement analysis indicate that approximately 90 percent of the primary consolidation of the cohesive layers will be complete within 150 days following the placement of the embankment. Since this is not a practical time period to accommodate during construction, it is recommended that a shorter wait period be specified and that the piles be designed to accommodate the downdrag loading.

Since the piles are driven to point bear on bedrock, downdrag at the forward abutment was calculated using the traditional method to determine the depth of downdrag. Per the traditional method for calculating the depth of downdrag, downdrag loads will develop along the portion of the pile above the interface where the relative soil movement from consolidation with respect to the pile is greater 0.40 inches. The magnitude of the downdrag load induced on the piles is a function of the degree of consolidation that will occur at the end of the specified hold period. The degree of consolidation represents the amount of primary consolidation that has occurred during the hold period, expressed as a percentage of the total settlement that is anticipated, and is calculated using the following equations:

$$U = \sqrt{\frac{4T_v}{\pi}} \times 100\% \text{ for } T_v \leq 0.217;$$

$$U = \left[1 + 10^{-\left(\frac{0.085+T_v}{0.933}\right)}\right] \times 100\% \text{ for } T_v > 0.217;$$

$$T_v = \frac{c_v t}{H_{dr}^{\ 2}}$$

Where:

U = the degree of consolidation
T_v = time factor
c_v = coefficient of consolidation
t = hold period
H_{dr} = length of longest drainage path (half the thickness of the compressible stratum)

For time rate of consolidation calculations, the coefficient of consolidation (C_v) shown in Table 13 of Section 5.3.1 was considered for the cohesive soil layers and the granular soils were considered fully consolidated at the completion of construction of the embankment. Based on the results of the settlement analysis, the depth of downdrag at the forward abutment following a 30 day hold period will be 17.0 feet.

The downdrag force induced on the piles was calculated using static analysis and is equal to the magnitude of the side resistance over the length of the pile within the downdrag zone. Using the calculated depth of downdrag and considering an HP 10x42 and HP 12x53 pile sizes, the unfactored downdrag load at forward abutment is 69 and 83 kips/pile, respectively. A load factor of 1.05 should be applied to the unfactored downdrag load when determining the factored downdrag load per pile at the strength limit state and should be added to the factored load per pile from the superstructure. The downdrag loads were calculated using the DrivenPiles software program, and the results are provided in Appendix VII.

Settlement platforms should be installed once the embankment has been constructed to monitor the settlement of the embankment over time. A shorter or longer hold period than specified may be required based on the settlement platform readings as directed by the geotechnical engineer. The required hold period may be considered complete when survey monitoring of the settlement platforms indicate that the above noted settlement has occurred for the hold period.

5.1.2.3 Pier 2 (Future SR 315 Embankment)

As previously noted, it is understood that Pier 2 will be designed to accommodate approximately 22.0 feet of new embankment fill, which will be placed over the proposed pier foundations as part of the future realignment and profile grade changes to SR 315 northbound. The bottom of footing elevation at Pier 2 is approximately 5.5 feet below the existing ground surface grade.

Downdrag was evaluated using the traditional method to determine the depth of downdrag, as outlined in Section 5.1.2.2. The total anticipated settlement below the existing ground surface grade at Piers 2 is 2.05 inches, with an anticipated settlement below the bottom of footing elevation 1.26 inches. Based on the results of the settlement analysis, downdrag loads will develop along the piles supporting Pier 2 following placement of the future embankment fill. Using the traditional method criterion, the depth of downdrag for 100 percent of primary consolidation is 18.0 feet below the bottom of footing elevation.

Using the calculated depth of downdrag and considering an HP 12x53 and HP 14x73 pile size, the unfactored downdrag load at forward abutment is 74 and 104 kips/pile, respectively. A load factor of 1.05 should be applied to the unfactored downdrag load when determining the factored downdrag load per pile at the strength limit state and should be added to the factored load per pile from the superstructure. The downdrag

load was calculated using the DrivenPiles software program, and the results are provided in Appendix VII.

5.1.3 Driven Pile Considerations

Proper pile installation is as important as pile design in order to obtain a cost effective and safe product. Driven piles must be installed to develop adequate soil resistance without structural damage. Because piles cannot be visually inspected after installation, direct quality control of the finished product is impossible. Consequently, substantial control must be exercised over peripheral operations leading to the pile placement within the foundation. It is essential that installation be considered during the design stage to insure that piles shown on the plans can be installed. Construction monitoring should be employed in (1) pile materials, (2) installation equipment, and (3) the estimation of the static load capacity.

It is recommended that the contractor submit a wave equation analysis (bearing graph) of his driving equipment, or the necessary pile driving and equipment data to perform the wave equation analysis, for hammer approval. A constant capacity wave equation analysis (inspector's chart) should also be performed to assist field personnel during inspection in accordance with the 2020 ODOT BDM.

Based on the plan information provided, it is understood that the forward abutment of the existing structure carrying I-70 eastbound over SR 315 will be abandoned in place and removed to 1.0-foot below finished grade. This would also include the existing piles, which consist of three rows of battered piles at the front of the footing. Based on the geometry of the piles shown on the site plan, there is concern that the existing battered piles may interfere with the installation of the back row, or potentially both rows, of piles for the proposed forward abutment substructure. Careful survey of the existing and proposed piles should be performed prior to installation to minimize the risk of interfering with the existing piling during pile driving operations. If a pile does strike an existing pile during installation, a contingency plan shall be available to either withdraw the pile or abandon it and install a new pile at an offset location.

5.1.4 Lateral Design

If lateral loads or moments are expected to be applied on the foundation elements, they should be analyzed to verify the pile has enough lateral and bending resistance against these loads. A boring-by-boring tabulation of parameters that should be used for lateral loading design is provided in Appendix XI. In order to evaluate the lateral capacity, it is recommended that a derivation of COM624, such as LPILE, be utilized to determine the proper embedment depth required to resist the lateral load for a given end condition and deflection. Table 8 lists the eleven different soil types internal to the LPILE program. These strata were utilized to define the soil strata in the soil profile for each boring provided in Appendix XI.

Table 8. Subsurface Strata Description

Strata	Description
1	Soft Clay
2	Stiff Clay with Water
3	Stiff Clay without Free Water
4	Sand (Reese)
5	User Defined
6	Vuggy Limestone (Strong Rock)
7	Silt (with cohesion and internal friction angle)
8	API Sand
9	Weak Rock
10	Liquefiable Sand (Rollins)
11	Stiff Clay without free water with a specified initial K (Brown)

5.2 MSE Wall Recommendations

It is proposed to construct MSE walls at the rear abutment (Retaining Wall W4) and south of the forward abutment (Retaining Wall W5) of the proposed bridge structure. MSE walls are constructed on earthen foundations at a minimum depth of 3.0 feet below grade, as defined by the top of the leveling pad to the ground surface located 4.0 feet from the face of the wall. Per Section 840.04.A of ODOT Supplemental Specification 840 (SS 840), the height of the MSE wall at the bridge abutment is defined as the elevation difference between the profile grade at the face of the wall and the top of the leveling pad, and where the wall does not cross in front of the abutment, the height of the wall is defined as the elevation difference between the top of coping and the top of the leveling pad. However, at the abutment, it is noted that the reinforced soil mass only extends from the foundation bearing elevation (top of leveling pad) to the bottom of footing elevation. Additionally, per Section 201.4.1.C.7 of the 2020 ODOT BDM, a minimum of one row of soil reinforcement straps should be attached to the backside of the abutment footing to resist horizontal forces from the bridge structure and lateral pressures along the back wall of the abutment footing, and prevent any load transfer from these forces to the coping and facing panels. The width of the MSE wall foundation (B) is defined by the length of the reinforced soil mass. Per the 307.4.A of the 2020 ODOT BDM and Section 840.04.A.2 of ODOT SS 840, the minimum length of the reinforced soil mass is equal to 70 percent of the height of the MSE wall or 8.0 feet whichever is greater. A non-structural bearing leveling pad consisting of a minimum of 6.0-inches of unreinforced concrete should be placed at the base of the wall facing for constructability purposes. Please note that the leveling pad is not a structural foundation.

Based upon the proposed plan information, the wall height at the rear abutment (Wall W4) is 25.2 feet from the top of the leveling pad to the proposed profile grade of the roadway. The wall height on the south side of the spill through embankment slope at the forward abutment (Wall W6) is 21.4 feet from the top of the leveling pad to the top of coping elevation, with a 2:1 graded backslope that extends up from a paved gutter to the abutment footing and roadway. For the analysis, the foundation width was set at 70 percent of the maximum wall height and the foundation width was increased, if required, until external and global stability requirements were satisfied.

Per Section 840.06.D of ODOT SS 840, the foundation subgrade should be inspected to verify that the subsurface conditions are the same as those anticipated in this report. The anticipated soils at the proposed bearing elevation along Wall W4 at the rear abutment will consist of stiff to very stiff silt and clay and sandy silt (ODOT A-6a, A-4a). The anticipated soils at the proposed bearing elevation along Wall W6 on the south side of the forward abutment will consist of very stiff silt and clay (ODOT A-6a) or loose to medium dense gravel, gravel with sand or gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-6). These soils in their current condition are suitable for foundation support of the proposed MSE wall structures.

Per 307.4.C of the 2020 AASHTO LRFD BDS and Section 840.06.D of ODOT SS 840, following foundation subgrade inspection and acceptance, a minimum of 12.0 inches of ODOT Item 703.16.C, Granular Material Type C, should be placed and compacted in accordance with ODOT Item 204.07.

5.2.1 Strength Parameters Utilized in External and Global Stability Analyses

The shear strength parameters utilized in the external and global stability analyses for the MSE walls at the abutments are provided in Table 9.

Table 9. Shear Strength Parameters Utilized in MSE Wall Stability Analyses

Material Type	γ (pcf)	φ' (1) (°)	c' (2) (psf)	S_u (3) (psf)
MSE Wall Backfill (Select granular fill)	120	34	0	N/A
Item 203 Embankment Fill (Retained soil)	120	30	0 to 100	2,000
Existing Embankment Fill: Stiff to Very Stiff Sandy Silt, Silt and Clay and Silty Clay (ODOT A-4a, A-6a, A-6b)	115 to 125	26 to 29	0 to 35	1,500 to 4,000
Stiff to Hard Sandy Silt (ODOT A-4a)	115 to 130	28 to 29	0	1,875 to 3,625
Medium Dense to Dense Granular Soil (ODOT A-1-a, A-1-b, A-2-4, A-3a)	130 to 135	36 to 42	0	N/A

1. *Per Figure 7-45, Section 7.6.9 of FHWA GEC 5 for cohesive soils and Table 10.4.6.2.4-1 of the 2020 AASHTO LRFS BDS for granular soils.*
2. *Estimated based on overconsolidated nature of soil.*
3. *$S_u = 125(N_{60})$, Terzaghi and Peck (1967).*

Shear strength parameters for the reinforced soil backfill and retained embankment are provided in Table 307-1 of the 2020 ODOT BDM and Section 840.04.A.3 of ODOT SS 840. Per these specifications, the select granular backfill in the reinforced zone and the retained embankment must meet the shear strength requirements provided in Table 9. The shear strength parameters for the natural soils were assigned using correlations provided in FHWA Geotechnical Engineering Circular (GEC) No. 5 (FHWA-NHI-16-072) Evaluation of Soil and Rock Properties, the 2020 AASHTO LRFD BDS and based on past experience in the vicinity of the site with projects performed in similar subsurface profiles.

5.2.2 Bearing Stability

The bearing soils along the alignment of Wall W4 at the rear abutment are anticipated to consist of stiff to very stiff silt and clay and sandy silt (ODOT A-6a, A-4a), and the anticipated soils along the alignment of Wall W6 south of the rear abutment are anticipated to consist of very stiff silt and clay (ODOT A-6a) or loose to medium dense gravel, gravel with sand or gravel with sand, silt and clay (ODOT A-1-a, A-1-b, A-2-6). MSE wall foundations bearing on these soils or engineered fill, placed and compacted in accordance with ODOT Item 203, may be proportioned for a factored bearing resistance as indicated in Table 10. A geotechnical resistance factor of φ_b=0.65 was considered in calculating the factored bearing resistance at the strength limit state. Given that the bearing soils consist cohesive material, the bearing resistance was evaluated under both drained and undrained conditions. The reinforcement lengths presented in the following table represent the minimum foundation widths required to satisfy external and global stability requirements, expressed as a percentage of the wall height.

Table 10. FRA-70-1301R (Retaining Wall W4 and W6) MSE Wall Design Parameters

Substructure Unit (Boring)	Wall Height Analyzed (feet)	Back-slope Behind Wall	Minimum Required Reinforcement Length [1] (feet)	Bearing Resistance at Strength Limit (ksf)		Strength Limit Equivalent Bearing Pressure [3] (ksf)
				Nominal	Factored [2]	
Rear Abutment / Retaining Wall W4 (B-015-1-13)	25.2	Level	22.7 (0.90H)	17.51	5.69 [(4)]	5.37
Forward Abutment / Retaining Wall W6 (B-108-5-13, B-012-E-68)	21.4	2:1 (Broken-Back)	19.3 (0.90H)	10.76	6.99	6.23

1. *The minimum reinforcement length is based on the maximum wall height analyzed. The value in parentheses represent the required reinforcement length expressed as a percentage of the wall height, H.*
2. *A geotechnical resistance factor of φ_b=0.65 was considered in calculating the factored bearing resistance at the strength limit state.*
3. *The strength limit equivalent bearing pressure is the uniformly distributed pressure asserted by the wall over an effective base width based on the eccentricity of the wall system at the strength limit state.*
4. *The factored bearing resistance includes a reduction factor applied to the nominal resistance to account for the fore slope in front of the wall per Section 10.6.3.1.2c of the 2020 AASHTO LRFD BDM.*

Rii performed a verification of the bearing pressure exerted on the subgrade material for the specified wall heights indicated in Table 10. Based on the minimum length of reinforced soil mass presented, the factored equivalent bearing pressure exerted below the wall **will not exceed** the factored bearing resistance at the strength limit state, considering the wall will bear on the existing fill material at the rear abutment.

5.2.3 Settlement Evaluation

The compressibility parameters utilized in the settlement analyses of the proposed MSE walls are provided in Table 11.

Table 11. Compressibility Parameters Utilized in Settlement Analysis

Material Type	γ (pcf)	LL (%)	C_c (1)	C_r (2)	e_o (3)	C_v (4) (ft^2/yr)	N_{60}	C' (5)
Upper Cohesive Soils: Stiff to Very Stiff Sandy Silt, Silt and Clay and Silty Clay (ODOT A-4a, A-6a, A-6b)	120	26 to 37	0.080 to 0.137 (6)	0.016 to 0.023 (6)	0.355 to 0.698 (6)	175 to 400 (6)	N/A	N/A
Lower Cohesive Soils: Stiff to Hard Sandy Silt (ODOT A-4a)	115 to 125	21	0.099	0.015	0.436	400	N/A	N/A
Medium Dense to Very Dense Granular Soils (ODOT A-1-a, A-1-b, A-2-6)	125 to 135	N/A	N/A	N/A	N/A	N/A	18 to 69	70 to 357

1. *Per Table 6-9, Section 6.14.1 of FHWA GEC 5.*
2. *Estimated at 10% of C_c per Section 8.11 of Holtz and Kovacs (1981).*
3. *Per Table 8-2 of Holtz and Kovacs (1981).*
4. *Per Figure 6-37, Section 6.14.2 of FHWA GEC 5.*
5. *Per Figure 10.6.2.4.2-1 of 2018 AASHTO LRFD BDS.*
6. *Values determined from consolidation test results on representative samples.*

Results of the settlement analysis are tabulated in Table 12. Total settlements of up to 2.94 inches at the center of the reinforced soil mass and 1.83 inches at the facing of the wall are anticipated along Wall W4 at the rear abutment. Total settlements ranging from 0.63 to 3.52 inches at the center of the reinforced soil mass and 0.47 to 2.13 inches at the facing of the wall are anticipated along Wall W6 on the south side of the forward abutment. Based on the results of the analysis, 90 percent of the total settlement is anticipated to occur over a period of approximately 31 to 51 days. For Wall W4 at the rear abutment, it is estimated that less than 0.40 inches of settlement will be remaining following a period of 21 days. Please note that the consolidation settlement and time rate of consolidation are based on estimates using correlated compressibility parameters provided in Table 11 for the underlying soils. Actual settlement and time rate of consolidation should be determined by monitoring the settlement of the wall using settlement platforms.

Table 12. MSE Wall Settlement Values

Substructure Unit (Boring)	Service Limit Equivalent Bearing Pressure [1] (ksf)	Total Settlement Values (inches)		Time Rate of Consolidation (Days)	
		Center of Wall Mass	Facing of Wall	90% Consolidation	0.40 inches Remaining
Rear Abutment / Retaining Wall W4 (B-015-1-13)	3.81	2.94	1.83	51	21
Forward Abutment / Retaining Wall W6 (B-108-5-13, B-012-E-68)	0.68 to 4.33	0.63 to 3.52	0.47 to 2.12	31 to 33	N/A

1. *The service limit equivalent bearing pressure is the uniformly distributed pressure asserted by the wall over an effective base width based on the eccentricity of the wall system at the service limit state.*

Per Section 307.1.6 of the 2020 ODOT BDM, the maximum allowable differential settlement in the longitudinal direction (regardless of the size of panels) is one (1) percent (1/100). Based on the results of the settlement analysis, differential settlement greater than 1/100 may occur along the wall facing based on the short distance that the wall is brought down to existing grade. If either the total or differential settlement values predicted present an issue with respect to the deformation tolerances that the wall can withstand, then measures should be taken to minimize the amount of settlement that will occur. This can be achieved by preloading the site and consolidating the underlying soils prior to constructing the walls. If preloading the site is not a desired option, then consideration could be given to ground improvement through the use of stone columns.

5.2.4 Eccentricity (Overturning Stability)

The resistance of the MSE walls to overturning will be dependent on the on the location of the resultant force at the bottom of the wall due to the overturning and resisting moments acting on the wall. For MSE walls, overturning stability is determined by calculating the eccentricity of the resultant force from the midpoint of the base of the wall and comparing this value to a limiting eccentricity value. Per Section 11.10.5.5 of the 2020 AASHTO LRFD BDS, for foundations bearing on soil, the location of the resultant of the reaction forces shall be within the middle two-thirds ($^2/_3$) of the base width. Therefore, the limiting eccentricity is one-third ($^1/_3$) of the base width of the wall. Rii performed a verification of the eccentricity of the resultant force for the specified wall height indicated in Table 10. Based on the minimum length of reinforced soil mass presented in Table 10 and utilizing the soil parameters listed in Section 5.2.1 for the retained embankment material, the calculated eccentricity of the resultant force **<u>will not exceed</u>** the limiting eccentricity at the strength limit state.

5.2.5 Sliding Stability

The resistance of the MSE walls to sliding was evaluated per Section 11.10.5.3 of the 2020 AASHTO LRFD BDS. Given that the bearing soils along both of the walls consist of cohesive material, the sliding resistance was evaluated under both drained and undrained conditions. For drained conditions, the sliding resistance is determined by multiplying a coefficient of sliding friction "f" times the total vertical force at the base of the wall. The coefficient of sliding friction is determined based on the limiting friction angle between the foundation soil and the reinforced soil backfill. Based on the soil parameters listed in Section 5.2.1 for the foundation soil and the reinforced soil backfill, a coefficient of sliding friction of 0.53 was utilized for design. For undrained conditions, the sliding resistance is taken as the limiting value between the undrained shear strength of the bearing soil and half of the vertical stress applied by the wall multiplied by the width of the MSE wall. Based on the soil parameters listed in Section 5.2.1, the undrained shear strength of the bearing material ranges from 2.00 to 3.13 ksf.

A geotechnical resistance factor of φ_τ=1.0 was considered in calculating the factored shear resistance between the reinforced soil mass and foundation for sliding. Based on the minimum length of reinforced soil mass presented in Table 10 and utilizing the soil parameters listed in Section 5.2.1 for the retained embankment material, the resultant horizontal forces on the back of the MSE walls **will not exceed** the factored shear resistance at the strength limit state under drained conditions for either wall.

5.2.6 Overall (Global) Stability

A slope stability analysis was performed to check the global stability of walls at the rear and forward abutments. As per Section 11.6.2.3 of the 2020 AASHTO LRFD BDS, safety against soil failure shall be evaluated at the service limit state by assuming the reinforced soil mass to be a rigid body. Soil parameters utilized in external stability analyses are presented in Section 5.2.1. For the global stability condition, it was considered that the failure plane will not cross through the reinforced soil masses. The computer software program Slide 2, manufactured by Rocscience Inc., was utilized to perform the analyses.

Per Section 307.1.2 of the 2020 ODOT BDM and Section 11.6.2.3 of the 2020 AASHTO LRFD BDS, overall (global) stability for MSE walls that are integrated with or supporting structural foundations or elements is satisfied if the product of the factor of safety from the slope stability output multiplied by the resistance factor φ=0.65 is greater than 1.0. Therefore, global stability is satisfied when a minimum factor of safety of 1.5 is obtained. For an MSE wall designed with the minimum strap length listed in Table 10, the resulting factor of safety under drained conditions (long-term stability) at the rear abutment (Wall 1) using the Spencer's analysis method was greater than 1.5.

5.2.7 Final MSE Wall Considerations

Based on the results of the external and global stability analysis performed for Wall W4 (rear abutment) and Wall W6 (south side of the forward abutment), the recommended controlling strap length is 0.9 times the maximum height of the MSE wall for both walls. Sliding resistance under drained and undrained conditions and bearing resistance under undrained conditions were the controlling factors in the determination of the recommended strap lengths.

Calculations for external (bearing and sliding resistance and limiting eccentricity), overall (global) stability and settlement of the MSE walls are provided in Appendix IX.

5.3 Embankment Settlement Evaluation (Pier 2 and Forward Abutment)

5.3.1 Compressibility Parameters

The compressibility parameters utilized in the settlement analyses of the future embankment fill at that will be placed at Pier 2 and the proposed spill through embankment at the forward abutment are provided in Table 13.

Table 13. Compressibility Parameters Utilized in Settlement Analysis

Material Type	γ (pcf)	LL (%)	C_c (1)	C_r (2)	e_o (3)	C_v (4) (ft^2/yr)	N_{60}	C' (5)
Upper Cohesive Soils: Very Stiff to Hard Silt and Clay and Clay (ODOT A-6a, A-7-6)	120 to 130	32 to 42	0.109 to 0.234 (6)	0.023 to 0.029 (6)	0.563 to 0.987 (6)	200 to 300 (6)	N/A	N/A
Lower Cohesive Soils: Hard Sandy Silt (ODOT A-4a)	125 to 135	19 to 20	0.081 to 0.090	0.012 to 0.014	0.420 to 0.436	400	N/A	N/A
Medium Dense to Very Dense Granular Soils (ODOT A-1-a, A-1-b)	125 to 140	N/A	N/A	N/A	N/A	N/A	15 to 100	66 to 355

1. *Per Table 6-9, Section 6.14.1 of FHWA GEC 5.*
2. *Estimated at 15% of C_c per Section 8.11 of Holtz and Kovacs (1981).*
3. *Per Table 8-2 of Holtz and Kovacs (1981).*
4. *Per Figure 6-37, Section 6.14.2 of FHWA GEC 5.*
5. *Per Figure 10.6.2.4.2-1 of 2018 AASHTO LRFD BDS.*
6. *Values determined from consolidation test results on representative samples.*

5.3.2 Settlement Analysis

The soil profile at pier 2 consists of a thin layer of stiff to very stiff silt and clay (ODOT A-6a) overlying granular soils comprised of medium dense to very dense gravel and gravel with sand (ODOT A-1-a, A-1-b) with isolated seams of hard sandy silt (ODOT A-4a) based on the conditions encountered in boring B-014-4-19. The soil profile at the forward abutment consists of hard silt and clay and clay (ODOT A-6a, A-7-6) overlying granular soils comprised of dense to very dense gravel and gravel with sand (ODOT A-1-a, A-1-b) with isolated seams of hard sandy silt (ODOT A-4a) based on the conditions encountered in boring B-014-7-20.

A settlement analysis was performed at each location to predict the long term consolidation settlement that will result after the embankment fill has been placed. Based on the plan and profile information provided, fill heights up to 22.0 feet for the future SR 315 embankment at Pier 2 and 29.5 feet for the forward abutment spill through embankment are anticipated. Results of the settlement analysis for each location are presented in Table 14.

Table 14. Anticipated Settlement

Substructure Unit	Boring Number	Anticipated Embankment Height (feet)	Total Settlement (in)
Pier 2	B-014-4-19	22.0	2.05
Forward Abutment	B-014-7-20	29.5	5.62

Results of the settlement analysis indicate that a total settlement of 2.05 inches should be expected due to the weight of the new embankment fill at Pier 2. Since the fill will be placed at a future date following construction of the bridge structure, time rate of settlement is not pertinent for this structure. The total settlement anticipated below the bottom of footing elevation at this substructure is anticipated to be 1.26 inches following the placement of the fill.

Results of the settlement analysis indicate that a total settlement of 5.62 inches should be expected due to the weight of the new embankment fill at the forward abutment. Based on the results of the analysis, 90 percent of the total settlement is anticipated to occur over a period of approximately 150 days, which results in a remaining settlement of 0.57 inches following this time period. Following a period of 30 days from the placement of the fill, the remaining settlement is estimated to be 2.57 inches, which is 53 percent of the total anticipated settlement. Please note that the consolidation settlement and time rate of consolidation are based on estimates using correlated compressibility parameters provided in Table 13 for the underlying soils. Actual settlement and time rate of consolidation should be determined by monitoring the settlement of the wall using settlement platforms. Results of the settlement analysis are provided in Appendix X.

5.4 Lateral Earth Pressure

For the soil types encountered in the borings, the "in-situ" unit weight (γ), cohesion (c), effective angle of friction (φ'), and lateral earth pressure coefficients for at-rest conditions (k_o), active conditions (k_a), and passive conditions (k_p) have been estimated and are provided in Table 15 and Table 16.

Table 15. Estimated Undrained (Short-term) Soil Parameters for Design

Soil Type	γ (pcf) [1]	c (psf)	φ	k_a	k_o	k_p
Soft to Stiff Cohesive Soil	115	1,000	0°	N/A	N/A	N/A
Very Stiff to Hard Cohesive Soil	125	3,000	0°	N/A	N/A	N/A
Loose Granular Soil	120	0	28°	0.32	0.53	5.07
Medium Dense to Dense Granular Soil	130	0	32°	0.27	0.47	6.82
Very Dense Granular Soil	135	0	35°	0.24	0.43	8.56
Compacted Cohesive Engineered Fill	120	2,000	0°	N/A	N/A	N/A
Compacted Granular Engineered Fill	130	0	33°	0.26	0.46	7.41

1. *When below groundwater table, use effective unit weight, $\gamma' = \gamma - 62.4$ pcf and add hydrostatic water pressure.*

Table 16. Estimated Drained (Long-term) Soil Parameters for Design

Soil Type	γ (pcf) [1]	c (psf)	φ'	k_a	k_o	k_p
Soft to Stiff Cohesive Soil	115	0	24°	0.37	0.59	3.97
Very Stiff to Hard Cohesive Soil	125	100	28°	0.32	0.53	5.07
Loose Granular Soil	120	0	28°	0.32	0.53	5.07
Medium Dense to Dense Granular Soil	130	0	32°	0.27	0.47	6.82
Very Dense Granular Soil	135	0	35°	0.24	0.43	8.56
Compacted Cohesive Engineered Fill	120	0	28°	0.32	0.53	5.07
Compacted Granular Engineered Fill	130	0	33°	0.26	0.46	7.41

1. *When below groundwater table, use effective unit weight, $\gamma' = \gamma - 62.4$ pcf and add hydrostatic water pressure.*

These parameters are considered appropriate for the design of all subsurface structures and any excavation support systems. Subsurface structures (where the top of the structure is restrained from movement) should be designed based on at-rest conditions (k_o). For proposed temporary retaining structures (where the top of the structure is allowed to move), earth pressure distributions should be based on active (k_a) and passive (k_p) conditions. Active earth pressure is developed as the structure moves away from the backfill or retained soil, while passive pressure is developed as the structure moves towards the backfill. A relatively small amount of lateral movement is needed to reach the active condition (≥ 0.1 percent of the height), whereas the movements required to engage the passive condition are approximately ten times greater than those required to develop active earth pressure. The values in this table have been estimated from correlation charts based on minimum standards specified for compacted engineered fill materials.

These recommendations do not take into consideration the effect of any surcharge loading or a sloped ground surface (a flat surface is assumed). Earth pressures on excavation support systems will be dependent on the type of sheeting and method of bracing or anchorage. Surcharge loads, such as that imposed by traffic loading, will create additional lateral loading on the subsurface structures and excavation support systems. The resulting lateral earth pressure should be evaluated based on active (k_a) and at-rest (k_o) conditions and the anticipated magnitude of the loading.

Where necessary, temporary retaining structures such as sheet pile system should be designed using the undrained soil parameters provided in Table 15, and the design should follow all applicable guidelines for the type of retaining structure utilized. Permanent retaining and subsurface structures should be designed using the drained soil parameters provided in Table 16. Regardless of whether the retaining structure is temporary or permanent, the effective unit weight ($\gamma' = \gamma$ - 62.4 pcf) plus the hydrostatic water pressure ($\gamma_w * h_w$, where h_w is the height of water behind the wall above the base of the wall) should be utilized below the design groundwater level. The lateral earth pressure coefficients should only be applied to the horizontal pressure resulting from the effective overburden pressure, and should not be applied to the hydrostatic water pressure.

5.5 Pavement Subgrade Recommendations

The soils at the proposed subgrade elevation along the I-70 eastbound lanes between Souder Avenue (begin Sta. 128+26) and the proposed FRA-70-13.21R bridge structure (end Sta. 147+63) consist of granular material comprised of medium dense gravel with sand (ODOT A-1-b) and natural or fill materials comprised of very stiff to hard sandy silt and silt and clay (ODOT A-4a, A-6a). Based on the soil conditions encountered during the drilling phase and the presence of fill materials, it is estimated that the subgrade soils will require some level of stabilization under ODOT GB1. It is understood that the existing and proposed roadway profiles will approximately match.

The moisture content of cohesive soil has a significant effect on the physical properties of the material. It should be noted that the moisture contents provided on the boring logs, and utilized in this analysis, represent the conditions during the drilling phase of the project. The referenced borings for subgrade analysis were drilled on April 27, 2020. These soil conditions, especially in the surficial soils, may not coincide with the soil conditions that will be encountered during construction. Consequently, the extent/need for subgrade improvement is entirely dependent on the subgrade conditions (i.e., moisture contents) encountered at the time of construction.

5.5.1 Station by Station Stabilization Recommendations

It is understood that specific, "station by station" recommendations for subgrade stabilization under GB1 are required for anticipated stabilization quantities. Therefore, a summary of recommended excavation and replacement quantities are presented in Table 17. A complete analysis of each soil boring, looking at the proposed subgrade soils at each location, is presented in Appendix XII. Please note that the excavation and replacement depths in Table 17 are measured from the proposed subgrade elevation, which is estimated to be 1.4 to 1.5 feet on average below the proposed roadway profile grade.

Table 17. Station by Station Subgrade Stabilization Summary

From Station [1]	To Station [1]	Length (feet)	Representative Boring(s)	GB1 Subgrade Stabilization
128+26 (Begin Project)	135+78	752	B-014-1-19 & B-014-2-19	No stabilization is anticipated. Subgrade should be proof rolled per ODOT Item 204 to verify that the subgrade will not require stabilization.
142+24	147+63 (End Project)	539	B-014-5-19	No stabilization is anticipated. Subgrade should be proof rolled per ODOT Item 204 to verify that the subgrade will not require stabilization.

1. *Beginning and ending station limits determined from plan information provided by ms consultants. Station limits estimated based on soil conditions encountered during the field exploration. Actual limits of stabilization may vary based on the conditions encountered during construction.*

Please note that the limits and depth of stabilization provided in the table above are estimated based on the soil conditions encountered in the borings performed during the field exploration. Actual limits and depth of stabilization may differ from the recommendations provided. Per ODOT GB1 requirements, if it is elected to perform station by station stabilization, the entire subgrade should be proof rolled to identify the actual limits of unstable subgrade and depth of stabilization required. Upon completion of the stabilization, areas that required stabilization should be proof rolled to verify that stability has been achieved.

5.5.2 Global Stabilization

Based on the ODOT GB1, when approximately 30 percent or more of the subgrade requires stabilization, consideration should be given to utilizing a global stabilization option. Per ODOT GB1, global stabilization recommendations are based upon the overall average site parameters, as noted in Table 18.

Table 18. Average Site Parameters from GB-1 Analysis

Average N_{60L}	Average PI	Average Moisture	Average Optimum Moisture	Average Group Index	Design CBR
20	8	14	12	5	8

Applying the averages in Table 18, GB1 recommends the following global stabilization options, which should be evaluated based upon a cost and constructability analysis:

Option 1. Chemically stabilize the entire subgrade with 12-inches of cement, as per ODOT Item 206. For estimating purposes, utilize a cement content of 6.0 percent by weight of soil. Actual application rates shall be verified by the contractor under Item 206.06 Mixture Design for Chemically Stabilized Soils.

Option 2. Stone stabilize the entire subgrade via a 12-inch undercut and replacement with ODOT Item 703.16C granular material, Type B, C or D installed over ODOT Item 712.09 Geotextile Fabric, Type D as detailed in accordance with ODOT Item 204.

Per ODOT GB1 requirements, if it is elected to perform global stabilization, the entire subgrade should be stabilized using one of the global stabilization options provided above (proof rolling of the subgrade prior to stabilization is not required). Upon completion of the stabilization, the entire subgrade should be proof rolled to verify that stability has been achieved.

Given that this section of I-70 is being reconstructed as part of a larger corridor construction project, it is recommended that global stabilization of the subgrade shall be performed regardless of the length of the project using the global chemical stabilization option (Option 1) above. This stabilization option will provide the most uniform and durable subgrade, and will match the proposed subgrade stabilization that is being utilized along the interstate sections within this corridor in the other phases of construction.

5.5.3 Subgrade Design Considerations

California Bearing Ratio (CBR) values for the entire project ranged from 6 to 12 with an average of 8. If it is elected to proceed with global stabilization of the entire subgrade, it is recommended that pavement design be based on the average CBR of 8 with a corresponding natural resilient modulus, M_R, of 9,600 psi. However, since the entire subgrade will receive global chemical stabilization, the resilient modulus can be increased per Section 203.4.1 of the ODOT Pavement Design Manual, which results in an increased design resilient modulus, $M_{R\text{-}GCS}$, of 13,056 psi. Correlation charts indicate a modulus of subgrade reaction (K) of 182 pci and a soil support value (SSV) of 5.4.

Per ODOT GB1, soils with sulfate content in excess of 5,000 ppm cannot be chemically stabilized due to the potential for sulfate heave in the soil. Based on the results of the testing, the sulfate contents of the subgrade soils in range from 640 to 1,900 parts per million (ppm or mg/kg of material). Therefore, soil with a sulfate content greater than 5,000 ppm was not encountered in any of the borings.

Please note that the recommended CBR values assume that the materials utilized for the road subgrade in fill areas are equivalent to, or better than materials at the existing subgrade elevation. Sources of borrow material should be designated in advance of construction. The material should be tested in the laboratory to verify the soil exhibits a minimum design CBR value of 8.

Pavement design is dependent on the inclusion of adequate surface and subsurface drainage in order to maintain the compacted subgrade near optimum moisture conditions throughout the lifetime of the pavement. If underdrain systems are considered, they should be installed in accordance to the specifications presented in Item 204.

5.6 Construction Considerations

All site work shall conform to local codes and to the latest ODOT Construction and Materials Specifications (CMS), including that all excavation and embankment preparation and construction should follow ODOT Item 200 (Earthwork).

5.6.1 Excavation Considerations

All excavations should be shored / braced or laid back at a safe angle in accordance to Occupational Safety and Health Administration (OSHA) guidelines. During excavation, if slopes cannot be laid back to OSHA Standards due to adjacent structures or other obstructions, temporary shoring may be required. The following table should be utilized as a general guide for implementing OSHA guidelines when estimating excavation back slopes at the various boring locations. Actual excavation back slopes must be field verified by qualified personnel at the time of excavation in strict accordance with OSHA guidelines.

Table 19. Excavation Back Slopes

Soil	Maximum Back Slope	Notes
Soft to Medium Stiff Cohesive	1.5 : 1.0	Above Ground Water Table and No Seepage
Stiff Cohesive	1.0 : 1.0	Above Ground Water Table and No Seepage
Very Stiff to Hard Cohesive	0.75 : 1.0	Above Ground Water Table and No Seepage
All Granular & Cohesive Soil Below Ground Water Table or with Seepage	1.5 : 1.0	None
Rock to 3.0' +/- below Auger Refusal	0.75 : 1.0	Above Ground Water Table and No Seepage
Stable Rock	Vertical	Above Ground Water Table and No Seepage

5.6.2 Groundwater Considerations

Based on the groundwater observations made during drilling, groundwater may be encountered during construction of Piers 2 and 3. Where groundwater is encountered, proper groundwater control should be employed and maintained to prevent disturbance to excavation bottoms consisting of cohesive soil, and to prevent the possible development of a quick or "boiling" condition where soft silts and/or fine sands are encountered. It is preferable that the groundwater level, if encountered, be maintained at least 36 inches below the deepest excavation. Any seepage or groundwater encountered at this site should be able to be controlled by pumping from temporary sumps. Additional measures may be required depending on seasonal fluctuations of the groundwater level. Note that determining and maintaining actual groundwater levels during construction is the responsibility of the contractor.

6.0 LIMITATIONS OF STUDY

The above recommendations are predicated upon construction inspection by a qualified soil technician under the direct supervision of a professional geotechnical engineer. Adequate testing and inspection during construction are considered necessary to assure an adequate foundation system and are part of these recommendations.

The recommendations for this project were developed utilizing soil and bedrock information obtained from the test borings that were made at the proposed site for the current investigation. Resource International is not responsible for the data, conclusions, opinions or recommendations made by others during previous investigations at this site. At this time we would like to point out that soil borings only depict the soil and bedrock conditions at the specific locations and time at which they were made. The conditions at other locations on the site may differ from those occurring at the boring locations.

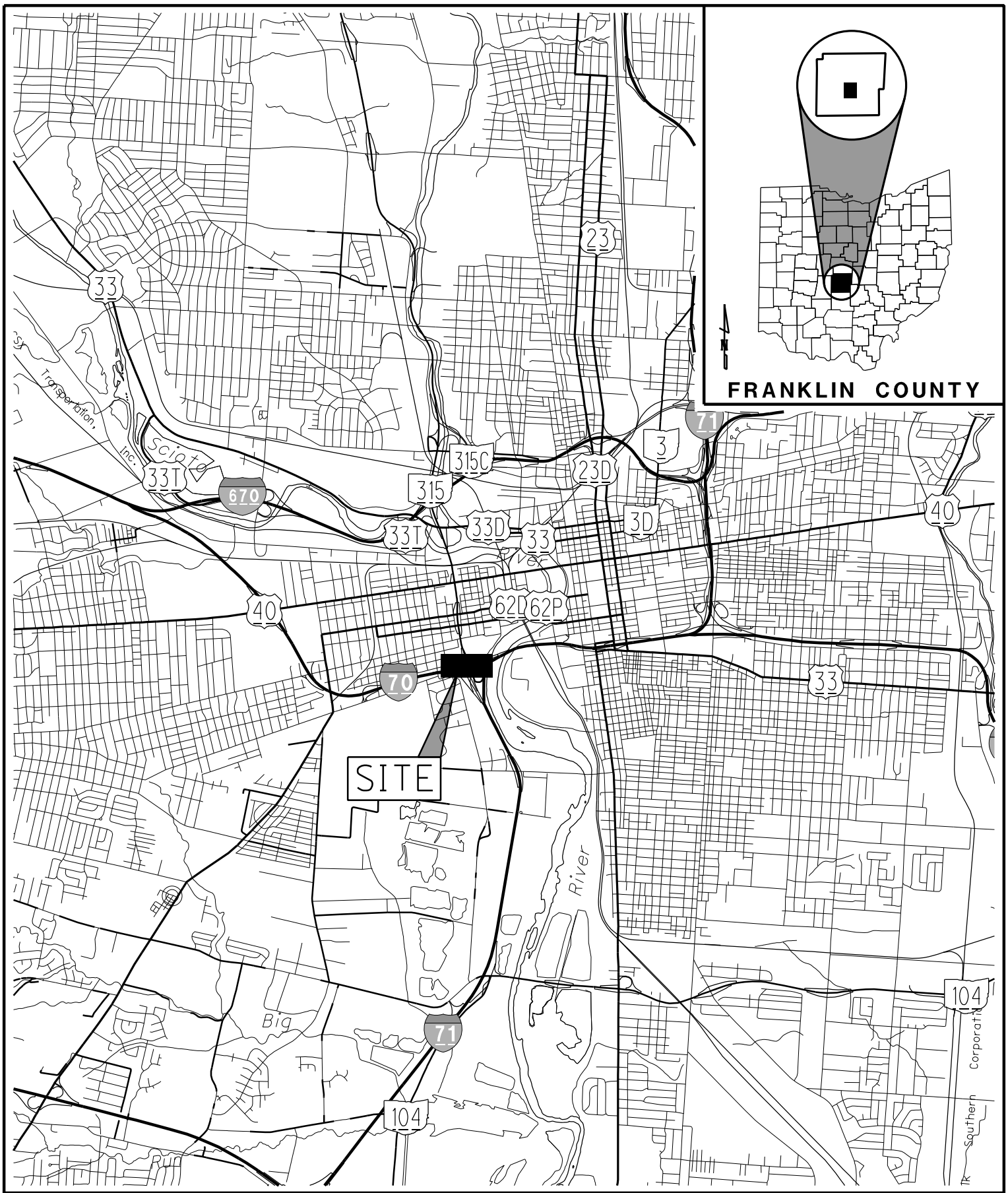
The conclusions and recommendations herein have been based upon the available soil and bedrock information and the design details furnished by a representative of the owner of the proposed project. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the geotechnical engineer to determine whether any changes in the foundation or earthwork recommendations are necessary. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the geotechnical engineer.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater or surface water within or beyond the site studied. Any statements in this report or on the test boring logs regarding odors, staining of soils or other unusual conditions observed are strictly for the information of our client.

Our professional services have been performed, our findings obtained and our recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. Resource International is not responsible for the conclusions, opinions or recommendations made by others based upon the data included.

APPENDIX I

VICINITY MAP AND BORING PLAN



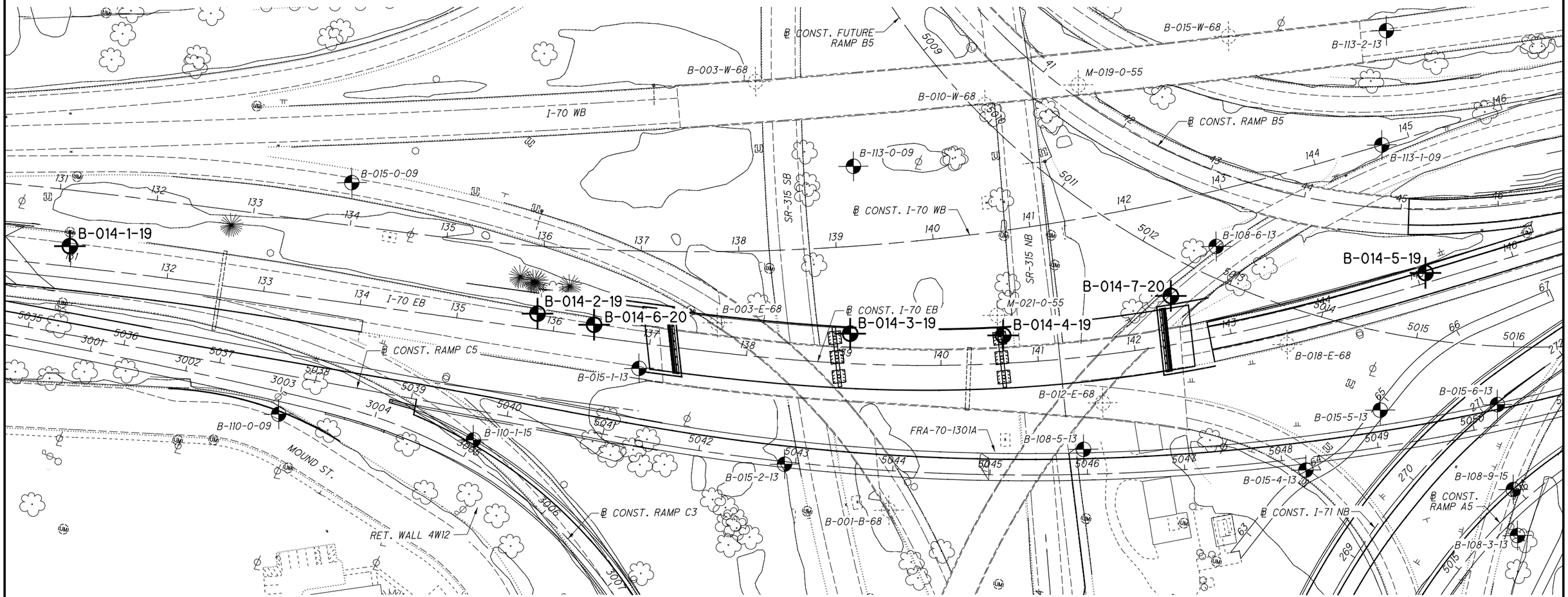
VICINITY MAP

FRA-70-13.01

COLUMBUS, OHIO

RII PROJECT NO. W-20-025	DRAWN RRM	
	REVIEWED BRT	
SCALE: 1"=5000' (0 2500 5000)	DATE 5/13/2020	

RESOURCE INTERNATIONAL Rii



BORING PLAN

FRA-70-13.01
COLUMBUS, OHIO

RII PROJECT NO. W-20-025		DRAWN RRM
SCALE: 1"=100' 0 50 100	N	REVIEWED BRT
		DATE 6/16/2021

RESOURCE INTERNATIONAL Rii

APPENDIX II

DESCRIPTION OF SOIL TERMS

DESCRIPTION OF SOIL TERMS

The following terminology was used to describe soils throughout this report and is generally adapted from ASTM 2487/2488 and ODOT Specifications for Geotechnical Explorations.

Granular Soils – ODOT A-1, A-2, A-3, A-4 (non-plastic)
The relative compactness of granular soils is described as:

Description	Blows per foot – SPT (N_{60})		
Very Loose	Below		5
Loose	5	-	10
Medium Dense	11	-	30
Dense	31	-	50
Very Dense	Over		50

Cohesive Soils – ODOT A-4, A-5, A-6, A-7, A-8
The relative consistency of cohesive soils is described as:

Description	Unconfined Compression (tsf)		
Very Soft	Less than		0.25
Soft	0.25	-	0.5
Medium Stiff	0.5	-	1.0
Stiff	1.0	-	2.0
Very Stiff	2.0	-	4.0
Hard	Over		4.0

Gradation - The following size-related denominations are used to describe soils:

Soil Fraction		Size
Boulders		Larger than 12”
Cobbles		12” to 3”
Gravel	coarse	3” to ¾“
	fine	¾” to 2.0 mm (¾” to #10 Sieve)
Sand	coarse	2.0 mm to 0.42 mm (#10 to #40 Sieve)
	fine	0.42 mm to 0.074 mm (#40 to #200 Sieve)
Silt		0.074 mm to 0.005 mm (#200 to 0.005 mm)
Clay		Smaller than 0.005 mm

Modifiers of Components - The following modifiers indicate the range of percentages of the minor soil components:

Term	Range		
Trace	0%	-	10%
Little	10%	-	20%
Some	20%	-	35%
And	35%	-	50%

Moisture Table - The following moisture-related denominations are used to describe cohesive soils:

Term	Range - ODOT
Dry	Well below Plastic Limit
Damp	Below Plastic Limit
Moist	Above PL to 3% below LL
Wet	3% below LL to above LL

Organic Content – The following terms are used to describe organic soils:

Term	Organic Content (%)
Slightly organic	2-4
Moderately organic	4-10
Highly organic	>10

Bedrock – The following terms are used to describe the relative strength of bedrock:

Description	Field Parameter
Very Weak	Can be carved with knife and scratched by fingernail. Pieces 1 in. thick can be broken by finger pressure.
Weak	Can be grooved or gouged with knife readily. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Can be grooved or gouged 0.05 in deep with knife. 1 in. size pieces from hard blows of geologist hammer.
Moderately Strong	Can be scratched with knife or pick. 1/4 in. size grooves or gouges from blows of geologist hammer.
Strong	Can be scratched with knife or pick with difficulty. Hard hammer blows to detach hand specimen.
Very Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to detach hand specimen.
Extremely Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to chip hand specimen.

CLASSIFICATION OF SOILS

Ohio Department of Transportation

(The classification of a soil is found by proceeding from top to bottom of the chart.
The first classification that the test data fits is the correct classification.)

SYMBOL	DESCRIPTION	Classifcation AASHTO	Classifcation OHIO	LL_O/LL x 100*	% Pass #40	% Pass #200	Liquid Limit (LL)	Plastic Index (PI)	Group Index Max.	REMARKS
	Gravel and/or Stone Fragments	A-1-a			30 Max.	15 Max.		6 Max.	0	Min. of 50% combined gravel, cobble and boulder sizes
	Gravel and/or Stone Fragments with Sand	A-1-b			50 Max.	25 Max.		6 Max.	0	
F.S.	Fine Sand	A-3			51 Min.	10 Max.	NON-PLASTIC		0	
	Coarse and Fine Sand	--	A-3a			35 Max.		6 Max.	0	Min. of 50% combined coarse and fine sand sizes
	Gravel and/or Stone Fragments with Sand and Silt	A-2-4				35 Max.	40 Max.	10 Max.	0	
		A-2-5					41 Min.			
	Gravel and/or Stone Fragments with Sand, Silt and Clay	A-2-6				35 Max.	40 Max.	11 Min.	4	
		A-2-7					41 Min.			
	Sandy Silt	A-4	A-4a	76 Min.		36 Min.	40 Max.	10 Max.	8	Less than 50% silt sizes
	Silt	A-4	A-4b	76 Min.		50 Min.	40 Max.	10 Max.	8	50% or more silt sizes
	Elastic Silt and Clay	A-5		76 Min.		36 Min.	41 Min.	10 Max.	12	
	Silt and Clay	A-6	A-6a	76 Min.		36 Min.	40 Max.	11 - 15	10	
	Silty Clay	A-6	A-6b	76 Min.		36 Min.	40 Max.	16 Min.	16	
	Elastic Clay	A-7-5		76 Min.		36 Min.	41 Min.	≤LL-30	20	
	Clay	A-7-6		76 Min.		36 Min.	41 Min.	>LL-30	20	
	Organic Silt	A-8	A-8a	75 Max.		36 Min.				W/o organics would classify as A-4a or A-4b
	Organic Clay	A-8	A-8b	75 Max.		36 Min.				W/o organics would classify as A-5, A-6a, A-6b, A-7-5 or A-7-6

MATERIAL CLASSIFIED BY VISUAL INSPECTION

Sod and Topsoil

Pavement or Base

Uncontrolled Fill (Describe)

Bouldery Zone

P Peat

* Only perform the oven-dried liquid limit test and this calculation if organic material is present in the sample.

DESCRIPTION OF ROCK TERMS

The following terminology was used to describe the rock throughout this report and is generally adapted from ASTM D5878 and the ODOT Specifications for Geotechnical Explorations.

Weathering – Describes the degree of weathering of the rock mass:

Description	Field Parameter
Unweathered	No evidence of any chemical or mechanical alteration of the rock mass. Mineral crystals have a right appearance with no discoloration. Fractures show little or not staining on surfaces.
Slightly Weathered	Slight discoloration of the rock surface with minor alterations along discontinuities. Less than 10% of the rock volume presents alteration.
Moderately Weathered	Portions of the rock mass are discolored as evident by a dull appearance. Surfaces may have a pitted appearance with weathering "halos" evident. Isolated zones of varying rock strengths due to alteration may be present. 10 to 15% of the rock volume presents alterations.
Highly Weathered	Entire rock mass appears discolored and dull. Some pockets of slightly to moderately weathered rock may be present and some areas of severely weathered materials may be present.
Severely Weathered	Majority of the rock mass reduced to a soil-like state with relic rock structure discernable. Zones of more resistant rock may be present but the material can generally be molded and crumbled by hand pressures.

Strength of Bedrock – The following terms are used to describe the relative strength of bedrock:

Description	Field Parameter
Very Weak	Can be carved with knife and scratched by fingernail. Pieces 1 in. thick can be broken by finger pressure.
Weak	Can be grooved or gouged with knife readily. Small, thin pieces can be broken by finger pressure.
Slightly Strong	Can be grooved or gouged 0.05 in deep with knife. 1 in. size pieces from hard blows of geologist hammer.
Moderately Strong	Can be scratched with knife or pick. 1/4 in. size grooves or gouges from blows of geologist hammer.
Strong	Can be scratched with knife or pick with difficulty. Hard hammer blows to detach hand specimen.
Very Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to detach hand specimen.
Extremely Strong	Cannot be scratched by knife or pick. Hard repeated blows of geologist hammer to chip hand specimen.

Bedding Thickness – Description of bedding thickness as the average perpendicular distances between bedding surfaces:

Description	Thickness
Very Thick	Greater than 36 inches
Thick	18 to 36 inches
Medium	10 to 18 inches
Thin	2 to 10 inches
Very Thin	0.4 to 2 inches
Laminated	0.1 to 0.4 inches
Thinly Laminated	Less than 0.1 inches

Fracturing – Describes the degree and condition of fracturing (fault, joint, or shear):

Degree of Fracturing

Description	Spacing
Unfractured	Greater than 10 feet
Intact	3 to 10 feet
Slightly Fractured	1 to 3 feet
Moderately Fractured	

Aperture Width

Description	Width
Open	Greater than 0.2 inches
Narrow	0.05 to 0.2 inches
Tight	Less than 0.05 inches

Surface Roughness

Description	Criteria
Very Rough	Near vertical steps and ridges occur on surface
Slightly Rough	Asperities on the surfaces distinguishable
Slickensided	Surface has smooth, glassy finish, evidence of Striations

RQD – Rock Quality Designation (calculation shown in report) and Rock Quality (ODOT, GB 3, January 13, 2006):

RQD %	Rock Index Property Classification (based on RQD, not slake durability index)
0 – 25%	Very Poor
26 – 50%	Poor
51 – 70%	Fair
71 – 85%	Good
86 – 100%	Very Good

APPENDIX III

PROJECT BORING LOGS:

B-014-1-19 through B014-7-20, B-015-1-13, B-015-2-13 and B-108-5-13 and B-108-6-13

BORING LOGS

Definitions of Abbreviations

AS	=	Auger sample
GI	=	Group index as determined from the Ohio Department of Transportation classification system
HP	=	Unconfined compressive strength as determined by a hand penetrometer (tons per square foot)
LL_o	=	Oven-dried liquid limit as determined by ASTM D4318. Per ASTM D2487, if LL_o/LL is less than 75 percent, soil is classified as "organic".
LOI	=	Percent organic content (by weight) as determined by ASTM D2974 (loss on ignition test)
PID	=	Photo-ionization detector reading (parts per million)
QR	=	Unconfined compressive strength of intact rock core sample as determined by ASTM D2938 (pounds per square inch)
QU	=	Unconfined compressive strength of soil sample as determined by ASTM D2166 (pounds per square foot)
RC	=	Rock core sample
REC	=	Ratio of total length of recovered soil or rock to the total sample length, expressed as a percentage
RQD	=	Rock quality designation – estimate of the degree of jointing or fracture in a rock mass, expressed as a percentage:

$$\frac{\sum \text{segments equal to or longer than 4.0 inches}}{\text{core run length}} \times 100$$

S	=	Sulfate content (parts per million)
SPT	=	Standard penetration test blow counts, per ASTM D1586. Driving resistance recorded in terms of blows per 6-inch interval while letting a 140-pound hammer free fall 30 inches to drive a 2-inch outer diameter (O.D.) split spoon sampler a total of 18 inches. The second and third intervals are added to obtain the number of blows per foot (N_m).
N_{60}	=	Measured blow counts corrected to an equivalent (60 percent) energy ratio (ER) by the following equation: $N_{60} = N_m*(ER/60)$
SS	=	Split spoon sample
2S	=	For instances of no recovery from standard SS interval, a 2.5 inch O.D. split spoon is driven the full length of the standard SS interval plus an additional 6.0 inches to obtain a representative sample. Only the final 6.0 inches of sample is retained. Blow counts from 2S sampling are not correlated with N_{60} values.
3S	=	Same as 2S, but using a 3.0 inch O.D. split spoon sampler.
TR	=	Top of rock
W	=	Initial water level measured during drilling
▼	=	Water level measured at completion of drilling

Classification Test Data

Gradation (as defined on Description of Soil Terms):

GR	=	% Gravel
SA	=	% Sand
SI	=	% Silt
CL	=	% Clay

Atterberg Limits:

LL	=	Liquid limit
PL	=	Plastic limit
PI	=	Plasticity Index
WC	=	Water content (%)

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / LH	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 130+97.17 / 20.8' LT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB
PID: 105430 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 9/4/18	ELEVATION: 736.5 (MSL) EOB: 7.5 ft.
START: 4/27/20 END: 4/27/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 91.2	LAT / LONG: 39.950225, -83.019864

EXPLORATION ID
B-014-1-19

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 736.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
0.4' - ASPHALT (4.5")	736.1																		
1.0' - CONCRETE (11.5")	735.1	1																	
MEDIUM DENSE, GRAY **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP.	733.5	2	6 5 5	15	72	SS-1	-	39	26	12	18	5	19	14	5	8	A-1-b (0)	1900	
VERY STIFF, GRAY **SANDY SILT**, SOME FINE GRAVEL, TRACE CLAY, DAMP.		3	10 8 12	30	67	SS-2	3.50	26	16	22	26	10	21	17	4	13	A-4a (0)	-	
	730.5	4	14 11 12	35	92	SS-3	3.50	-	-	-	-	-	-	-	-	13	A-4a (V)	-	
HARD, GRAY **SILT AND CLAY**, LITTLE COARSE TO FINE SAND, LITTLE FINE GRAVEL, DAMP.	729.0	5	8 12 14	39	72	SS-4	4.5+	-	-	-	-	-	-	-	-	11	A-6a (V)	-	
		6																	
		7																	
		EOB																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS. PAVEMENT PATCHED WITH COLD PATCH ASPHALT. .

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / LH	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 135+81.56 / 15.6' LT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB
PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 9/4/18	ELEVATION: 744.5 (MSL) EOB: 94.6 ft.
START: 4/27/20 END: 4/29/20	SAMPLING METHOD: SPT/RC	ENERGY RATIO (%): 91.2	LAT / LONG: 39.950298, -83.018137

EXPLORATION ID B-014-2-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 744.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
0.4' - ASPHALT (4.5")	744.1																		
1.1' - CONCRETE (13.5")	743.0	1																	
FILL: VERY STIFF TO HARD, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP TO MOIST.		2, 3	8 6 8	21	50	SS-1	3.50	32	23	9	24	12	19	16	3	16	A-4a (0)	1500	
		4, 5	11 8 11	29	33	SS-2	3.75	-	-	-	-	-	-	-	-	11	A-4a (V)	-	
		6, 7	9 8 6	21	14	SS-3	4.50	-	-	-	-	-	-	-	-	8	A-4a (V)	-	
	736.3	8	10	-	50	SS-3A	3.00	-	-	-	-	-	-	-	-	13	A-4a (V)	-	
FILL: VERY STIFF, GRAY **SILT AND CLAY**, SOME COARSE TO FINE SAND, SOME FINE GRAVEL, DAMP TO MOIST.		9	8 3 7	15	69	SS-4	3.00	21	12	15	32	20	26	15	11	13	A-6a (4)	-	
		11, 12	3 4 6	15	72	SS-5	3.75	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		14, 15	4 3 7	15	75	SS-6	3.50	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		16, 17	3 7 8	23	67	SS-7	3.75	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		19, 20	5 9 9	27	78	SS-8	2.75	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		21, 22	4 4 7	17	75	SS-9	3.25	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
	721.5	23																	
FILL: VERY STIFF, GRAY **SANDY SILT**, LITTLE CLAY, LITTLE FINE GRAVEL, DAMP TO MOIST.		24, 25	8 10 12	33	94	SS-10	3.50	12	13	19	38	18	25	16	9	13	A-4a (4)	-	
		26, 27	4 6 9	23	100	SS-11	4.00	-	-	-	-	-	-	-	-	18	A-4a (V)	-	
	716.5	28																	
VERY STIFF TO HARD, GRAY **SANDY SILT**, LITTLE CLAY, SOME FINE GRAVEL, DAMP.		29	4 12 50/4"	-	100	SS-12	4.00	-	-	-	-	-	-	-	-	9	A-4a (V)	-	

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 13581.56, 16' LT.	START: 4/27/20	END: 4/29/20	PG 2 OF 4	B-014-2-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 714.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
VERY STIFF TO HARD, GRAY **SANDY SILT**, LITTLE CLAY, SOME FINE GRAVEL, DAMP. *(continued)*		31																	
		32																	
-COBBLES @ 30.0'-31.5'		33																	
		34	27 26 19	68	42	SS-13	4.25	27	11	16	29	17	25	15	10	10	A-4a (2)	-	
		35																	
		36																	
		37																	
		38																	
		39	38 50/2"	-	75	SS-14	4.5+	-	-	-	-	-	-	-	-	9	A-4a (V)	-	
		40																	
		41																	
	702.5	42																	
VERY STIFF, BROWN AND DARK BROWN **CLAY**, "AND" SILT, TRACE COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.		43																	
		44	4 6 9	23	92	SS-15	3.75	1	1	9	45	44	47	22	25	24	A-7-6 (15)	-	
		45																	
		46																	
		47																	
		48																	
	695.3	49	4 11 17	42	81	SS-16A	3.50	-	-	-	-	-	-	-	-	23	A-7-6 (V)	-	
VERY STIFF, BROWN **SANDY SILT**, LITTLE CLAY, TRACE FINE GRAVEL, DAMP.		50				SS-16B	3.50	-	-	-	-	-	-	-	-	9	A-4a (V)	-	
		51																	
	692.5	52																	
MEDIUM DENSE TO VERY DENSE, BROWN AND DARK BROWN **GRAVEL WITH SAND**, SOME SILT, TRACE CLAY, MOIST TO WET.		53																	
		54	8 31 33	96	78	SS-17	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	-	
-WATER ADDED @ 55.0'		55																	
		56																	
		57																	
		58																	
		59	15 30 17	71	33	SS-18	-	47	24	8	14	7	21	15	6	11	A-1-b (0)	-	
		60																	
		61																	
-COBBLES @ 61.5'		W 682.5																	

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 13581.56, 16' LT.	START: 4/27/20	END: 4/29/20	PG 3 OF 4	B-014-2-19

MATERIAL DESCRIPTION AND NOTES	ELEV. 682.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
MEDIUM DENSE TO VERY DENSE, BROWN AND DARK BROWN **GRAVEL WITH SAND**, SOME SILT, TRACE CLAY, MOIST TO WET. *(continued)*		63																	
		64, 65	15 10 10	30	58	SS-19	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	-	
		66, 67, 68																	
		69, 70	9 7 11	27	89	SS-20	-	-	-	-	-	-	-	-	-	16	A-1-b (V)	-	
		71, 72, 73																	
		74, 75	15 13 16	44	94	SS-21	-	47	29	13	9	2	NP	NP	NP	9	A-1-b (0)	-	
		76, 77, 78																	
-WATER ADDED @ 78.3'																			
-HEAVING SAND @ 78.5'		79, 80	21 14 12	39	89	SS-22	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	-	
		81																	
AUGER REFUSAL @ 82.0'	662.5																		
BOULDERS/COBBLES: LIMESTONE, DOLOMITE, GRANITE, SILTSTONE FRAGMENTS.		82, 83, 84	0		0	NQ-1											CORE		
		85, 86, 87, 88, 89	0		25	NQ-2											CORE		
		90, 91, 92, 93, 94	0		4	NQ-3											CORE		

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 13581.56, 16' LT.	START: 4/27/20	END: 4/29/20	PG 4 OF 4	B-014-2-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
	650.2																		
	649.9	EOB																	

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 62.0'; CAVE-IN DEPTH @ 72.3'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 94 LBS CEMENT / 50 LBS BENTONITE POWDER / 20 GAL WATER. PAVEMENT PATCHED WITH ASPHALT COLD PATCH. .

B-014-2-19 – NQ-2 and NQ-3 – Depth from 84.6 to 94.6 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / SB	DRILL RIG: CME 750X (310218)	STATION / OFFSET: 139+05.23 / 30.7' LT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB
PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 9/4/18	ELEVATION: 700.9 (MSL) EOB: 54.8 ft.
START: 4/24/20 END: 4/24/20	SAMPLING METHOD: SPT/RC	ENERGY RATIO (%): 79.5	LAT / LONG: 39.950416, -83.017000

EXPLORATION ID B-014-3-19

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 700.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
0.4' - TOPSOIL (4.0")	700.5		5			SS-1A	-	-	-	-	-	-	-	-	-	-		-	
DENSE, DARK BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, MOIST.	699.4	1	11 14	33	56	SS-1B	-	73	8	5	9	5	26	19	7	9	A-2-4 (0)	-	
DENSE TO VERY DENSE, DARK BROWN TO BROWNISH GRAY **GRAVEL**, LITTLE FINE TO COARSE SAND, LITTLE SILT, TRACE CLAY, MOIST.		2 3	11 39 25	85	56	SS-2	-	-	-	-	-	-	-	-	-	5	A-1-a (V)	-	
		4 5	12 14 18	42	69	SS-3	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	-	
-COBBLES @ 5.0'		6 7	24 23 30	70	72	SS-4	-	-	-	-	-	-	-	-	-	6	A-1-a (V)	-	
		8 9	24 30 24	72	89	SS-5	-	66	13	6	11	4	NP	NP	NP	7	A-1-a (0)	-	
-COBBLES @ 10.0'		10 11																	
		W 688.9 12	19 14 12	34	75	SS-6	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	-	
		13 14	16 16 13	38	39	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-a (V)	-	
-MUD ADDED @ 16.0'		15 16 17	18 17 11	37	69	SS-8	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	-	
	682.9	18																	
MEDIUM DENSE, GRAY **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, WET.		19 20	3 5 6	15	36	SS-9	-	-	-	-	-	-	-	-	-	17	A-1-b (V)	-	
		21 22	6 7 6	17	81	SS-10	-	22	51	14	10	3	NP	NP	NP	16	A-1-b (0)	-	
	677.9	23																	
STIFF, GRAY **SANDY SILT**, LITTLE CLAY, TRACE FINE GRAVEL, MOIST.		24 25	5 15 20	46	92	SS-11	1.25	-	-	-	-	-	-	-	-	19	A-4a (V)	-	
	675.4																		
VERY DENSE, GRAY **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST. -HEAVING SAND @ 26.0'		26 27	14 25 50/5"	-	85	SS-12	-	-	-	-	-	-	-	-	-	9	A-1-b (V)	-	
		28 29	41 22 40	82	47	SS-13	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	-	
-COBBLES @ 29.0'																			

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 13905.23, 31' LT.	START: 4/24/20	END: 4/24/20	PG 2 OF 2	B-014-3-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
VERY DENSE, GRAY **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST. *(continued)*	670.9	31 32 33																	
VERY STIFF, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE SILT, DAMP TO MOIST.	668.9	34 35	10 8 12	27	0	SS-14	-	-	-	-	-	-	-	-	-	-		-	
			11	-	100	2S-14A	2.50	26	13	14	30	17	21	14	7	18	A-4a (2)	-	
		36 37 38 39	6 9 11	27	56	SS-15	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	-	
		40 41 42 43 44 45	28 31 11	56	39	SS-16	3.50	-	-	-	-	-	-	-	-	13	A-4a (V)	-	
AUGER REFUSAL @ 46.0'	654.9	TR 46																	
LIMESTONE : DARK GRAY, DARK BROWN TO LIGHT GRAY, SLIGHTLY WEATHERED, SLIGHTLY STRONG TO STRONG, THICK TO VERY THICK BEDDED, CHERTY, CRYSTALLINE, FOSSILIFEROUS, SLIGHTLY TO MODERATELY FRACTURED, NARROW, SLIGHTLY ROUGH, INTACT, GOOD SURFACE CONDITIONS; RQD 32%, REC 93%. -VERTICAL FRACTURE @ 48.2'-48.7'		47 48 49	24		93	NQ-1											CORE		
		50 51 52 53 54	40		93	NQ-2											CORE		
	646.1	EOB																	

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 12.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 94 LBS CEMENT / 50 LBS BENTONITE POWDER / 20 GAL WATER. .

B-014-3-19 – NQ-1 and NQ-2 – Depth from 46.0 to 54.8 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / SB	DRILL RIG: CME 750X (310218)	STATION / OFFSET: 140+65.30 / 28.7' LT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB
PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA / NQ	CALIBRATION DATE: 9/4/18	ELEVATION: 698.8 (MSL) EOB: 49.7 ft.
START: 4/22/20 END: 4/22/20	SAMPLING METHOD: SPT/RC	ENERGY RATIO (%): 79.5	LAT / LONG: 39.950496, -83.016450

EXPLORATION ID B-014-4-19

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 698.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
0.4' - TOPSOIL (5.0")	698.4																		
STIFF TO VERY STIFF, DARK GRAY TO DARK BROWN **SILT AND CLAY**, "AND" FINE GRAVEL, LITTLE FINE TO COARSE SAND, DAMP.		1	3 10 9	25	50	SS-1A	-	-	-	-	-	-	-	-	-	-		-	
						SS-1B	2.75	-	-	-	-	-	-	-	-	10	A-6a (V)	-	
-COBBLES @ 3.0'	695.6	2 3	9 11 17	37	50	SS-2	1.50	44	13	7	23	13	33	19	14	16	A-6a (1)	-	
MEDIUM DENSE TO VERY DENSE, BROWNISH GRAY TO GRAY **GRAVEL**, SOME FINE TO COARSE SAND, TRACE SILT, TRACE CLAY, MOIST TO WET.		4 5	8 12 12	32	61	SS-3	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	-	
		6 7	8 22 8	40	44	SS-4	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	-	
-COBBLES @ 7.5'		W 690.8 8 9	10 11 12	30	56	SS-5	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	-	
		10 11 12	12 17 16	44	83	SS-6	-	64	15	6	11	4	20	18	2	8	A-1-a (0)	-	
-COBBLES @ 14.0'		13 14 15	5 8 13	28	61	SS-7	-	-	-	-	-	-	-	-	-	14	A-1-a (V)	-	
		16 17	3 9 9	24	72	SS-8	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	-	
-MUD ADDED @ 20.0'		18 19	8 7 4	15	78	SS-9	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	-	
-COBBLES @ 20.0'		20 21 22	18 30 25	73	86	SS-10	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	-	
-COBBLES @ 23.0'		23 24 25	15 29 26	73	81	SS-11	-	69	18	5	7	1	NP	NP	NP	9	A-1-a (0)	-	
	672.3	26	22 15 11	34	94	SS-12A	-	-	-	-	-	-	-	-	-	7	A-1-a (V)	-	
HARD, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP.		27 28 29				SS-12B	4.5+	-	-	-	-	-	-	-	-	11	A-4a (V)	-	
			5 9 11	27	81	SS-13	4.5+	25	11	14	32	18	20	14	6	11	A-4a (3)	-	

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 14065.3, 29' LT.	START: 4/22/20	END: 4/22/20	PG 2 OF 2	B-014-4-19

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
HARD, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP. *(continued)*	668.8																		
	666.8	31																	
MEDIUM DENSE, GRAY **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST.		32																	
		33																	
		34	6 8 11	25	50	SS-14	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	-	
		35																	
	662.3	36																	
HARD, GRAY **SANDY SILT**, TRACE CLAY, TRACE FINE GRAVEL, DAMP.		37																	
		38																	
		39	50/4"	-	88	SS-15	4.5+	-	-	-	-	-	-	-	-	8	A-4a (V)	-	
	658.3	40																	
GRAY **LIMESTONE FRAGMENTS**		TR 41																	
AUGER REFUSAL @ 42.0'	656.7	42	50/1"	-	100	SS-16	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	-	
LIMESTONE : DARK GRAY AND DARK BROWN, SLIGHTLY WEATHERED, STRONG, THICK TO VERY THICK BEDDED, CHERTY, FOSSILIFEROUS, CRYSTALLINE, INTACT, NARROW, SLIGHTLY ROUGH; RQD 71.5%, REC 96.5%. -LOST WATER RETURNED @ 44.5'		43	54		97	NQ-1											CORE		
		44																	
		45																	
		46																	
		47	89		96	NQ-2											CORE		
		48																	
	649.1	49 EOB																	

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 8.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 70 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER .

B-014-4-19 – NQ-1 and NQ-2 – Depth from 42.0 to 49.7 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / LH	DRILL RIG: CME 55 (386345)	STATION / OFFSET: 145+09.20 / 10' LT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / TG	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB
PID: 105430 SFN: NA	DRILLING METHOD: 4.5" CFA	CALIBRATION DATE: 9/4/18	ELEVATION: 736.1 (MSL) EOB: 7.3 ft.
START: 4/27/20 END: 4/27/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 91.2	LAT / LONG: 39.950903, -83.014979

EXPLORATION ID
B-014-5-19

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 736.1	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
0.5' - ASPHALT (5.5")	735.6																		
0.9' - CONCRETE (11.5")	734.7	1																	
VERY STIFF, BROWN **SANDY SILT**, LITTLE CLAY, TRACE FINE GRAVEL, DAMP.	733.9	2	10 9 9	27	92	SS-1A	3.25	-	-	-	-	-	-	-	-	9	A-4a (V)	640	
	733.1					SS-1B	3.50	13	21	15	33	18	36	21	15	13	A-6a (5)	-	
VERY STIFF, DARK GRAY **SILT AND CLAY**, "AND" FINE TO COARSE SAND, LITTLE FINE GRAVEL, DAMP.		3	11 8 7	23	72	SS-2	3.50	21	18	17	26	18	33	23	10	20	A-4a (2)	-	
VERY STIFF TO HARD, DARK GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP.		4	4 8 11	29	100	SS-3	3.00	-	-	-	-	-	-	-	-	21	A-4a (V)	-	
		5	12 18 50/4"	-	100	SS-4	4.25	-	-	-	-	-	-	-	-	14	A-4a (V)	-	
	728.8	6 EOB 7																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS. PAVEMENT PATCHED WITH COLD PATCH ASPHALT. .

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / LH	DRILL RIG: CME 55 - 386345	STATION / OFFSET: 136+40.68 / 12.2' LT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / JP	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB
PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/14/20	ELEVATION: 745.4 (MSL) EOB: 88.1 ft.
START: 12/10/20 END: 12/10/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 84.2	LAT / LONG: 39.950299, -83.017926

EXPLORATION ID B-014-6-20

MATERIAL DESCRIPTION AND NOTES	ELEV. 745.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
0.4' - ASPHALT (4.5")	745.0																		
1.1' - CONCRETE (13.5")	743.9																		
FILL:: HARD, DARK GRAY TO GRAY **SILT AND CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, DAMP.		1, 2, 3																	
		4, 5	3 4 5	13	33	SS-1	4.5+	-	-	-	-	-	-	-	-	13	A-6a (V)	-	
		6, 7, 8, 9, 10, 11																	
		12, 13	6 6 7	18	78	SS-2	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
		14, 15			71	ST-3	4.5+	8	9	16	31	36	27	15	12	13	A-6a (7)	-	
		16, 17, 18, 19, 20, 21, 22, 23																	
		24, 25	12 9 9	25	83	SS-4	4.5+	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
-COBBLES @ 25.5'	719.4																		
VERY STIFF TO HARD, BROWN TO GRAY **SILT AND CLAY**, LITTLE TO SOME COARSE TO FINE SAND, TRACE TO LITTLE FINE GRAVEL, DRY TO MOIST.		26, 27			0	ST-5	-	-	-	-	-	-	-	-	-	-		-	
-ATTEMPTED SHELBY TUBE @ 26.0'. MAXED OUT DOWN PRESSURE AND CRUSHED TUBE.		28, 29			100	ST-6	4.5+	1	5	10	45	39	34	20	14	20	A-6a (10)	-	

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 13640.68, 12' LT.	START: 12/10/20	END: 12/10/20	PG 2 OF 3	B-014-6-20

MATERIAL DESCRIPTION AND NOTES	ELEV. 715.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
VERY STIFF TO HARD, BROWN TO GRAY **SILT AND CLAY**, LITTLE TO SOME COARSE TO FINE SAND, TRACE TO LITTLE FINE GRAVEL, DRY TO MOIST. *(continued)*		31																	
		32	33 12 20	45	44	SS-7	3.50	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
-ATTEMPTED SHELBY TUBE @ 32.5'. MAXED OUT DOWN PRESSURE AND CRUSHED TUBE.		33 34			0	ST-8	-	-	-	-	-	-	-	-	-	-		-	
		35 36 37 38 39 40																	
-LIMESTONE FRAGMENTS IN SS-9		41 42	16 10 50/4"	-	63	SS-9	3.00	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
		43 44 45			67	ST-10	4.00	19	18	14	27	22	34	21	13	13	A-6a (4)	-	
		46 47 48 49 50																	
VERY DENSE, BROWN **GRAVEL WITH SAND**, SOME SILT, TRACE CLAY, MOIST.	695.4	51 52 53																	
		54 55	24 23 31	76	100	SS-11	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	-	
		56 57 58 59 60																	
STIFF, DARK BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.	685.4	61																	

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 13640.68, 12' LT.	START: 12/10/20	END: 12/10/20	PG 3 OF 3	B-014-6-20

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
STIFF, DARK BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST. *(continued)*	683.3	W 681.9																	
-WATER ADDED TO THE AUGERS @ 63.5'		63–65	45 35 42	108	33	SS-12	2.00	-	-	-	-	-	-	-	-	18	A-6a (V)	-	
	675.4	66–69																	
DENSE, BROWN **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST TO WET.		70–72																	
		73	11 8 17	35	17	SS-13	-	-	-	-	-	-	-	-	-	12	A-1-b (V)	-	
-ATTEMPTED SHELBY TUBE @ 74.0'. MAXED OUT DOWN PRESSURE AND CRUSHED TUBE.		74			0	ST-14	-	-	-	-	-	-	-	-	-	-		-	
		75–79																	
		80–85																	
-DUE TO TIME RESTRICTIONS, SPLIT SPOON NOT ATTEMPTED AT 88.0'. ATTEMPTED SHELBY TUBE @ 88.0'. MAXED OUT DOWN PRESSURE AND CRUSHED TUBE.	657.3	86–88 EOB			0	ST-15	-	-	-	-	-	-	-	-	-	-		-	

NOTES: GROUNDWATER INITIALLY ENCOUNTERED @ 63.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 94 LBS CEMENT / 25 LBS BENTONITE POWDER / 26 GAL WATER. PAVEMENT PATCHED WITH CONCRETE .

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.01	DRILLING FIRM / OPERATOR: RII / SB	DRILL RIG: CME 750X - 310218	STATION / OFFSET: 142+45.72 / 49.7' LT
TYPE: BRIDGE REPLACEMENT	SAMPLING FIRM / LOGGER: RII / KS	HAMMER: AUTOMATIC	ALIGNMENT: BL CONST. I-70 EB
PID: 105430 SFN: NA	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 9/14/20	ELEVATION: 715.5 (MSL) EOB: 56.6 ft.
START: 12/15/20 END: 12/15/20	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.2	LAT / LONG: 39.950698, -83.015876

EXPLORATION ID B-014-7-20

MATERIAL DESCRIPTION AND NOTES	ELEV. 715.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
0.2' - TOPSOIL (2.0")	715.3																		
FILL: HARD, GRAY **SILT AND CLAY**, SOME FINE TO COARSE SAND, SOME FINE GRAVEL, DAMP.		1, 2, 3																	
		4	4 5 10	22	0	SS-1	-	-	-	-	-	-	-	-	-	-		-	
-LIMESTONE FRAGMENTS PRESENT THROUGHOUT		5	15	-	67	2S-1A	4.50	26	16	14	20	24	32	21	11	14	A-6a (2)	-	
		6																	
		7	7 9 28	53	83	SS-2	4.50	-	-	-	-	-	-	-	-	15	A-6a (V)	-	
-ATTEMPTED SHELBY TUBES @ 8.0' AND 9.0'. MAXED OUT DOWN PRESSURE AND CRUSHED TUBES.		8			0	ST-3	-	-	-	-	-	-	-	-	-	-		-	
		9			0	ST-4	-	-	-	-	-	-	-	-	-	-		-	
		10, 11																	
HARD, DARK GRAY **CLAY**, "AND" SILT, LITTLE COARSE TO FINE SAND, MOIST.	704.0	12																	
		13	6 7 9	23	44	SS-5	4.50	0	5	7	41	47	46	25	21	23	A-7-6 (14)	-	
		14																	
		15			85	ST-6	4.50	32	10	7	32	19	42	27	15	23	A-7-6 (5)	-	
		16, 17, 18, 19, 20, 21, 22, 23, 24																	
	690.5	W 690.5 25																	
VERY DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, WET.		26																	
-HEAVING SANDS @ 26.5'		27	21 40 49	128	94	SS-7	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	-	
		28	50/5"	-	80	SS-8	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	-	
		29																	
			36																

PID: 105430	SFN: NA	PROJECT: FRA-70-13.01	STATION / OFFSET: 14245.72, 50' LT.	START: 12/15/20	END: 12/15/20	PG 2 OF 2	B-014-7-20

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
VERY DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, WET. *(continued)*	685.5	31	24 23	68	83	SS-9	-	62	15	6	14	3	NP	NP	NP	9	A-1-b (0)	-	
DENSE, BROWN **GRAVEL**, "AND" FINE TO COARSE SAND, TRACE SILT, WET. -COBBLES @ 33.0'	683.5	32, 33, 34																	
		35	13 15 15	43	72	SS-10	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	-	
		36, 37, 38																	
		39	12 14 14	40	78	SS-11	-	54	30	7	9	0	NP	NP	NP	11	A-1-a (0)	-	
	673.5	40, 41, 42																	
HARD, DARK GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP. -LIMESTONE FRAGMENTS IN SS-12		43																	
		44	3 6 10	23	67	SS-12	4.50	23	17	17	31	12	19	14	5	10	A-4a (2)	-	
		45, 46			0	ST-13	-	-	-	-	-	-	-	-	-	-		-	
	667.5	47, 48																	
DENSE TO VERY DENSE, GRAY **GRAVEL**, SOME FINE TO COARSE SAND, TRACE SILT, WET.		49	9 13 18	45	61	SS-14	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	-	
-LIMESTONE FRAGMENTS PRESENT THROUGHOUT		50, 51, 52, 53																	
		54	11 50/5"	-	55	SS-15	-	64	23	6	7	0	NP	NP	NP	9	A-1-a (0)	-	
-COBBLES @ 55.0'		55, 56																	
AUGER REFUSAL @ 56.6'	658.9	EOB	50/1"	-	100	SS-16	-	-	-	-	-	-	-	-	-	8	A-1-a (V)	-	

NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 25.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 100 LBS BENTONITE CHIPS AND SOIL CUTTINGS. .

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-12.68 - PHASE 4A	DRILLING FIRM / OPERATOR: RII / J.B.	DRILL RIG: MOBILE B-53 (SN 624400)	STATION / OFFSET: 5041+24.30 / 73.2' LT
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / A.D.	HAMMER: AUTOMATIC	ALIGNMENT: BL RAMP C5
PID: 77372 BR ID: FRA-70-1301A	DRILLING METHOD: 4.25" HSA	CALIBRATION DATE: 4/26/13	ELEVATION: 746.7 (MSL) EOB: 95.0 ft.
START: 7/25/13 END: 7/30/13	SAMPLING METHOD: SPT	ENERGY RATIO (%): 77.7	LAT / LONG: 39.949844277, -83.017516074

EXPLORATION ID B-015-1-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 746.7	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
0.8' - ASPHALT (9.0")	745.9																	
0.5' - AGGREGATE BASE (6.0")	745.4																	
FILL: VERY STIFF, GRAYISH BROWN TO GRAY **SILT AND CLAY**, LITTLE TO SOME COARSE TO FINE SAND, TRACE TO LITTLE FINE GRAVEL, DAMP. -STONE FRAGMENTS PRESENT IN SS-1		1																
		2	6 13 19	41	67	SS-1	4.00	-	-	-	-	-	-	-	-	9	A-6a (V)	
		3																
		4	3 6 11	22	67	SS-2	3.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
		5																
		6	3 4 7	14	83	SS-3	4.00	-	-	-	-	-	-	-	-	12	A-6a (V)	
		7																
		8																
		9	4 4 4	10	33	SS-4	3.50	13	6	14	41	26	29	16	13	10	A-6a (8)	
		10																
		11																
		12	4 4 7	14	67	SS-5	4.00	-	-	-	-	-	-	-	-	14	A-6a (V)	
		13																
		14	2 2 6	10	67	SS-6	4.00	-	-	-	-	-	-	-	-	12	A-6a (V)	
		15																
		16																
		17	3 13 13	34	33	SS-7	4.00	-	-	-	-	-	-	-	-	13	A-6a (V)	
		18																
		19	5 7 13	26	61	SS-8	3.25	3	8	16	46	27	27	16	11	10	A-6a (8)	
		20																
		21																
		22	3 6 9	19	78	SS-9	3.50	-	-	-	-	-	-	-	-	14	A-6a (V)	
		23																
		24	6 13 9	28	61	SS-10	4.00	-	-	-	-	-	-	-	-	14	A-6a (V)	
	721.2	25																
STIFF, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP.		26																
		27	2 6 7	17	78	SS-11	-	23	24	16	25	12	29	19	10	12	A-4a (0)	
	718.7	28																
VERY DENSE, BROWN **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST.		29	21 28 25	69	83	SS-12	-	-	-	-	-	-	-	-	-	7	A-1-b (V)	

PID: 77372	BR ID: FRA-70-1301A	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5041+24.30 / 73.2 LT	START: 7/25/13	END: 7/30/13	PG 2 OF 4	B-015-1-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
VERY DENSE, BROWN **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST. *(same as above)*	716.7																	
VERY STIFF, DARK BROWN **SILTY CLAY**, SOME FINE GRAVEL, LITTLE COARSE TO FINE SAND, DAMP.	714.7	31, 32, 33, 34, 35	10 6 9	19	83	SS-13	2.50	30	13	7	28	22	37	18	19	17	A-6b (6)	
STIFF TO HARD, DARK GRAY TO BROWN **SANDY SILT**, "AND" GRAVEL, TRACE CLAY, DAMP.	709.7	36, 37, 38, 39, 40	8 11 7	23	33	SS-14	4.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
		41, 42, 43, 44, 45	7 6 7	17	33	SS-15	4.50	-	-	-	-	-	-	-	-	11	A-4a (V)	
		46, 47, 48, 49, 50	8 9 13	28	61	SS-16	2.00	44	9	9	29	9	26	20	6	14	A-4a (1)	
MEDIUM DENSE TO DENSE, BROWNISH GRAY TO GRAY **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST.	694.7	51, 52, 53, 54, 55	6 16 22	49	78	SS-17	-	-	-	-	-	-	-	-	-	8	A-1-b (V)	
-COBBLES PRESENT @ 52.0'		W 56, 57, 58, 59, 60	2 20 5	32	50	SS-18	-	-	-	-	-	-	-	-	-	18	A-1-b (V)	
		61																

PID: 77372	BR ID: FRA-70-1301A	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5041+24.30 / 73.2 LT	START: 7/25/13	END: 7/30/13	PG 3 OF 4	B-015-1-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 684.6	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
MEDIUM DENSE TO DENSE, BROWNISH GRAY TO GRAY **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST. *(same as above)* -HEAVING SANDS ENCOUNTERED @ 63.5'		63																
		64	1 1 26	35	33	SS-19	-	47	29	10	11	3	22	19	3	13	A-1-b (0)	
		65																
		66																
		67																
		68																
		W																
		69	5 10 8	23	100	SS-20	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
		70																
		71																
	674.7	72																
STIFF TO VERY STIFF, GRAY **SANDY SILT**, LITTLE CLAY, LITTLE FINE GRAVEL, DAMP.		73																
		74	8 10 8	23	100	SS-21	2.50	-	-	-	-	-	-	-	-	13	A-4a (V)	
		75																
		76																
		77																
		78																
-SWITCHED TO ROTARY DRILLING TECHNIQUES WITH MUD @ 76.0'		79	9 5 6	14	50	SS-22	2.00	-	-	-	-	-	-	-	-	12	A-4a (V)	
		80																
		81																
		82																
		83																
		84	WOH 5 9	18	100	SS-23	2.00	17	13	17	35	18	21	15	6	7	A-4a (4)	
		85																
		86																
		87																
		88																
		89	2 4 4	10	100	SS-24	1.25	-	-	-	-	-	-	-	-	11	A-4a (V)	
		90																
		91																
		92																
		93																
		94	2															

PID: 77372	BR ID: FRA-70-1301A	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5041+24.30 / 73.2 LT	START: 7/25/13	END: 7/30/13	PG 4 OF 4	B-015-1-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 652.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
	651.7	EOB 95	4 6	13	72	SS-25	1.50	-	-	-	-	-	-	-	-	11	A-4a (V)	

NOTES: SEEPAGE ENCOUNTERED @ 58.5'; GROUNDWATER ENCOUNTERED INITIALLY @ 68.5'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: COMPACTED WITH THE AUGER 100 LBS BENTONITE CHIPS AND SOIL CUTTINGS

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-12.68 - PHASE 4A	DRILLING FIRM / OPERATOR: RII / S.M.	DRILL RIG: CME-750 (SN 98048)	STATION / OFFSET: 5042+88.86 / 2.6' RT
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B.	HAMMER: CME AUTOMATIC	ALIGNMENT: BL RAMP C5
PID: 77372 BR ID: FRA-70-1301A	DRILLING METHOD: 3.75" HSA / RC	CALIBRATION DATE: 4/26/13	ELEVATION: 700.4 (MSL) EOB: 68.5 ft.
START: 6/27/13 END: 6/28/13	SAMPLING METHOD: SPT / NQ	ENERGY RATIO (%): 82.6	LAT / LONG: 39.950018890, -83.017141752

EXPLORATION ID B-015-2-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 700.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
0.4' - TOPSOIL (4.0")	700.0																	
MEDIUM DENSE TO DENSE, BROWN **GRAVEL WITH SAND AND SILT**, TRACE CLAY, DAMP TO MOIST. -TRACE ROOT FIBERS PRESENT IN SS-1		1, 2	10 17 17	47	72	SS-1	-	-	-	-	-	-	-	-	-	5	A-2-4 (V)	
		3																
-COBBLES PRESENT @ 5.0'	694.9	4, 5	6 6 6	17	56	SS-2	-	40	18	12	22	8	25	18	7	11	A-2-4 (0)	
DENSE TO VERY DENSE, GRAY **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, DAMP.		6, 7	6 18 22	55	56	SS-3	-	-	-	-	-	-	-	-	-	5	A-1-b (V)	
		8																
		9	18 19 10	40	56	SS-4	-	59	15	7	16	3	18	17	1	6	A-1-b (0)	
	689.9	W 10																
LOOSE TO MEDIUM DENSE, GRAY **GRAVEL AND SAND**, LITTLE SILT, TRACE CLAY, MOIST TO WET.		W 11, 12	8 4 6	14	33	SS-5	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
		13																
		14, 15	2 3 4	10	33	SS-6	-	-	-	-	-	-	-	-	-	15	A-1-b (V)	
		16																
		17	3 6 4	14	33	SS-7	-	-	-	-	-	-	-	-	-	14	A-1-b (V)	
		18																
		19	17 12 9	29	33	SS-8	-	-	-	-	-	-	-	-	-	10	A-1-b (V)	
-HEAVING SANDS ENCOUNTERED @ 20.0'		20																
-INTRODUCED MUD @ 20.0'		21, 22	16 13 8	29	33	SS-9	-	-	-	-	-	-	-	-	-	24	A-1-b (V)	
	677.4	23																
MEDIUM DENSE TO VERY DENSE, GRAY **GRAVEL**, SOME FINE TO COARSE SAND, TRACE SILT, TRACE CLAY, MOIST.		24, 25	2 7 16	32	33	SS-10	-	-	-	-	-	-	-	-	-	13	A-1-a (V)	
		26																
		27	11 19 21	55	50	SS-11	-	72	18	4	5	1	NP	NP	NP	10	A-1-a (0)	
		28																
		29	6 6 10	22	28	SS-12	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	

PID: 77372	BR ID: FRA-70-1301A	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5042+88.86 / 2.6 RT	START: 6/27/13	END: 6/28/13	PG 2 OF 3	B-015-2-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 670.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
MEDIUM DENSE TO VERY DENSE, GRAY **GRAVEL**, SOME FINE TO COARSE SAND, TRACE SILT, TRACE CLAY, MOIST. *(same as above)*	668.4																	
VERY STIFF TO HARD, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP TO MOIST.		31, 32, 33																
		34, 35	3 14 21	48	50	SS-13	4.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
		36, 37, 38																
		39, 40	11 15 16	43	72	SS-14	4.50	-	-	-	-	-	-	-	-	11	A-4a (V)	
		41, 42, 43																
		44, 45	8 10 16	36	89	SS-15	4.50	23	13	15	32	17	20	12	8	11	A-4a (3)	
		46, 47, 48																
		49, 50	4 9 12	29	89	SS-16	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)	
		51, 52, 53																
		54, 55	4 10 12	30	72	SS-17	4.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
		56, 57, 58																
AUGER REFUSAL @ 58.5'	641.9	TR																
LIMESTONE : DARK AND LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, CHERTY, DOLOMITIC, FOSSILIFEROUS, STYOLITIC, HIGHLY FRACTURED, OPEN APERTURE, VERY ROUGH; RQD 68%, REC 92%.		59	54		100	RC-1											CORE	
		60, 61																

PID: 77372	BR ID: FRA-70-1301A	PROJECT: FRA-70-12.68 - PHASE 4A	STATION / OFFSET: 5042+88.86 / 2.6 RT	START: 6/27/13	END: 6/28/13	PG 3 OF 3	B-015-2-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
LIMESTONE : DARK AND LIGHT GRAY, SLIGHTLY WEATHERED, STRONG, VERY THIN TO THIN BEDDED, CHERTY, DOLOMITIC, FOSSILIFEROUS, STYOLITIC, HIGHLY FRACTURED, OPEN APERTURE, VERY ROUGH; RQD 68%, REC 92%. *(same as above)*	638.3	63	63		87	RC-2											CORE	
-RC-3: VUGGY, TRACE PETROLEUM RESIDUE PRESENT -QU @ 67.6' = 5,771 PSI		64 65 66 67	78		96	RC-3											CORE	
	631.9	68 EOB																

NOTES: SEEPAGE ENCOUNTERED @ 10.0'; GROUNDWATER INITIALLY ENCOUNTERED @ 11.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 141 LBS PORTLAND CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER

B-015-2-13 – RC-1, RC-2, and RC-3 – Depth from 58.5 to 68.5 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / T.F.	DRILL RIG: CME-750X (SN 310218)	STATION / OFFSET: 239+69.30 / 18.7' RT
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B.	HAMMER: CME AUTOMATIC	ALIGNMENT: BL I-71 SB
PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 4.25" HSA / HQ	CALIBRATION DATE: 4/26/13	ELEVATION: 700.3 (MSL) EOB: 63.0 ft.
START: 6/30/14 END: 7/1/14	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 86.8	LAT / LONG: 39.950226, -83.016079

EXPLORATION ID B-108-5-13

PAGE 1 OF 3

MATERIAL DESCRIPTION AND NOTES	ELEV. 700.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.5' - TOPSOIL (6.0")	699.8																	
MEDIUM DENSE, BROWN AND GRAY **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP.	697.3	1–2	3 5 12	25	33	SS-1	-	-	-	-	-	-	-	-	-	6	A-1-b (V)	
STIFF, DARK BROWN **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE FINE GRAVEL, MOIST. -ROCK FRAGMENTS AND ORGANICS PRESENT IN SS-2	694.8	3–5	6 4 4	12	33	SS-2	2.00	20	16	15	30	19	30	17	13	18	A-6a (4)	
MEDIUM DENSE, BROWN TO DARK BROWN **GRAVEL WITH SAND, SILT, AND CLAY**, MOIST.		6–7	2 5 6	16	0	SS-3	-	-	-	-	-	-	-	-	-	-		
-COBBLES PRESENT THROUGHOUT		8	5	-	100	3S-3A	-	-	-	-	-	-	-	-	-	13	A-2-6 (V)	
-ROCK FRAGMENTS PRESENT IN 3S-4A	689.8	9–10	3 5 9	20	0	SS-4	-	-	-	-	-	-	-	-	-	-		
			9	-	100	3S-4A	-	43	17	10	17	13	30	18	12	15	A-2-6 (0)	
MEDIUM DENSE TO DENSE, BROWN **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST.		W 11–12	8 7 7	20	39	SS-5	-	-	-	-	-	-	-	-	-	6	A-1-a (V)	
-COBBLES PRESENT THROUGHOUT		14–15	20 20 8	41	33	SS-6	-	-	-	-	-	-	-	-	-	12	A-1-a (V)	
	682.3	16–17	11 9 10	27	100	SS-7	-	67	17	7	6	3	NP	NP	NP	13	A-1-a (0)	
MEDIUM DENSE, BROWN **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, WET.		19–20	3 5 6	16	100	SS-8	-	3	61	20	11	5	NP	NP	NP	24	A-1-b (0)	
-ROCK FRAGMENTS PRESENT IN SS-9	677.3	21–22	3 6 9	22	78	SS-9	-	-	-	-	-	-	-	-	-	23	A-1-b (V)	
DENSE TO VERY DENSE, GRAY TO BROWN **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST.		24–25	9 12 13	36	67	SS-10	-	-	-	-	-	-	-	-	-	6	A-1-a (V)	
		26–27	11 14 15	42	89	SS-11	-	67	15	7	8	3	17	14	3	10	A-1-a (0)	
-COBBLES PRESENT THROUGHOUT		29	50/3"	-	100	SS-12	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 239+69.30 / 18.7 RT	START: 6/30/14	END: 7/1/14	PG 2 OF 3	B-108-5-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 670.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
DENSE TO VERY DENSE, GRAY TO BROWN **GRAVEL**, SOME COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST. *(same as above)*	668.3	31																
DENSE, BROWN AND BLACK **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST. -ROCK FRAGMENTS PRESENT IN SS-13	663.3	32, 33, 34, 35, 36, 37, 38	7 10 13	33	61	SS-13	-	43	43	8	4	2	NP	NP	NP	12	A-1-b (0)	
VERY STIFF TO HARD, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP.		39, 40	19 9 12	30	67	SS-14	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	
		41, 42, 43, 44, 45	11 9 12	30	83	SS-15	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)	
		46, 47, 48, 49, 50	8 9 10	27	67	SS-16	4.00	21	12	16	32	19	20	12	8	11	A-4a (3)	
-ROCK FRAGMENTS PRESENT IN SS-17 AUGER REFUSAL @ 54.5 FEET	645.8	51, 52, 53, 54	22 50/5"	-	100	SS-17	4.5+	-	-	-	-	-	-	-	-	10	A-4a (V)	
LIMESTONE : BLUISH GRAY TO LIGHT BROWN AND GRAY, UNWEATHERED, VERY STRONG, VERY THICK BEDDED, CALCAREOUS, SILICEOUS, FOSSILIFEROUS, VUGGY, SLIGHTLY FRACTURED TO FRACTURED, TIGHT TO OPEN APERTURES, SLIGHTLY TO VERY ROUGH; RQD 79%, REC 95%. -QU @ 56.8' = 11,933 PSI		TR 55, 56, 57, 58, 59	79		100	RC-1											CORE	
-DOLOMITIC AND SLIGHTLY TO HIGHLY FRACTURED FROM 59.5' TO 63.0'		60, 61	79		87	RC-2											CORE	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 239+69.30 / 18.7 RT	START: 6/30/14	END: 7/1/14	PG 3 OF 3	B-108-5-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 638.2	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
	637.3	EOB 63																

NOTES: GROUNDWATER ENCOUNTERED INITIALLY @ 11.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER

B-108-5-13 – RC-1 and RC-2 – Depth from 54.5 to 63.0 feet

RESOURCE INTERNATIONAL, INC.

PROJECT: FRA-70-13.10 - PHASE 6A	DRILLING FIRM / OPERATOR: RII / R.B.	DRILL RIG: CME-750X (SN 310218)	STATION / OFFSET: 242+23.02 / 20.7' RT	EXPLORATION ID B-108-6-13
TYPE: STRUCTURE	SAMPLING FIRM / LOGGER: RII / S.B.	HAMMER: CME AUTOMATIC	ALIGNMENT: BL I-71 SB	
PID: 89464 BR ID: FRA-71-1503L	DRILLING METHOD: 4.25" HSA / NQ	CALIBRATION DATE: 4/26/13	ELEVATION: 714.5 (MSL) EOB: 67.1 ft.	PAGE 1 OF 3
START: 7/7/14 END: 7/8/14	SAMPLING METHOD: SPT / RC	ENERGY RATIO (%): 86.8	LAT / LONG: 39.950860, -83.015750	

MATERIAL DESCRIPTION AND NOTES	ELEV. 714.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
0.2' - TOPSOIL (2.0")	714.3																	
FILL: MEDIUM DENSE TO DENSE, BROWN **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, DAMP. -BRICK AND CONCRETE FRAGMENTS PRESENT THROUGHOUT	709.0	1 2	9 13 10	33	67	SS-1	-	-	-	-	-	-	-	-	-	7	A-2-4 (V)	
		3 4 5	5 6 7	19	72	SS-2	-	50	16	5	15	14	NP	NP	NP	6	A-2-4 (0)	
FILL: MEDIUM STIFF, BLACK **SILT AND CLAY**, SOME COARSE TO FINE SAND, TRACE FINE GRAVEL, MOIST.	706.5	6 7	3 2 3	7	78	SS-3	-	-	-	-	-	-	-	-	-	19	A-6a (V)	
FILL: MEDIUM DENSE, BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST.	704.0	8 9	7 7 4	16	11	SS-4	-	-	-	-	-	-	-	-	-	5	A-1-a (V)	
		10	5	-	100	3S-4A	-	-	-	-	-	-	-	-	-	9	A-1-a (V)	
FILL: MEDIUM STIFF TO STIFF, GRAY TO BROWNISH GRAY **SILT AND CLAY**, SOME COARSE TO FINE SAND, LITTLE TO SOME FINE GRAVEL, DAMP TO MOIST.		11 12 W	2 3 3	9	44	SS-5	1.50	22	24	11	25	18	26	15	11	12	A-6a (2)	
-ASPHALT AND COAL FRAGMENTS PRESENT IN SS-6		13 14 15	4 3 5	12	33	SS-6	1.75	-	-	-	-	-	-	-	-	21	A-6a (V)	
		16 17	1 2 3	7	94	SS-7	1.00	16	12	11	28	33	31	19	12	24	A-6a (6)	
-BRICK FRAGMENTS PRESENT THROUGHOUT		18 19 20	2 2 3	7	67	SS-8	0.75	-	-	-	-	-	-	-	-	21	A-6a (V)	
		21 22	1 10 22	46	72	SS-9	1.75	-	-	-	-	-	-	-	-	24	A-6a (V)	
		23 24 25	12 5 3	12	61	SS-10	1.50	12	16	12	30	30	31	20	11	20	A-6a (5)	
FILL: MEDIUM STIFF TO STIFF, BROWNISH GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP.	689.0	26 27	4 5 3	12	67	SS-11	1.75	-	-	-	-	-	-	-	-	15	A-4a (V)	
		28 29	4 2 4	9	44	SS-12	1.25	33	20	10	18	19	25	19	6	17	A-4a (0)	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 242+23.02 / 20.7 RT	START: 7/7/14	END: 7/8/14	PG 2 OF 3	B-108-6-13

MATERIAL DESCRIPTION AND NOTES	ELEV. 684.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
FILL: MEDIUM STIFF TO STIFF, BROWNISH GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP. *(same as above)* -BRICK, ASPHALT AND COAL FRAGMENTS PRESENT THROUGHOUT		31, 32, 33, 34, 35, 36, 37, 38	3 3 3	9	44	SS-13	1.00	-	-	-	-	-	-	-	-	18	A-4a (V)	
MEDIUM DENSE TO VERY DENSE, BROWN TO GRAYISH BROWN **GRAVEL**, LITTLE COARSE TO FINE SAND, TRACE SILT, TRACE CLAY, MOIST. -HEAVING SANDS ENCOUNTERED @ 40.0' -INTRODUCED MUD @ 40.0' -ROCK FRAGMENTS PRESENT THROUGHOUT	677.5	W, 39, 40, 41, 42, 43, 44, 45, 46	1 11 7	26	83	SS-14	-	-	-	-	-	-	-	-	-	11	A-1-a (V)	
			13 15 22	54	100	SS-15	-	81	9	3	4	3	NP	NP	NP	9	A-1-a (0)	
HARD, GRAY **SANDY SILT**, SOME FINE GRAVEL, LITTLE CLAY, DAMP.	667.5	47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57	15 23 35	84	50	SS-16	4.50	26	14	10	29	21	20	15	5	10	A-4a (3)	
			50/5"	-	0	SS-17	-	-	-	-	-	-	-	-	-	-		
AUGER REFUSAL @ 57.5'	657.0	TR, 58, 59, 60, 61																
LIMESTONE : GRAY, UNWEATHERED, VERY STRONG, VERY THICK BEDDED, CALCAREOUS, SILICEOUS, CHERTY, DOLOMITIC, PYRITIC, MODERATELY TO HIGHLY FRACTURED, OPEN APERTURES, SLIGHTLY ROUGH; RQD 73%, REC 99%. -QU @ 59.6' = 8,033 PSI			55		100	RC-1											CORE	

PID: 89464	BR ID: FRA-71-1503L	PROJECT: FRA-70-13.10 - PHASE 6A	STATION / OFFSET: 242+23.02 / 20.7 RT	START: 7/7/14	END: 7/8/14	PG 3 OF 3	B-108-6-13

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	HOLE SEALED
LIMESTONE : GRAY, UNWEATHERED, VERY STRONG, VERY THICK BEDDED, CALCAREOUS, SILICEOUS, CHERTY, DOLOMITIC, PYRITIC, MODERATELY TO HIGHLY FRACTURED, OPEN APERTURES, SLIGHTLY ROUGH; RQD 73%, REC 99%. *(same as above)*	652.4	63	90		98	RC-2											CORE	
		64																
		65																
		66																
	647.4	EOB 67																

NOTES: SEEPAGE ENCOUNTERED @ 12.5'; GROUNDWATER ENCOUNTERED INITIALLY @ 38.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PUMPED 188 LBS CEMENT / 50 LBS BENTONITE POWDER / 40 GAL WATER

B-108-6-13 – RC-1 and RC-2 – Depth from 57.5 to 67.1 feet

APPENDIX IV

HISTORIC BORING LOGS:

B-003-E-68 and B-012-E-68

B-003-E-68

LOG OF BORING

Date Started 7-15-68 | Sampler Typ. SS | Dia 1 3/8" | Water Elev _____

Date Completed 7-17-68 | Casing Length 55' | Dia 3 1/2"

Boring No B-3 | Station & Offset 494+81, 19' Lt. (First Pier) | Surface Elev 719.0'

Elev.	Depth	Std Pen (N)	Rec ft.	Loss ft.	Description	Sample No	% Agg	% C S	% F S	% Silt	% Clay	L L	P I	W C	SHTL Class.
719.0	0														
	2														
	4														
714.0	6	11/14			Brownish-Gray Sandy Gravelly Silt	1	40	9	8	18	25	28	9	22	A-4a
	8														
709.0	10	14/16			Brown Gravelly Sand (Wash Sample)	2	37	53	4	- 6	-	NP	NP	22	A-1-b
	12														
	14														
704.0	16	10/12			Gray Silt and Clay, Slightly Organic	3	0	5	11	36	48	44	16	22	A-7-6
	18														
699.0	20	50* (0.7')			Brown Silty Sandy Gravel	4	66	12	7	-15	-	NP	NP	14	A-1-a
	22														
	24														
694.0	26	50*/ (0.4')			Brown Silty Sandy Gravel	5	65	16	7	-12	-	NP	NP	9	A-1-a
	28														
689.0	30	50* (0.7')			Gray Gravel	6	90	6	2	- 2	-	NP	NP	29	A-1-a
	32														
	34														
684.0	36	9/4			Brown Gravel	7	81	7	4	- 8	-	NP	NP	9	A-1-a
	38														
679.0	40	11/17			Brown Silty Sandy Gravel	8	72	9	7	-12	-	NP	NP	4	A-1-a
	42														
	44														
674.0	46	27/27			Gray Sandy Gravel	9	72	14	6	- 8	-	NP	NP	10	A-1-a
	48														
669.0	50	12/14			Gray Silty Sand	10	12	56	19	-13	-	NP	NP	20	A-1-b
	52														
	54														
664.0	56	10/15			Brown Gravelly Sandy Silt	11	24	13	16	24	23	19	6	10	A-4a
	58														
659.0	60	15/16			Gray Gravelly Sandy Silt	12	22	16	17	24	21	20	7	10	A-4a
	62														
	64														
654.0	66	11/13			Gray Gravelly Sandy Silt	13	16	13	17	23	31	21	9	14	A-4a
	68														
649.0	70	50/*			TOP OF ROCK										
	72		4.5	0.0	Limestone, light-gray, hard, dense, crystalline, few fossils, few chert seams. No Core Loss.										
	74														
644.0					BOTTOM OF BORING										

*Refusal

B-012-E-68

LOG OF BORING

Date Started 7-11-68 | Sampler Type SS | Dia 1 3/8"
Date Completed 7-17-68 | Casing Length 58' | Dia 3 1/2"
Boring No B-12 | Station & Offset 498+62, 65' Rt. (5th Pier)

Water Elev _____
Surface Elev 705.0'

Elev.	Depth	Std Pen (N)	Rec ft.	Loss ft.	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	SHTL Class.
705.0	0														
702.5	2														
	4				No Sample Recovered (Hole Caved in)		V	I		S		U	A	L	
700.0	6	9/9			Brown Sandy Gravel	1	51	43	3	- 3	-	NP	NP	13	A-1-a
697.5	8				No Sample Recovered (Hole Caved in)		V	I		S		U	A	L	
695.0	10	6/3			Brown Silty Sandy Gravel	2	49	27	9	-15	-	NP	NP	18	A-1-b
	12														
	14														
690.0	16	3/1			Brown Sandy Gravel	3	67	24	3	- 6	-	NP	NP	10	A-1-a
	18														
685.0	20	23/24			Brown Silty Sandy Gravel	4	68	12	8	-12	-	NP	NP	8	A-1-a
	22														
	24														
680.0	26	15/12			Brown Sandy Gravel	5	70	16	6	- 8	-	NP	NP	12	A-1-a
	28														
675.0	30	50*/ (0.4')			Gray Gravel	6	90	8	1	- 1	-	NP	NP	4	A-1-a
	32														
	34														
670.0	36	50* (0.9')			Gray Silty Sandy Gravel	7	38	23	11	17	11	16	4	14	A-2-4
	38														
665.0	40	11/15			Gray Sandy Gravelly Silt	8	35	9	13	23	20	NP	NP	12	A-4a
	42														
	44														
660.0	46	50* (0.6')			Gray Gravelly Sandy Silt	9	25	17	16	19	23	19	6	15	A-4a
	48														
655.0	50	11/12			Gray Silty Sandy Gravel	10	44	11	12	15	18	-	-	10	A-2-4
	52														
	54														
650.0	56	23/27			Gray Silty Sandy Gravel	11	52	15	13	-20	-	NP	NP	10	A-1-b
647.0	58				TOP OF ROCK										
645.0	60		2.0	0.0	Limestone, light-gray, hard, dense, crystalline, few small fossils. No Core Loss.										

BOTTOM OF BORING

*Refusal

APPENDIX V

LABORATORY TESTS RESULTS

One-Dimensional Consolidation Test Report (ASTM D2435)

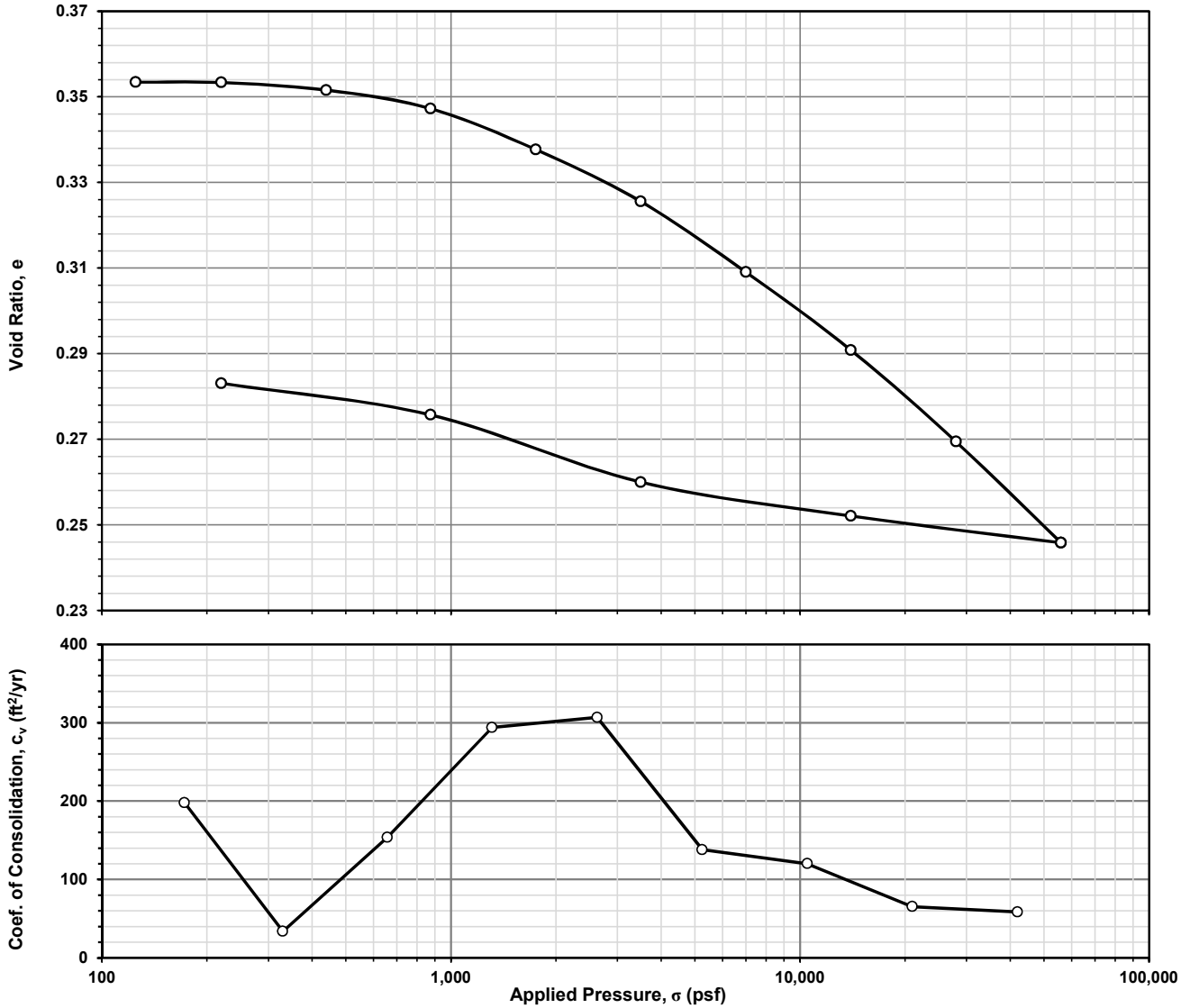
Project Number:	W-20-025	Boring Number:	B-014-6-20
Project Name:	FRA-70-13.01	Sample No. / Depth:	ST-3 / 10.0'
Project Location:	Franklin County, Ohio	Date of Testing:	12/21/2020 to 01/02/2021
Client:	ODOT	Technician:	E.Mesko

Soil Description: Gray Silt and Clay, some coarse to fine sand, trace fine gravel.
Soil Classification: ODOT A-6a (7)

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	27	15	12	8.0	9.0	16.0	31.0	36.0

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	σ_p' [1] (psf)	c_c [1]	c_r [1]
S_o	w_o								
99.5%	13.6%	123.0	139.2	1,200	2.67	0.355	3,819	0.080	0.016

1. The vaules listed for σ_p', c_c and c_r are interpreted by Rii using Cassagrande and Schemertman methods. Other interpretation methods may be utilized.



Notes:

One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number:	W-20-025	Boring Number:	B-014-6-20
Project Name:	FRA-70-13.01	Sample No. / Depth:	ST-6 / 28.6-28.8'
Project Location:	Franklin County, Ohio	Date of Testing:	12/16/2020 to 12/28/2020
Client:	ODOT	Technician:	C.Straub

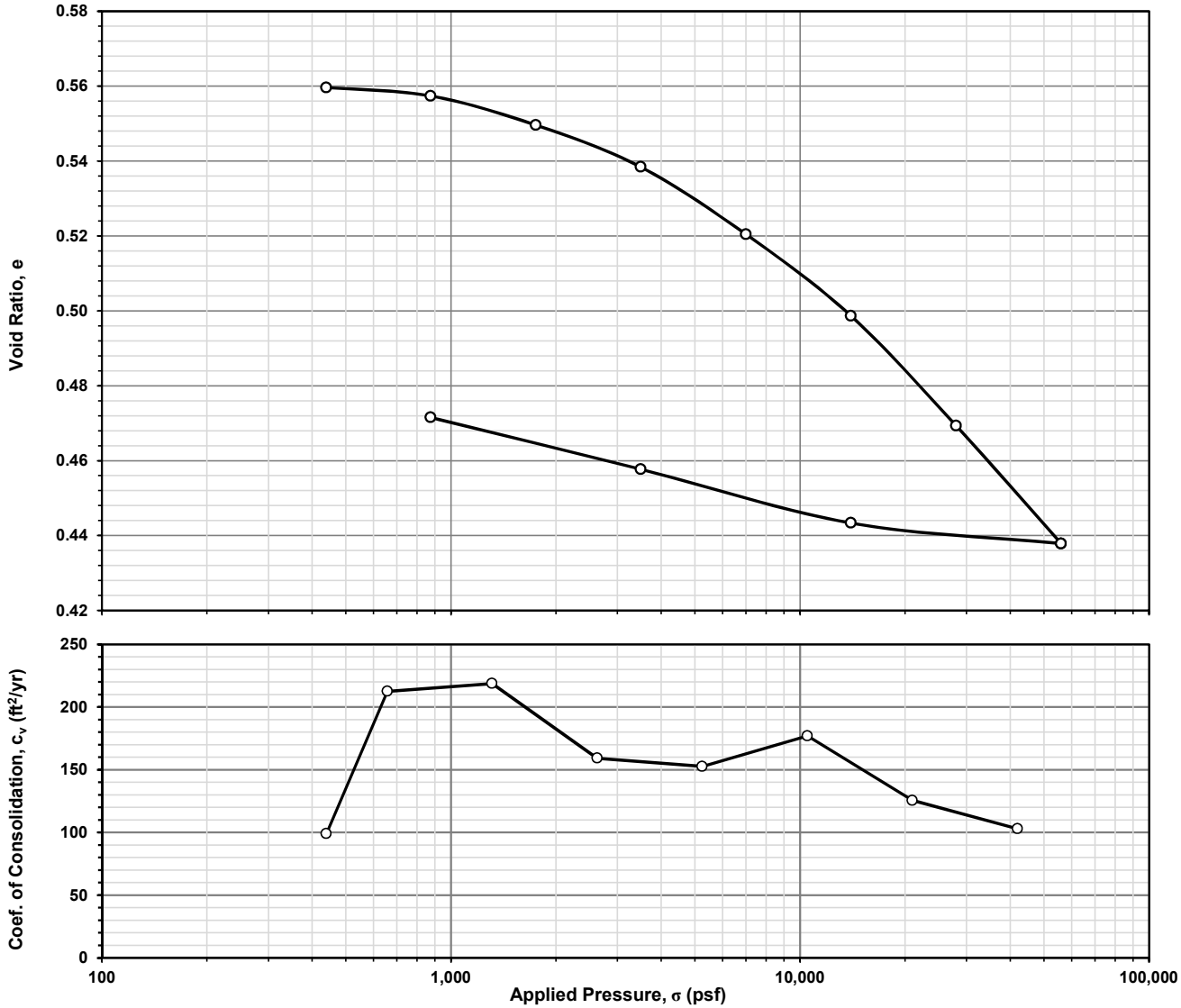
Soil Description: Brown Silt and Clay, little coarse to fine sand, trace fine gravel.

Soil Classification: ODOT A-6a (10)

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	34	20	14	1.0	5.0	10.0	45.0	39.0

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	σ_p' [1] (psf)	c_c [1]	c_r [1]
S_o	w_o								
91.6%	19.8%	106.2	126.8	3,575	2.659	0.563	6,151	0.109	0.023

1. The vaules listed for σ_p', c_c and c_r are interpreted by Rii using Cassagrande and Schemertman methods. Other interpretation methods may be utilized.



Notes:

One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number:	W-20-025	Boring Number:	B-014-6-20
Project Name:	FRA-70-13.01	Sample No. / Depth:	ST-10 / 44.8'
Project Location:	Franklin County, Ohio	Date of Testing:	12/31/2020 to 01/13/2021
Client:	ms consultants, inc.	Technician:	C.Straub

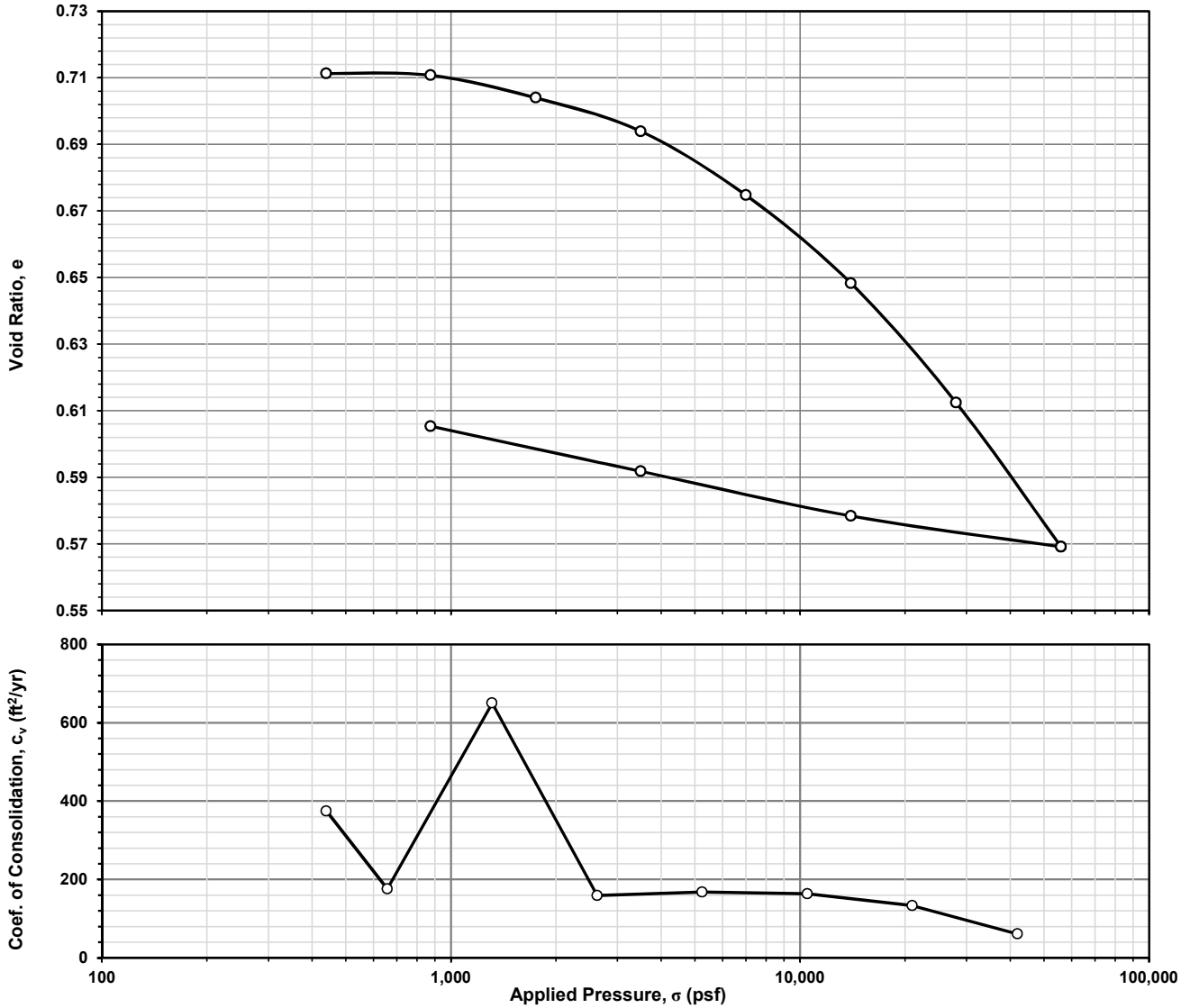
Soil Description: Gray Silt and Clay, some coarse to fine sand, little fine gravel.

Soil Classification: ODOT A-6a

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	34	21	13	18.9	18.1	13.9	26.8	22.3

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	σ_p' [1] (psf)	c_c [1]	c_r [1]
S_o	w_o								
90.6%	24.4%	98.1	121.4	5,600	2.67	0.698	8,157	0.137	0.018

1. The vaules listed for σ_p', c_c and c_r are interpreted by Rii using Cassagrande and Schemertman methods. Other interpretation methods may be utilized.



Notes: Several rocks were in test sample.

One-Dimensional Consolidation Test Report (ASTM D2435)

Project Number:	W-20-025	Boring Number:	B-014-7-20
Project Name:	FRA-70-13.01	Sample No. / Depth:	ST-6 / 14.8'
Project Location:	Franklin County, Ohio	Date of Testing:	01/07/2021 to 01/20/2021
Client:	ms consultants, inc.	Technician:	E.Mesko

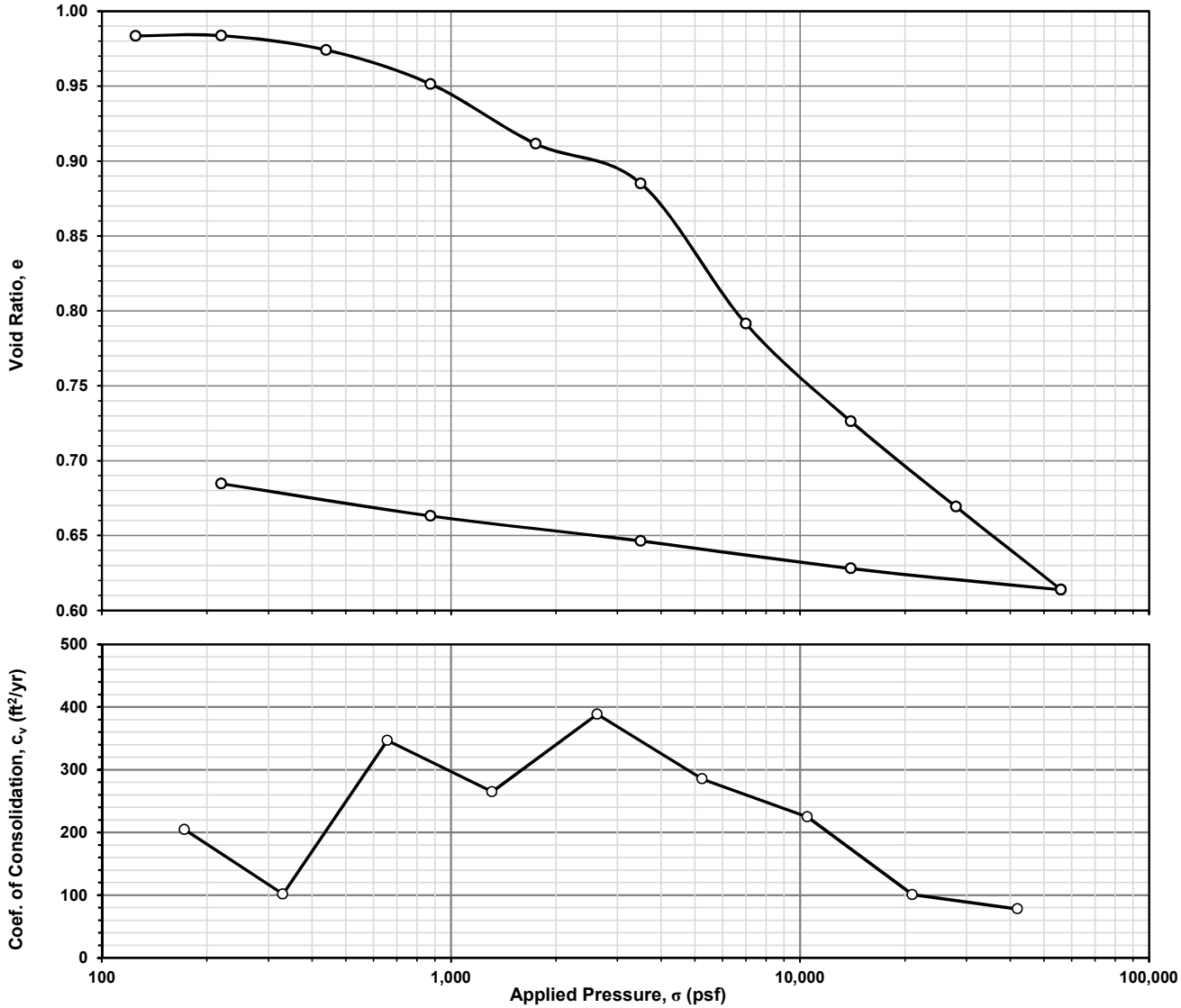
Soil Description: Dark gray CLAY, some silt, some fine gravel, little coarse to fine sand

Soil Classification: ODOT A-7-6

Physical Characteristics	L.L.	P.L.	P.I.	Gravel%	C. Sand%	F. Sand%	Silt%	Clay%
	42	27	15	31.6	9.8	7.5	32.5	18.6

Natural		γ_d (pcf)	γ_{sat} (pcf)	σ_{vo}' (psf)	S_G	e_o	σ_p' [1] (psf)	c_c [1]	c_r [1]
S_o	w_o								
68.5%	23.3%	86.0	107.2	1,702	2.737	0.987	1,710	0.234	0.029

1. The vaules listed for σ_p', c_c and c_r are interpreted by Rii using Cassagrande and Schemertman methods. Other interpretation methods may be utilized.



Notes: Two rocks were contained within the test specimen.

RESOURCE INTERNATIONAL, INC.

Engineering Consultants

Unconfined Compressive Strength of Intact Rock Core Specimens (ASTM D 7012-04)

6350 Presidential Gatew.
Columbus, OH 43231
Phone (614) 823-4949

9885 Rockside Road
Cleveland, OH 44125
Phone (216) 573-0955

4480 Lake Forest Drive
Cincinnati, Ohio 45242
Phone (513) 769-6998

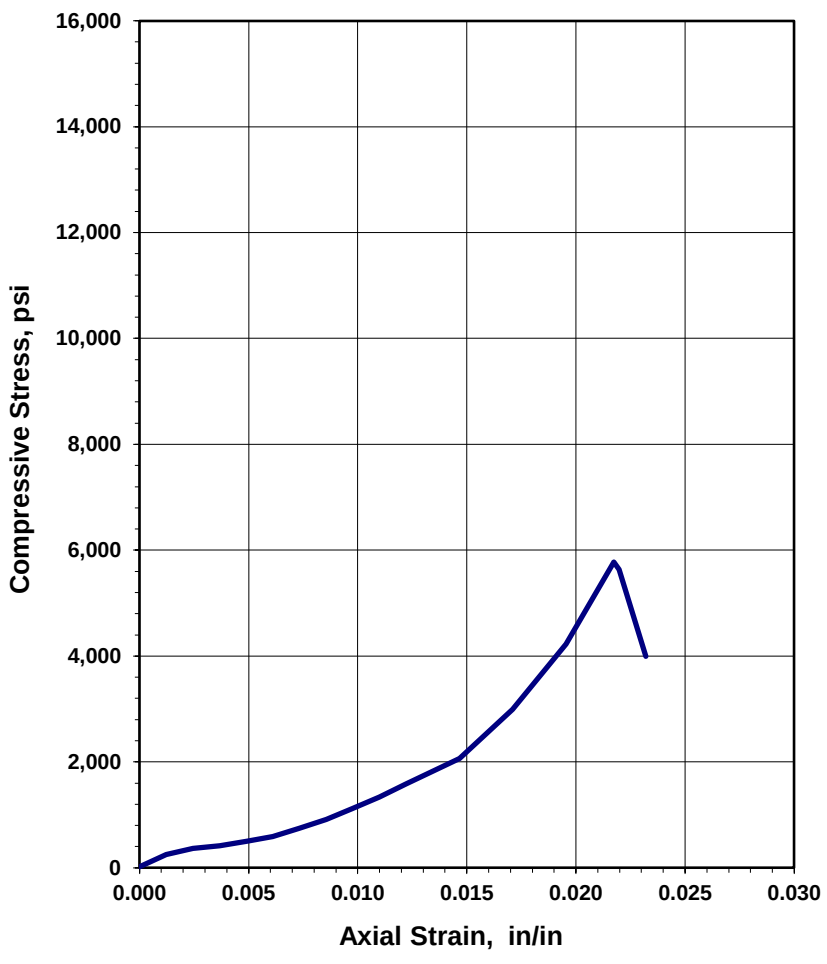
Project: FRA-70-12.68
Project No.: W-13-045
Date of Testing: 7/12/2013
Test Performed by: JJH/TK

Rock Description: LIMESTONE: Light gray, slightly weathered, strong.

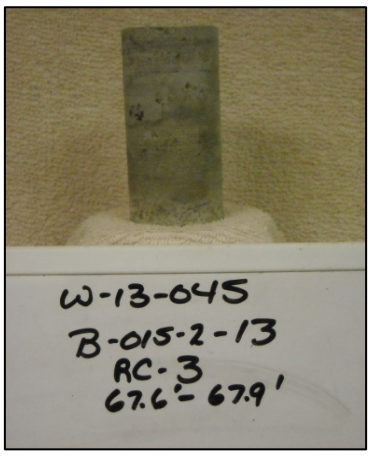
Boring No.:	B-015-2-13	Average Length:	4.094 in
Station / Offset:	5042+88.86, 2.6' Rt.	Average Diameter:	1.872 in
Sample No. / Depth:	RC-3 / 67.6 ft.	Length to diameter ratio:	2.187
Moisture condition:	As received	Cross Sectional Area:	2.751 in^2
		Failure Load:	15,880 lbs
Rate of Loading:	79.4 lbs/sec	Axial Strain at Failure:	0.0217 in/in
Testing Time:	200 sec	Stress:	5,771 psi

(Rate 2-15 minutes to failure)

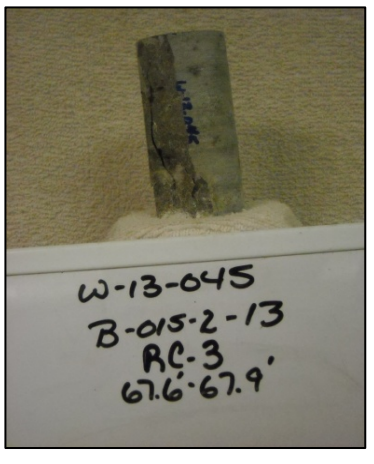
Unconfined Compression Test



Before Testing



After Failure



REMARKS:

RESOURCE INTERNATIONAL, INC.

Engineering Consultants

Unconfined Compressive Strength

of Intact Rock Core Specimens (ASTM D 7012-04)

6350 Presidential Gatew.	9885 Rockside Road	4480 Lake Forest Drive
Columbus, OH 43231	Cleveland, OH 44125	Cincinnati, Ohio 45242
Phone (614) 823-4949	Phone (216) 573-0955	Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

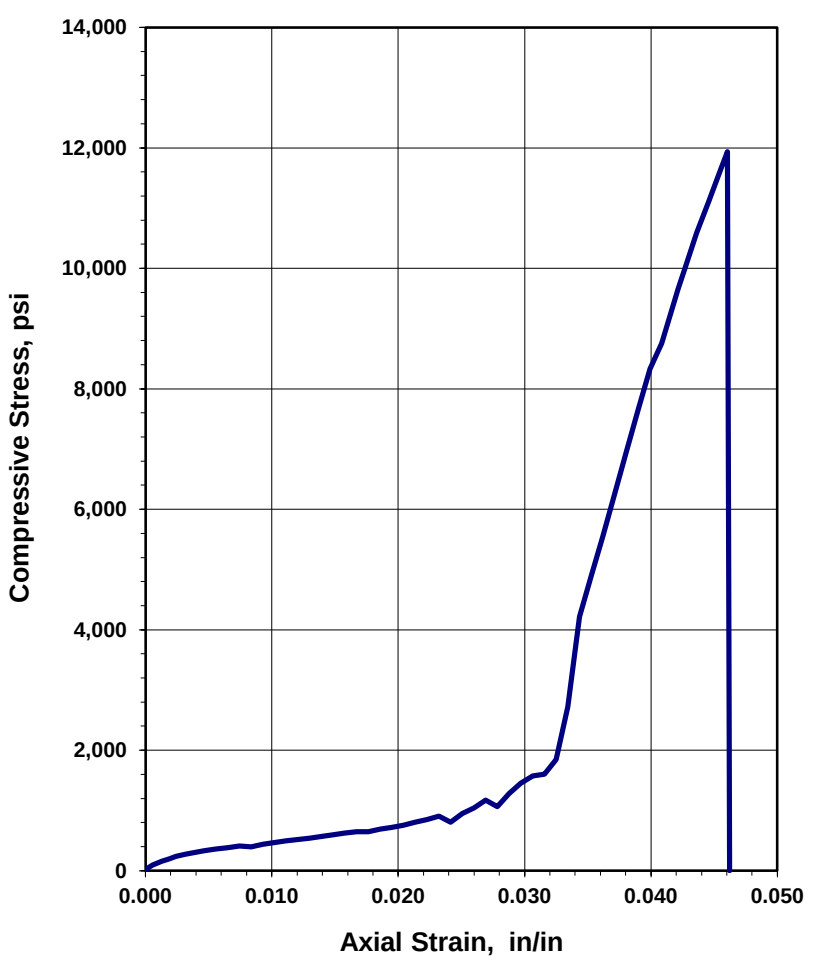
Date of Testing: 7/3/2014

Test Performed by: K.R./T.K.

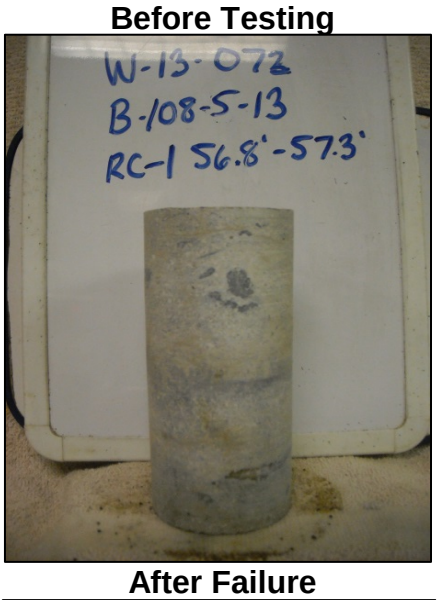
Rock Description: Dolomitic Limestone

Boring No.:	B-108-5-13	Average Length:	5.386 in
Station / Offset:	239+69.30, 18.7' Rt.	Average Diameter:	2.408 in
Sample No. / Depth:	RC-1 / 56.8 ft	Length to diameter ratio:	2.237
Moisture condition:	As received	Cross Sectional Area:	4.552 in^2
Rate of Loading:	72.6 lbs/sec	Failure Load:	54,340 lbs
Testing Time:	749 sec	Axial Strain at Failure:	0.0460 in/in
	(Rate 2-15 minutes to failure)	Stress:	11,933 psi

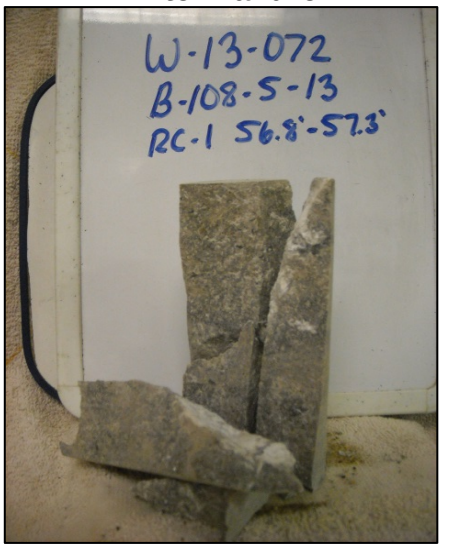
Unconfined Compression Test



Before Testing



After Failure



REMARKS:

RESOURCE INTERNATIONAL, INC.

Engineering Consultants

Unconfined Compressive Strength

of Intact Rock Core Specimens (ASTM D 7012-04)

6350 Presidential Gatew.	9885 Rockside Road	4480 Lake Forest Drive
Columbus, OH 43231	Cleveland, OH 44125	Cincinnati, Ohio 45242
Phone (614) 823-4949	Phone (216) 573-0955	Phone (513) 769-6998

Project: FRA-70-13.10 - Project 6A

Project No.: W-13-072

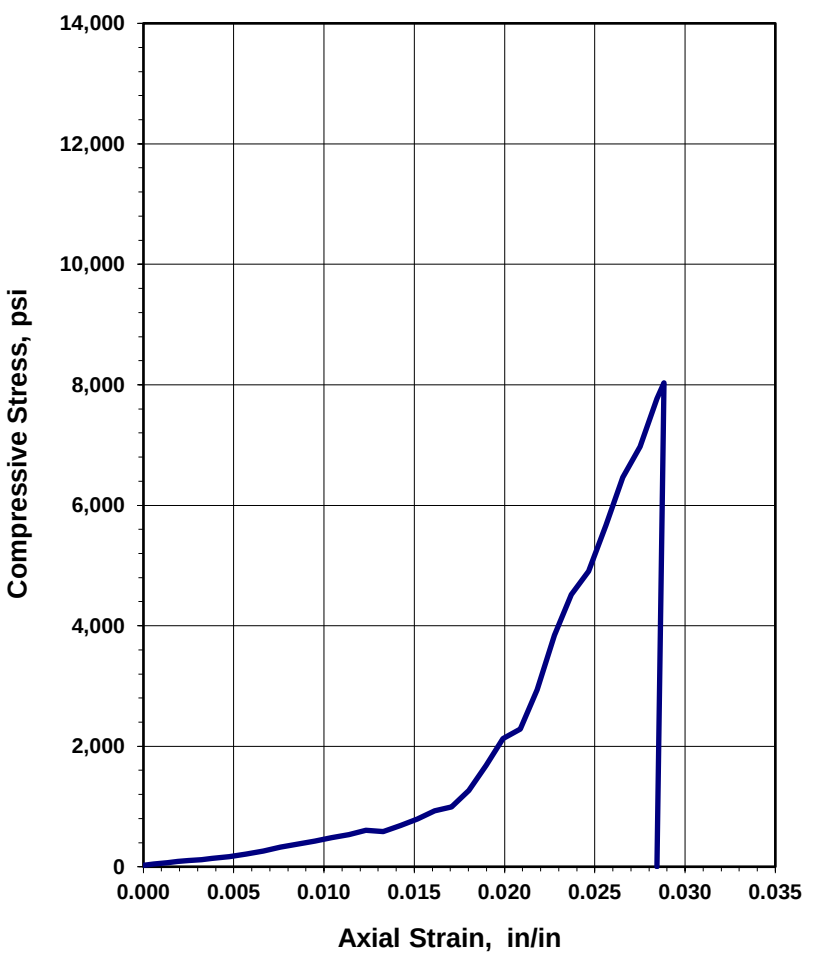
Date of Testing: 7/9/2014

Test Performed by: K.R./T.K.

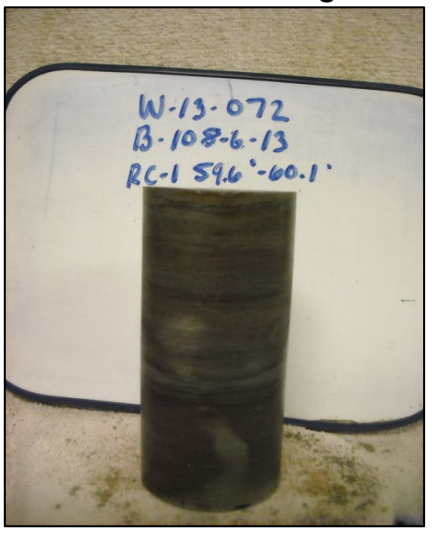
Rock Description: Dolomitic Limestone

Boring No.:	B-108-6-13	Average Length:	5.272 in
Station / Offset:	242+23.02, 20.7' Rt.	Average Diameter:	2.398 in
Sample No. / Depth:	RC-1 / 59.6 ft	Length to diameter ratio:	2.198
Moisture condition:	As received	Cross Sectional Area:	4.514 in^2
Rate of Loading:	63.5 lbs/sec	Failure Load:	36,270 lbs
Testing Time:	571 sec	Axial Strain at Failure:	0.0288 in/in
	(Rate 2-15 minutes to failure)	Stress:	8,033 psi

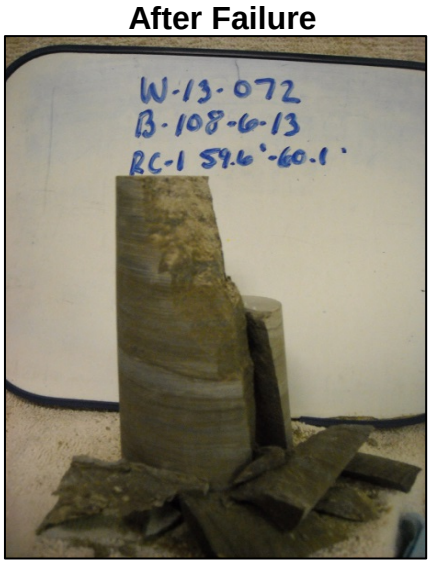
Unconfined Compression Test



Before Testing



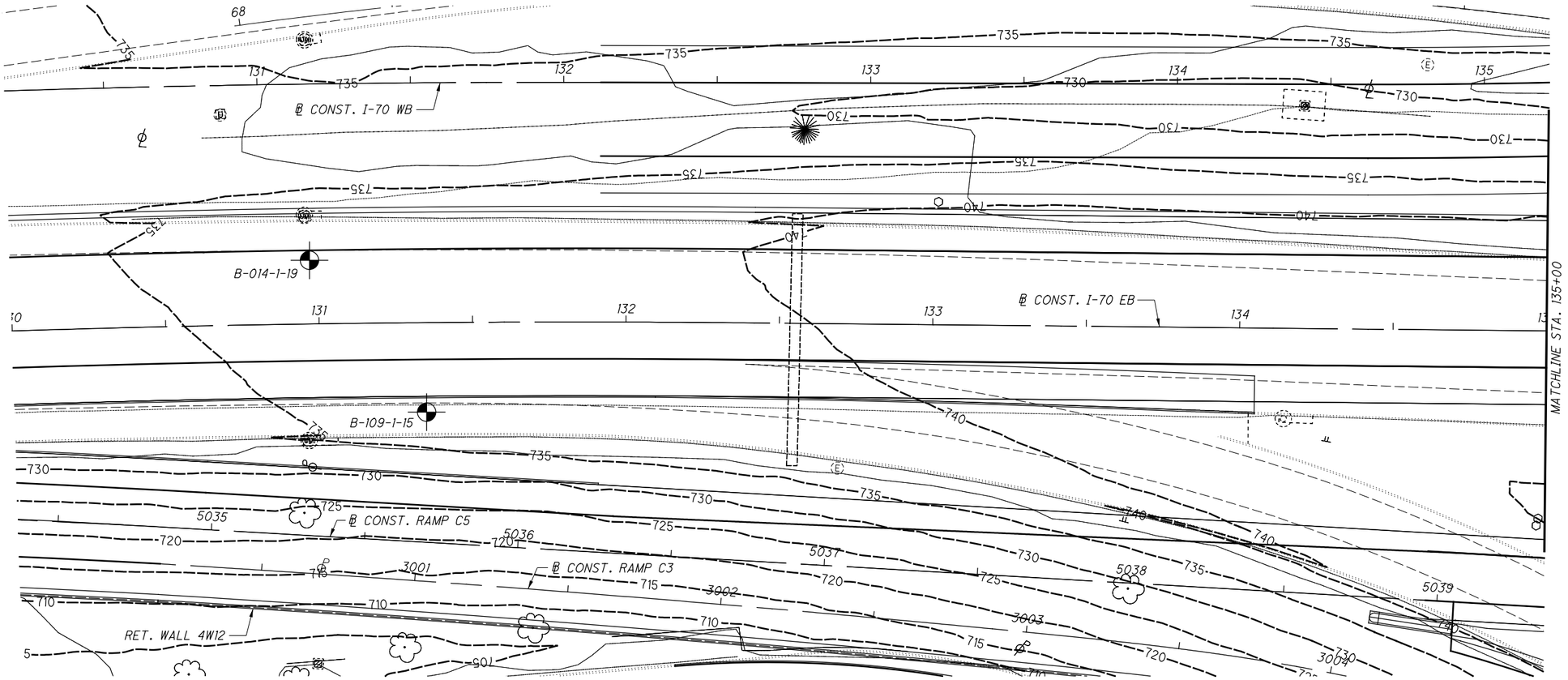
After Failure

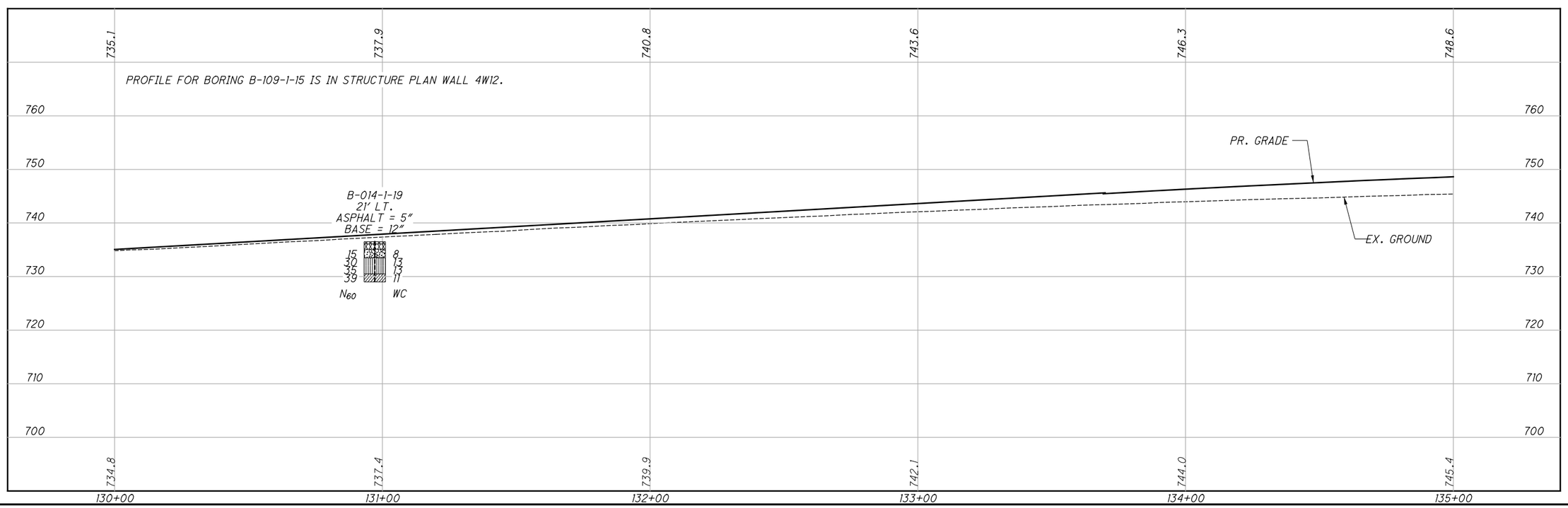


REMARKS:

APPENDIX VI

STRUCTURE FOUNDATION EXPLORATION SHEETS





HORIZONTAL SCALE IN FEET

DRAWN RRM
CHECKED BRT

SOIL PROFILE
I-70 EB STA. 130+00 TO STA. 135+00

FRA-70-13.01

109A496

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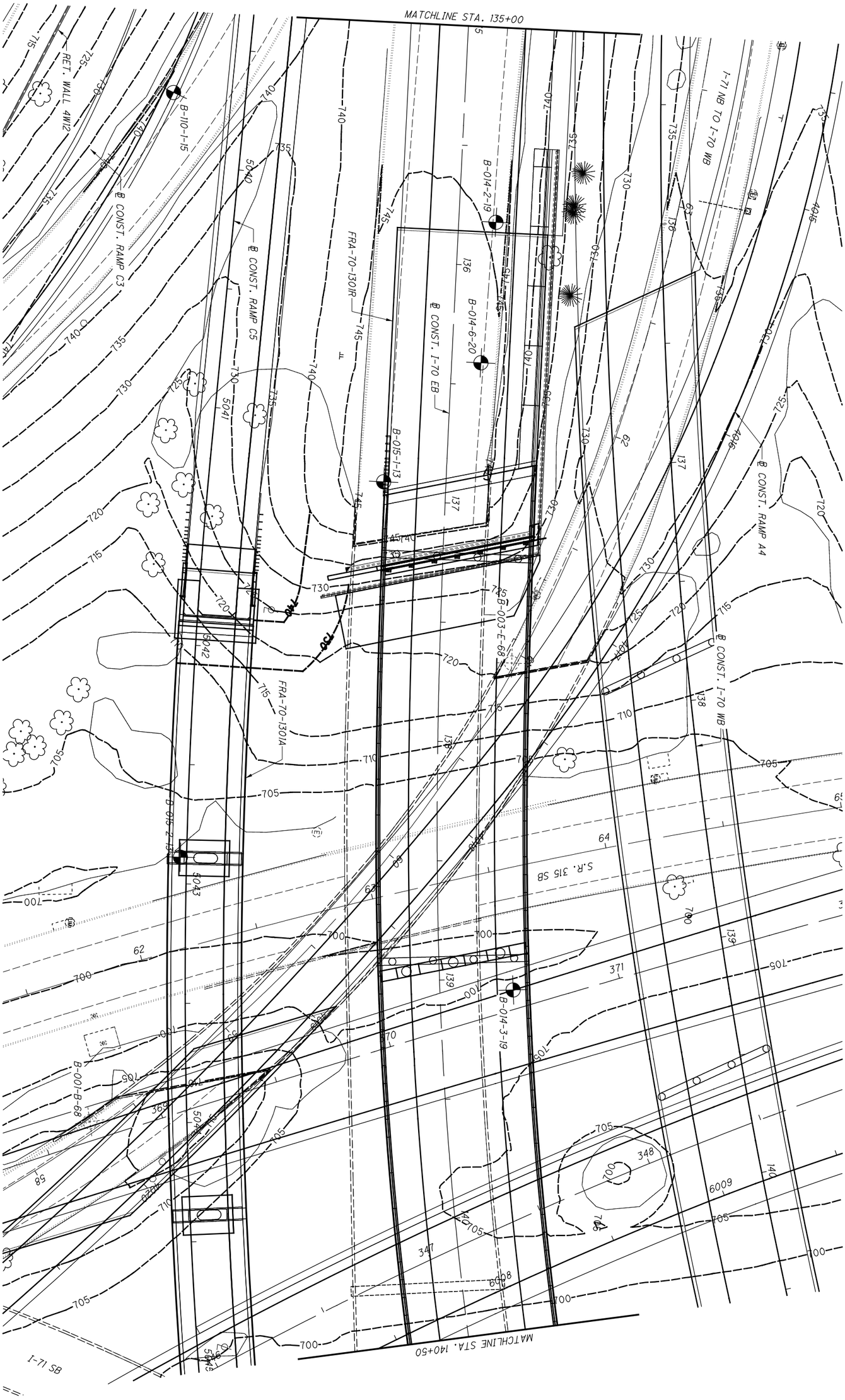
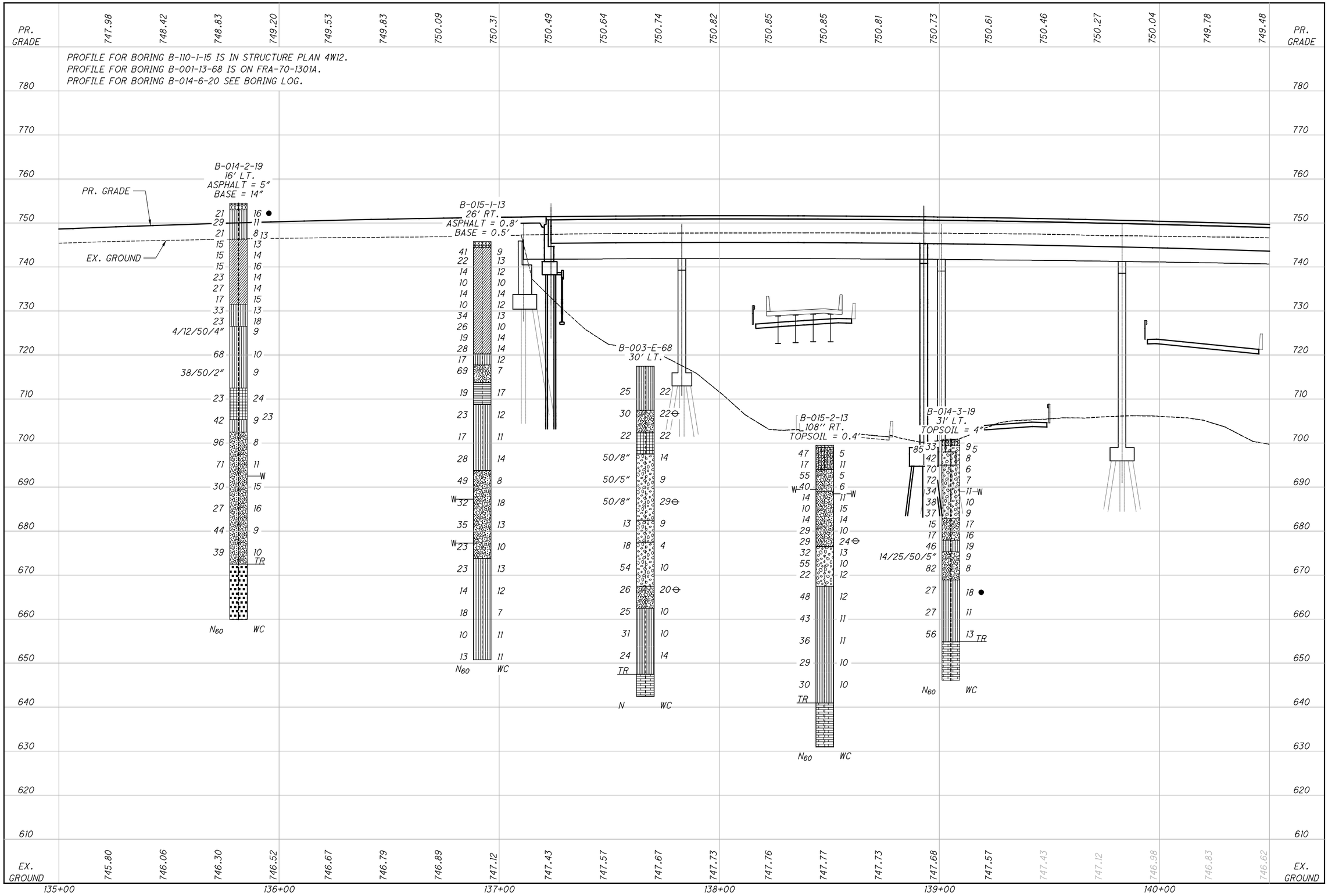


1	06/24/21	FRA-70-13.01	STRUCTURE FOUNDATION EXPLORATION FRA-70-1301R I-70 EB OVER SR 315 STA. 135+00 TO STA. 140+50	DRAWN RRM CHECKED BRT 0 10 20 40 HORIZONTAL SCALE IN FEET



HORIZONTAL SCALE IN FEET

DRAWN RRM

CHECKED BRT

STRUCTURE FOUNDATION EXPLORATION
FRA-70-1301R I-70 EB OVER SR 315
STA. 135+00 TO STA. 140+50

FRA-70-13.01

1090496

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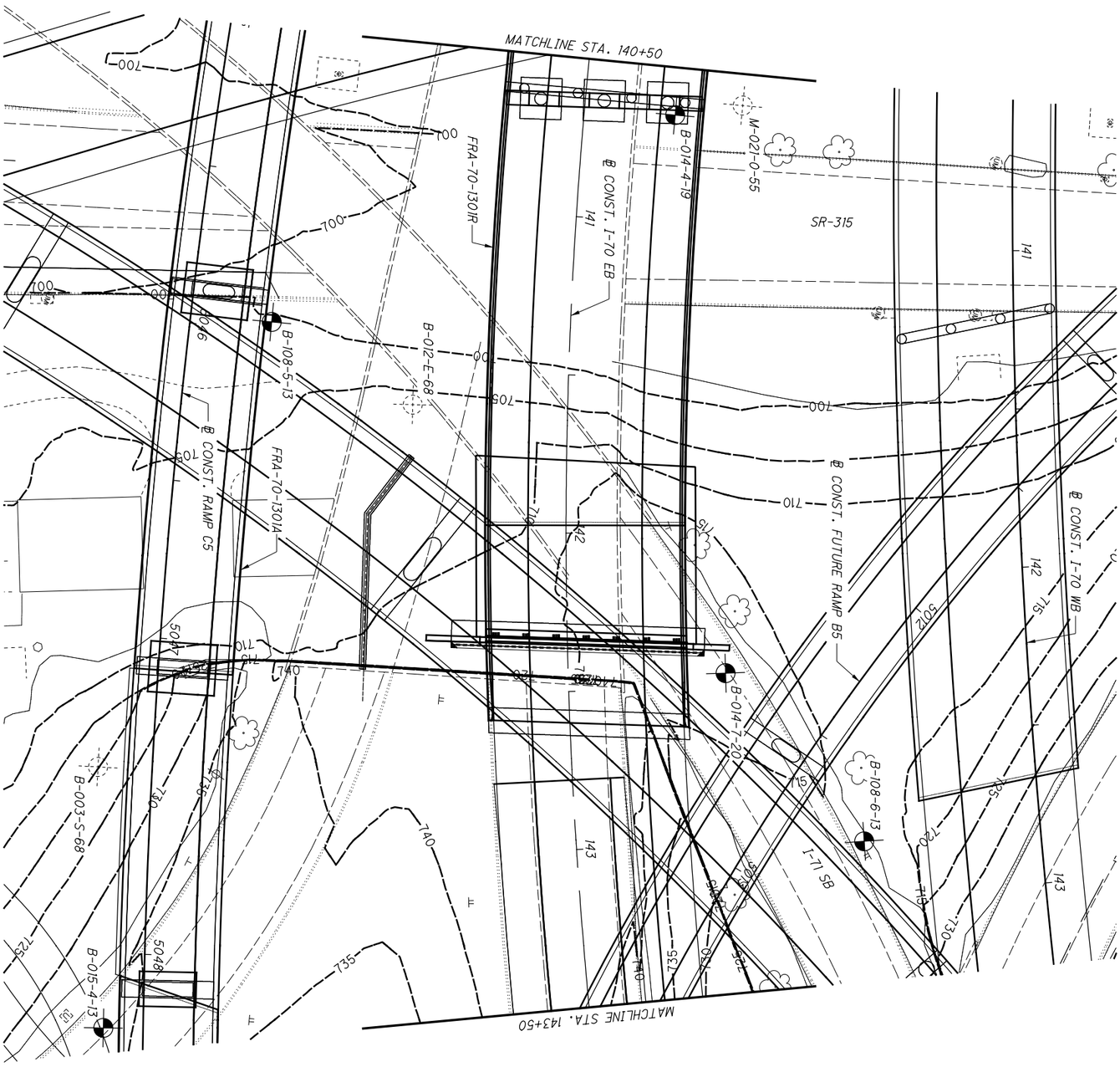
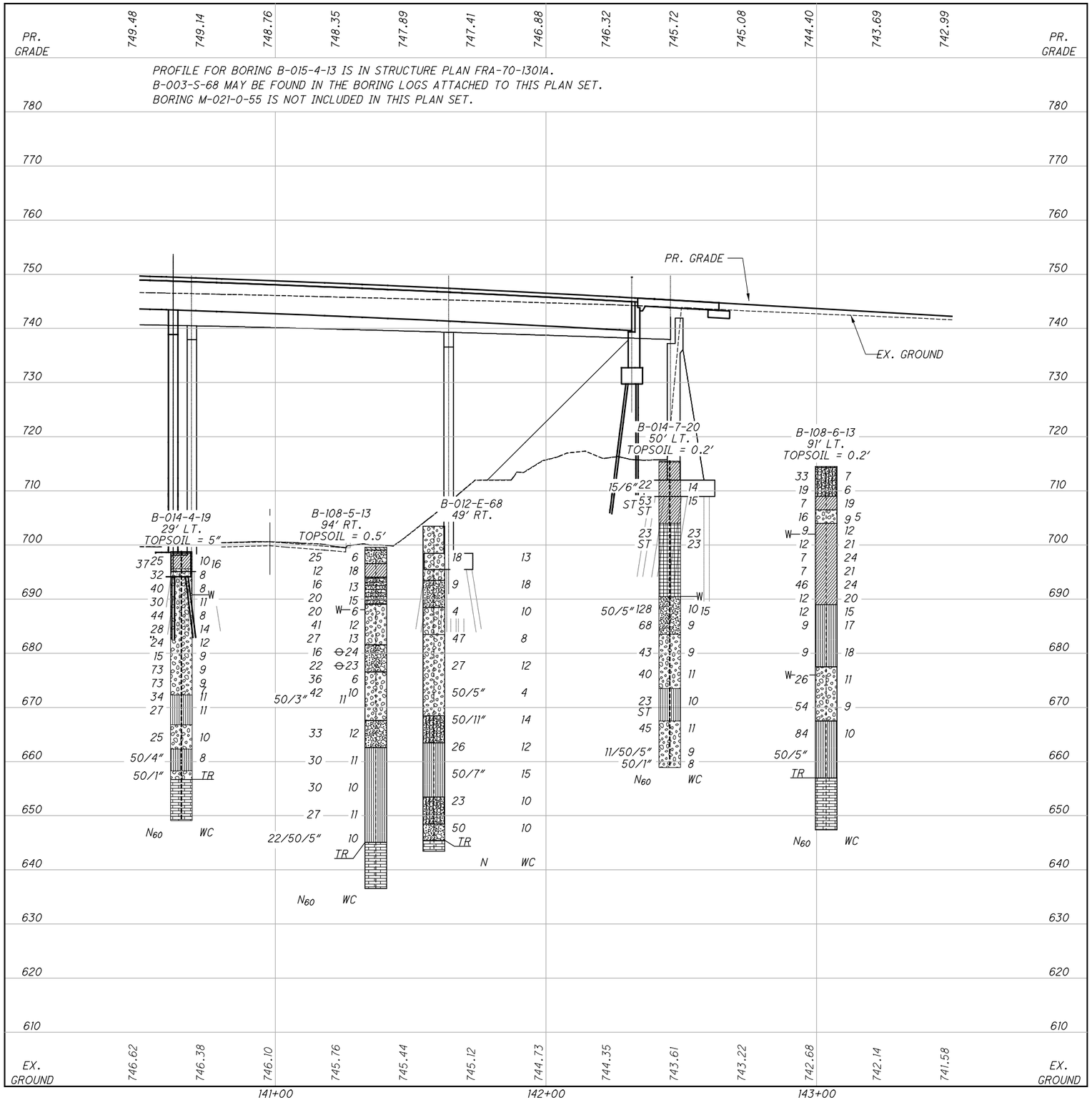


10 of 49	FRA-70-13.01	STRUCTURE FOUNDATION EXPLORATION FRA-70-1301 I-70 EB OVER SR 315 STA. 140+50 TO STA. 143+50	DRAWN RRM CHECKED BRT	0 10 20 40 HORIZONTAL SCALE IN FEET



HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN RRM
CHECKED BRT

STRUCTURE FOUNDATION EXPLORATION
FRA-70-1301R I-70 EB OVER SR 315
STA. 140+50 TO STA. 143+50

FRA-70-13.01

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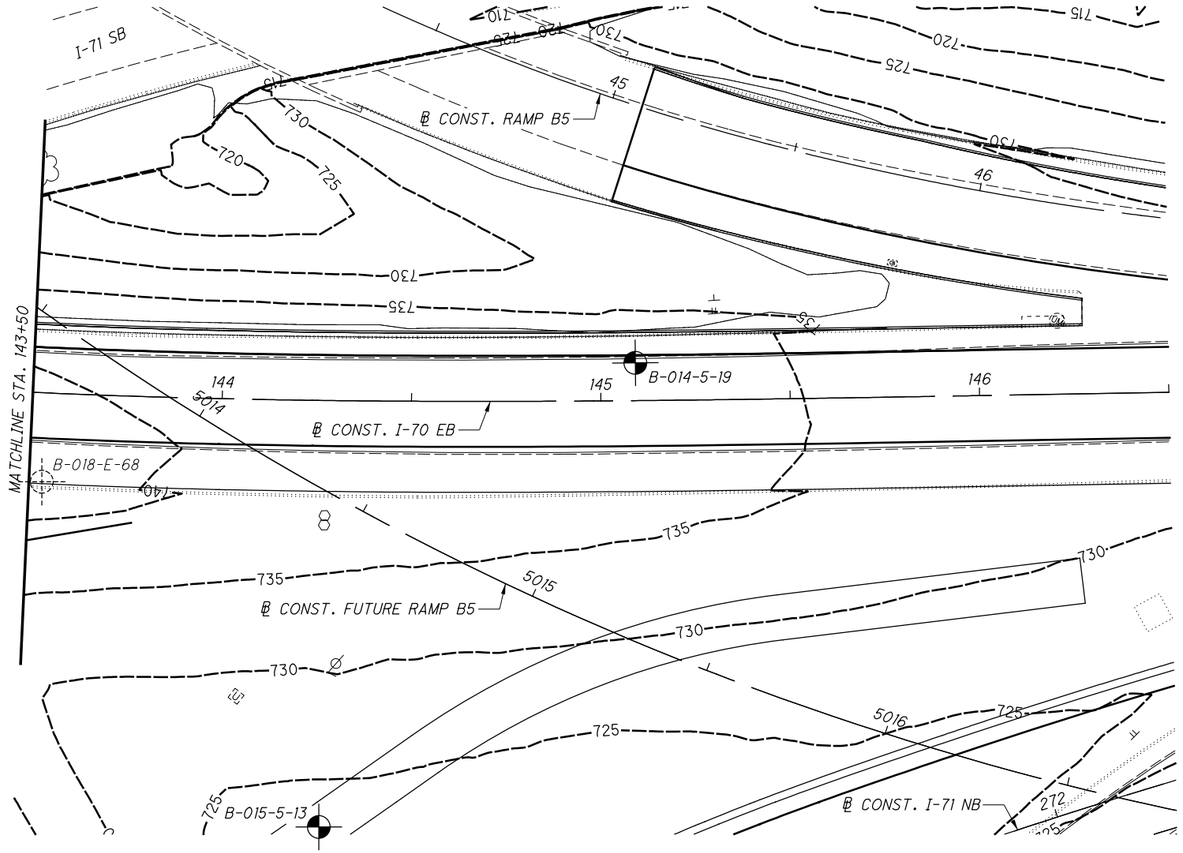

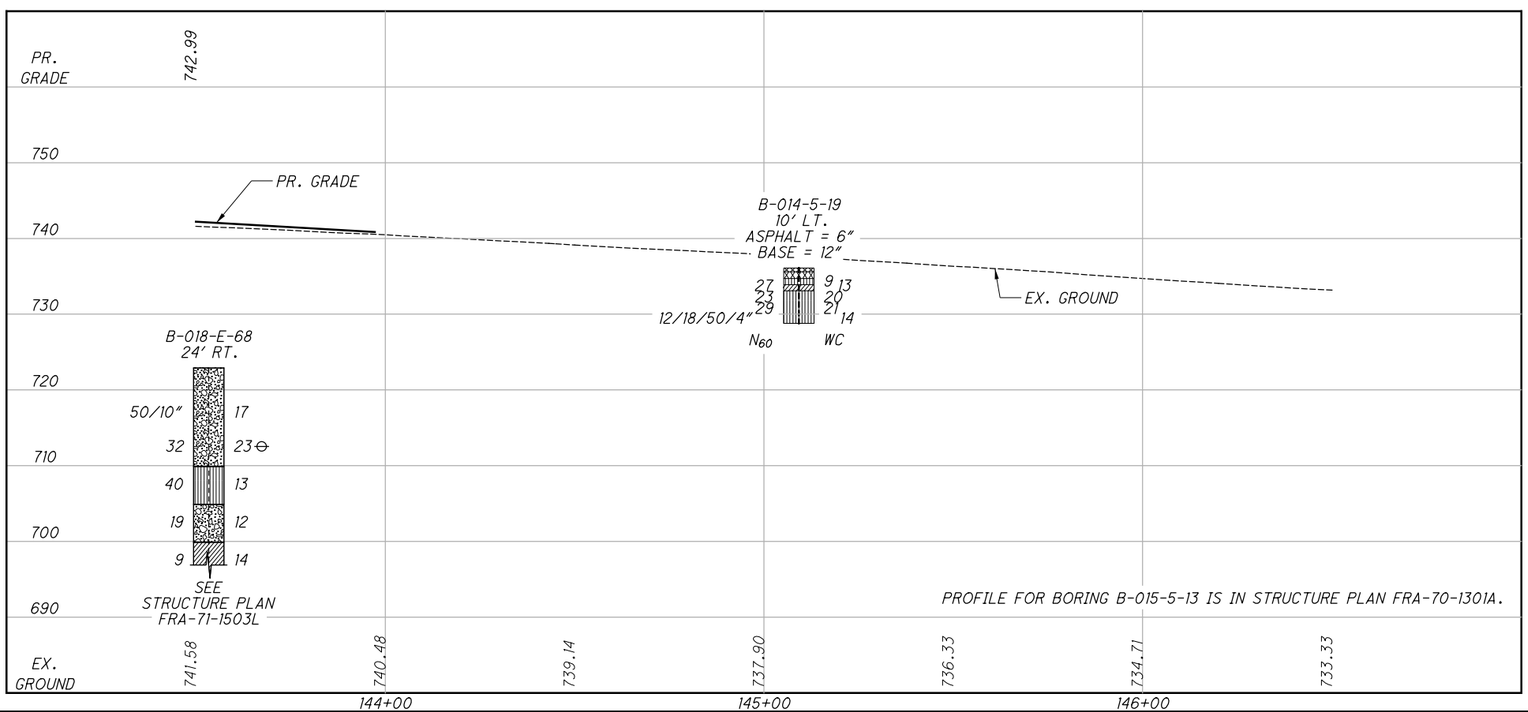

HORIZONTAL SCALE IN FEET
0 10 20 40

DRAWN RRM
CHECKED BRT

SOIL PROFILE
I-70 EB STA. 143+50 TO STA. 146+50

FRA-70-13.01

109F496

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APPENDIX VII

DRIVEN ANALYSIS OUTPUTS

Rear Abutment
(B-015-1-13)

DrivenPiles - Report

General Project Information

Filename: ...3.01\Analysis\Driven Piles\Rear Abutment\FRA-70-13.01 - Rear Abutment HP 10x42-B-015-1-13.dvn
Project Name: FRA-70-13.01 Rear Abutment (B-015-1-13)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 0.00 ft
Diameter of Pile: 10.08 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	58.00 ft
Driving/Restrike:	58.00 ft
Nominal:	58.00 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	0.00 ft

Nominal Profile

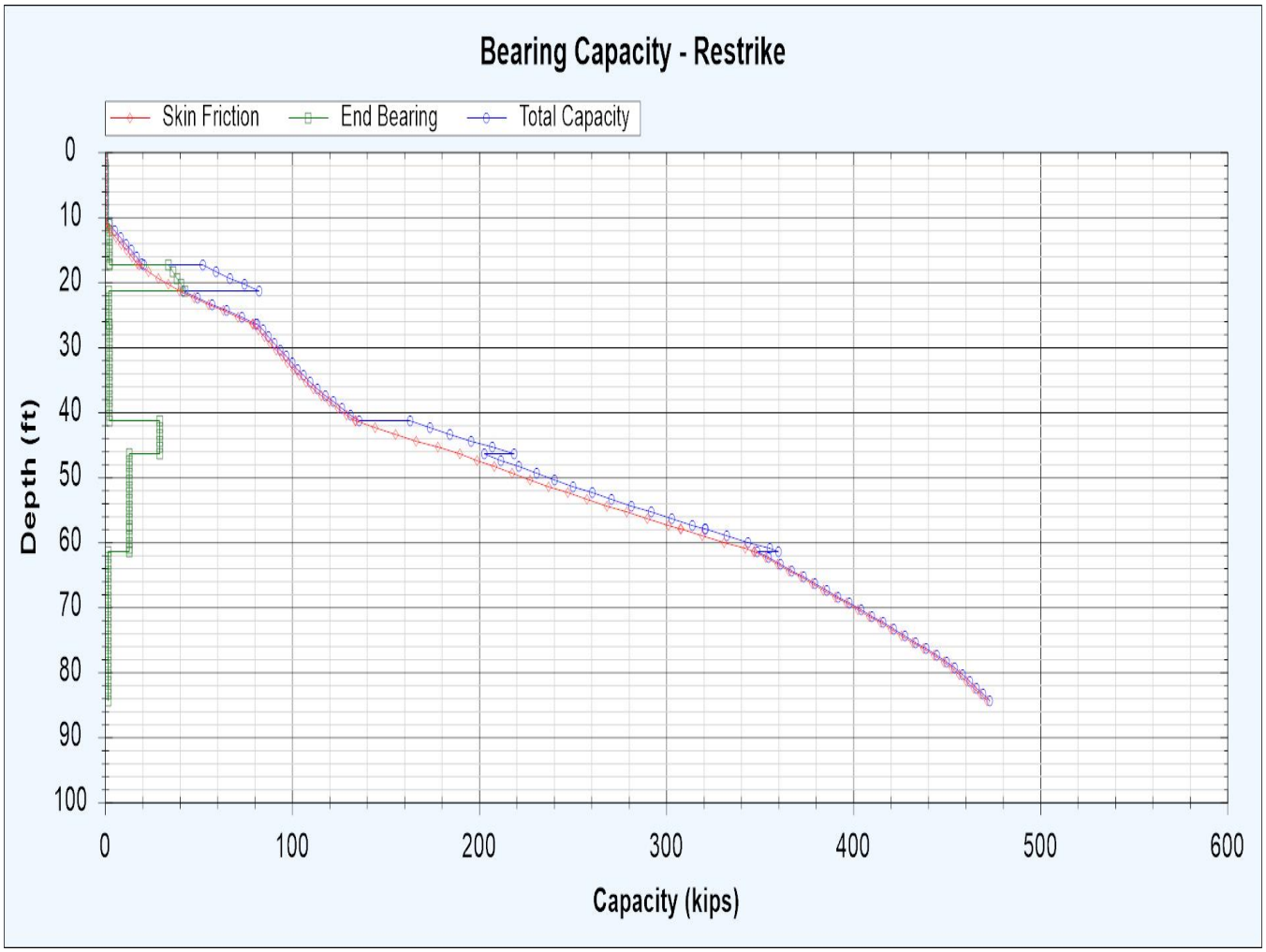
Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	11.10 ft	1.000	120.00 pcf	0.0/0.0	Nordlund
2	Cohesive	6.30 ft	1.500	120.00 pcf	3125.00 psf	T-80 Same
3	Cohesionless	4.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
4	Cohesive	5.00 ft	1.750	120.00 pcf	2375.00 psf	T-80 Sand
5	Cohesive	15.00 ft	1.500	120.00 pcf	2875.00 psf	T-80 Same
6	Cohesionless	5.00 ft	1.000	135.00 pcf	39.0/39.0	Nordlund
7	Cohesionless	15.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
8	Cohesive	23.00 ft	1.500	115.00 pcf	1875.00 psf	T-80 Sand

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.04 kips	0.04 kips
3.00 ft	0.00 kips	0.05 kips	0.05 kips
4.00 ft	0.00 kips	0.07 kips	0.07 kips
5.00 ft	0.00 kips	0.09 kips	0.09 kips
6.00 ft	0.00 kips	0.11 kips	0.11 kips
7.00 ft	0.00 kips	0.13 kips	0.13 kips
8.00 ft	0.00 kips	0.14 kips	0.14 kips
9.00 ft	0.00 kips	0.16 kips	0.16 kips
10.00 ft	0.00 kips	0.18 kips	0.18 kips
11.00 ft	0.00 kips	0.20 kips	0.20 kips
11.09 ft	0.00 kips	0.20 kips	0.20 kips
11.11 ft	0.03 kips	2.42 kips	2.45 kips
12.10 ft	2.89 kips	2.42 kips	5.31 kips
13.10 ft	5.78 kips	2.42 kips	8.20 kips
14.10 ft	8.67 kips	2.42 kips	11.10 kips
15.10 ft	11.57 kips	2.42 kips	13.99 kips
16.10 ft	14.46 kips	2.42 kips	16.88 kips
17.10 ft	17.35 kips	2.42 kips	19.77 kips
17.39 ft	18.19 kips	2.42 kips	20.61 kips
17.41 ft	18.26 kips	33.98 kips	52.24 kips
18.40 ft	23.16 kips	36.15 kips	59.31 kips
19.40 ft	28.41 kips	38.35 kips	66.76 kips
20.40 ft	33.98 kips	40.54 kips	74.52 kips
21.39 ft	39.79 kips	42.72 kips	82.51 kips
21.41 ft	39.93 kips	1.84 kips	41.77 kips
22.40 ft	47.68 kips	1.84 kips	49.52 kips
23.40 ft	55.51 kips	1.84 kips	57.35 kips
24.40 ft	63.33 kips	1.84 kips	65.17 kips
25.40 ft	71.16 kips	1.84 kips	73.00 kips
26.39 ft	78.91 kips	1.84 kips	80.75 kips
26.41 ft	79.02 kips	2.23 kips	81.25 kips
27.40 ft	82.11 kips	2.23 kips	84.33 kips
28.40 ft	85.22 kips	2.23 kips	87.45 kips
29.40 ft	88.34 kips	2.23 kips	90.57 kips
30.40 ft	91.46 kips	2.23 kips	93.68 kips
31.40 ft	94.57 kips	2.23 kips	96.80 kips
32.40 ft	97.69 kips	2.23 kips	99.92 kips
33.40 ft	100.81 kips	2.23 kips	103.03 kips
34.40 ft	103.92 kips	2.23 kips	106.15 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	107.48 kips	2.23 kips	109.71 kips
36.40 ft	111.46 kips	2.23 kips	113.69 kips
37.40 ft	115.60 kips	2.23 kips	117.83 kips
38.40 ft	119.90 kips	2.23 kips	122.13 kips
39.40 ft	124.37 kips	2.23 kips	126.60 kips
40.40 ft	129.00 kips	2.23 kips	131.22 kips
41.39 ft	133.74 kips	2.23 kips	135.97 kips
41.41 ft	133.89 kips	29.17 kips	163.06 kips
42.40 ft	144.39 kips	29.17 kips	173.56 kips
43.40 ft	155.27 kips	29.17 kips	184.44 kips
44.40 ft	166.44 kips	29.17 kips	195.61 kips
45.40 ft	177.89 kips	29.17 kips	207.05 kips
46.39 ft	189.49 kips	29.17 kips	218.66 kips
46.41 ft	189.70 kips	13.05 kips	202.76 kips
47.40 ft	198.71 kips	13.05 kips	211.77 kips
48.40 ft	208.02 kips	13.05 kips	221.08 kips
49.40 ft	217.53 kips	13.05 kips	230.59 kips
50.40 ft	227.25 kips	13.05 kips	240.30 kips
51.40 ft	237.17 kips	13.05 kips	250.23 kips
52.40 ft	247.30 kips	13.05 kips	260.35 kips
53.40 ft	257.63 kips	13.05 kips	270.69 kips
54.40 ft	268.17 kips	13.05 kips	281.22 kips
55.40 ft	278.91 kips	13.05 kips	291.97 kips
56.40 ft	289.86 kips	13.05 kips	302.91 kips
57.40 ft	301.01 kips	13.05 kips	314.07 kips
57.99 ft	307.69 kips	13.05 kips	320.74 kips
58.01 ft	307.92 kips	13.05 kips	320.97 kips
59.00 ft	319.23 kips	13.05 kips	332.29 kips
60.00 ft	330.77 kips	13.05 kips	343.83 kips
61.00 ft	342.42 kips	13.05 kips	355.47 kips
61.39 ft	346.99 kips	13.05 kips	360.04 kips
61.41 ft	347.17 kips	1.45 kips	348.62 kips
62.40 ft	353.29 kips	1.45 kips	354.74 kips
63.40 ft	359.47 kips	1.45 kips	360.92 kips
64.40 ft	365.65 kips	1.45 kips	367.10 kips
65.40 ft	371.83 kips	1.45 kips	373.28 kips
66.40 ft	378.00 kips	1.45 kips	379.46 kips
67.40 ft	384.18 kips	1.45 kips	385.64 kips
68.40 ft	390.36 kips	1.45 kips	391.82 kips
69.40 ft	396.54 kips	1.45 kips	398.00 kips
70.40 ft	402.59 kips	1.45 kips	404.04 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	408.51 kips	1.45 kips	409.97 kips
72.40 ft	414.39 kips	1.45 kips	415.84 kips
73.40 ft	420.21 kips	1.45 kips	421.66 kips
74.40 ft	425.99 kips	1.45 kips	427.44 kips
75.40 ft	431.71 kips	1.45 kips	433.17 kips
76.40 ft	437.39 kips	1.45 kips	438.85 kips
77.40 ft	443.02 kips	1.45 kips	444.48 kips
78.40 ft	448.36 kips	1.45 kips	449.82 kips
79.40 ft	452.66 kips	1.45 kips	454.11 kips
80.40 ft	456.77 kips	1.45 kips	458.22 kips
81.40 ft	460.70 kips	1.45 kips	462.15 kips
82.40 ft	464.44 kips	1.45 kips	465.89 kips
83.40 ft	468.00 kips	1.45 kips	469.45 kips
84.39 ft	471.34 kips	1.45 kips	472.79 kips

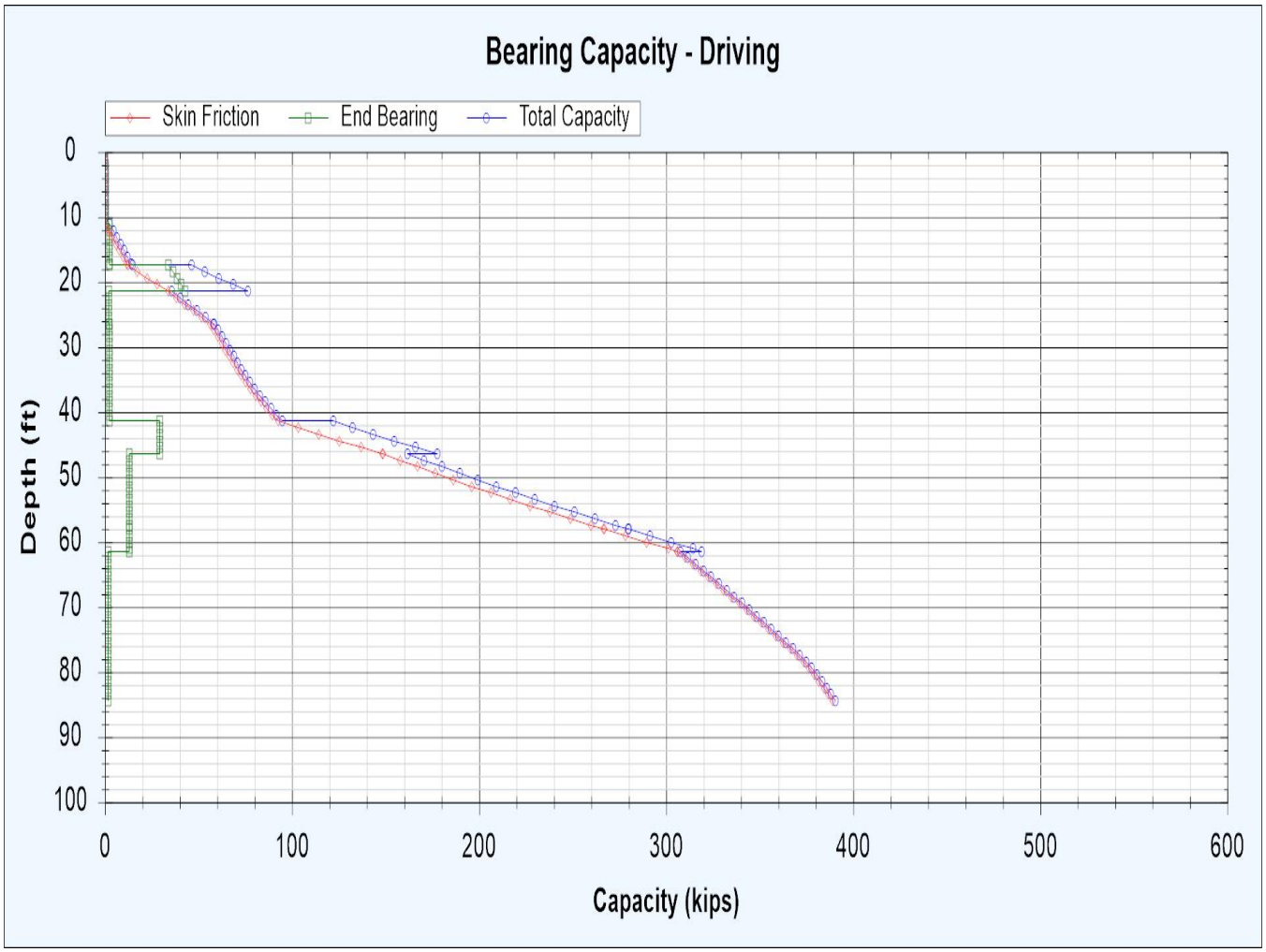

Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.04 kips	0.04 kips
3.00 ft	0.00 kips	0.05 kips	0.05 kips
4.00 ft	0.00 kips	0.07 kips	0.07 kips
5.00 ft	0.00 kips	0.09 kips	0.09 kips
6.00 ft	0.00 kips	0.11 kips	0.11 kips
7.00 ft	0.00 kips	0.13 kips	0.13 kips
8.00 ft	0.00 kips	0.14 kips	0.14 kips
9.00 ft	0.00 kips	0.16 kips	0.16 kips
10.00 ft	0.00 kips	0.18 kips	0.18 kips
11.00 ft	0.00 kips	0.20 kips	0.20 kips
11.09 ft	0.00 kips	0.20 kips	0.20 kips
11.11 ft	0.02 kips	2.42 kips	2.44 kips
12.10 ft	1.93 kips	2.42 kips	4.35 kips
13.10 ft	3.86 kips	2.42 kips	6.28 kips
14.10 ft	5.78 kips	2.42 kips	8.20 kips
15.10 ft	7.71 kips	2.42 kips	10.13 kips
16.10 ft	9.64 kips	2.42 kips	12.06 kips
17.10 ft	11.57 kips	2.42 kips	13.99 kips
17.39 ft	12.12 kips	2.42 kips	14.55 kips
17.41 ft	12.19 kips	33.98 kips	46.17 kips
18.40 ft	17.09 kips	36.15 kips	53.24 kips
19.40 ft	22.34 kips	38.35 kips	60.69 kips
20.40 ft	27.91 kips	40.54 kips	68.45 kips
21.39 ft	33.72 kips	42.72 kips	76.44 kips
21.41 ft	33.82 kips	1.84 kips	35.66 kips
22.40 ft	38.25 kips	1.84 kips	40.09 kips
23.40 ft	42.72 kips	1.84 kips	44.57 kips
24.40 ft	47.20 kips	1.84 kips	49.04 kips
25.40 ft	51.67 kips	1.84 kips	53.51 kips
26.39 ft	56.10 kips	1.84 kips	57.94 kips
26.41 ft	56.16 kips	2.23 kips	58.39 kips
27.40 ft	58.22 kips	2.23 kips	60.45 kips
28.40 ft	60.30 kips	2.23 kips	62.53 kips
29.40 ft	62.38 kips	2.23 kips	64.60 kips
30.40 ft	64.45 kips	2.23 kips	66.68 kips
31.40 ft	66.53 kips	2.23 kips	68.76 kips
32.40 ft	68.61 kips	2.23 kips	70.84 kips
33.40 ft	70.69 kips	2.23 kips	72.92 kips
34.40 ft	72.77 kips	2.23 kips	74.99 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	75.14 kips	2.23 kips	77.37 kips
36.40 ft	77.79 kips	2.23 kips	80.02 kips
37.40 ft	80.55 kips	2.23 kips	82.78 kips
38.40 ft	83.42 kips	2.23 kips	85.65 kips
39.40 ft	86.40 kips	2.23 kips	88.62 kips
40.40 ft	89.48 kips	2.23 kips	91.71 kips
41.39 ft	92.64 kips	2.23 kips	94.87 kips
41.41 ft	92.78 kips	29.17 kips	121.95 kips
42.40 ft	103.28 kips	29.17 kips	132.45 kips
43.40 ft	114.16 kips	29.17 kips	143.33 kips
44.40 ft	125.33 kips	29.17 kips	154.50 kips
45.40 ft	136.78 kips	29.17 kips	165.94 kips
46.39 ft	148.38 kips	29.17 kips	177.55 kips
46.41 ft	148.59 kips	13.05 kips	161.65 kips
47.40 ft	157.60 kips	13.05 kips	170.66 kips
48.40 ft	166.91 kips	13.05 kips	179.97 kips
49.40 ft	176.42 kips	13.05 kips	189.48 kips
50.40 ft	186.14 kips	13.05 kips	199.19 kips
51.40 ft	196.06 kips	13.05 kips	209.12 kips
52.40 ft	206.19 kips	13.05 kips	219.24 kips
53.40 ft	216.52 kips	13.05 kips	229.58 kips
54.40 ft	227.06 kips	13.05 kips	240.11 kips
55.40 ft	237.80 kips	13.05 kips	250.86 kips
56.40 ft	248.75 kips	13.05 kips	261.80 kips
57.40 ft	259.90 kips	13.05 kips	272.96 kips
57.99 ft	266.58 kips	13.05 kips	279.63 kips
58.01 ft	266.81 kips	13.05 kips	279.86 kips
59.00 ft	278.12 kips	13.05 kips	291.18 kips
60.00 ft	289.66 kips	13.05 kips	302.72 kips
61.00 ft	301.31 kips	13.05 kips	314.36 kips
61.39 ft	305.88 kips	13.05 kips	318.93 kips
61.41 ft	306.04 kips	1.45 kips	307.49 kips
62.40 ft	310.12 kips	1.45 kips	311.57 kips
63.40 ft	314.24 kips	1.45 kips	315.69 kips
64.40 ft	318.36 kips	1.45 kips	319.81 kips
65.40 ft	322.48 kips	1.45 kips	323.93 kips
66.40 ft	326.60 kips	1.45 kips	328.05 kips
67.40 ft	330.72 kips	1.45 kips	332.17 kips
68.40 ft	334.84 kips	1.45 kips	336.29 kips
69.40 ft	338.96 kips	1.45 kips	340.41 kips
70.40 ft	342.99 kips	1.45 kips	344.44 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	346.94 kips	1.45 kips	348.39 kips
72.40 ft	350.85 kips	1.45 kips	352.30 kips
73.40 ft	354.74 kips	1.45 kips	356.19 kips
74.40 ft	358.59 kips	1.45 kips	360.04 kips
75.40 ft	362.40 kips	1.45 kips	363.86 kips
76.40 ft	366.19 kips	1.45 kips	367.64 kips
77.40 ft	369.94 kips	1.45 kips	371.40 kips
78.40 ft	373.50 kips	1.45 kips	374.96 kips
79.40 ft	376.37 kips	1.45 kips	377.82 kips
80.40 ft	379.11 kips	1.45 kips	380.56 kips
81.40 ft	381.73 kips	1.45 kips	383.18 kips
82.40 ft	384.22 kips	1.45 kips	385.67 kips
83.40 ft	386.59 kips	1.45 kips	388.05 kips
84.39 ft	388.82 kips	1.45 kips	390.27 kips

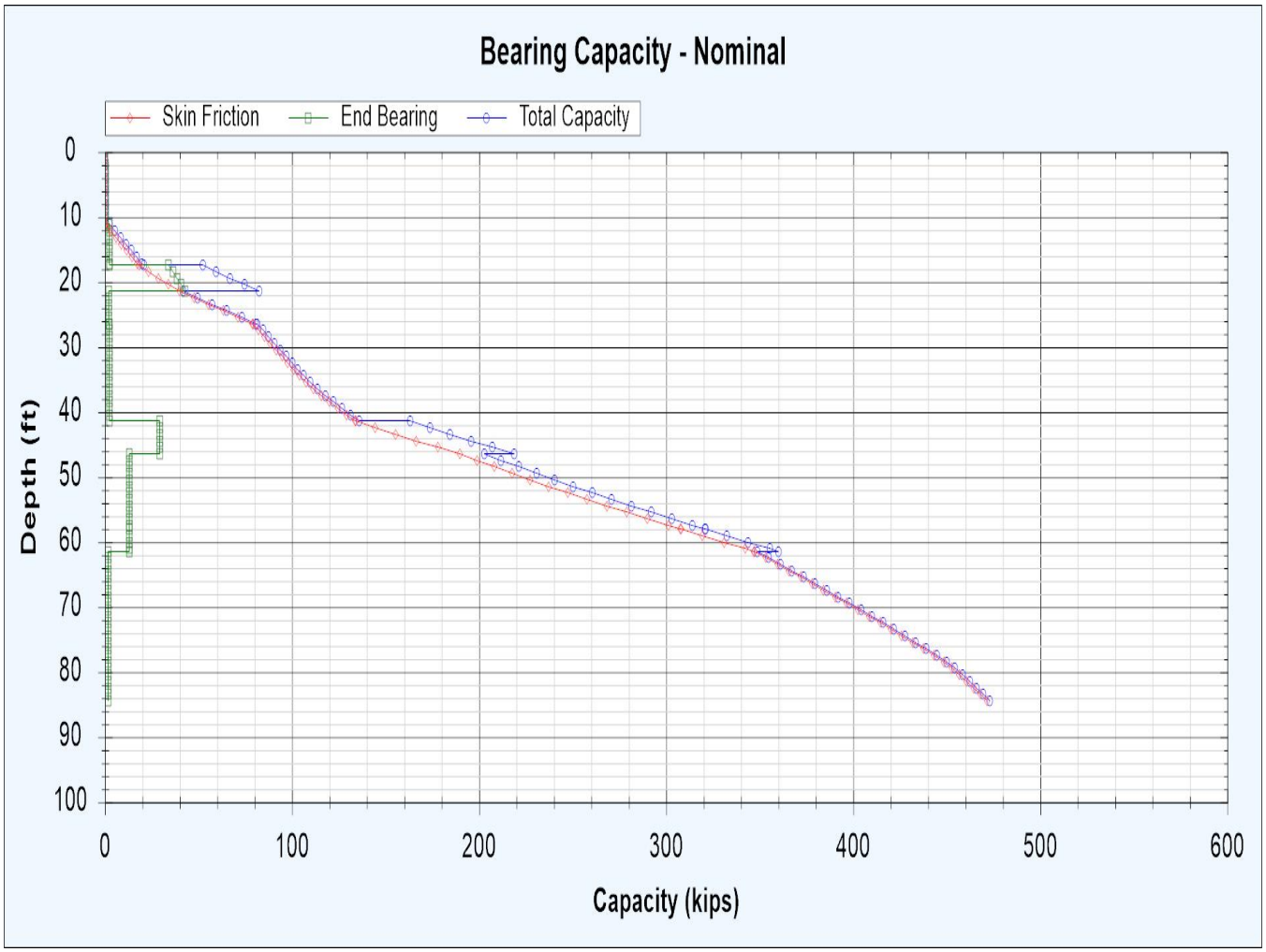

Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.04 kips	0.04 kips
3.00 ft	0.00 kips	0.05 kips	0.05 kips
4.00 ft	0.00 kips	0.07 kips	0.07 kips
5.00 ft	0.00 kips	0.09 kips	0.09 kips
6.00 ft	0.00 kips	0.11 kips	0.11 kips
7.00 ft	0.00 kips	0.13 kips	0.13 kips
8.00 ft	0.00 kips	0.14 kips	0.14 kips
9.00 ft	0.00 kips	0.16 kips	0.16 kips
10.00 ft	0.00 kips	0.18 kips	0.18 kips
11.00 ft	0.00 kips	0.20 kips	0.20 kips
11.09 ft	0.00 kips	0.20 kips	0.20 kips
11.11 ft	0.03 kips	2.42 kips	2.45 kips
12.10 ft	2.89 kips	2.42 kips	5.31 kips
13.10 ft	5.78 kips	2.42 kips	8.20 kips
14.10 ft	8.67 kips	2.42 kips	11.10 kips
15.10 ft	11.57 kips	2.42 kips	13.99 kips
16.10 ft	14.46 kips	2.42 kips	16.88 kips
17.10 ft	17.35 kips	2.42 kips	19.77 kips
17.39 ft	18.19 kips	2.42 kips	20.61 kips
17.41 ft	18.26 kips	33.98 kips	52.24 kips
18.40 ft	23.16 kips	36.15 kips	59.31 kips
19.40 ft	28.41 kips	38.35 kips	66.76 kips
20.40 ft	33.98 kips	40.54 kips	74.52 kips
21.39 ft	39.79 kips	42.72 kips	82.51 kips
21.41 ft	39.93 kips	1.84 kips	41.77 kips
22.40 ft	47.68 kips	1.84 kips	49.52 kips
23.40 ft	55.51 kips	1.84 kips	57.35 kips
24.40 ft	63.33 kips	1.84 kips	65.17 kips
25.40 ft	71.16 kips	1.84 kips	73.00 kips
26.39 ft	78.91 kips	1.84 kips	80.75 kips
26.41 ft	79.02 kips	2.23 kips	81.25 kips
27.40 ft	82.11 kips	2.23 kips	84.33 kips
28.40 ft	85.22 kips	2.23 kips	87.45 kips
29.40 ft	88.34 kips	2.23 kips	90.57 kips
30.40 ft	91.46 kips	2.23 kips	93.68 kips
31.40 ft	94.57 kips	2.23 kips	96.80 kips
32.40 ft	97.69 kips	2.23 kips	99.92 kips
33.40 ft	100.81 kips	2.23 kips	103.03 kips
34.40 ft	103.92 kips	2.23 kips	106.15 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	107.48 kips	2.23 kips	109.71 kips
36.40 ft	111.46 kips	2.23 kips	113.69 kips
37.40 ft	115.60 kips	2.23 kips	117.83 kips
38.40 ft	119.90 kips	2.23 kips	122.13 kips
39.40 ft	124.37 kips	2.23 kips	126.60 kips
40.40 ft	129.00 kips	2.23 kips	131.22 kips
41.39 ft	133.74 kips	2.23 kips	135.97 kips
41.41 ft	133.89 kips	29.17 kips	163.06 kips
42.40 ft	144.39 kips	29.17 kips	173.56 kips
43.40 ft	155.27 kips	29.17 kips	184.44 kips
44.40 ft	166.44 kips	29.17 kips	195.61 kips
45.40 ft	177.89 kips	29.17 kips	207.05 kips
46.39 ft	189.49 kips	29.17 kips	218.66 kips
46.41 ft	189.70 kips	13.05 kips	202.76 kips
47.40 ft	198.71 kips	13.05 kips	211.77 kips
48.40 ft	208.02 kips	13.05 kips	221.08 kips
49.40 ft	217.53 kips	13.05 kips	230.59 kips
50.40 ft	227.25 kips	13.05 kips	240.30 kips
51.40 ft	237.17 kips	13.05 kips	250.23 kips
52.40 ft	247.30 kips	13.05 kips	260.35 kips
53.40 ft	257.63 kips	13.05 kips	270.69 kips
54.40 ft	268.17 kips	13.05 kips	281.22 kips
55.40 ft	278.91 kips	13.05 kips	291.97 kips
56.40 ft	289.86 kips	13.05 kips	302.91 kips
57.40 ft	301.01 kips	13.05 kips	314.07 kips
57.99 ft	307.69 kips	13.05 kips	320.74 kips
58.01 ft	307.92 kips	13.05 kips	320.97 kips
59.00 ft	319.23 kips	13.05 kips	332.29 kips
60.00 ft	330.77 kips	13.05 kips	343.83 kips
61.00 ft	342.42 kips	13.05 kips	355.47 kips
61.39 ft	346.99 kips	13.05 kips	360.04 kips
61.41 ft	347.17 kips	1.45 kips	348.62 kips
62.40 ft	353.29 kips	1.45 kips	354.74 kips
63.40 ft	359.47 kips	1.45 kips	360.92 kips
64.40 ft	365.65 kips	1.45 kips	367.10 kips
65.40 ft	371.83 kips	1.45 kips	373.28 kips
66.40 ft	378.00 kips	1.45 kips	379.46 kips
67.40 ft	384.18 kips	1.45 kips	385.64 kips
68.40 ft	390.36 kips	1.45 kips	391.82 kips
69.40 ft	396.54 kips	1.45 kips	398.00 kips
70.40 ft	402.59 kips	1.45 kips	404.04 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	408.51 kips	1.45 kips	409.97 kips
72.40 ft	414.39 kips	1.45 kips	415.84 kips
73.40 ft	420.21 kips	1.45 kips	421.66 kips
74.40 ft	425.99 kips	1.45 kips	427.44 kips
75.40 ft	431.71 kips	1.45 kips	433.17 kips
76.40 ft	437.39 kips	1.45 kips	438.85 kips
77.40 ft	443.02 kips	1.45 kips	444.48 kips
78.40 ft	448.36 kips	1.45 kips	449.82 kips
79.40 ft	452.66 kips	1.45 kips	454.11 kips
80.40 ft	456.77 kips	1.45 kips	458.22 kips
81.40 ft	460.70 kips	1.45 kips	462.15 kips
82.40 ft	464.44 kips	1.45 kips	465.89 kips
83.40 ft	468.00 kips	1.45 kips	469.45 kips
84.39 ft	471.34 kips	1.45 kips	472.79 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
Capacity (kips)

DrivenPiles - Report

General Project Information

Filename: ...3.01\Analysis\Driven Piles\Rear Abutment\FRA-70-13.01 - Rear Abutment HP 10x42-B-015-1-13.dvn
Project Name: FRA-70-13.01 Rear Abutment (B-015-1-13)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 0.00 ft
Diameter of Pile: 10.08 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	58.00 ft
Driving/Restrike:	58.00 ft
Nominal:	58.00 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	0.00 ft

Nominal Profile

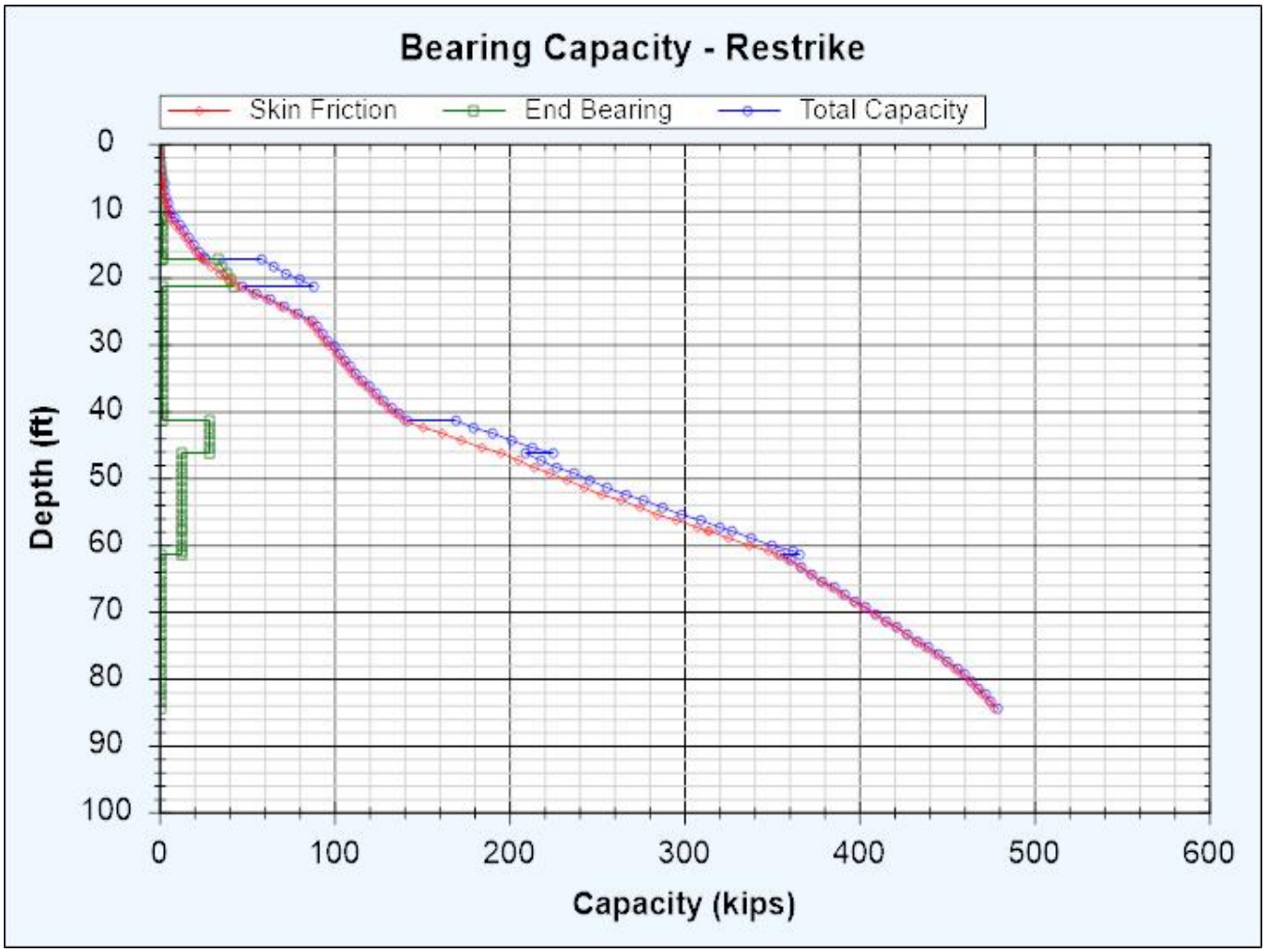
Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	11.10 ft	1.000	120.00 pcf	28.0/28.0	Nordlund
2	Cohesive	6.30 ft	1.500	120.00 pcf	3125.00 psf	T-80 Same
3	Cohesionless	4.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
4	Cohesive	5.00 ft	1.750	120.00 pcf	2375.00 psf	T-80 Sand
5	Cohesive	15.00 ft	1.500	120.00 pcf	2875.00 psf	T-80 Same
6	Cohesionless	5.00 ft	1.000	135.00 pcf	39.0/39.0	Nordlund
7	Cohesionless	15.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
8	Cohesive	23.00 ft	1.500	115.00 pcf	1875.00 psf	T-80 Sand

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
11.09 ft	6.12 kips	1.15 kips	7.27 kips
11.11 ft	6.16 kips	2.42 kips	8.58 kips
12.10 ft	9.02 kips	2.42 kips	11.44 kips
13.10 ft	11.91 kips	2.42 kips	14.33 kips
14.10 ft	14.80 kips	2.42 kips	17.23 kips
15.10 ft	17.70 kips	2.42 kips	20.12 kips
16.10 ft	20.59 kips	2.42 kips	23.01 kips
17.10 ft	23.48 kips	2.42 kips	25.90 kips
17.39 ft	24.32 kips	2.42 kips	26.74 kips
17.41 ft	24.39 kips	33.98 kips	58.37 kips
18.40 ft	29.29 kips	36.15 kips	65.44 kips
19.40 ft	34.54 kips	38.35 kips	72.89 kips
20.40 ft	40.11 kips	40.54 kips	80.65 kips
21.39 ft	45.92 kips	42.72 kips	88.64 kips
21.41 ft	46.06 kips	1.84 kips	47.90 kips
22.40 ft	53.81 kips	1.84 kips	55.65 kips
23.40 ft	61.64 kips	1.84 kips	63.48 kips
24.40 ft	69.46 kips	1.84 kips	71.30 kips
25.40 ft	77.29 kips	1.84 kips	79.13 kips
26.39 ft	85.04 kips	1.84 kips	86.88 kips
26.41 ft	85.15 kips	2.23 kips	87.38 kips
27.40 ft	88.24 kips	2.23 kips	90.46 kips
28.40 ft	91.35 kips	2.23 kips	93.58 kips
29.40 ft	94.47 kips	2.23 kips	96.70 kips
30.40 ft	97.59 kips	2.23 kips	99.81 kips
31.40 ft	100.70 kips	2.23 kips	102.93 kips
32.40 ft	103.82 kips	2.23 kips	106.05 kips
33.40 ft	106.94 kips	2.23 kips	109.16 kips
34.40 ft	110.05 kips	2.23 kips	112.28 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	113.61 kips	2.23 kips	115.84 kips
36.40 ft	117.59 kips	2.23 kips	119.82 kips
37.40 ft	121.73 kips	2.23 kips	123.96 kips
38.40 ft	126.03 kips	2.23 kips	128.26 kips
39.40 ft	130.50 kips	2.23 kips	132.73 kips
40.40 ft	135.13 kips	2.23 kips	137.35 kips
41.39 ft	139.87 kips	2.23 kips	142.10 kips
41.41 ft	140.02 kips	29.17 kips	169.19 kips
42.40 ft	150.52 kips	29.17 kips	179.69 kips
43.40 ft	161.40 kips	29.17 kips	190.57 kips
44.40 ft	172.57 kips	29.17 kips	201.74 kips
45.40 ft	184.02 kips	29.17 kips	213.18 kips
46.39 ft	195.62 kips	29.17 kips	224.79 kips
46.41 ft	195.83 kips	13.05 kips	208.89 kips
47.40 ft	204.84 kips	13.05 kips	217.90 kips
48.40 ft	214.15 kips	13.05 kips	227.21 kips
49.40 ft	223.66 kips	13.05 kips	236.72 kips
50.40 ft	233.38 kips	13.05 kips	246.43 kips
51.40 ft	243.30 kips	13.05 kips	256.36 kips
52.40 ft	253.43 kips	13.05 kips	266.48 kips
53.40 ft	263.76 kips	13.05 kips	276.82 kips
54.40 ft	274.30 kips	13.05 kips	287.35 kips
55.40 ft	285.04 kips	13.05 kips	298.10 kips
56.40 ft	295.99 kips	13.05 kips	309.04 kips
57.40 ft	307.14 kips	13.05 kips	320.20 kips
57.99 ft	313.82 kips	13.05 kips	326.87 kips
58.01 ft	314.05 kips	13.05 kips	327.10 kips
59.00 ft	325.36 kips	13.05 kips	338.42 kips
60.00 ft	336.90 kips	13.05 kips	349.96 kips
61.00 ft	348.55 kips	13.05 kips	361.60 kips
61.39 ft	353.12 kips	13.05 kips	366.17 kips
61.41 ft	353.30 kips	1.45 kips	354.75 kips
62.40 ft	359.42 kips	1.45 kips	360.87 kips
63.40 ft	365.60 kips	1.45 kips	367.05 kips
64.40 ft	371.78 kips	1.45 kips	373.23 kips
65.40 ft	377.95 kips	1.45 kips	379.41 kips
66.40 ft	384.13 kips	1.45 kips	385.59 kips
67.40 ft	390.31 kips	1.45 kips	391.77 kips
68.40 ft	396.49 kips	1.45 kips	397.95 kips
69.40 ft	402.67 kips	1.45 kips	404.13 kips
70.40 ft	408.72 kips	1.45 kips	410.17 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	414.64 kips	1.45 kips	416.10 kips
72.40 ft	420.52 kips	1.45 kips	421.97 kips
73.40 ft	426.34 kips	1.45 kips	427.79 kips
74.40 ft	432.12 kips	1.45 kips	433.57 kips
75.40 ft	437.84 kips	1.45 kips	439.30 kips
76.40 ft	443.52 kips	1.45 kips	444.98 kips
77.40 ft	449.15 kips	1.45 kips	450.61 kips
78.40 ft	454.49 kips	1.45 kips	455.95 kips
79.40 ft	458.79 kips	1.45 kips	460.24 kips
80.40 ft	462.90 kips	1.45 kips	464.35 kips
81.40 ft	466.83 kips	1.45 kips	468.28 kips
82.40 ft	470.57 kips	1.45 kips	472.02 kips
83.40 ft	474.13 kips	1.45 kips	475.58 kips
84.39 ft	477.47 kips	1.45 kips	478.92 kips


Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
11.09 ft	6.12 kips	1.15 kips	7.27 kips
11.11 ft	6.15 kips	2.42 kips	8.57 kips
12.10 ft	8.06 kips	2.42 kips	10.48 kips
13.10 ft	9.99 kips	2.42 kips	12.41 kips
14.10 ft	11.91 kips	2.42 kips	14.33 kips
15.10 ft	13.84 kips	2.42 kips	16.26 kips
16.10 ft	15.77 kips	2.42 kips	18.19 kips
17.10 ft	17.70 kips	2.42 kips	20.12 kips
17.39 ft	18.26 kips	2.42 kips	20.68 kips
17.41 ft	18.32 kips	33.98 kips	52.30 kips
18.40 ft	23.22 kips	36.15 kips	59.37 kips
19.40 ft	28.47 kips	38.35 kips	66.82 kips
20.40 ft	34.04 kips	40.54 kips	74.58 kips
21.39 ft	39.85 kips	42.72 kips	82.57 kips
21.41 ft	39.95 kips	1.84 kips	41.80 kips
22.40 ft	44.38 kips	1.84 kips	46.22 kips
23.40 ft	48.86 kips	1.84 kips	50.70 kips
24.40 ft	53.33 kips	1.84 kips	55.17 kips
25.40 ft	57.80 kips	1.84 kips	59.64 kips
26.39 ft	62.23 kips	1.84 kips	64.07 kips
26.41 ft	62.29 kips	2.23 kips	64.52 kips
27.40 ft	64.35 kips	2.23 kips	66.58 kips
28.40 ft	66.43 kips	2.23 kips	68.66 kips
29.40 ft	68.51 kips	2.23 kips	70.74 kips
30.40 ft	70.58 kips	2.23 kips	72.81 kips
31.40 ft	72.66 kips	2.23 kips	74.89 kips
32.40 ft	74.74 kips	2.23 kips	76.97 kips
33.40 ft	76.82 kips	2.23 kips	79.05 kips
34.40 ft	78.90 kips	2.23 kips	81.12 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	81.27 kips	2.23 kips	83.50 kips
36.40 ft	83.92 kips	2.23 kips	86.15 kips
37.40 ft	86.68 kips	2.23 kips	88.91 kips
38.40 ft	89.55 kips	2.23 kips	91.78 kips
39.40 ft	92.53 kips	2.23 kips	94.76 kips
40.40 ft	95.61 kips	2.23 kips	97.84 kips
41.39 ft	98.77 kips	2.23 kips	101.00 kips
41.41 ft	98.91 kips	29.17 kips	128.08 kips
42.40 ft	109.41 kips	29.17 kips	138.58 kips
43.40 ft	120.29 kips	29.17 kips	149.46 kips
44.40 ft	131.46 kips	29.17 kips	160.63 kips
45.40 ft	142.91 kips	29.17 kips	172.07 kips
46.39 ft	154.51 kips	29.17 kips	183.68 kips
46.41 ft	154.72 kips	13.05 kips	167.78 kips
47.40 ft	163.74 kips	13.05 kips	176.79 kips
48.40 ft	173.04 kips	13.05 kips	186.10 kips
49.40 ft	182.55 kips	13.05 kips	195.61 kips
50.40 ft	192.27 kips	13.05 kips	205.33 kips
51.40 ft	202.19 kips	13.05 kips	215.25 kips
52.40 ft	212.32 kips	13.05 kips	225.37 kips
53.40 ft	222.65 kips	13.05 kips	235.71 kips
54.40 ft	233.19 kips	13.05 kips	246.24 kips
55.40 ft	243.93 kips	13.05 kips	256.99 kips
56.40 ft	254.88 kips	13.05 kips	267.93 kips
57.40 ft	266.03 kips	13.05 kips	279.09 kips
57.99 ft	272.71 kips	13.05 kips	285.76 kips
58.01 ft	272.94 kips	13.05 kips	285.99 kips
59.00 ft	284.26 kips	13.05 kips	297.31 kips
60.00 ft	295.79 kips	13.05 kips	308.85 kips
61.00 ft	307.44 kips	13.05 kips	320.49 kips
61.39 ft	312.01 kips	13.05 kips	325.06 kips
61.41 ft	312.17 kips	1.45 kips	313.62 kips
62.40 ft	316.25 kips	1.45 kips	317.70 kips
63.40 ft	320.37 kips	1.45 kips	321.82 kips
64.40 ft	324.49 kips	1.45 kips	325.94 kips
65.40 ft	328.61 kips	1.45 kips	330.06 kips
66.40 ft	332.73 kips	1.45 kips	334.18 kips
67.40 ft	336.85 kips	1.45 kips	338.30 kips
68.40 ft	340.97 kips	1.45 kips	342.42 kips
69.40 ft	345.09 kips	1.45 kips	346.54 kips
70.40 ft	349.12 kips	1.45 kips	350.57 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	353.07 kips	1.45 kips	354.52 kips
72.40 ft	356.98 kips	1.45 kips	358.44 kips
73.40 ft	360.87 kips	1.45 kips	362.32 kips
74.40 ft	364.72 kips	1.45 kips	366.17 kips
75.40 ft	368.53 kips	1.45 kips	369.99 kips
76.40 ft	372.32 kips	1.45 kips	373.77 kips
77.40 ft	376.07 kips	1.45 kips	377.53 kips
78.40 ft	379.63 kips	1.45 kips	381.09 kips
79.40 ft	382.50 kips	1.45 kips	383.95 kips
80.40 ft	385.24 kips	1.45 kips	386.69 kips
81.40 ft	387.86 kips	1.45 kips	389.31 kips
82.40 ft	390.35 kips	1.45 kips	391.81 kips
83.40 ft	392.72 kips	1.45 kips	394.18 kips
84.39 ft	394.95 kips	1.45 kips	396.40 kips

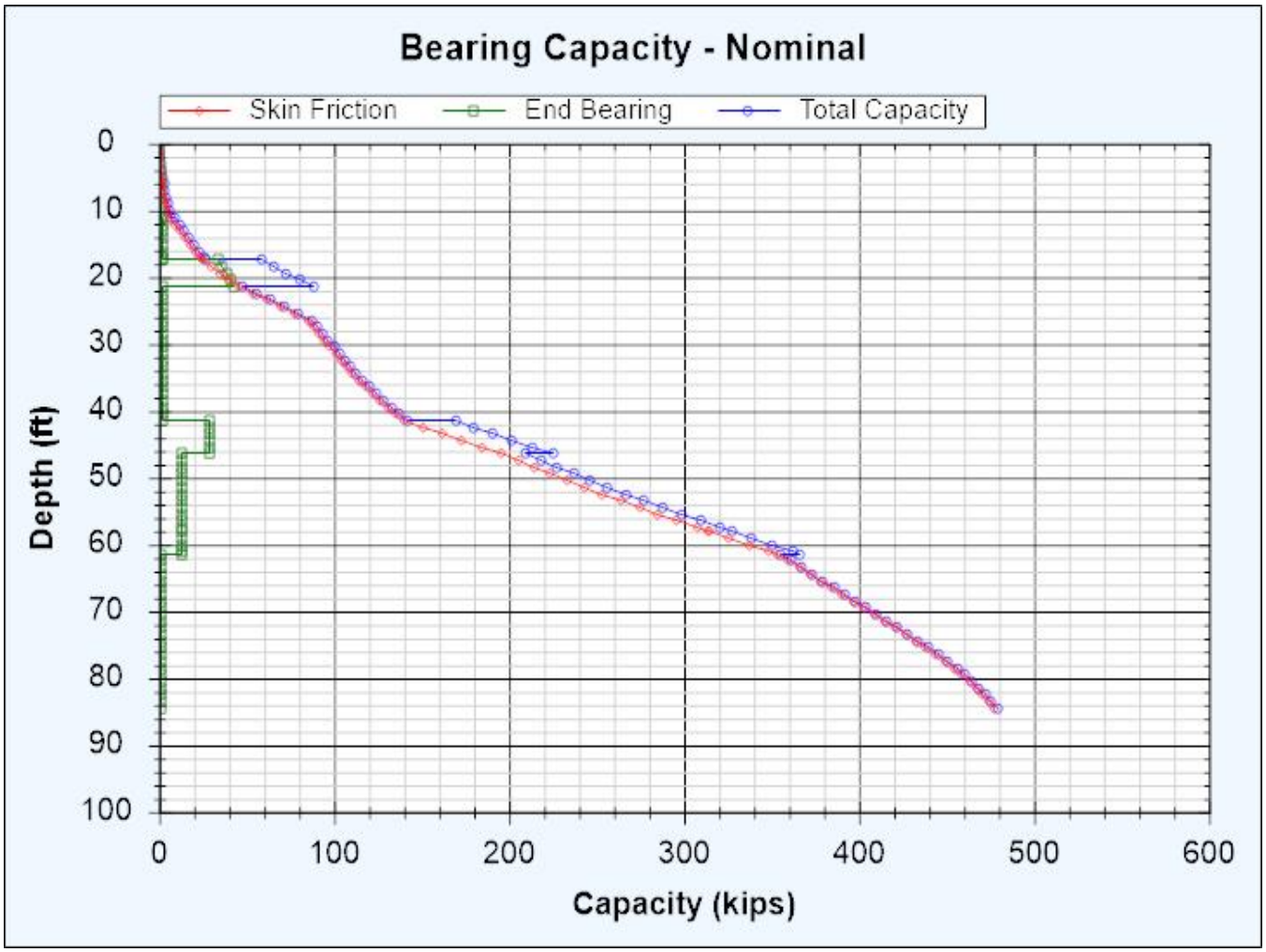

Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.05 kips	0.13 kips	0.18 kips
2.00 ft	0.20 kips	0.25 kips	0.45 kips
3.00 ft	0.45 kips	0.38 kips	0.83 kips
4.00 ft	0.80 kips	0.51 kips	1.30 kips
5.00 ft	1.24 kips	0.63 kips	1.88 kips
6.00 ft	1.79 kips	0.76 kips	2.55 kips
7.00 ft	2.44 kips	0.88 kips	3.32 kips
8.00 ft	3.18 kips	1.01 kips	4.19 kips
9.00 ft	4.03 kips	1.14 kips	5.17 kips
10.00 ft	4.98 kips	1.15 kips	6.12 kips
11.00 ft	6.02 kips	1.15 kips	7.17 kips
11.09 ft	6.12 kips	1.15 kips	7.27 kips
11.11 ft	6.16 kips	2.42 kips	8.58 kips
12.10 ft	9.02 kips	2.42 kips	11.44 kips
13.10 ft	11.91 kips	2.42 kips	14.33 kips
14.10 ft	14.80 kips	2.42 kips	17.23 kips
15.10 ft	17.70 kips	2.42 kips	20.12 kips
16.10 ft	20.59 kips	2.42 kips	23.01 kips
17.10 ft	23.48 kips	2.42 kips	25.90 kips
17.39 ft	24.32 kips	2.42 kips	26.74 kips
17.41 ft	24.39 kips	33.98 kips	58.37 kips
18.40 ft	29.29 kips	36.15 kips	65.44 kips
19.40 ft	34.54 kips	38.35 kips	72.89 kips
20.40 ft	40.11 kips	40.54 kips	80.65 kips
21.39 ft	45.92 kips	42.72 kips	88.64 kips
21.41 ft	46.06 kips	1.84 kips	47.90 kips
22.40 ft	53.81 kips	1.84 kips	55.65 kips
23.40 ft	61.64 kips	1.84 kips	63.48 kips
24.40 ft	69.46 kips	1.84 kips	71.30 kips
25.40 ft	77.29 kips	1.84 kips	79.13 kips
26.39 ft	85.04 kips	1.84 kips	86.88 kips
26.41 ft	85.15 kips	2.23 kips	87.38 kips
27.40 ft	88.24 kips	2.23 kips	90.46 kips
28.40 ft	91.35 kips	2.23 kips	93.58 kips
29.40 ft	94.47 kips	2.23 kips	96.70 kips
30.40 ft	97.59 kips	2.23 kips	99.81 kips
31.40 ft	100.70 kips	2.23 kips	102.93 kips
32.40 ft	103.82 kips	2.23 kips	106.05 kips
33.40 ft	106.94 kips	2.23 kips	109.16 kips
34.40 ft	110.05 kips	2.23 kips	112.28 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	113.61 kips	2.23 kips	115.84 kips
36.40 ft	117.59 kips	2.23 kips	119.82 kips
37.40 ft	121.73 kips	2.23 kips	123.96 kips
38.40 ft	126.03 kips	2.23 kips	128.26 kips
39.40 ft	130.50 kips	2.23 kips	132.73 kips
40.40 ft	135.13 kips	2.23 kips	137.35 kips
41.39 ft	139.87 kips	2.23 kips	142.10 kips
41.41 ft	140.02 kips	29.17 kips	169.19 kips
42.40 ft	150.52 kips	29.17 kips	179.69 kips
43.40 ft	161.40 kips	29.17 kips	190.57 kips
44.40 ft	172.57 kips	29.17 kips	201.74 kips
45.40 ft	184.02 kips	29.17 kips	213.18 kips
46.39 ft	195.62 kips	29.17 kips	224.79 kips
46.41 ft	195.83 kips	13.05 kips	208.89 kips
47.40 ft	204.84 kips	13.05 kips	217.90 kips
48.40 ft	214.15 kips	13.05 kips	227.21 kips
49.40 ft	223.66 kips	13.05 kips	236.72 kips
50.40 ft	233.38 kips	13.05 kips	246.43 kips
51.40 ft	243.30 kips	13.05 kips	256.36 kips
52.40 ft	253.43 kips	13.05 kips	266.48 kips
53.40 ft	263.76 kips	13.05 kips	276.82 kips
54.40 ft	274.30 kips	13.05 kips	287.35 kips
55.40 ft	285.04 kips	13.05 kips	298.10 kips
56.40 ft	295.99 kips	13.05 kips	309.04 kips
57.40 ft	307.14 kips	13.05 kips	320.20 kips
57.99 ft	313.82 kips	13.05 kips	326.87 kips
58.01 ft	314.05 kips	13.05 kips	327.10 kips
59.00 ft	325.36 kips	13.05 kips	338.42 kips
60.00 ft	336.90 kips	13.05 kips	349.96 kips
61.00 ft	348.55 kips	13.05 kips	361.60 kips
61.39 ft	353.12 kips	13.05 kips	366.17 kips
61.41 ft	353.30 kips	1.45 kips	354.75 kips
62.40 ft	359.42 kips	1.45 kips	360.87 kips
63.40 ft	365.60 kips	1.45 kips	367.05 kips
64.40 ft	371.78 kips	1.45 kips	373.23 kips
65.40 ft	377.95 kips	1.45 kips	379.41 kips
66.40 ft	384.13 kips	1.45 kips	385.59 kips
67.40 ft	390.31 kips	1.45 kips	391.77 kips
68.40 ft	396.49 kips	1.45 kips	397.95 kips
69.40 ft	402.67 kips	1.45 kips	404.13 kips
70.40 ft	408.72 kips	1.45 kips	410.17 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	414.64 kips	1.45 kips	416.10 kips
72.40 ft	420.52 kips	1.45 kips	421.97 kips
73.40 ft	426.34 kips	1.45 kips	427.79 kips
74.40 ft	432.12 kips	1.45 kips	433.57 kips
75.40 ft	437.84 kips	1.45 kips	439.30 kips
76.40 ft	443.52 kips	1.45 kips	444.98 kips
77.40 ft	449.15 kips	1.45 kips	450.61 kips
78.40 ft	454.49 kips	1.45 kips	455.95 kips
79.40 ft	458.79 kips	1.45 kips	460.24 kips
80.40 ft	462.90 kips	1.45 kips	464.35 kips
81.40 ft	466.83 kips	1.45 kips	468.28 kips
82.40 ft	470.57 kips	1.45 kips	472.02 kips
83.40 ft	474.13 kips	1.45 kips	475.58 kips
84.39 ft	477.47 kips	1.45 kips	478.92 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
Capacity (kips)

DrivenPiles - Report

General Project Information

Filename: ...3.01\Analysis\Driven Piles\Rear Abutment\FRA-70-13.01 - Rear Abutment HP 12x53-B-015-1-13.dvn
Project Name: FRA-70-13.01 Rear Abutment (B-015-1-13)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 0.00 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	58.00 ft
Driving/Restrike:	58.00 ft
Nominal:	58.00 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	0.00 ft

Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	11.10 ft	1.000	120.00 pcf	0.0/0.0	Nordlund
2	Cohesive	6.30 ft	1.500	120.00 pcf	3125.00 psf	T-80 Same
3	Cohesionless	4.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
4	Cohesive	5.00 ft	1.750	120.00 pcf	2375.00 psf	T-80 Sand
5	Cohesive	15.00 ft	1.200	120.00 pcf	2875.00 psf	T-80 Same
6	Cohesionless	5.00 ft	1.000	135.00 pcf	39.0/39.0	Nordlund
7	Cohesionless	15.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
8	Cohesive	23.00 ft	1.200	115.00 pcf	1875.00 psf	T-80 Sand

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.05 kips	0.05 kips
3.00 ft	0.00 kips	0.07 kips	0.07 kips
4.00 ft	0.00 kips	0.09 kips	0.09 kips
5.00 ft	0.00 kips	0.11 kips	0.11 kips
6.00 ft	0.00 kips	0.14 kips	0.14 kips
7.00 ft	0.00 kips	0.16 kips	0.16 kips
8.00 ft	0.00 kips	0.18 kips	0.18 kips
9.00 ft	0.00 kips	0.20 kips	0.20 kips
10.00 ft	0.00 kips	0.23 kips	0.23 kips
11.00 ft	0.00 kips	0.25 kips	0.25 kips
11.09 ft	0.00 kips	0.25 kips	0.25 kips
11.11 ft	0.03 kips	3.03 kips	3.06 kips
12.10 ft	3.48 kips	3.03 kips	6.51 kips
13.10 ft	6.96 kips	3.03 kips	9.99 kips
14.10 ft	10.44 kips	3.03 kips	13.47 kips
15.10 ft	13.92 kips	3.03 kips	16.95 kips
16.10 ft	17.40 kips	3.03 kips	20.43 kips
17.10 ft	20.88 kips	3.03 kips	23.91 kips
17.39 ft	21.89 kips	3.03 kips	24.92 kips
17.41 ft	21.99 kips	42.47 kips	64.46 kips
18.40 ft	28.33 kips	45.19 kips	73.52 kips
19.40 ft	35.14 kips	47.93 kips	83.08 kips
20.40 ft	42.36 kips	50.68 kips	93.03 kips
21.39 ft	49.89 kips	53.40 kips	103.29 kips
21.41 ft	50.06 kips	2.30 kips	52.37 kips
22.40 ft	59.39 kips	2.30 kips	61.69 kips
23.40 ft	68.81 kips	2.30 kips	71.11 kips
24.40 ft	78.23 kips	2.30 kips	80.53 kips
25.40 ft	87.65 kips	2.30 kips	89.95 kips
26.39 ft	96.98 kips	2.30 kips	99.28 kips
26.41 ft	97.11 kips	2.79 kips	99.90 kips
27.40 ft	100.83 kips	2.79 kips	103.61 kips
28.40 ft	104.58 kips	2.79 kips	107.36 kips
29.40 ft	108.33 kips	2.79 kips	111.11 kips
30.40 ft	112.08 kips	2.79 kips	114.86 kips
31.40 ft	115.83 kips	2.79 kips	118.61 kips
32.40 ft	119.58 kips	2.79 kips	122.37 kips
33.40 ft	123.33 kips	2.79 kips	126.12 kips
34.40 ft	127.08 kips	2.79 kips	129.87 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	130.83 kips	2.79 kips	133.62 kips
36.40 ft	134.58 kips	2.79 kips	137.37 kips
37.40 ft	139.24 kips	2.79 kips	142.02 kips
38.40 ft	144.06 kips	2.79 kips	146.84 kips
39.40 ft	149.04 kips	2.79 kips	151.82 kips
40.40 ft	154.18 kips	2.79 kips	156.97 kips
41.39 ft	159.44 kips	2.79 kips	162.23 kips
41.41 ft	159.63 kips	36.46 kips	196.09 kips
42.40 ft	173.18 kips	36.46 kips	209.64 kips
43.40 ft	187.23 kips	36.46 kips	223.69 kips
44.40 ft	201.64 kips	36.46 kips	238.10 kips
45.40 ft	216.42 kips	36.46 kips	252.88 kips
46.39 ft	231.40 kips	36.46 kips	267.86 kips
46.41 ft	231.67 kips	16.32 kips	247.99 kips
47.40 ft	243.22 kips	16.32 kips	259.54 kips
48.40 ft	255.14 kips	16.32 kips	271.46 kips
49.40 ft	267.33 kips	16.32 kips	283.65 kips
50.40 ft	279.78 kips	16.32 kips	296.10 kips
51.40 ft	292.50 kips	16.32 kips	308.81 kips
52.40 ft	305.47 kips	16.32 kips	321.79 kips
53.40 ft	318.71 kips	16.32 kips	335.03 kips
54.40 ft	332.21 kips	16.32 kips	348.53 kips
55.40 ft	345.98 kips	16.32 kips	362.30 kips
56.40 ft	360.01 kips	16.32 kips	376.33 kips
57.40 ft	374.30 kips	16.32 kips	390.62 kips
57.99 ft	382.85 kips	16.32 kips	399.17 kips
58.01 ft	383.14 kips	16.32 kips	399.46 kips
59.00 ft	397.65 kips	16.32 kips	413.97 kips
60.00 ft	412.43 kips	16.32 kips	428.75 kips
61.00 ft	427.35 kips	16.32 kips	443.67 kips
61.39 ft	433.21 kips	16.32 kips	449.53 kips
61.41 ft	433.43 kips	1.82 kips	435.25 kips
62.40 ft	440.80 kips	1.82 kips	442.61 kips
63.40 ft	448.24 kips	1.82 kips	450.05 kips
64.40 ft	455.67 kips	1.82 kips	457.49 kips
65.40 ft	463.11 kips	1.82 kips	464.93 kips
66.40 ft	470.55 kips	1.82 kips	472.36 kips
67.40 ft	477.99 kips	1.82 kips	479.80 kips
68.40 ft	485.42 kips	1.82 kips	487.24 kips
69.40 ft	492.86 kips	1.82 kips	494.68 kips
70.40 ft	500.30 kips	1.82 kips	502.11 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	507.74 kips	1.82 kips	509.55 kips
72.40 ft	514.90 kips	1.82 kips	516.72 kips
73.40 ft	522.02 kips	1.82 kips	523.84 kips
74.40 ft	529.09 kips	1.82 kips	530.91 kips
75.40 ft	536.11 kips	1.82 kips	537.93 kips
76.40 ft	543.08 kips	1.82 kips	544.90 kips
77.40 ft	550.00 kips	1.82 kips	551.82 kips
78.40 ft	556.87 kips	1.82 kips	558.69 kips
79.40 ft	563.70 kips	1.82 kips	565.51 kips
80.40 ft	570.47 kips	1.82 kips	572.29 kips
81.40 ft	577.20 kips	1.82 kips	579.01 kips
82.40 ft	582.43 kips	1.82 kips	584.25 kips
83.40 ft	587.48 kips	1.82 kips	589.29 kips
84.39 ft	592.29 kips	1.82 kips	594.11 kips


Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.05 kips	0.05 kips
3.00 ft	0.00 kips	0.07 kips	0.07 kips
4.00 ft	0.00 kips	0.09 kips	0.09 kips
5.00 ft	0.00 kips	0.11 kips	0.11 kips
6.00 ft	0.00 kips	0.14 kips	0.14 kips
7.00 ft	0.00 kips	0.16 kips	0.16 kips
8.00 ft	0.00 kips	0.18 kips	0.18 kips
9.00 ft	0.00 kips	0.20 kips	0.20 kips
10.00 ft	0.00 kips	0.23 kips	0.23 kips
11.00 ft	0.00 kips	0.25 kips	0.25 kips
11.09 ft	0.00 kips	0.25 kips	0.25 kips
11.11 ft	0.02 kips	3.03 kips	3.05 kips
12.10 ft	2.32 kips	3.03 kips	5.35 kips
13.10 ft	4.64 kips	3.03 kips	7.67 kips
14.10 ft	6.96 kips	3.03 kips	9.99 kips
15.10 ft	9.28 kips	3.03 kips	12.31 kips
16.10 ft	11.60 kips	3.03 kips	14.63 kips
17.10 ft	13.92 kips	3.03 kips	16.95 kips
17.39 ft	14.59 kips	3.03 kips	17.62 kips
17.41 ft	14.68 kips	42.47 kips	57.15 kips
18.40 ft	21.03 kips	45.19 kips	66.22 kips
19.40 ft	27.84 kips	47.93 kips	75.77 kips
20.40 ft	35.05 kips	50.68 kips	85.73 kips
21.39 ft	42.59 kips	53.40 kips	95.98 kips
21.41 ft	42.72 kips	2.30 kips	45.02 kips
22.40 ft	48.05 kips	2.30 kips	50.35 kips
23.40 ft	53.43 kips	2.30 kips	55.73 kips
24.40 ft	58.81 kips	2.30 kips	61.11 kips
25.40 ft	64.20 kips	2.30 kips	66.50 kips
26.39 ft	69.52 kips	2.30 kips	71.83 kips
26.41 ft	69.61 kips	2.79 kips	72.40 kips
27.40 ft	72.70 kips	2.79 kips	75.49 kips
28.40 ft	75.83 kips	2.79 kips	78.62 kips
29.40 ft	78.96 kips	2.79 kips	81.74 kips
30.40 ft	82.08 kips	2.79 kips	84.87 kips
31.40 ft	85.21 kips	2.79 kips	87.99 kips
32.40 ft	88.33 kips	2.79 kips	91.12 kips
33.40 ft	91.46 kips	2.79 kips	94.24 kips
34.40 ft	94.58 kips	2.79 kips	97.37 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	97.71 kips	2.79 kips	100.49 kips
36.40 ft	100.84 kips	2.79 kips	103.62 kips
37.40 ft	104.71 kips	2.79 kips	107.50 kips
38.40 ft	108.73 kips	2.79 kips	111.51 kips
39.40 ft	112.88 kips	2.79 kips	115.67 kips
40.40 ft	117.17 kips	2.79 kips	119.95 kips
41.39 ft	121.55 kips	2.79 kips	124.33 kips
41.41 ft	121.73 kips	36.46 kips	158.19 kips
42.40 ft	135.28 kips	36.46 kips	171.74 kips
43.40 ft	149.33 kips	36.46 kips	185.79 kips
44.40 ft	163.74 kips	36.46 kips	200.20 kips
45.40 ft	178.52 kips	36.46 kips	214.98 kips
46.39 ft	193.50 kips	36.46 kips	229.96 kips
46.41 ft	193.77 kips	16.32 kips	210.09 kips
47.40 ft	205.32 kips	16.32 kips	221.63 kips
48.40 ft	217.24 kips	16.32 kips	233.56 kips
49.40 ft	229.43 kips	16.32 kips	245.75 kips
50.40 ft	241.88 kips	16.32 kips	258.20 kips
51.40 ft	254.59 kips	16.32 kips	270.91 kips
52.40 ft	267.57 kips	16.32 kips	283.89 kips
53.40 ft	280.81 kips	16.32 kips	297.13 kips
54.40 ft	294.31 kips	16.32 kips	310.63 kips
55.40 ft	308.08 kips	16.32 kips	324.40 kips
56.40 ft	322.11 kips	16.32 kips	338.42 kips
57.40 ft	336.40 kips	16.32 kips	352.71 kips
57.99 ft	344.95 kips	16.32 kips	361.27 kips
58.01 ft	345.24 kips	16.32 kips	361.56 kips
59.00 ft	359.75 kips	16.32 kips	376.06 kips
60.00 ft	374.53 kips	16.32 kips	390.85 kips
61.00 ft	389.45 kips	16.32 kips	405.77 kips
61.39 ft	395.31 kips	16.32 kips	411.63 kips
61.41 ft	395.52 kips	1.82 kips	397.34 kips
62.40 ft	401.66 kips	1.82 kips	403.47 kips
63.40 ft	407.85 kips	1.82 kips	409.67 kips
64.40 ft	414.05 kips	1.82 kips	415.87 kips
65.40 ft	420.25 kips	1.82 kips	422.07 kips
66.40 ft	426.45 kips	1.82 kips	428.26 kips
67.40 ft	432.65 kips	1.82 kips	434.46 kips
68.40 ft	438.84 kips	1.82 kips	440.66 kips
69.40 ft	445.04 kips	1.82 kips	446.86 kips
70.40 ft	451.24 kips	1.82 kips	453.05 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	457.44 kips	1.82 kips	459.25 kips
72.40 ft	463.41 kips	1.82 kips	465.22 kips
73.40 ft	469.34 kips	1.82 kips	471.16 kips
74.40 ft	475.23 kips	1.82 kips	477.05 kips
75.40 ft	481.08 kips	1.82 kips	482.90 kips
76.40 ft	486.89 kips	1.82 kips	488.70 kips
77.40 ft	492.66 kips	1.82 kips	494.47 kips
78.40 ft	498.38 kips	1.82 kips	500.20 kips
79.40 ft	504.07 kips	1.82 kips	505.89 kips
80.40 ft	509.71 kips	1.82 kips	511.53 kips
81.40 ft	515.32 kips	1.82 kips	517.13 kips
82.40 ft	519.68 kips	1.82 kips	521.50 kips
83.40 ft	523.88 kips	1.82 kips	525.70 kips
84.39 ft	527.90 kips	1.82 kips	529.71 kips

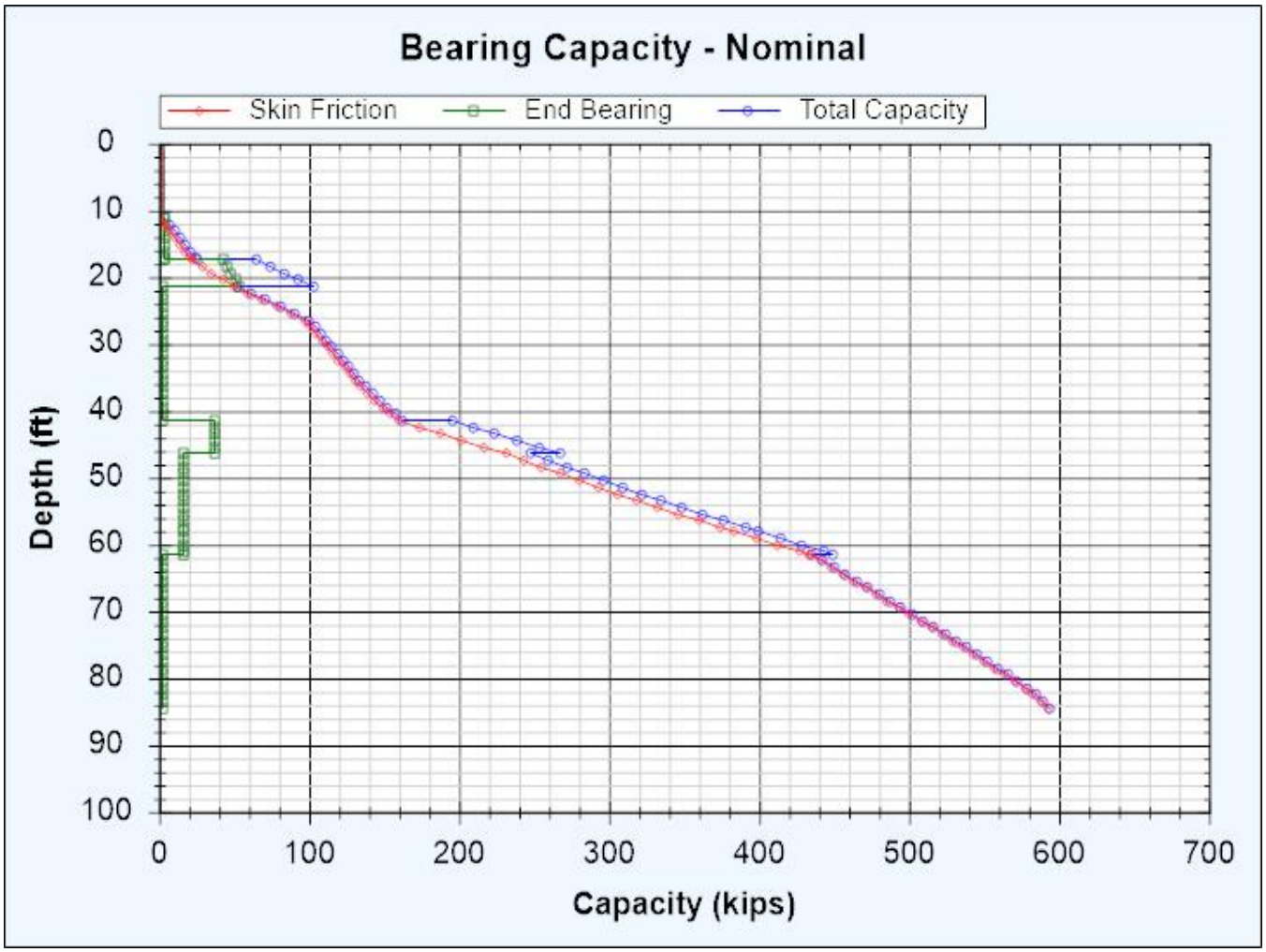

Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.02 kips	0.02 kips
2.00 ft	0.00 kips	0.05 kips	0.05 kips
3.00 ft	0.00 kips	0.07 kips	0.07 kips
4.00 ft	0.00 kips	0.09 kips	0.09 kips
5.00 ft	0.00 kips	0.11 kips	0.11 kips
6.00 ft	0.00 kips	0.14 kips	0.14 kips
7.00 ft	0.00 kips	0.16 kips	0.16 kips
8.00 ft	0.00 kips	0.18 kips	0.18 kips
9.00 ft	0.00 kips	0.20 kips	0.20 kips
10.00 ft	0.00 kips	0.23 kips	0.23 kips
11.00 ft	0.00 kips	0.25 kips	0.25 kips
11.09 ft	0.00 kips	0.25 kips	0.25 kips
11.11 ft	0.03 kips	3.03 kips	3.06 kips
12.10 ft	3.48 kips	3.03 kips	6.51 kips
13.10 ft	6.96 kips	3.03 kips	9.99 kips
14.10 ft	10.44 kips	3.03 kips	13.47 kips
15.10 ft	13.92 kips	3.03 kips	16.95 kips
16.10 ft	17.40 kips	3.03 kips	20.43 kips
17.10 ft	20.88 kips	3.03 kips	23.91 kips
17.39 ft	21.89 kips	3.03 kips	24.92 kips
17.41 ft	21.99 kips	42.47 kips	64.46 kips
18.40 ft	28.33 kips	45.19 kips	73.52 kips
19.40 ft	35.14 kips	47.93 kips	83.08 kips
20.40 ft	42.36 kips	50.68 kips	93.03 kips
21.39 ft	49.89 kips	53.40 kips	103.29 kips
21.41 ft	50.06 kips	2.30 kips	52.37 kips
22.40 ft	59.39 kips	2.30 kips	61.69 kips
23.40 ft	68.81 kips	2.30 kips	71.11 kips
24.40 ft	78.23 kips	2.30 kips	80.53 kips
25.40 ft	87.65 kips	2.30 kips	89.95 kips
26.39 ft	96.98 kips	2.30 kips	99.28 kips
26.41 ft	97.11 kips	2.79 kips	99.90 kips
27.40 ft	100.83 kips	2.79 kips	103.61 kips
28.40 ft	104.58 kips	2.79 kips	107.36 kips
29.40 ft	108.33 kips	2.79 kips	111.11 kips
30.40 ft	112.08 kips	2.79 kips	114.86 kips
31.40 ft	115.83 kips	2.79 kips	118.61 kips
32.40 ft	119.58 kips	2.79 kips	122.37 kips
33.40 ft	123.33 kips	2.79 kips	126.12 kips
34.40 ft	127.08 kips	2.79 kips	129.87 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	130.83 kips	2.79 kips	133.62 kips
36.40 ft	134.58 kips	2.79 kips	137.37 kips
37.40 ft	139.24 kips	2.79 kips	142.02 kips
38.40 ft	144.06 kips	2.79 kips	146.84 kips
39.40 ft	149.04 kips	2.79 kips	151.82 kips
40.40 ft	154.18 kips	2.79 kips	156.97 kips
41.39 ft	159.44 kips	2.79 kips	162.23 kips
41.41 ft	159.63 kips	36.46 kips	196.09 kips
42.40 ft	173.18 kips	36.46 kips	209.64 kips
43.40 ft	187.23 kips	36.46 kips	223.69 kips
44.40 ft	201.64 kips	36.46 kips	238.10 kips
45.40 ft	216.42 kips	36.46 kips	252.88 kips
46.39 ft	231.40 kips	36.46 kips	267.86 kips
46.41 ft	231.67 kips	16.32 kips	247.99 kips
47.40 ft	243.22 kips	16.32 kips	259.54 kips
48.40 ft	255.14 kips	16.32 kips	271.46 kips
49.40 ft	267.33 kips	16.32 kips	283.65 kips
50.40 ft	279.78 kips	16.32 kips	296.10 kips
51.40 ft	292.50 kips	16.32 kips	308.81 kips
52.40 ft	305.47 kips	16.32 kips	321.79 kips
53.40 ft	318.71 kips	16.32 kips	335.03 kips
54.40 ft	332.21 kips	16.32 kips	348.53 kips
55.40 ft	345.98 kips	16.32 kips	362.30 kips
56.40 ft	360.01 kips	16.32 kips	376.33 kips
57.40 ft	374.30 kips	16.32 kips	390.62 kips
57.99 ft	382.85 kips	16.32 kips	399.17 kips
58.01 ft	383.14 kips	16.32 kips	399.46 kips
59.00 ft	397.65 kips	16.32 kips	413.97 kips
60.00 ft	412.43 kips	16.32 kips	428.75 kips
61.00 ft	427.35 kips	16.32 kips	443.67 kips
61.39 ft	433.21 kips	16.32 kips	449.53 kips
61.41 ft	433.43 kips	1.82 kips	435.25 kips
62.40 ft	440.80 kips	1.82 kips	442.61 kips
63.40 ft	448.24 kips	1.82 kips	450.05 kips
64.40 ft	455.67 kips	1.82 kips	457.49 kips
65.40 ft	463.11 kips	1.82 kips	464.93 kips
66.40 ft	470.55 kips	1.82 kips	472.36 kips
67.40 ft	477.99 kips	1.82 kips	479.80 kips
68.40 ft	485.42 kips	1.82 kips	487.24 kips
69.40 ft	492.86 kips	1.82 kips	494.68 kips
70.40 ft	500.30 kips	1.82 kips	502.11 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	507.74 kips	1.82 kips	509.55 kips
72.40 ft	514.90 kips	1.82 kips	516.72 kips
73.40 ft	522.02 kips	1.82 kips	523.84 kips
74.40 ft	529.09 kips	1.82 kips	530.91 kips
75.40 ft	536.11 kips	1.82 kips	537.93 kips
76.40 ft	543.08 kips	1.82 kips	544.90 kips
77.40 ft	550.00 kips	1.82 kips	551.82 kips
78.40 ft	556.87 kips	1.82 kips	558.69 kips
79.40 ft	563.70 kips	1.82 kips	565.51 kips
80.40 ft	570.47 kips	1.82 kips	572.29 kips
81.40 ft	577.20 kips	1.82 kips	579.01 kips
82.40 ft	582.43 kips	1.82 kips	584.25 kips
83.40 ft	587.48 kips	1.82 kips	589.29 kips
84.39 ft	592.29 kips	1.82 kips	594.11 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
Capacity (kips)

DrivenPiles - Report

General Project Information

Filename: ...3.01\Analysis\Driven Piles\Rear Abutment\FRA-70-13.01 - Rear Abutment HP 12x53-B-015-1-13.dvn
Project Name: FRA-70-13.01 Rear Abutment (B-015-1-13)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 0.00 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	58.00 ft
Driving/Restrike:	58.00 ft
Nominal:	58.00 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	0.00 ft

Nominal Profile

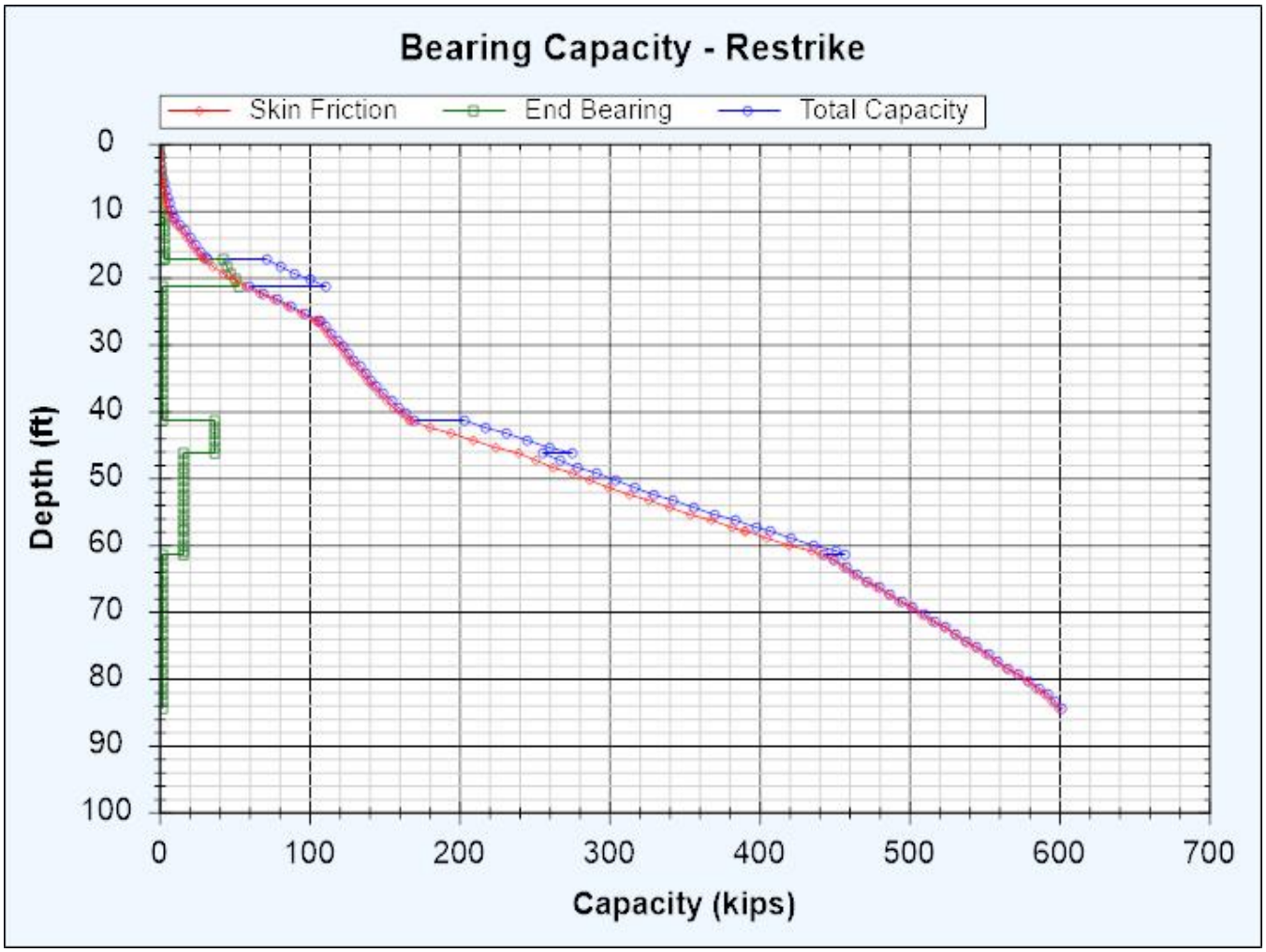
Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	11.10 ft	1.000	120.00 pcf	28.0/28.0	Nordlund
2	Cohesive	6.30 ft	1.500	120.00 pcf	3125.00 psf	T-80 Same
3	Cohesionless	4.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
4	Cohesive	5.00 ft	1.750	120.00 pcf	2375.00 psf	T-80 Sand
5	Cohesive	15.00 ft	1.200	120.00 pcf	2875.00 psf	T-80 Same
6	Cohesionless	5.00 ft	1.000	135.00 pcf	39.0/39.0	Nordlund
7	Cohesionless	15.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
8	Cohesive	23.00 ft	1.200	115.00 pcf	1875.00 psf	T-80 Sand

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
11.09 ft	7.72 kips	1.43 kips	9.16 kips
11.11 ft	7.77 kips	3.03 kips	10.80 kips
12.10 ft	11.22 kips	3.03 kips	14.24 kips
13.10 ft	14.70 kips	3.03 kips	17.72 kips
14.10 ft	18.18 kips	3.03 kips	21.20 kips
15.10 ft	21.66 kips	3.03 kips	24.68 kips
16.10 ft	25.14 kips	3.03 kips	28.16 kips
17.10 ft	28.62 kips	3.03 kips	31.64 kips
17.39 ft	29.62 kips	3.03 kips	32.65 kips
17.41 ft	29.72 kips	42.47 kips	72.19 kips
18.40 ft	36.07 kips	45.19 kips	81.26 kips
19.40 ft	42.88 kips	47.93 kips	90.81 kips
20.40 ft	50.09 kips	50.68 kips	100.77 kips
21.39 ft	57.63 kips	53.40 kips	111.02 kips
21.41 ft	57.80 kips	2.30 kips	60.10 kips
22.40 ft	67.13 kips	2.30 kips	69.43 kips
23.40 ft	76.55 kips	2.30 kips	78.85 kips
24.40 ft	85.97 kips	2.30 kips	88.27 kips
25.40 ft	95.39 kips	2.30 kips	97.69 kips
26.39 ft	104.72 kips	2.30 kips	107.02 kips
26.41 ft	104.85 kips	2.79 kips	107.63 kips
27.40 ft	108.56 kips	2.79 kips	111.35 kips
28.40 ft	112.31 kips	2.79 kips	115.10 kips
29.40 ft	116.06 kips	2.79 kips	118.85 kips
30.40 ft	119.81 kips	2.79 kips	122.60 kips
31.40 ft	123.57 kips	2.79 kips	126.35 kips
32.40 ft	127.32 kips	2.79 kips	130.10 kips
33.40 ft	131.07 kips	2.79 kips	133.85 kips
34.40 ft	134.82 kips	2.79 kips	137.60 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	138.57 kips	2.79 kips	141.35 kips
36.40 ft	142.32 kips	2.79 kips	145.10 kips
37.40 ft	146.97 kips	2.79 kips	149.76 kips
38.40 ft	151.79 kips	2.79 kips	154.58 kips
39.40 ft	156.77 kips	2.79 kips	159.56 kips
40.40 ft	161.92 kips	2.79 kips	164.71 kips
41.39 ft	167.18 kips	2.79 kips	169.96 kips
41.41 ft	167.37 kips	36.46 kips	203.83 kips
42.40 ft	180.92 kips	36.46 kips	217.38 kips
43.40 ft	194.97 kips	36.46 kips	231.43 kips
44.40 ft	209.38 kips	36.46 kips	245.84 kips
45.40 ft	224.15 kips	36.46 kips	260.61 kips
46.39 ft	239.14 kips	36.46 kips	275.60 kips
46.41 ft	239.41 kips	16.32 kips	255.73 kips
47.40 ft	250.95 kips	16.32 kips	267.27 kips
48.40 ft	262.88 kips	16.32 kips	279.20 kips
49.40 ft	275.07 kips	16.32 kips	291.39 kips
50.40 ft	287.52 kips	16.32 kips	303.84 kips
51.40 ft	300.23 kips	16.32 kips	316.55 kips
52.40 ft	313.21 kips	16.32 kips	329.53 kips
53.40 ft	326.45 kips	16.32 kips	342.77 kips
54.40 ft	339.95 kips	16.32 kips	356.27 kips
55.40 ft	353.72 kips	16.32 kips	370.03 kips
56.40 ft	367.74 kips	16.32 kips	384.06 kips
57.40 ft	382.03 kips	16.32 kips	398.35 kips
57.99 ft	390.59 kips	16.32 kips	406.91 kips
58.01 ft	390.88 kips	16.32 kips	407.20 kips
59.00 ft	405.38 kips	16.32 kips	421.70 kips
60.00 ft	420.17 kips	16.32 kips	436.49 kips
61.00 ft	435.09 kips	16.32 kips	451.41 kips
61.39 ft	440.95 kips	16.32 kips	457.26 kips
61.41 ft	441.17 kips	1.82 kips	442.99 kips
62.40 ft	448.53 kips	1.82 kips	450.35 kips
63.40 ft	455.97 kips	1.82 kips	457.79 kips
64.40 ft	463.41 kips	1.82 kips	465.23 kips
65.40 ft	470.85 kips	1.82 kips	472.66 kips
66.40 ft	478.28 kips	1.82 kips	480.10 kips
67.40 ft	485.72 kips	1.82 kips	487.54 kips
68.40 ft	493.16 kips	1.82 kips	494.98 kips
69.40 ft	500.60 kips	1.82 kips	502.41 kips
70.40 ft	508.03 kips	1.82 kips	509.85 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	515.47 kips	1.82 kips	517.29 kips
72.40 ft	522.64 kips	1.82 kips	524.46 kips
73.40 ft	529.76 kips	1.82 kips	531.57 kips
74.40 ft	536.83 kips	1.82 kips	538.64 kips
75.40 ft	543.85 kips	1.82 kips	545.66 kips
76.40 ft	550.82 kips	1.82 kips	552.63 kips
77.40 ft	557.74 kips	1.82 kips	559.55 kips
78.40 ft	564.61 kips	1.82 kips	566.43 kips
79.40 ft	571.43 kips	1.82 kips	573.25 kips
80.40 ft	578.21 kips	1.82 kips	580.02 kips
81.40 ft	584.93 kips	1.82 kips	586.75 kips
82.40 ft	590.17 kips	1.82 kips	591.98 kips
83.40 ft	595.21 kips	1.82 kips	597.03 kips
84.39 ft	600.03 kips	1.82 kips	601.84 kips


Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
11.09 ft	7.72 kips	1.43 kips	9.16 kips
11.11 ft	7.76 kips	3.03 kips	10.79 kips
12.10 ft	10.06 kips	3.03 kips	13.08 kips
13.10 ft	12.38 kips	3.03 kips	15.40 kips
14.10 ft	14.70 kips	3.03 kips	17.72 kips
15.10 ft	17.02 kips	3.03 kips	20.04 kips
16.10 ft	19.34 kips	3.03 kips	22.36 kips
17.10 ft	21.66 kips	3.03 kips	24.68 kips
17.39 ft	22.33 kips	3.03 kips	25.36 kips
17.41 ft	22.41 kips	42.47 kips	64.89 kips
18.40 ft	28.76 kips	45.19 kips	73.95 kips
19.40 ft	35.57 kips	47.93 kips	83.51 kips
20.40 ft	42.79 kips	50.68 kips	93.46 kips
21.39 ft	50.32 kips	53.40 kips	103.72 kips
21.41 ft	50.45 kips	2.30 kips	52.75 kips
22.40 ft	55.78 kips	2.30 kips	58.08 kips
23.40 ft	61.17 kips	2.30 kips	63.47 kips
24.40 ft	66.55 kips	2.30 kips	68.85 kips
25.40 ft	71.93 kips	2.30 kips	74.23 kips
26.39 ft	77.26 kips	2.30 kips	79.56 kips
26.41 ft	77.35 kips	2.79 kips	80.13 kips
27.40 ft	80.44 kips	2.79 kips	83.23 kips
28.40 ft	83.57 kips	2.79 kips	86.35 kips
29.40 ft	86.69 kips	2.79 kips	89.48 kips
30.40 ft	89.82 kips	2.79 kips	92.60 kips
31.40 ft	92.94 kips	2.79 kips	95.73 kips
32.40 ft	96.07 kips	2.79 kips	98.85 kips
33.40 ft	99.19 kips	2.79 kips	101.98 kips
34.40 ft	102.32 kips	2.79 kips	105.10 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	105.45 kips	2.79 kips	108.23 kips
36.40 ft	108.57 kips	2.79 kips	111.36 kips
37.40 ft	112.45 kips	2.79 kips	115.23 kips
38.40 ft	116.46 kips	2.79 kips	119.25 kips
39.40 ft	120.62 kips	2.79 kips	123.40 kips
40.40 ft	124.90 kips	2.79 kips	127.69 kips
41.39 ft	129.28 kips	2.79 kips	132.07 kips
41.41 ft	129.46 kips	36.46 kips	165.92 kips
42.40 ft	143.02 kips	36.46 kips	179.48 kips
43.40 ft	157.07 kips	36.46 kips	193.53 kips
44.40 ft	171.48 kips	36.46 kips	207.94 kips
45.40 ft	186.25 kips	36.46 kips	222.71 kips
46.39 ft	201.24 kips	36.46 kips	237.70 kips
46.41 ft	201.51 kips	16.32 kips	217.82 kips
47.40 ft	213.05 kips	16.32 kips	229.37 kips
48.40 ft	224.98 kips	16.32 kips	241.30 kips
49.40 ft	237.17 kips	16.32 kips	253.48 kips
50.40 ft	249.62 kips	16.32 kips	265.93 kips
51.40 ft	262.33 kips	16.32 kips	278.65 kips
52.40 ft	275.31 kips	16.32 kips	291.63 kips
53.40 ft	288.55 kips	16.32 kips	304.86 kips
54.40 ft	302.05 kips	16.32 kips	318.37 kips
55.40 ft	315.81 kips	16.32 kips	332.13 kips
56.40 ft	329.84 kips	16.32 kips	346.16 kips
57.40 ft	344.13 kips	16.32 kips	360.45 kips
57.99 ft	352.69 kips	16.32 kips	369.01 kips
58.01 ft	352.98 kips	16.32 kips	369.30 kips
59.00 ft	367.48 kips	16.32 kips	383.80 kips
60.00 ft	382.27 kips	16.32 kips	398.58 kips
61.00 ft	397.19 kips	16.32 kips	413.51 kips
61.39 ft	403.04 kips	16.32 kips	419.36 kips
61.41 ft	403.26 kips	1.82 kips	405.07 kips
62.40 ft	409.39 kips	1.82 kips	411.21 kips
63.40 ft	415.59 kips	1.82 kips	417.41 kips
64.40 ft	421.79 kips	1.82 kips	423.60 kips
65.40 ft	427.99 kips	1.82 kips	429.80 kips
66.40 ft	434.18 kips	1.82 kips	436.00 kips
67.40 ft	440.38 kips	1.82 kips	442.20 kips
68.40 ft	446.58 kips	1.82 kips	448.39 kips
69.40 ft	452.78 kips	1.82 kips	454.59 kips
70.40 ft	458.97 kips	1.82 kips	460.79 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	465.17 kips	1.82 kips	466.99 kips
72.40 ft	471.14 kips	1.82 kips	472.96 kips
73.40 ft	477.08 kips	1.82 kips	478.89 kips
74.40 ft	482.97 kips	1.82 kips	484.78 kips
75.40 ft	488.82 kips	1.82 kips	490.63 kips
76.40 ft	494.62 kips	1.82 kips	496.44 kips
77.40 ft	500.39 kips	1.82 kips	502.21 kips
78.40 ft	506.12 kips	1.82 kips	507.94 kips
79.40 ft	511.80 kips	1.82 kips	513.62 kips
80.40 ft	517.45 kips	1.82 kips	519.27 kips
81.40 ft	523.05 kips	1.82 kips	524.87 kips
82.40 ft	527.41 kips	1.82 kips	529.23 kips
83.40 ft	531.62 kips	1.82 kips	533.44 kips
84.39 ft	535.63 kips	1.82 kips	537.45 kips

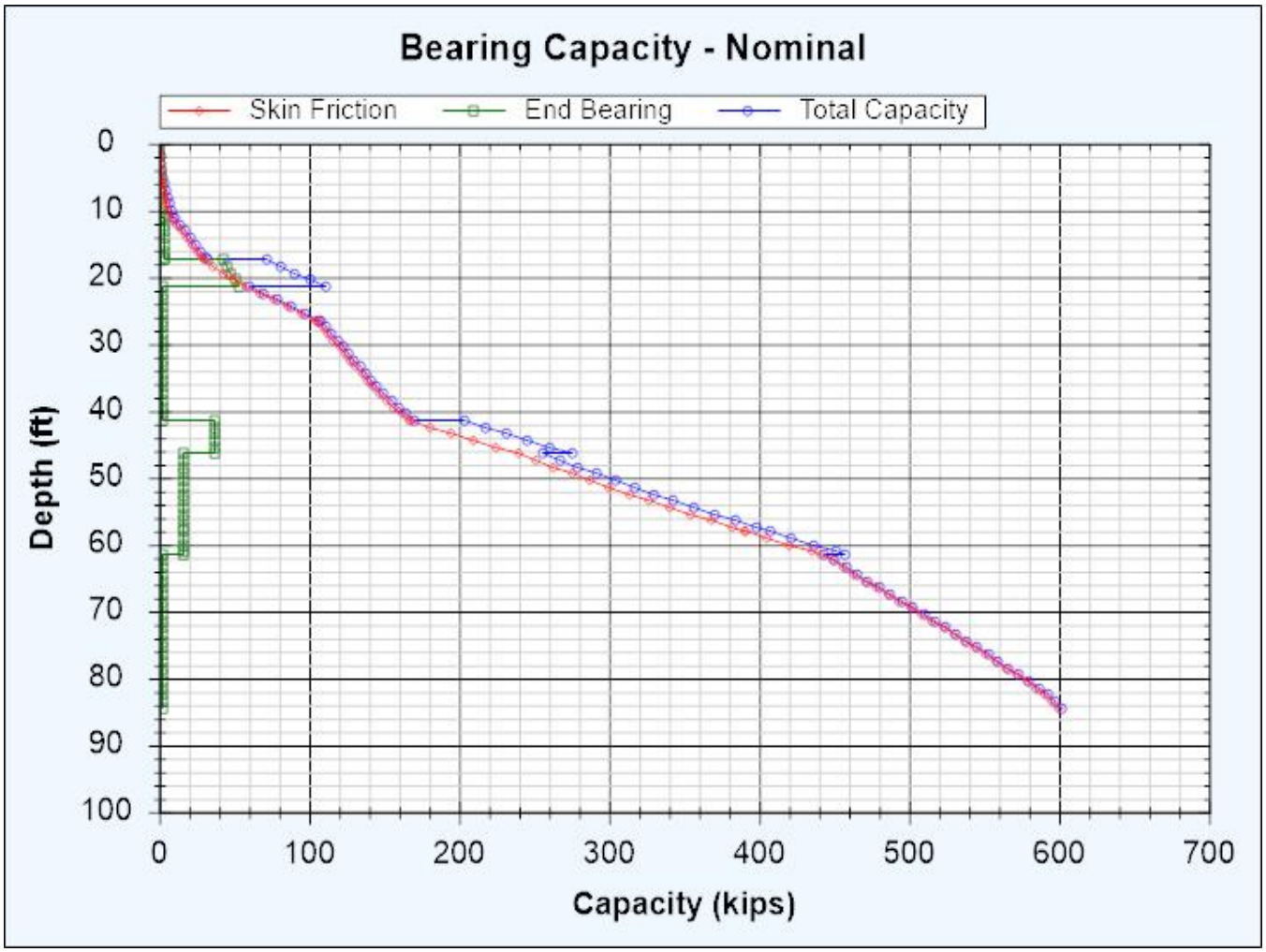

Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.06 kips	0.16 kips	0.22 kips
2.00 ft	0.25 kips	0.32 kips	0.57 kips
3.00 ft	0.57 kips	0.47 kips	1.04 kips
4.00 ft	1.00 kips	0.63 kips	1.64 kips
5.00 ft	1.57 kips	0.79 kips	2.36 kips
6.00 ft	2.26 kips	0.95 kips	3.21 kips
7.00 ft	3.08 kips	1.10 kips	4.18 kips
8.00 ft	4.02 kips	1.26 kips	5.28 kips
9.00 ft	5.09 kips	1.42 kips	6.51 kips
10.00 ft	6.28 kips	1.43 kips	7.71 kips
11.00 ft	7.60 kips	1.43 kips	9.03 kips
11.09 ft	7.72 kips	1.43 kips	9.16 kips
11.11 ft	7.77 kips	3.03 kips	10.80 kips
12.10 ft	11.22 kips	3.03 kips	14.24 kips
13.10 ft	14.70 kips	3.03 kips	17.72 kips
14.10 ft	18.18 kips	3.03 kips	21.20 kips
15.10 ft	21.66 kips	3.03 kips	24.68 kips
16.10 ft	25.14 kips	3.03 kips	28.16 kips
17.10 ft	28.62 kips	3.03 kips	31.64 kips
17.39 ft	29.62 kips	3.03 kips	32.65 kips
17.41 ft	29.72 kips	42.47 kips	72.19 kips
18.40 ft	36.07 kips	45.19 kips	81.26 kips
19.40 ft	42.88 kips	47.93 kips	90.81 kips
20.40 ft	50.09 kips	50.68 kips	100.77 kips
21.39 ft	57.63 kips	53.40 kips	111.02 kips
21.41 ft	57.80 kips	2.30 kips	60.10 kips
22.40 ft	67.13 kips	2.30 kips	69.43 kips
23.40 ft	76.55 kips	2.30 kips	78.85 kips
24.40 ft	85.97 kips	2.30 kips	88.27 kips
25.40 ft	95.39 kips	2.30 kips	97.69 kips
26.39 ft	104.72 kips	2.30 kips	107.02 kips
26.41 ft	104.85 kips	2.79 kips	107.63 kips
27.40 ft	108.56 kips	2.79 kips	111.35 kips
28.40 ft	112.31 kips	2.79 kips	115.10 kips
29.40 ft	116.06 kips	2.79 kips	118.85 kips
30.40 ft	119.81 kips	2.79 kips	122.60 kips
31.40 ft	123.57 kips	2.79 kips	126.35 kips
32.40 ft	127.32 kips	2.79 kips	130.10 kips
33.40 ft	131.07 kips	2.79 kips	133.85 kips
34.40 ft	134.82 kips	2.79 kips	137.60 kips

Depth	Skin Friction	End Bearing	Total Capacity
35.40 ft	138.57 kips	2.79 kips	141.35 kips
36.40 ft	142.32 kips	2.79 kips	145.10 kips
37.40 ft	146.97 kips	2.79 kips	149.76 kips
38.40 ft	151.79 kips	2.79 kips	154.58 kips
39.40 ft	156.77 kips	2.79 kips	159.56 kips
40.40 ft	161.92 kips	2.79 kips	164.71 kips
41.39 ft	167.18 kips	2.79 kips	169.96 kips
41.41 ft	167.37 kips	36.46 kips	203.83 kips
42.40 ft	180.92 kips	36.46 kips	217.38 kips
43.40 ft	194.97 kips	36.46 kips	231.43 kips
44.40 ft	209.38 kips	36.46 kips	245.84 kips
45.40 ft	224.15 kips	36.46 kips	260.61 kips
46.39 ft	239.14 kips	36.46 kips	275.60 kips
46.41 ft	239.41 kips	16.32 kips	255.73 kips
47.40 ft	250.95 kips	16.32 kips	267.27 kips
48.40 ft	262.88 kips	16.32 kips	279.20 kips
49.40 ft	275.07 kips	16.32 kips	291.39 kips
50.40 ft	287.52 kips	16.32 kips	303.84 kips
51.40 ft	300.23 kips	16.32 kips	316.55 kips
52.40 ft	313.21 kips	16.32 kips	329.53 kips
53.40 ft	326.45 kips	16.32 kips	342.77 kips
54.40 ft	339.95 kips	16.32 kips	356.27 kips
55.40 ft	353.72 kips	16.32 kips	370.03 kips
56.40 ft	367.74 kips	16.32 kips	384.06 kips
57.40 ft	382.03 kips	16.32 kips	398.35 kips
57.99 ft	390.59 kips	16.32 kips	406.91 kips
58.01 ft	390.88 kips	16.32 kips	407.20 kips
59.00 ft	405.38 kips	16.32 kips	421.70 kips
60.00 ft	420.17 kips	16.32 kips	436.49 kips
61.00 ft	435.09 kips	16.32 kips	451.41 kips
61.39 ft	440.95 kips	16.32 kips	457.26 kips
61.41 ft	441.17 kips	1.82 kips	442.99 kips
62.40 ft	448.53 kips	1.82 kips	450.35 kips
63.40 ft	455.97 kips	1.82 kips	457.79 kips
64.40 ft	463.41 kips	1.82 kips	465.23 kips
65.40 ft	470.85 kips	1.82 kips	472.66 kips
66.40 ft	478.28 kips	1.82 kips	480.10 kips
67.40 ft	485.72 kips	1.82 kips	487.54 kips
68.40 ft	493.16 kips	1.82 kips	494.98 kips
69.40 ft	500.60 kips	1.82 kips	502.41 kips
70.40 ft	508.03 kips	1.82 kips	509.85 kips

Depth	Skin Friction	End Bearing	Total Capacity
71.40 ft	515.47 kips	1.82 kips	517.29 kips
72.40 ft	522.64 kips	1.82 kips	524.46 kips
73.40 ft	529.76 kips	1.82 kips	531.57 kips
74.40 ft	536.83 kips	1.82 kips	538.64 kips
75.40 ft	543.85 kips	1.82 kips	545.66 kips
76.40 ft	550.82 kips	1.82 kips	552.63 kips
77.40 ft	557.74 kips	1.82 kips	559.55 kips
78.40 ft	564.61 kips	1.82 kips	566.43 kips
79.40 ft	571.43 kips	1.82 kips	573.25 kips
80.40 ft	578.21 kips	1.82 kips	580.02 kips
81.40 ft	584.93 kips	1.82 kips	586.75 kips
82.40 ft	590.17 kips	1.82 kips	591.98 kips
83.40 ft	595.21 kips	1.82 kips	597.03 kips
84.39 ft	600.03 kips	1.82 kips	601.84 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
90
100
0
100
200
300
400
500
600
700
Capacity (kips)

Pier 1
(B-014-3-19)

DrivenPiles - Report

General Project Information

Filename: ...-20-025 FRA-70-13.01\Analysis\Driven Piles\Pier 1\FRA-70-13.01 - Pier 1 HP 12x53-B-014-3-19.dvn
Project Name: FRA-70-13.01 Pier 1 (B-014-3-19)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 7.15 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	12.00 ft
Driving/Restrike:	12.00 ft
Nominal:	12.00 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	0.00 ft

Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesionless	1.50 ft	1.200	130.00 pcf	41.0/41.0	Nordlund
2	Cohesionless	1.50 ft	1.000	135.00 pcf	43.0/43.0	Nordlund
3	Cohesionless	2.50 ft	1.000	130.00 pcf	43.0/43.0	Nordlund
4	Cohesionless	5.00 ft	1.000	135.00 pcf	43.0/43.0	Nordlund
5	Cohesionless	7.50 ft	1.000	130.00 pcf	41.0/41.0	Nordlund
6	Cohesionless	5.00 ft	1.000	130.00 pcf	36.0/36.0	Nordlund
7	Cohesive	2.50 ft	1.500	135.00 pcf	5750.00 psf	T-80 Sand
8	Cohesionless	6.50 ft	1.000	140.00 pcf	42.0/42.0	Nordlund
9	Cohesive	10.00 ft	1.500	135.00 pcf	3375.00 psf	T-80 Sand
10	Cohesive	4.00 ft	1.500	140.00 pcf	7000.00 psf	T-80 Same

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.49 ft	0.00 kips	0.00 kips	0.00 kips
5.51 ft	0.00 kips	0.00 kips	0.00 kips
6.50 ft	0.00 kips	0.00 kips	0.00 kips
7.14 ft	0.00 kips	0.00 kips	0.00 kips
7.16 ft	0.03 kips	24.52 kips	24.55 kips
8.15 ft	3.04 kips	27.99 kips	31.02 kips
9.15 ft	6.47 kips	31.48 kips	37.96 kips
10.15 ft	10.32 kips	34.98 kips	45.30 kips
10.49 ft	11.72 kips	36.17 kips	47.89 kips
10.51 ft	11.80 kips	23.18 kips	34.98 kips
11.50 ft	16.06 kips	25.31 kips	41.37 kips
11.99 ft	18.31 kips	26.36 kips	44.68 kips
12.01 ft	18.41 kips	26.40 kips	44.80 kips
13.00 ft	23.14 kips	27.50 kips	50.65 kips
14.00 ft	28.13 kips	28.62 kips	56.75 kips
15.00 ft	33.31 kips	29.74 kips	63.06 kips
16.00 ft	38.70 kips	30.86 kips	69.56 kips
17.00 ft	44.28 kips	31.98 kips	76.26 kips
17.99 ft	50.00 kips	33.09 kips	83.09 kips
18.01 ft	50.10 kips	11.58 kips	61.67 kips
19.00 ft	54.17 kips	11.96 kips	66.13 kips
20.00 ft	58.41 kips	12.35 kips	70.77 kips
21.00 ft	62.79 kips	12.74 kips	75.53 kips
22.00 ft	67.31 kips	13.12 kips	80.44 kips
22.99 ft	71.92 kips	13.51 kips	85.42 kips
23.01 ft	72.19 kips	5.57 kips	77.76 kips
24.00 ft	94.77 kips	5.57 kips	100.34 kips
25.00 ft	117.58 kips	5.57 kips	123.15 kips
25.49 ft	128.76 kips	5.57 kips	134.33 kips
25.51 ft	129.06 kips	51.19 kips	180.26 kips
26.50 ft	136.59 kips	52.76 kips	189.34 kips
27.50 ft	144.42 kips	54.33 kips	198.75 kips

Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	152.48 kips	55.91 kips	208.39 kips
29.50 ft	160.78 kips	57.49 kips	218.27 kips
30.50 ft	169.30 kips	59.07 kips	228.37 kips
31.50 ft	178.06 kips	60.64 kips	238.70 kips
31.99 ft	182.43 kips	61.42 kips	243.85 kips
32.01 ft	182.66 kips	3.27 kips	185.93 kips
33.00 ft	195.91 kips	3.27 kips	199.18 kips
34.00 ft	209.30 kips	3.27 kips	212.57 kips
35.00 ft	222.68 kips	3.27 kips	225.95 kips
36.00 ft	236.07 kips	3.27 kips	239.34 kips
37.00 ft	249.46 kips	3.27 kips	252.73 kips
38.00 ft	262.85 kips	3.27 kips	266.12 kips
39.00 ft	276.23 kips	3.27 kips	279.50 kips
40.00 ft	289.62 kips	3.27 kips	292.89 kips
41.00 ft	303.01 kips	3.27 kips	306.28 kips
41.99 ft	316.26 kips	3.27 kips	319.53 kips
42.01 ft	316.46 kips	6.78 kips	323.24 kips
43.00 ft	323.01 kips	6.78 kips	329.79 kips
44.00 ft	329.61 kips	6.78 kips	336.40 kips
45.00 ft	336.22 kips	6.78 kips	343.00 kips
45.99 ft	342.76 kips	6.78 kips	349.55 kips


Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
0
50
100
150
200
250
300
350
400
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.49 ft	0.00 kips	0.00 kips	0.00 kips
5.51 ft	0.00 kips	0.00 kips	0.00 kips
6.50 ft	0.00 kips	0.00 kips	0.00 kips
7.14 ft	0.00 kips	0.00 kips	0.00 kips
7.16 ft	0.03 kips	24.52 kips	24.55 kips
8.15 ft	3.04 kips	27.99 kips	31.02 kips
9.15 ft	6.47 kips	31.48 kips	37.96 kips
10.15 ft	10.32 kips	34.98 kips	45.30 kips
10.49 ft	11.72 kips	36.17 kips	47.89 kips
10.51 ft	11.80 kips	23.18 kips	34.98 kips
11.50 ft	16.06 kips	25.31 kips	41.37 kips
11.99 ft	18.31 kips	26.36 kips	44.68 kips
12.01 ft	18.41 kips	26.40 kips	44.80 kips
13.00 ft	23.14 kips	27.50 kips	50.65 kips
14.00 ft	28.13 kips	28.62 kips	56.75 kips
15.00 ft	33.31 kips	29.74 kips	63.06 kips
16.00 ft	38.70 kips	30.86 kips	69.56 kips
17.00 ft	44.28 kips	31.98 kips	76.26 kips
17.99 ft	50.00 kips	33.09 kips	83.09 kips
18.01 ft	50.10 kips	11.58 kips	61.67 kips
19.00 ft	54.17 kips	11.96 kips	66.13 kips
20.00 ft	58.41 kips	12.35 kips	70.77 kips
21.00 ft	62.79 kips	12.74 kips	75.53 kips
22.00 ft	67.31 kips	13.12 kips	80.44 kips
22.99 ft	71.92 kips	13.51 kips	85.42 kips
23.01 ft	72.12 kips	5.57 kips	77.69 kips
24.00 ft	87.17 kips	5.57 kips	92.74 kips
25.00 ft	102.38 kips	5.57 kips	107.95 kips
25.49 ft	109.83 kips	5.57 kips	115.40 kips
25.51 ft	110.06 kips	51.19 kips	161.25 kips
26.50 ft	117.58 kips	52.76 kips	170.34 kips
27.50 ft	125.42 kips	54.33 kips	179.75 kips

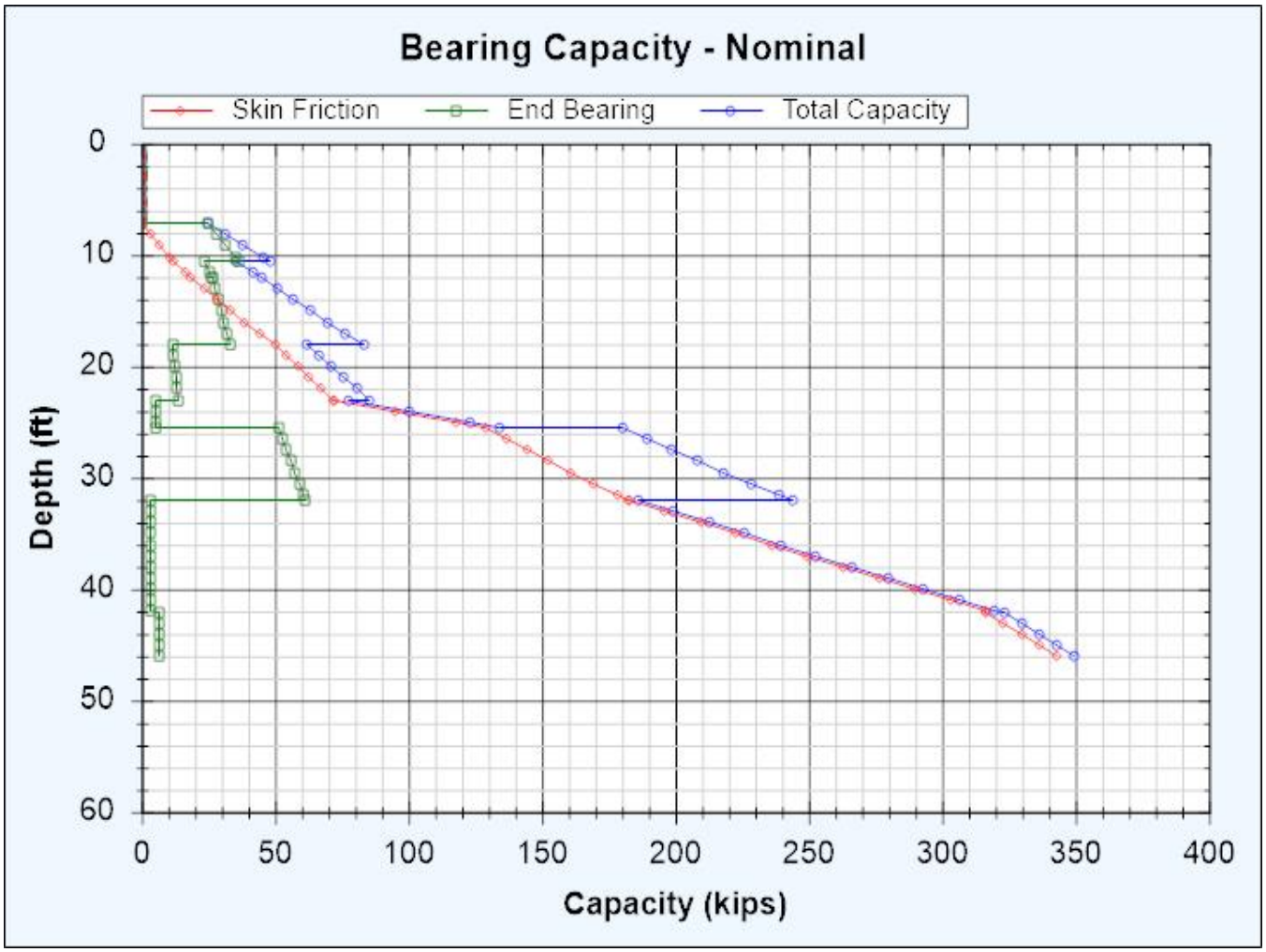
Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	133.48 kips	55.91 kips	189.39 kips
29.50 ft	141.77 kips	57.49 kips	199.26 kips
30.50 ft	150.30 kips	59.07 kips	209.36 kips
31.50 ft	159.05 kips	60.64 kips	219.70 kips
31.99 ft	163.43 kips	61.42 kips	224.84 kips
32.01 ft	163.61 kips	3.27 kips	166.88 kips
33.00 ft	172.44 kips	3.27 kips	175.71 kips
34.00 ft	181.37 kips	3.27 kips	184.64 kips
35.00 ft	190.29 kips	3.27 kips	193.56 kips
36.00 ft	199.22 kips	3.27 kips	202.49 kips
37.00 ft	208.14 kips	3.27 kips	211.41 kips
38.00 ft	217.07 kips	3.27 kips	220.34 kips
39.00 ft	226.00 kips	3.27 kips	229.26 kips
40.00 ft	234.92 kips	3.27 kips	238.19 kips
41.00 ft	243.85 kips	3.27 kips	247.12 kips
41.99 ft	252.68 kips	3.27 kips	255.95 kips
42.01 ft	252.82 kips	6.78 kips	259.60 kips
43.00 ft	257.18 kips	6.78 kips	263.96 kips
44.00 ft	261.58 kips	6.78 kips	268.36 kips
45.00 ft	265.99 kips	6.78 kips	272.77 kips
45.99 ft	270.35 kips	6.78 kips	277.13 kips


Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
0
50
100
150
200
250
300
350
400
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.49 ft	0.00 kips	0.00 kips	0.00 kips
5.51 ft	0.00 kips	0.00 kips	0.00 kips
6.50 ft	0.00 kips	0.00 kips	0.00 kips
7.14 ft	0.00 kips	0.00 kips	0.00 kips
7.16 ft	0.03 kips	24.52 kips	24.55 kips
8.15 ft	3.04 kips	27.99 kips	31.02 kips
9.15 ft	6.47 kips	31.48 kips	37.96 kips
10.15 ft	10.32 kips	34.98 kips	45.30 kips
10.49 ft	11.72 kips	36.17 kips	47.89 kips
10.51 ft	11.80 kips	23.18 kips	34.98 kips
11.50 ft	16.06 kips	25.31 kips	41.37 kips
11.99 ft	18.31 kips	26.36 kips	44.68 kips
12.01 ft	18.41 kips	26.40 kips	44.80 kips
13.00 ft	23.14 kips	27.50 kips	50.65 kips
14.00 ft	28.13 kips	28.62 kips	56.75 kips
15.00 ft	33.31 kips	29.74 kips	63.06 kips
16.00 ft	38.70 kips	30.86 kips	69.56 kips
17.00 ft	44.28 kips	31.98 kips	76.26 kips
17.99 ft	50.00 kips	33.09 kips	83.09 kips
18.01 ft	50.10 kips	11.58 kips	61.67 kips
19.00 ft	54.17 kips	11.96 kips	66.13 kips
20.00 ft	58.41 kips	12.35 kips	70.77 kips
21.00 ft	62.79 kips	12.74 kips	75.53 kips
22.00 ft	67.31 kips	13.12 kips	80.44 kips
22.99 ft	71.92 kips	13.51 kips	85.42 kips
23.01 ft	72.19 kips	5.57 kips	77.76 kips
24.00 ft	94.77 kips	5.57 kips	100.34 kips
25.00 ft	117.58 kips	5.57 kips	123.15 kips
25.49 ft	128.76 kips	5.57 kips	134.33 kips
25.51 ft	129.06 kips	51.19 kips	180.26 kips
26.50 ft	136.59 kips	52.76 kips	189.34 kips
27.50 ft	144.42 kips	54.33 kips	198.75 kips

Depth	Skin Friction	End Bearing	Total Capacity
28.50 ft	152.48 kips	55.91 kips	208.39 kips
29.50 ft	160.78 kips	57.49 kips	218.27 kips
30.50 ft	169.30 kips	59.07 kips	228.37 kips
31.50 ft	178.06 kips	60.64 kips	238.70 kips
31.99 ft	182.43 kips	61.42 kips	243.85 kips
32.01 ft	182.66 kips	3.27 kips	185.93 kips
33.00 ft	195.91 kips	3.27 kips	199.18 kips
34.00 ft	209.30 kips	3.27 kips	212.57 kips
35.00 ft	222.68 kips	3.27 kips	225.95 kips
36.00 ft	236.07 kips	3.27 kips	239.34 kips
37.00 ft	249.46 kips	3.27 kips	252.73 kips
38.00 ft	262.85 kips	3.27 kips	266.12 kips
39.00 ft	276.23 kips	3.27 kips	279.50 kips
40.00 ft	289.62 kips	3.27 kips	292.89 kips
41.00 ft	303.01 kips	3.27 kips	306.28 kips
41.99 ft	316.26 kips	3.27 kips	319.53 kips
42.01 ft	316.46 kips	6.78 kips	323.24 kips
43.00 ft	323.01 kips	6.78 kips	329.79 kips
44.00 ft	329.61 kips	6.78 kips	336.40 kips
45.00 ft	336.22 kips	6.78 kips	343.00 kips
45.99 ft	342.76 kips	6.78 kips	349.55 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
Capacity (kips)
0
50
100
150
200
250
300
350
400

Pier 2
(B-014-4-19)

DrivenPiles - Report

General Project Information

Filename: ...alysis\Driven Piles\Pier 2\With Downdrag Analysis\FRA-70-13.01 - Pier 2 HP- B-014-4-19-wDD.DVN
Project Name: FRA-70-13.01
Project Client: ms consultants, inc.
Prepared By: HSK
Project Manager: BRT

Pile Information

Pile Type: H Pile
Top of Pile: 5.40 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	8.00 ft
Driving/Restrike:	8.00 ft
Nominal:	8.00 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	23.40 ft

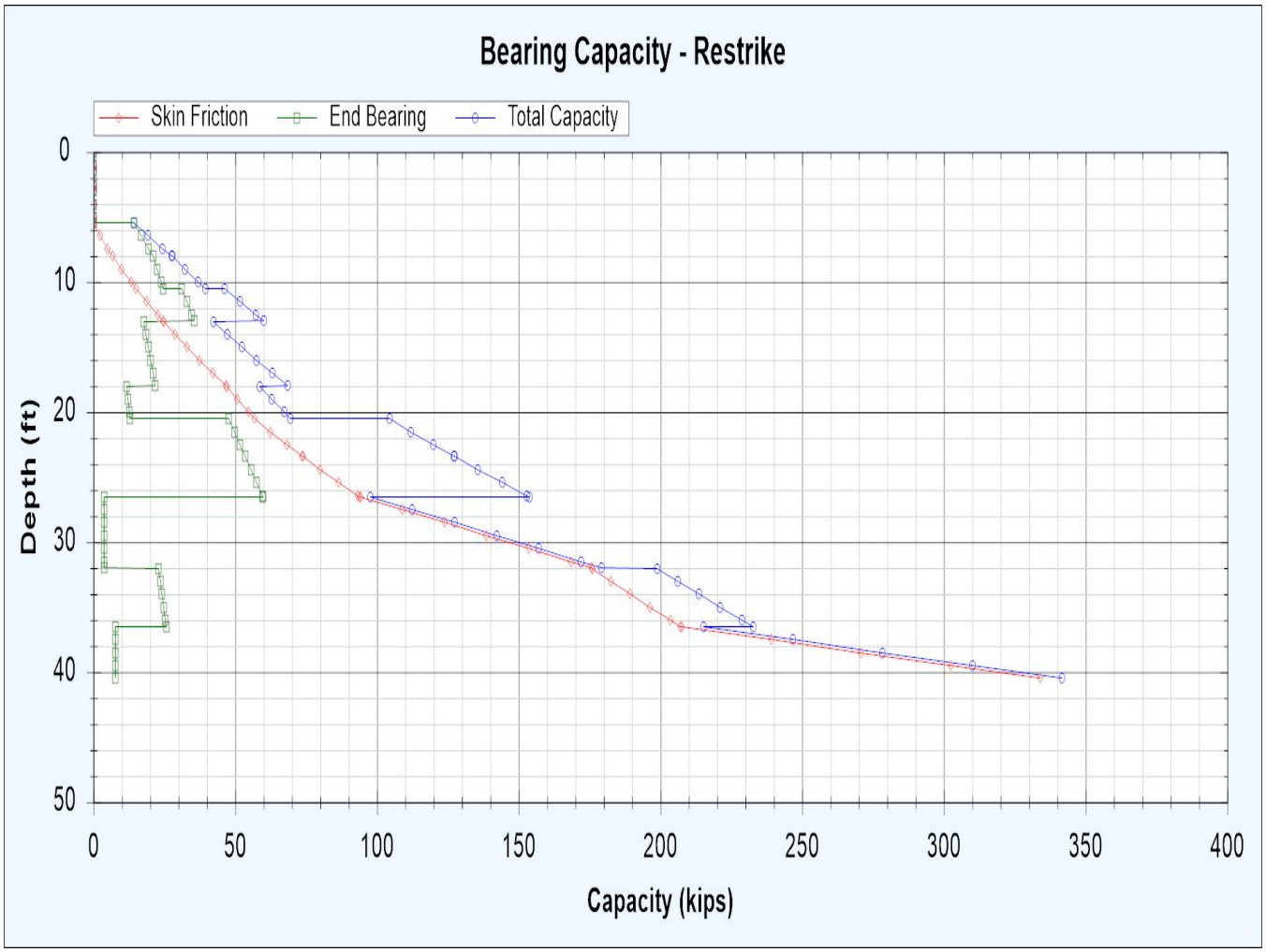
Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesive	1.50 ft	1.493	125.00 pcf	3125.00 psf	T-80 Same
2	Cohesive	1.50 ft	1.493	130.00 pcf	4625.00 psf	T-80 Same
3	Cohesionless	7.50 ft	1.000	130.00 pcf	42.0/42.0	Nordlund
4	Cohesionless	2.50 ft	1.000	130.00 pcf	43.0/43.0	Nordlund
5	Cohesionless	5.00 ft	1.000	125.00 pcf	40.0/40.0	Nordlund
6	Cohesionless	2.50 ft	1.000	125.00 pcf	37.0/37.0	Nordlund
7	Cohesionless	6.00 ft	1.000	140.00 pcf	43.0/43.0	Nordlund
8	Cohesive	5.50 ft	1.493	130.00 pcf	3750.00 psf	T-80 Sand
9	Cohesionless	4.50 ft	1.000	130.00 pcf	38.0/38.0	Nordlund
10	Cohesive	4.00 ft	1.493	135.00 pcf	8000.00 psf	T-80 Sand

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.02 kips	14.14 kips	14.17 kips
6.40 ft	2.26 kips	16.76 kips	19.02 kips
7.40 ft	4.90 kips	19.40 kips	24.31 kips
7.99 ft	6.65 kips	20.96 kips	27.61 kips
8.01 ft	6.71 kips	21.00 kips	27.71 kips
9.00 ft	9.85 kips	22.36 kips	32.21 kips
10.00 ft	13.22 kips	23.74 kips	36.96 kips
10.49 ft	14.94 kips	24.41 kips	39.35 kips
10.51 ft	15.02 kips	31.15 kips	46.16 kips
11.50 ft	18.68 kips	32.88 kips	51.56 kips
12.50 ft	22.59 kips	34.63 kips	57.22 kips
12.99 ft	24.57 kips	35.49 kips	60.06 kips
13.01 ft	24.65 kips	17.71 kips	42.37 kips
14.00 ft	28.69 kips	18.51 kips	47.20 kips
15.00 ft	32.96 kips	19.32 kips	52.27 kips
16.00 ft	37.40 kips	20.13 kips	57.53 kips
17.00 ft	42.02 kips	20.94 kips	62.96 kips
17.99 ft	46.78 kips	21.74 kips	68.52 kips
18.01 ft	46.87 kips	11.70 kips	58.57 kips
19.00 ft	50.67 kips	12.13 kips	62.80 kips
20.00 ft	54.66 kips	12.56 kips	67.22 kips
20.49 ft	56.66 kips	12.77 kips	69.44 kips
20.51 ft	56.76 kips	47.69 kips	104.45 kips
21.50 ft	62.33 kips	49.68 kips	112.01 kips
22.50 ft	68.20 kips	51.69 kips	119.89 kips
23.39 ft	73.61 kips	53.48 kips	127.09 kips
23.41 ft	73.73 kips	53.52 kips	127.25 kips
24.40 ft	79.98 kips	55.51 kips	135.49 kips
25.40 ft	86.51 kips	57.52 kips	144.03 kips
26.40 ft	93.28 kips	59.53 kips	152.81 kips
26.49 ft	93.90 kips	59.71 kips	153.62 kips

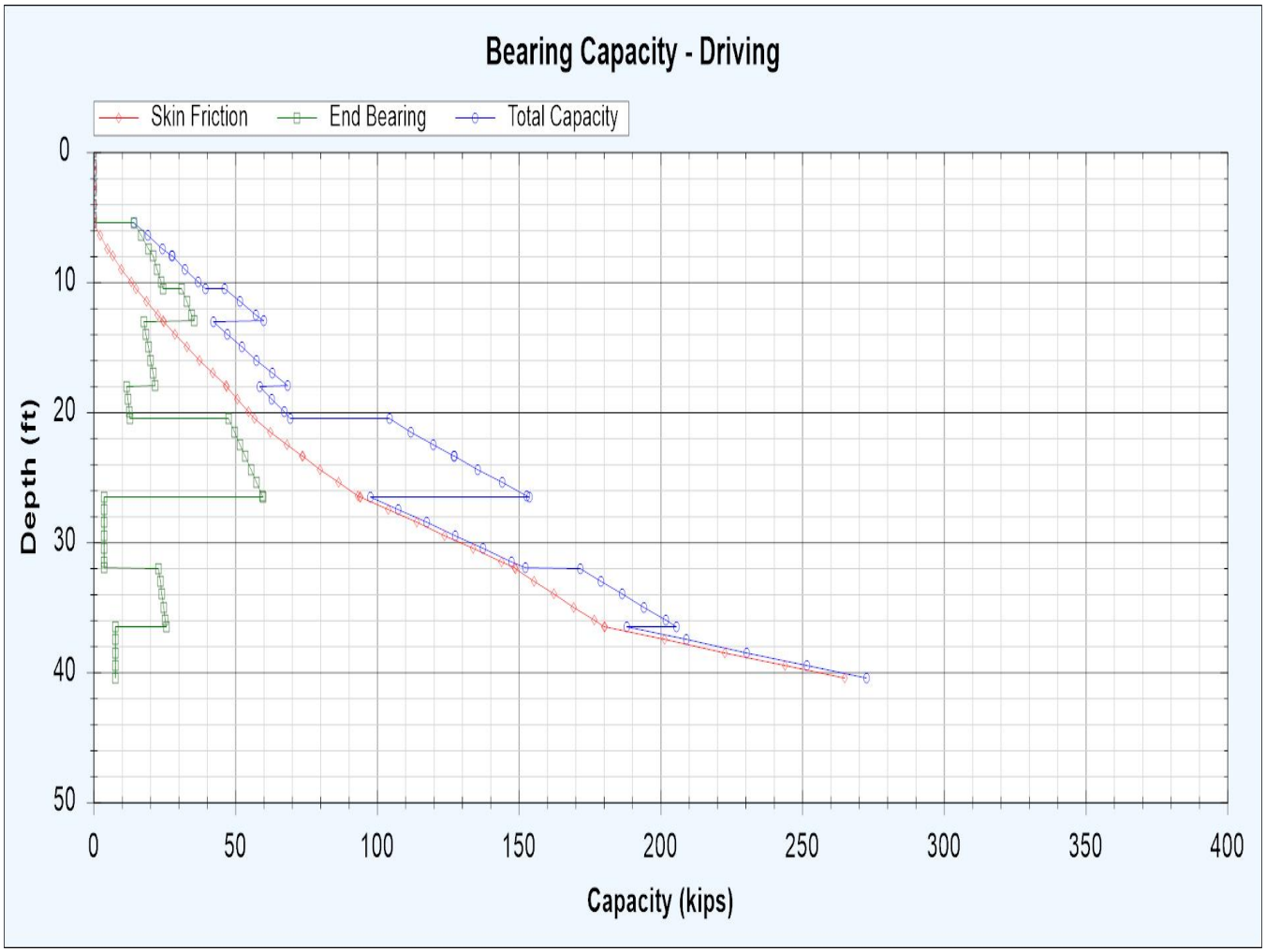
Depth	Skin Friction	End Bearing	Total Capacity
26.51 ft	94.12 kips	3.63 kips	97.76 kips
27.50 ft	108.85 kips	3.63 kips	112.48 kips
28.50 ft	123.72 kips	3.63 kips	127.36 kips
29.50 ft	138.60 kips	3.63 kips	142.23 kips
30.50 ft	153.47 kips	3.63 kips	157.11 kips
31.50 ft	168.35 kips	3.63 kips	171.98 kips
31.99 ft	175.64 kips	3.63 kips	179.27 kips
32.01 ft	175.85 kips	22.98 kips	198.83 kips
33.00 ft	182.47 kips	23.55 kips	206.02 kips
34.00 ft	189.32 kips	24.13 kips	213.45 kips
35.00 ft	196.34 kips	24.71 kips	221.05 kips
36.00 ft	203.52 kips	25.29 kips	228.81 kips
36.49 ft	207.10 kips	25.58 kips	232.68 kips
36.51 ft	207.49 kips	7.75 kips	215.24 kips
37.50 ft	238.91 kips	7.75 kips	246.66 kips
38.50 ft	270.64 kips	7.75 kips	278.39 kips
39.50 ft	302.37 kips	7.75 kips	310.12 kips
40.49 ft	333.79 kips	7.75 kips	341.54 kips


Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
0
50
100
150
200
250
300
350
400
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.02 kips	14.14 kips	14.17 kips
6.40 ft	2.26 kips	16.76 kips	19.02 kips
7.40 ft	4.90 kips	19.40 kips	24.31 kips
7.99 ft	6.65 kips	20.96 kips	27.61 kips
8.01 ft	6.71 kips	21.00 kips	27.71 kips
9.00 ft	9.85 kips	22.36 kips	32.21 kips
10.00 ft	13.22 kips	23.74 kips	36.96 kips
10.49 ft	14.94 kips	24.41 kips	39.35 kips
10.51 ft	15.02 kips	31.15 kips	46.16 kips
11.50 ft	18.68 kips	32.88 kips	51.56 kips
12.50 ft	22.59 kips	34.63 kips	57.22 kips
12.99 ft	24.57 kips	35.49 kips	60.06 kips
13.01 ft	24.65 kips	17.71 kips	42.37 kips
14.00 ft	28.69 kips	18.51 kips	47.20 kips
15.00 ft	32.96 kips	19.32 kips	52.27 kips
16.00 ft	37.40 kips	20.13 kips	57.53 kips
17.00 ft	42.02 kips	20.94 kips	62.96 kips
17.99 ft	46.78 kips	21.74 kips	68.52 kips
18.01 ft	46.87 kips	11.70 kips	58.57 kips
19.00 ft	50.67 kips	12.13 kips	62.80 kips
20.00 ft	54.66 kips	12.56 kips	67.22 kips
20.49 ft	56.66 kips	12.77 kips	69.44 kips
20.51 ft	56.76 kips	47.69 kips	104.45 kips
21.50 ft	62.33 kips	49.68 kips	112.01 kips
22.50 ft	68.20 kips	51.69 kips	119.89 kips
23.39 ft	73.61 kips	53.48 kips	127.09 kips
23.41 ft	73.73 kips	53.52 kips	127.25 kips
24.40 ft	79.98 kips	55.51 kips	135.49 kips
25.40 ft	86.51 kips	57.52 kips	144.03 kips
26.40 ft	93.28 kips	59.53 kips	152.81 kips
26.49 ft	93.90 kips	59.71 kips	153.62 kips

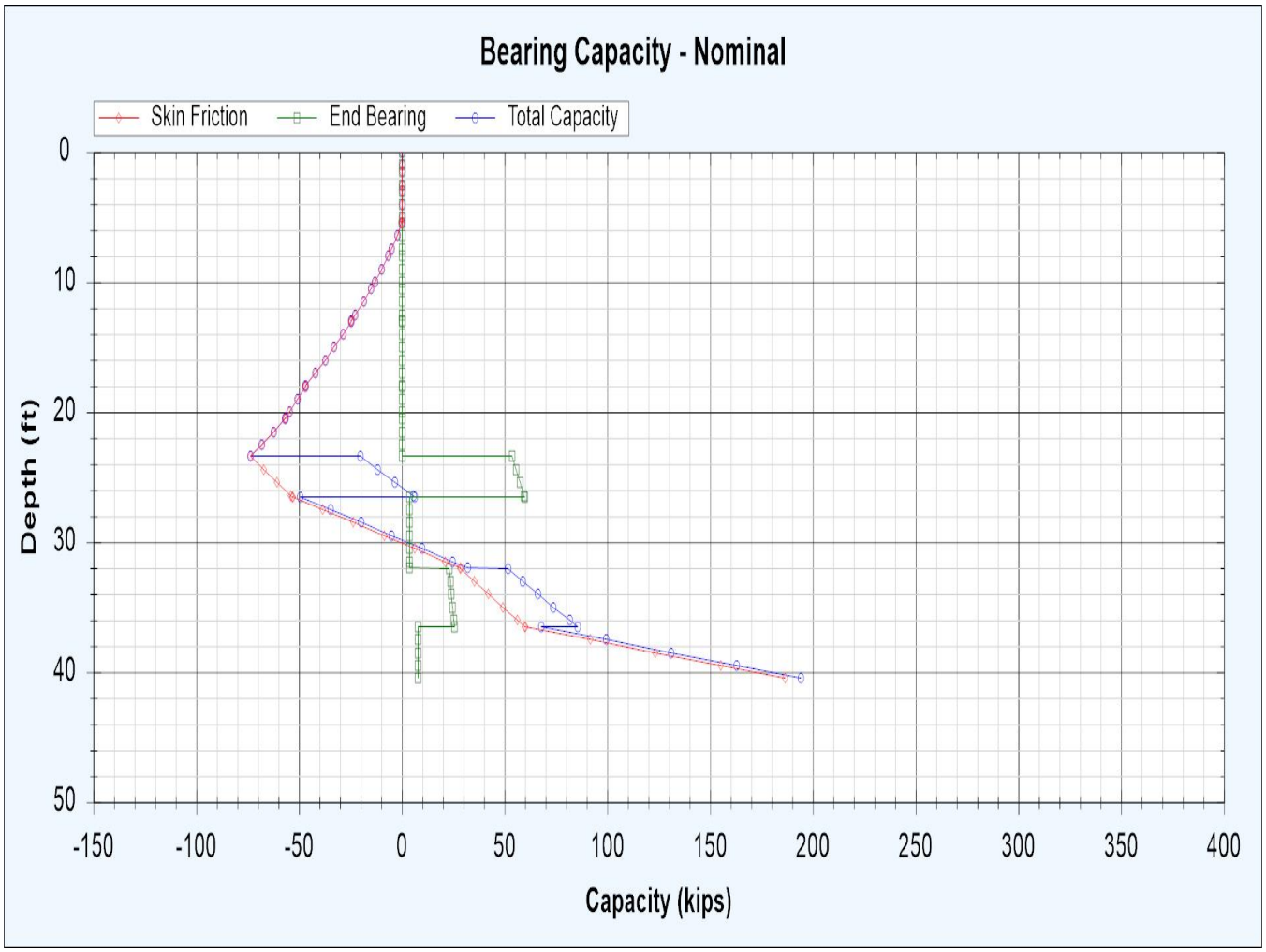
Depth	Skin Friction	End Bearing	Total Capacity
26.51 ft	94.07 kips	3.63 kips	97.71 kips
27.50 ft	103.94 kips	3.63 kips	107.57 kips
28.50 ft	113.91 kips	3.63 kips	117.54 kips
29.50 ft	123.87 kips	3.63 kips	127.51 kips
30.50 ft	133.84 kips	3.63 kips	137.47 kips
31.50 ft	143.80 kips	3.63 kips	147.44 kips
31.99 ft	148.69 kips	3.63 kips	152.32 kips
32.01 ft	148.85 kips	22.98 kips	171.83 kips
33.00 ft	155.47 kips	23.55 kips	179.02 kips
34.00 ft	162.32 kips	24.13 kips	186.45 kips
35.00 ft	169.34 kips	24.71 kips	194.05 kips
36.00 ft	176.52 kips	25.29 kips	201.81 kips
36.49 ft	180.10 kips	25.58 kips	205.68 kips
36.51 ft	180.39 kips	7.75 kips	188.14 kips
37.50 ft	201.44 kips	7.75 kips	209.19 kips
38.50 ft	222.70 kips	7.75 kips	230.45 kips
39.50 ft	243.96 kips	7.75 kips	251.71 kips
40.49 ft	265.01 kips	7.75 kips	272.76 kips


Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
0
50
100
150
200
250
300
350
400
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	-0.02 kips	0.00 kips	-0.02 kips
6.40 ft	-2.26 kips	0.00 kips	-2.26 kips
7.40 ft	-4.90 kips	0.00 kips	-4.90 kips
7.99 ft	-6.65 kips	0.00 kips	-6.65 kips
8.01 ft	-6.71 kips	0.00 kips	-6.71 kips
9.00 ft	-9.85 kips	0.00 kips	-9.85 kips
10.00 ft	-13.22 kips	0.00 kips	-13.22 kips
10.49 ft	-14.94 kips	0.00 kips	-14.94 kips
10.51 ft	-15.02 kips	0.00 kips	-15.02 kips
11.50 ft	-18.68 kips	0.00 kips	-18.68 kips
12.50 ft	-22.59 kips	0.00 kips	-22.59 kips
12.99 ft	-24.57 kips	0.00 kips	-24.57 kips
13.01 ft	-24.65 kips	0.00 kips	-24.65 kips
14.00 ft	-28.69 kips	0.00 kips	-28.69 kips
15.00 ft	-32.96 kips	0.00 kips	-32.96 kips
16.00 ft	-37.40 kips	0.00 kips	-37.40 kips
17.00 ft	-42.02 kips	0.00 kips	-42.02 kips
17.99 ft	-46.78 kips	0.00 kips	-46.78 kips
18.01 ft	-46.87 kips	0.00 kips	-46.87 kips
19.00 ft	-50.67 kips	0.00 kips	-50.67 kips
20.00 ft	-54.66 kips	0.00 kips	-54.66 kips
20.49 ft	-56.66 kips	0.00 kips	-56.66 kips
20.51 ft	-56.76 kips	0.00 kips	-56.76 kips
21.50 ft	-62.33 kips	0.00 kips	-62.33 kips
22.50 ft	-68.20 kips	0.00 kips	-68.20 kips
23.39 ft	-73.61 kips	0.00 kips	-73.61 kips
23.41 ft	-73.55 kips	53.52 kips	-20.03 kips
24.40 ft	-67.30 kips	55.51 kips	-11.79 kips
25.40 ft	-60.77 kips	57.52 kips	-3.25 kips
26.40 ft	-54.00 kips	59.53 kips	5.53 kips
26.49 ft	-53.38 kips	59.71 kips	6.34 kips

Depth	Skin Friction	End Bearing	Total Capacity
26.51 ft	-53.16 kips	3.63 kips	-49.53 kips
27.50 ft	-38.43 kips	3.63 kips	-34.80 kips
28.50 ft	-23.56 kips	3.63 kips	-19.92 kips
29.50 ft	-8.68 kips	3.63 kips	-5.05 kips
30.50 ft	6.19 kips	3.63 kips	9.83 kips
31.50 ft	21.07 kips	3.63 kips	24.70 kips
31.99 ft	28.36 kips	3.63 kips	31.99 kips
32.01 ft	28.57 kips	22.98 kips	51.55 kips
33.00 ft	35.19 kips	23.55 kips	58.74 kips
34.00 ft	42.04 kips	24.13 kips	66.17 kips
35.00 ft	49.06 kips	24.71 kips	73.77 kips
36.00 ft	56.24 kips	25.29 kips	81.53 kips
36.49 ft	59.82 kips	25.58 kips	85.40 kips
36.51 ft	60.21 kips	7.75 kips	67.96 kips
37.50 ft	91.63 kips	7.75 kips	99.38 kips
38.50 ft	123.36 kips	7.75 kips	131.11 kips
39.50 ft	155.09 kips	7.75 kips	162.84 kips
40.49 ft	186.51 kips	7.75 kips	194.26 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
-150
-100
-50
0
50
100
150
200
250
300
350
400
Capacity (kips)

DrivenPiles - Report

General Project Information

Filename: ...alysis\Driven Piles\Pier 2\With Downdrag Analysis\FRA-70-13.01 - Pier 2 HP- B-014-4-19-wDD.DVN
Project Name: FRA-70-13.01
Project Client: ms consultants, inc.
Prepared By: HSK
Project Manager: BRT

Pile Information

Pile Type: H Pile
Top of Pile: 5.40 ft
Diameter of Pile: 14.60 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	8.00 ft
Driving/Restrike:	8.00 ft
Nominal:	8.00 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	23.40 ft

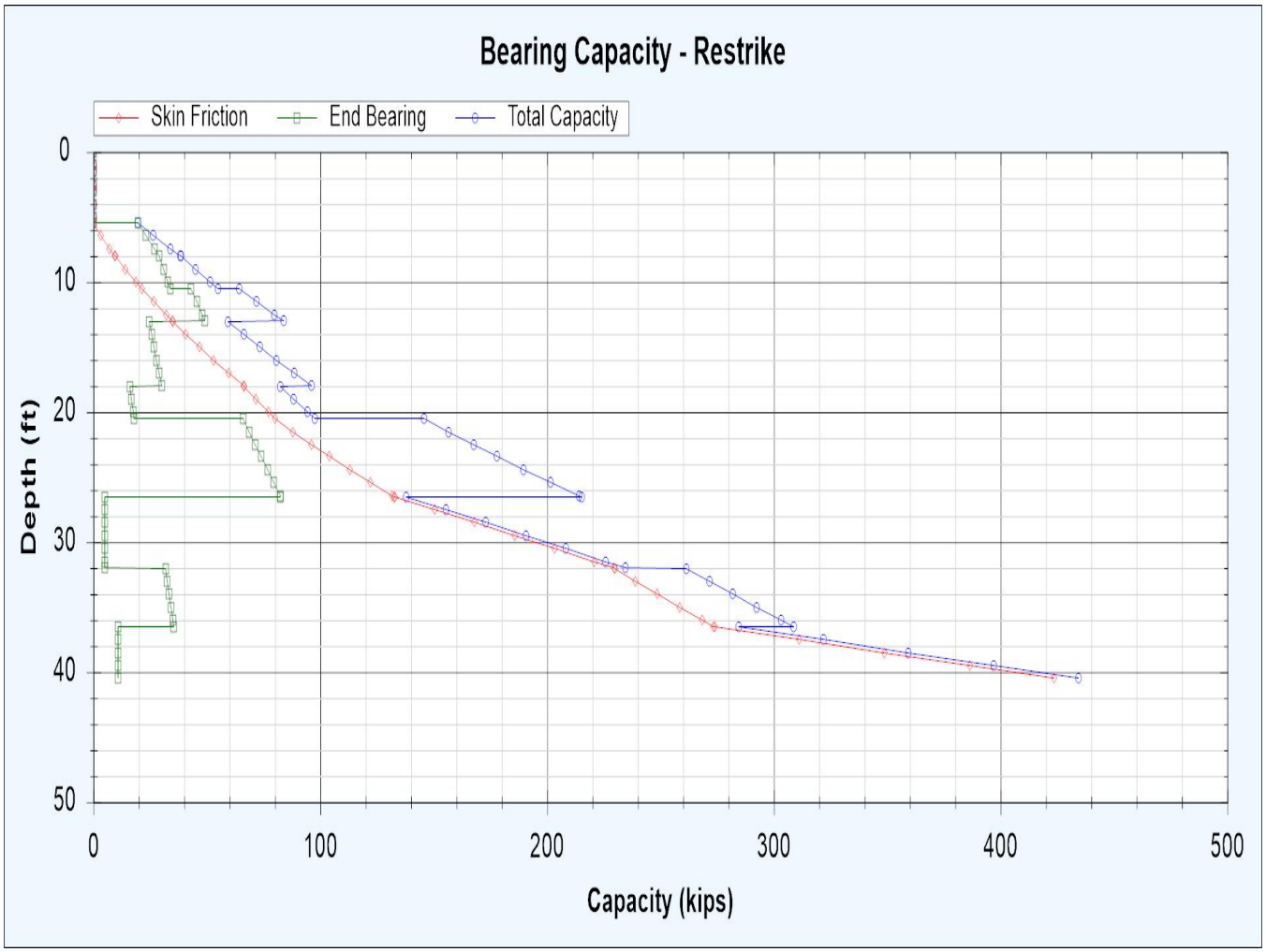
Nominal Profile

Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesive	1.50 ft	1.493	125.00 pcf	3125.00 psf	T-80 Same
2	Cohesive	1.50 ft	1.493	130.00 pcf	4625.00 psf	T-80 Same
3	Cohesionless	7.50 ft	1.000	130.00 pcf	42.0/42.0	Nordlund
4	Cohesionless	2.50 ft	1.000	130.00 pcf	43.0/43.0	Nordlund
5	Cohesionless	5.00 ft	1.000	125.00 pcf	40.0/40.0	Nordlund
6	Cohesionless	2.50 ft	1.000	125.00 pcf	37.0/37.0	Nordlund
7	Cohesionless	6.00 ft	1.000	140.00 pcf	43.0/43.0	Nordlund
8	Cohesive	5.50 ft	1.493	130.00 pcf	3750.00 psf	T-80 Sand
9	Cohesionless	4.50 ft	1.000	130.00 pcf	38.0/38.0	Nordlund
10	Cohesive	4.00 ft	1.493	135.00 pcf	8000.00 psf	T-80 Sand

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.03 kips	19.53 kips	19.56 kips
6.40 ft	3.20 kips	23.14 kips	26.34 kips
7.40 ft	6.95 kips	26.79 kips	33.73 kips
7.99 ft	9.41 kips	28.94 kips	38.35 kips
8.01 ft	9.50 kips	29.00 kips	38.50 kips
9.00 ft	13.95 kips	30.88 kips	44.82 kips
10.00 ft	18.72 kips	32.77 kips	51.50 kips
10.49 ft	21.17 kips	33.70 kips	54.87 kips
10.51 ft	21.27 kips	43.00 kips	64.27 kips
11.50 ft	26.47 kips	45.39 kips	71.86 kips
12.50 ft	32.00 kips	47.81 kips	79.82 kips
12.99 ft	34.82 kips	49.00 kips	83.82 kips
13.01 ft	34.93 kips	24.45 kips	59.39 kips
14.00 ft	40.64 kips	25.56 kips	66.19 kips
15.00 ft	46.65 kips	26.67 kips	73.33 kips
16.00 ft	52.93 kips	27.79 kips	80.72 kips
17.00 ft	59.46 kips	28.91 kips	88.36 kips
17.99 ft	66.18 kips	30.01 kips	96.19 kips
18.01 ft	66.30 kips	16.15 kips	82.45 kips
19.00 ft	71.57 kips	16.74 kips	88.31 kips
20.00 ft	77.08 kips	17.34 kips	94.42 kips
20.49 ft	79.85 kips	17.64 kips	97.49 kips
20.51 ft	79.99 kips	65.84 kips	145.83 kips
21.50 ft	87.89 kips	68.59 kips	156.48 kips
22.50 ft	96.21 kips	71.37 kips	167.57 kips
23.39 ft	103.88 kips	73.84 kips	177.72 kips
23.41 ft	104.06 kips	73.89 kips	177.95 kips
24.40 ft	112.91 kips	76.64 kips	189.55 kips
25.40 ft	122.18 kips	79.42 kips	201.59 kips
26.40 ft	131.78 kips	82.19 kips	213.97 kips
26.49 ft	132.66 kips	82.44 kips	215.10 kips

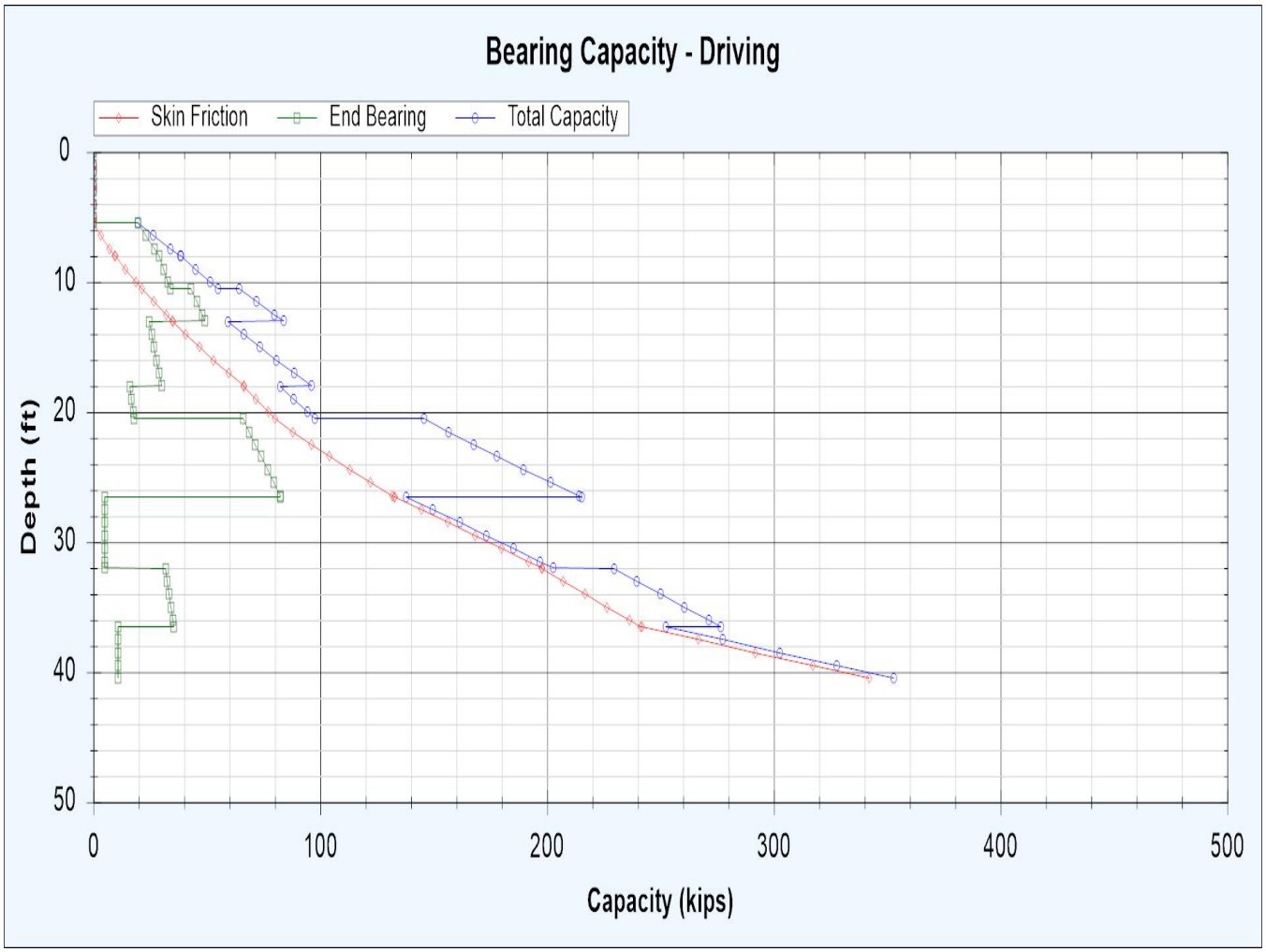
Depth	Skin Friction	End Bearing	Total Capacity
26.51 ft	132.93 kips	5.02 kips	137.95 kips
27.50 ft	150.38 kips	5.02 kips	155.39 kips
28.50 ft	168.00 kips	5.02 kips	173.02 kips
29.50 ft	185.63 kips	5.02 kips	190.64 kips
30.50 ft	203.25 kips	5.02 kips	208.27 kips
31.50 ft	220.88 kips	5.02 kips	225.89 kips
31.99 ft	229.52 kips	5.02 kips	234.53 kips
32.01 ft	229.78 kips	31.72 kips	261.51 kips
33.00 ft	239.01 kips	32.52 kips	271.53 kips
34.00 ft	248.56 kips	33.32 kips	281.88 kips
35.00 ft	258.35 kips	34.12 kips	292.47 kips
36.00 ft	268.37 kips	34.92 kips	303.29 kips
36.49 ft	273.36 kips	35.31 kips	308.67 kips
36.51 ft	273.84 kips	10.70 kips	284.54 kips
37.50 ft	311.06 kips	10.70 kips	321.76 kips
38.50 ft	348.66 kips	10.70 kips	359.36 kips
39.50 ft	386.26 kips	10.70 kips	396.96 kips
40.49 ft	423.49 kips	10.70 kips	434.19 kips


Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
0
100
200
300
400
500
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	0.03 kips	19.53 kips	19.56 kips
6.40 ft	3.20 kips	23.14 kips	26.34 kips
7.40 ft	6.95 kips	26.79 kips	33.73 kips
7.99 ft	9.41 kips	28.94 kips	38.35 kips
8.01 ft	9.50 kips	29.00 kips	38.50 kips
9.00 ft	13.95 kips	30.88 kips	44.82 kips
10.00 ft	18.72 kips	32.77 kips	51.50 kips
10.49 ft	21.17 kips	33.70 kips	54.87 kips
10.51 ft	21.27 kips	43.00 kips	64.27 kips
11.50 ft	26.47 kips	45.39 kips	71.86 kips
12.50 ft	32.00 kips	47.81 kips	79.82 kips
12.99 ft	34.82 kips	49.00 kips	83.82 kips
13.01 ft	34.93 kips	24.45 kips	59.39 kips
14.00 ft	40.64 kips	25.56 kips	66.19 kips
15.00 ft	46.65 kips	26.67 kips	73.33 kips
16.00 ft	52.93 kips	27.79 kips	80.72 kips
17.00 ft	59.46 kips	28.91 kips	88.36 kips
17.99 ft	66.18 kips	30.01 kips	96.19 kips
18.01 ft	66.30 kips	16.15 kips	82.45 kips
19.00 ft	71.57 kips	16.74 kips	88.31 kips
20.00 ft	77.08 kips	17.34 kips	94.42 kips
20.49 ft	79.85 kips	17.64 kips	97.49 kips
20.51 ft	79.99 kips	65.84 kips	145.83 kips
21.50 ft	87.89 kips	68.59 kips	156.48 kips
22.50 ft	96.21 kips	71.37 kips	167.57 kips
23.39 ft	103.88 kips	73.84 kips	177.72 kips
23.41 ft	104.06 kips	73.89 kips	177.95 kips
24.40 ft	112.91 kips	76.64 kips	189.55 kips
25.40 ft	122.18 kips	79.42 kips	201.59 kips
26.40 ft	131.78 kips	82.19 kips	213.97 kips
26.49 ft	132.66 kips	82.44 kips	215.10 kips

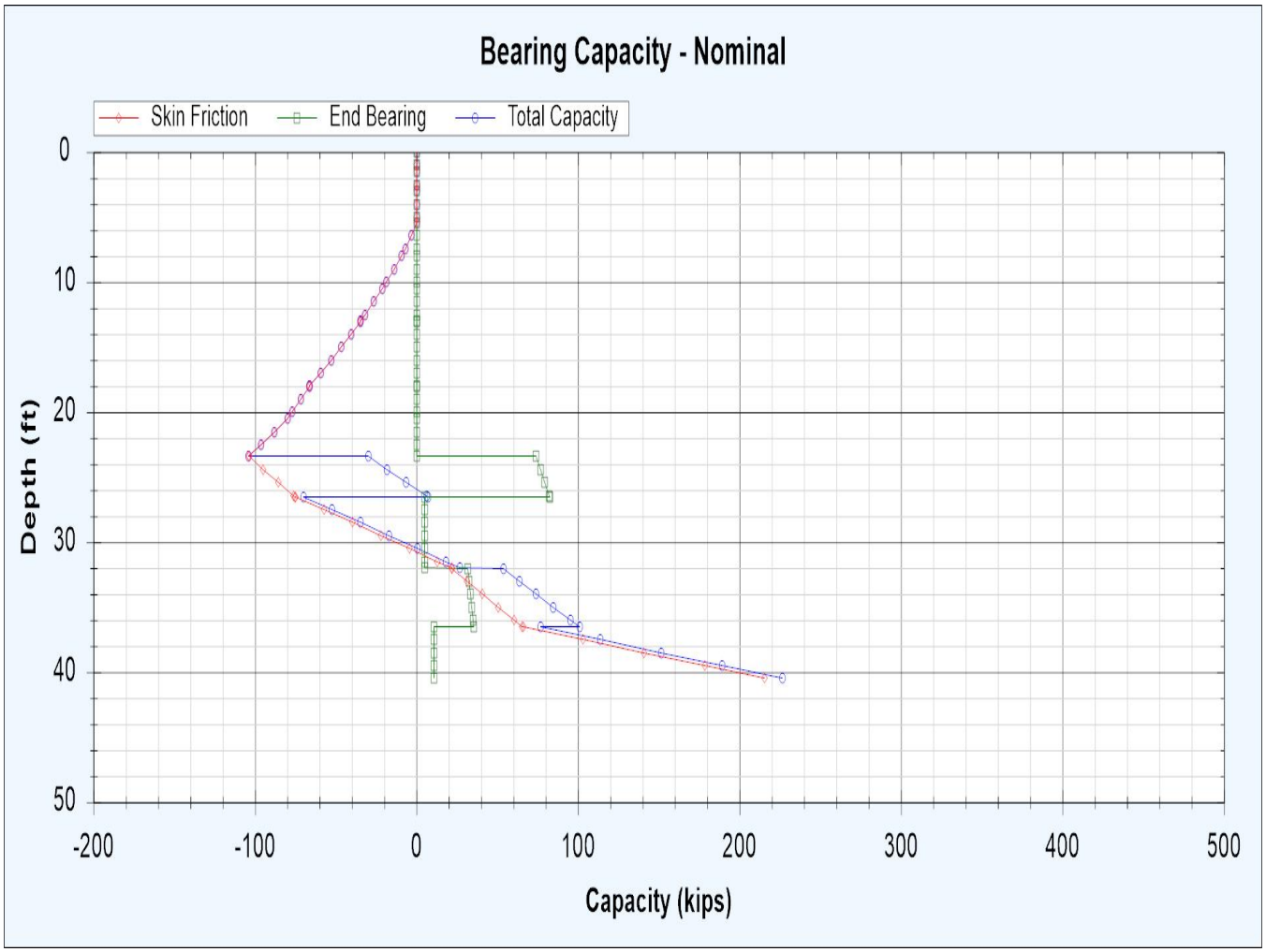
Depth	Skin Friction	End Bearing	Total Capacity
26.51 ft	132.87 kips	5.02 kips	137.89 kips
27.50 ft	144.56 kips	5.02 kips	149.58 kips
28.50 ft	156.37 kips	5.02 kips	161.39 kips
29.50 ft	168.18 kips	5.02 kips	173.20 kips
30.50 ft	179.99 kips	5.02 kips	185.00 kips
31.50 ft	191.80 kips	5.02 kips	196.81 kips
31.99 ft	197.58 kips	5.02 kips	202.60 kips
32.01 ft	197.79 kips	31.72 kips	229.52 kips
33.00 ft	207.02 kips	32.52 kips	239.54 kips
34.00 ft	216.58 kips	33.32 kips	249.89 kips
35.00 ft	226.36 kips	34.12 kips	260.48 kips
36.00 ft	236.38 kips	34.92 kips	271.30 kips
36.49 ft	241.37 kips	35.31 kips	276.68 kips
36.51 ft	241.73 kips	10.70 kips	252.43 kips
37.50 ft	266.67 kips	10.70 kips	277.37 kips
38.50 ft	291.86 kips	10.70 kips	302.56 kips
39.50 ft	317.05 kips	10.70 kips	327.75 kips
40.49 ft	341.99 kips	10.70 kips	352.69 kips


Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
0
100
200
300
400
500
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 kips	0.00 kips	0.00 kips
1.00 ft	0.00 kips	0.00 kips	0.00 kips
1.49 ft	0.00 kips	0.00 kips	0.00 kips
1.51 ft	0.00 kips	0.00 kips	0.00 kips
2.50 ft	0.00 kips	0.00 kips	0.00 kips
2.99 ft	0.00 kips	0.00 kips	0.00 kips
3.01 ft	0.00 kips	0.00 kips	0.00 kips
4.00 ft	0.00 kips	0.00 kips	0.00 kips
5.00 ft	0.00 kips	0.00 kips	0.00 kips
5.39 ft	0.00 kips	0.00 kips	0.00 kips
5.41 ft	-0.03 kips	0.00 kips	-0.03 kips
6.40 ft	-3.20 kips	0.00 kips	-3.20 kips
7.40 ft	-6.95 kips	0.00 kips	-6.95 kips
7.99 ft	-9.41 kips	0.00 kips	-9.41 kips
8.01 ft	-9.50 kips	0.00 kips	-9.50 kips
9.00 ft	-13.95 kips	0.00 kips	-13.95 kips
10.00 ft	-18.72 kips	0.00 kips	-18.72 kips
10.49 ft	-21.17 kips	0.00 kips	-21.17 kips
10.51 ft	-21.27 kips	0.00 kips	-21.27 kips
11.50 ft	-26.47 kips	0.00 kips	-26.47 kips
12.50 ft	-32.00 kips	0.00 kips	-32.00 kips
12.99 ft	-34.82 kips	0.00 kips	-34.82 kips
13.01 ft	-34.93 kips	0.00 kips	-34.93 kips
14.00 ft	-40.64 kips	0.00 kips	-40.64 kips
15.00 ft	-46.65 kips	0.00 kips	-46.65 kips
16.00 ft	-52.93 kips	0.00 kips	-52.93 kips
17.00 ft	-59.46 kips	0.00 kips	-59.46 kips
17.99 ft	-66.18 kips	0.00 kips	-66.18 kips
18.01 ft	-66.30 kips	0.00 kips	-66.30 kips
19.00 ft	-71.57 kips	0.00 kips	-71.57 kips
20.00 ft	-77.08 kips	0.00 kips	-77.08 kips
20.49 ft	-79.85 kips	0.00 kips	-79.85 kips
20.51 ft	-79.99 kips	0.00 kips	-79.99 kips
21.50 ft	-87.89 kips	0.00 kips	-87.89 kips
22.50 ft	-96.21 kips	0.00 kips	-96.21 kips
23.39 ft	-103.88 kips	0.00 kips	-103.88 kips
23.41 ft	-103.79 kips	73.89 kips	-29.90 kips
24.40 ft	-94.94 kips	76.64 kips	-18.30 kips
25.40 ft	-85.67 kips	79.42 kips	-6.26 kips
26.40 ft	-76.08 kips	82.19 kips	6.12 kips
26.49 ft	-75.19 kips	82.44 kips	7.25 kips

Depth	Skin Friction	End Bearing	Total Capacity
26.51 ft	-74.92 kips	5.02 kips	-69.91 kips
27.50 ft	-57.47 kips	5.02 kips	-52.46 kips
28.50 ft	-39.85 kips	5.02 kips	-34.83 kips
29.50 ft	-22.22 kips	5.02 kips	-17.21 kips
30.50 ft	-4.60 kips	5.02 kips	0.42 kips
31.50 ft	13.03 kips	5.02 kips	18.04 kips
31.99 ft	21.66 kips	5.02 kips	26.68 kips
32.01 ft	21.93 kips	31.72 kips	53.66 kips
33.00 ft	31.16 kips	32.52 kips	63.68 kips
34.00 ft	40.71 kips	33.32 kips	74.03 kips
35.00 ft	50.50 kips	34.12 kips	84.62 kips
36.00 ft	60.52 kips	34.92 kips	95.43 kips
36.49 ft	65.51 kips	35.31 kips	100.82 kips
36.51 ft	65.99 kips	10.70 kips	76.69 kips
37.50 ft	103.21 kips	10.70 kips	113.91 kips
38.50 ft	140.81 kips	10.70 kips	151.51 kips
39.50 ft	178.41 kips	10.70 kips	189.11 kips
40.49 ft	215.64 kips	10.70 kips	226.34 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
-200
-100
0
100
200
300
400
500
Capacity (kips)

Forward Abutment
(B-014-7-20)

DrivenPiles - Report

General Project Information

Filename: ...nalysis\Driven Piles\Forward Abutment\FRA-70-13.01 - Forward Abutment HP 10x42-B-014-7-20.dvn
Project Name: FRA-70-13.01 Forward Abutment (B-014-7-20)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 0.00 ft
Diameter of Pile: 10.08 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	41.10 ft
Driving/Restrike:	41.10 ft
Nominal:	41.10 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	0.00 ft

Nominal Profile

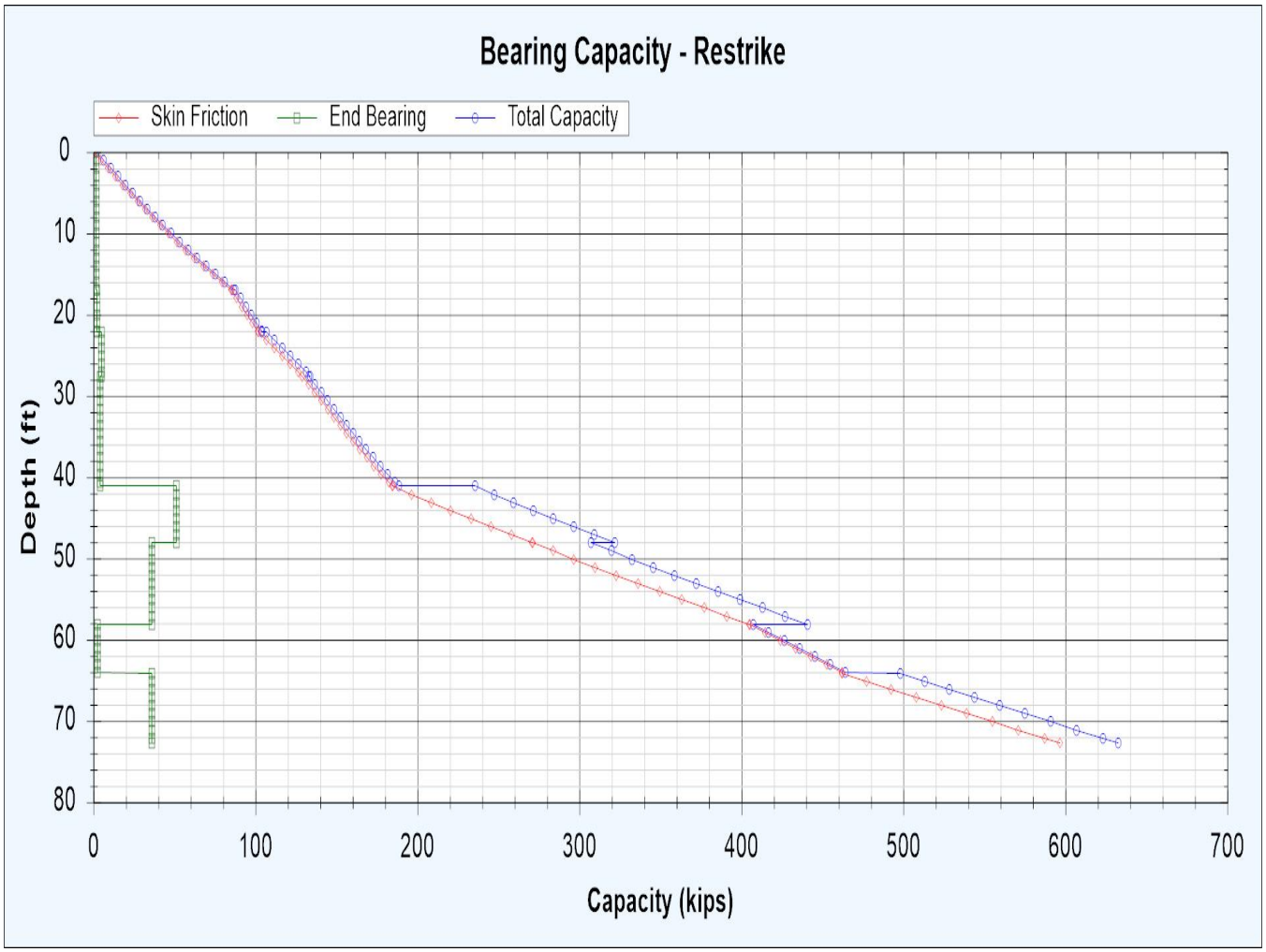
Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesive	17.00 ft	1.500	120.00 pcf	2000.00 psf	T-80 Same
2	Cohesive	5.10 ft	1.500	120.00 pcf	2750.00 psf	T-80 Same
3	Cohesive	5.50 ft	1.500	130.00 pcf	6250.00 psf	T-80 Same
4	Cohesive	13.50 ft	2.000	130.00 pcf	5000.00 psf	T-80 Same
5	Cohesionless	7.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
6	Cohesionless	10.00 ft	1.000	130.00 pcf	40.0/40.0	Nordlund
7	Cohesive	6.00 ft	1.500	125.00 pcf	2875.00 psf	T-80 Sand
8	Cohesionless	8.60 ft	1.000	130.00 pcf	40.0/40.0	Nordlund

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 kips	1.55 kips	1.60 kips
1.00 ft	4.53 kips	1.55 kips	6.08 kips
2.00 ft	9.06 kips	1.55 kips	10.61 kips
3.00 ft	13.60 kips	1.55 kips	15.15 kips
4.00 ft	18.13 kips	1.55 kips	19.68 kips
5.00 ft	22.66 kips	1.55 kips	24.21 kips
6.00 ft	27.19 kips	1.55 kips	28.74 kips
7.00 ft	31.73 kips	1.55 kips	33.28 kips
8.00 ft	36.26 kips	1.55 kips	37.81 kips
9.00 ft	41.09 kips	1.55 kips	42.64 kips
10.00 ft	46.22 kips	1.55 kips	47.77 kips
11.00 ft	51.45 kips	1.55 kips	53.00 kips
12.00 ft	56.79 kips	1.55 kips	58.34 kips
13.00 ft	62.25 kips	1.55 kips	63.80 kips
14.00 ft	67.82 kips	1.55 kips	69.37 kips
15.00 ft	73.50 kips	1.55 kips	75.05 kips
16.00 ft	79.29 kips	1.55 kips	80.84 kips
16.99 ft	85.13 kips	1.55 kips	86.68 kips
17.01 ft	85.22 kips	2.13 kips	87.35 kips
18.00 ft	88.46 kips	2.13 kips	90.59 kips
19.00 ft	91.73 kips	2.13 kips	93.86 kips
20.00 ft	95.00 kips	2.13 kips	97.13 kips
21.00 ft	98.27 kips	2.13 kips	100.40 kips
22.00 ft	101.54 kips	2.13 kips	103.67 kips
22.09 ft	101.83 kips	2.13 kips	103.97 kips
22.11 ft	101.92 kips	4.84 kips	106.76 kips
23.10 ft	106.77 kips	4.84 kips	111.61 kips
24.10 ft	111.67 kips	4.84 kips	116.52 kips
25.10 ft	116.58 kips	4.84 kips	121.42 kips
26.10 ft	121.48 kips	4.84 kips	126.32 kips
27.10 ft	126.38 kips	4.84 kips	131.22 kips
27.59 ft	128.78 kips	4.84 kips	133.63 kips
27.61 ft	128.87 kips	3.87 kips	132.75 kips
28.60 ft	132.75 kips	3.87 kips	136.63 kips
29.60 ft	136.68 kips	3.87 kips	140.55 kips
30.60 ft	140.60 kips	3.87 kips	144.47 kips
31.60 ft	144.52 kips	3.87 kips	148.39 kips
32.60 ft	148.44 kips	3.87 kips	152.32 kips
33.60 ft	152.36 kips	3.87 kips	156.24 kips
34.60 ft	156.29 kips	3.87 kips	160.16 kips
35.60 ft	160.21 kips	3.87 kips	164.08 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.60 ft	164.35 kips	3.87 kips	168.22 kips
37.60 ft	168.69 kips	3.87 kips	172.57 kips
38.60 ft	173.12 kips	3.87 kips	176.99 kips
39.60 ft	177.62 kips	3.87 kips	181.50 kips
40.60 ft	182.21 kips	3.87 kips	186.08 kips
41.09 ft	184.48 kips	3.87 kips	188.36 kips
41.11 ft	184.65 kips	51.03 kips	235.67 kips
42.10 ft	196.36 kips	51.03 kips	247.39 kips
43.10 ft	208.36 kips	51.03 kips	259.39 kips
44.10 ft	220.53 kips	51.03 kips	271.55 kips
45.10 ft	232.86 kips	51.03 kips	283.88 kips
46.10 ft	245.36 kips	51.03 kips	296.38 kips
47.10 ft	258.02 kips	51.03 kips	309.05 kips
48.09 ft	270.72 kips	51.03 kips	321.75 kips
48.11 ft	270.98 kips	35.96 kips	306.94 kips
49.10 ft	283.59 kips	35.96 kips	319.55 kips
50.10 ft	296.49 kips	35.96 kips	332.45 kips
51.10 ft	309.53 kips	35.96 kips	345.49 kips
52.10 ft	322.73 kips	35.96 kips	358.69 kips
53.10 ft	336.08 kips	35.96 kips	372.04 kips
54.10 ft	349.58 kips	35.96 kips	385.54 kips
55.10 ft	363.24 kips	35.96 kips	399.20 kips
56.10 ft	377.04 kips	35.96 kips	413.00 kips
57.10 ft	391.00 kips	35.96 kips	426.96 kips
58.09 ft	404.97 kips	35.96 kips	440.93 kips
58.11 ft	405.20 kips	2.23 kips	407.43 kips
59.10 ft	414.59 kips	2.23 kips	416.81 kips
60.10 ft	424.06 kips	2.23 kips	426.29 kips
61.10 ft	433.54 kips	2.23 kips	435.76 kips
62.10 ft	443.01 kips	2.23 kips	445.24 kips
63.10 ft	452.49 kips	2.23 kips	454.72 kips
64.09 ft	461.87 kips	2.23 kips	464.10 kips
64.11 ft	462.11 kips	35.96 kips	498.07 kips
65.10 ft	477.07 kips	35.96 kips	513.03 kips
66.10 ft	492.33 kips	35.96 kips	528.29 kips
67.10 ft	507.74 kips	35.96 kips	543.70 kips
68.10 ft	523.30 kips	35.96 kips	559.26 kips
69.10 ft	539.02 kips	35.96 kips	574.98 kips
70.10 ft	554.89 kips	35.96 kips	590.85 kips
71.10 ft	570.90 kips	35.96 kips	606.86 kips
72.10 ft	587.08 kips	35.96 kips	623.04 kips

Depth	Skin Friction	End Bearing	Total Capacity
72.69 ft	596.69 kips	35.96 kips	632.65 kips

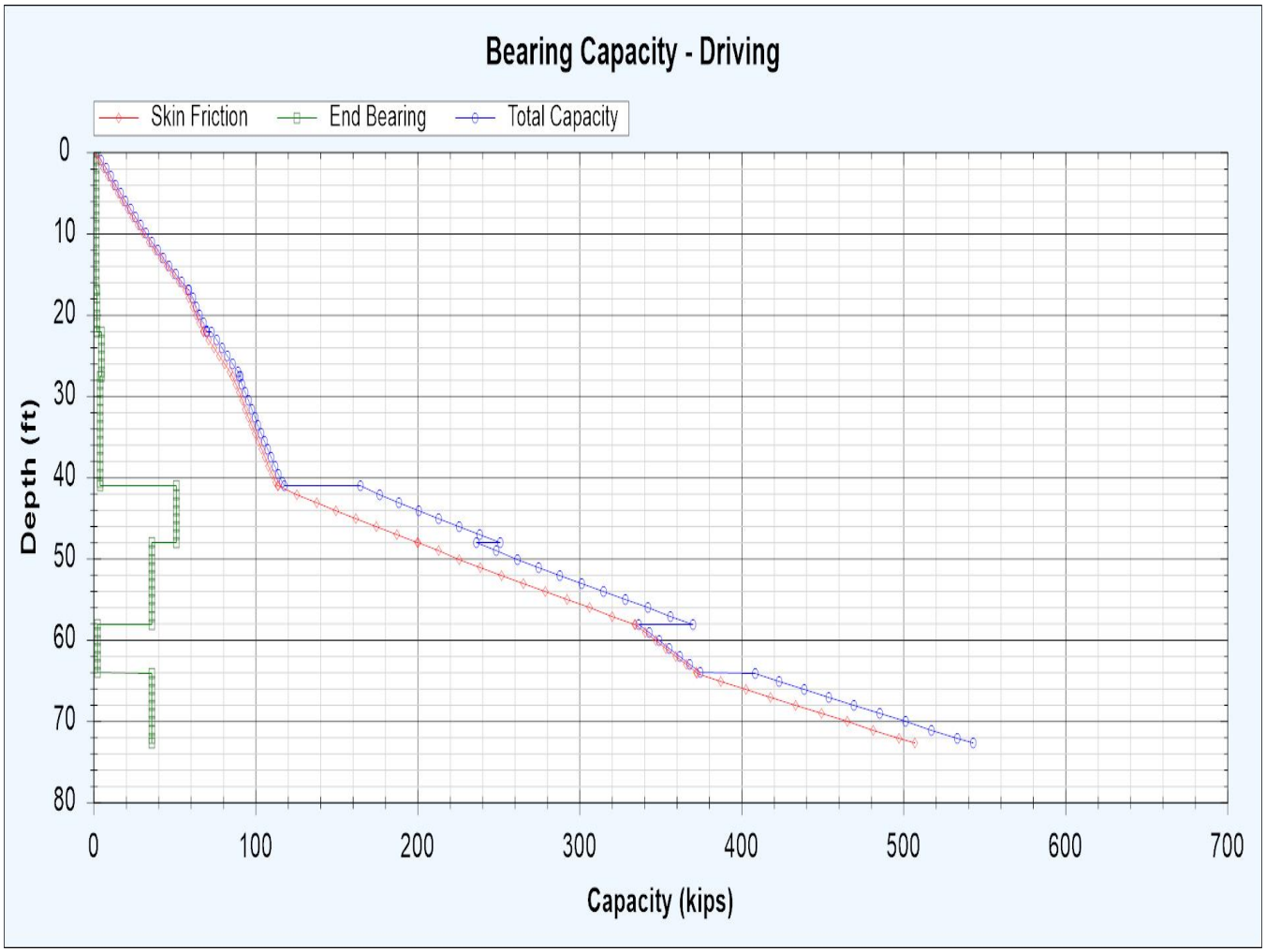

Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
0
100
200
300
400
500
600
700
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.03 kips	1.55 kips	1.58 kips
1.00 ft	3.02 kips	1.55 kips	4.57 kips
2.00 ft	6.04 kips	1.55 kips	7.59 kips
3.00 ft	9.06 kips	1.55 kips	10.61 kips
4.00 ft	12.09 kips	1.55 kips	13.64 kips
5.00 ft	15.11 kips	1.55 kips	16.66 kips
6.00 ft	18.13 kips	1.55 kips	19.68 kips
7.00 ft	21.15 kips	1.55 kips	22.70 kips
8.00 ft	24.17 kips	1.55 kips	25.72 kips
9.00 ft	27.40 kips	1.55 kips	28.95 kips
10.00 ft	30.81 kips	1.55 kips	32.36 kips
11.00 ft	34.30 kips	1.55 kips	35.85 kips
12.00 ft	37.86 kips	1.55 kips	39.41 kips
13.00 ft	41.50 kips	1.55 kips	43.05 kips
14.00 ft	45.21 kips	1.55 kips	46.76 kips
15.00 ft	49.00 kips	1.55 kips	50.55 kips
16.00 ft	52.86 kips	1.55 kips	54.41 kips
16.99 ft	56.75 kips	1.55 kips	58.30 kips
17.01 ft	56.81 kips	2.13 kips	58.95 kips
18.00 ft	58.97 kips	2.13 kips	61.10 kips
19.00 ft	61.15 kips	2.13 kips	63.28 kips
20.00 ft	63.33 kips	2.13 kips	65.46 kips
21.00 ft	65.51 kips	2.13 kips	67.65 kips
22.00 ft	67.69 kips	2.13 kips	69.83 kips
22.09 ft	67.89 kips	2.13 kips	70.02 kips
22.11 ft	67.95 kips	4.84 kips	72.79 kips
23.10 ft	71.18 kips	4.84 kips	76.02 kips
24.10 ft	74.45 kips	4.84 kips	79.29 kips
25.10 ft	77.72 kips	4.84 kips	82.56 kips
26.10 ft	80.99 kips	4.84 kips	85.83 kips
27.10 ft	84.26 kips	4.84 kips	89.10 kips
27.59 ft	85.86 kips	4.84 kips	90.70 kips
27.61 ft	85.91 kips	3.87 kips	89.78 kips
28.60 ft	87.85 kips	3.87 kips	91.73 kips
29.60 ft	89.81 kips	3.87 kips	93.69 kips
30.60 ft	91.77 kips	3.87 kips	95.65 kips
31.60 ft	93.73 kips	3.87 kips	97.61 kips
32.60 ft	95.69 kips	3.87 kips	99.57 kips
33.60 ft	97.66 kips	3.87 kips	101.53 kips
34.60 ft	99.62 kips	3.87 kips	103.49 kips
35.60 ft	101.58 kips	3.87 kips	105.45 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.60 ft	103.65 kips	3.87 kips	107.52 kips
37.60 ft	105.82 kips	3.87 kips	109.69 kips
38.60 ft	108.03 kips	3.87 kips	111.91 kips
39.60 ft	110.28 kips	3.87 kips	114.16 kips
40.60 ft	112.58 kips	3.87 kips	116.45 kips
41.09 ft	113.71 kips	3.87 kips	117.59 kips
41.11 ft	113.86 kips	51.03 kips	164.88 kips
42.10 ft	125.57 kips	51.03 kips	176.60 kips
43.10 ft	137.57 kips	51.03 kips	188.60 kips
44.10 ft	149.73 kips	51.03 kips	200.76 kips
45.10 ft	162.07 kips	51.03 kips	213.09 kips
46.10 ft	174.57 kips	51.03 kips	225.59 kips
47.10 ft	187.23 kips	51.03 kips	238.26 kips
48.09 ft	199.93 kips	51.03 kips	250.96 kips
48.11 ft	200.19 kips	35.96 kips	236.15 kips
49.10 ft	212.80 kips	35.96 kips	248.76 kips
50.10 ft	225.70 kips	35.96 kips	261.66 kips
51.10 ft	238.74 kips	35.96 kips	274.70 kips
52.10 ft	251.94 kips	35.96 kips	287.90 kips
53.10 ft	265.29 kips	35.96 kips	301.25 kips
54.10 ft	278.79 kips	35.96 kips	314.75 kips
55.10 ft	292.44 kips	35.96 kips	328.40 kips
56.10 ft	306.25 kips	35.96 kips	342.21 kips
57.10 ft	320.21 kips	35.96 kips	356.17 kips
58.09 ft	334.18 kips	35.96 kips	370.14 kips
58.11 ft	334.38 kips	2.23 kips	336.61 kips
59.10 ft	340.64 kips	2.23 kips	342.86 kips
60.10 ft	346.95 kips	2.23 kips	349.18 kips
61.10 ft	353.27 kips	2.23 kips	355.50 kips
62.10 ft	359.59 kips	2.23 kips	361.81 kips
63.10 ft	365.90 kips	2.23 kips	368.13 kips
64.09 ft	372.16 kips	2.23 kips	374.39 kips
64.11 ft	372.37 kips	35.96 kips	408.33 kips
65.10 ft	387.33 kips	35.96 kips	423.29 kips
66.10 ft	402.59 kips	35.96 kips	438.55 kips
67.10 ft	418.00 kips	35.96 kips	453.96 kips
68.10 ft	433.56 kips	35.96 kips	469.52 kips
69.10 ft	449.28 kips	35.96 kips	485.24 kips
70.10 ft	465.14 kips	35.96 kips	501.10 kips
71.10 ft	481.16 kips	35.96 kips	517.12 kips
72.10 ft	497.33 kips	35.96 kips	533.29 kips

Depth	Skin Friction	End Bearing	Total Capacity
72.69 ft	506.95 kips	35.96 kips	542.91 kips

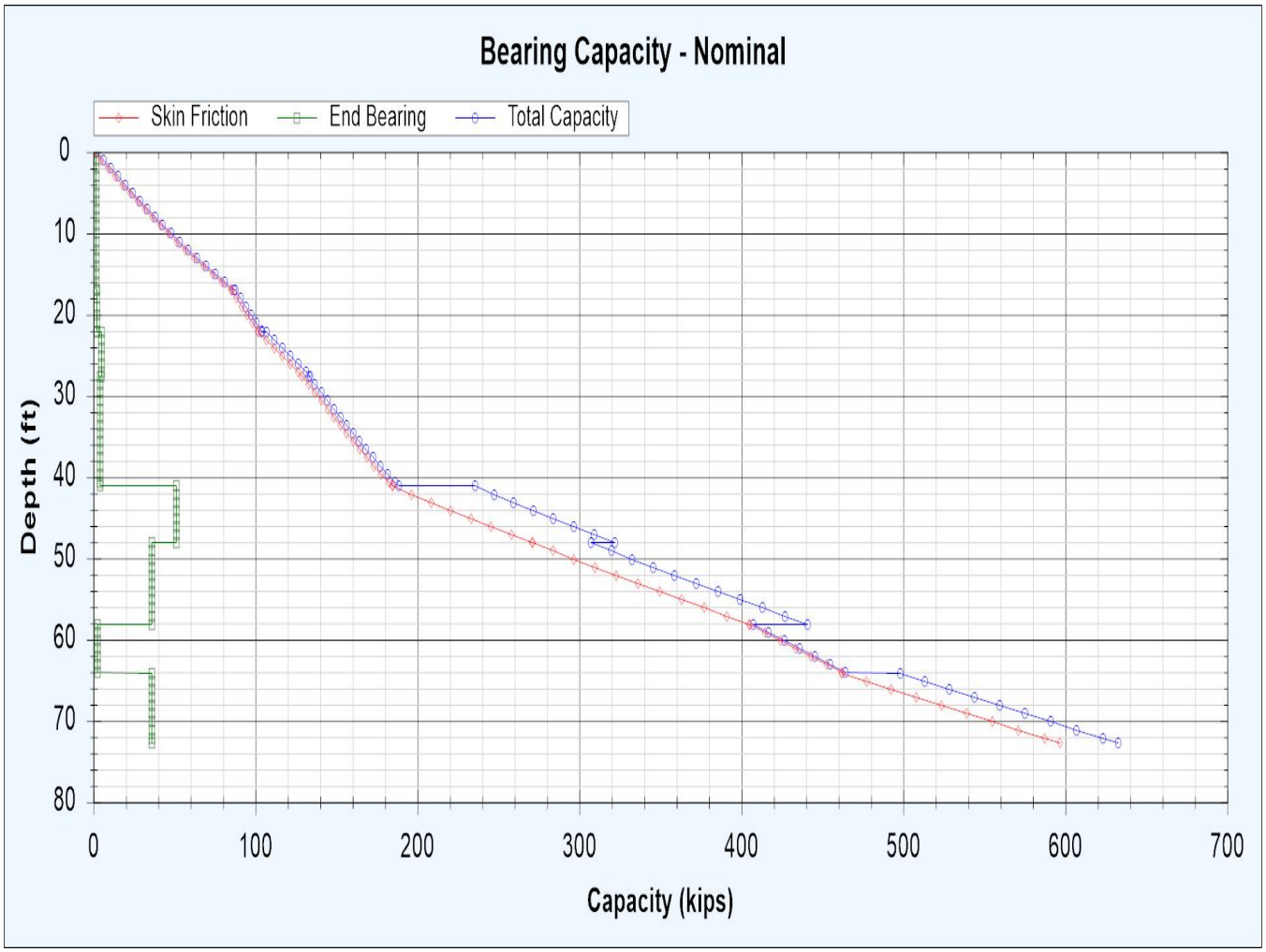

Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
0
100
200
300
400
500
600
700
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 kips	1.55 kips	1.60 kips
1.00 ft	4.53 kips	1.55 kips	6.08 kips
2.00 ft	9.06 kips	1.55 kips	10.61 kips
3.00 ft	13.60 kips	1.55 kips	15.15 kips
4.00 ft	18.13 kips	1.55 kips	19.68 kips
5.00 ft	22.66 kips	1.55 kips	24.21 kips
6.00 ft	27.19 kips	1.55 kips	28.74 kips
7.00 ft	31.73 kips	1.55 kips	33.28 kips
8.00 ft	36.26 kips	1.55 kips	37.81 kips
9.00 ft	41.09 kips	1.55 kips	42.64 kips
10.00 ft	46.22 kips	1.55 kips	47.77 kips
11.00 ft	51.45 kips	1.55 kips	53.00 kips
12.00 ft	56.79 kips	1.55 kips	58.34 kips
13.00 ft	62.25 kips	1.55 kips	63.80 kips
14.00 ft	67.82 kips	1.55 kips	69.37 kips
15.00 ft	73.50 kips	1.55 kips	75.05 kips
16.00 ft	79.29 kips	1.55 kips	80.84 kips
16.99 ft	85.13 kips	1.55 kips	86.68 kips
17.01 ft	85.22 kips	2.13 kips	87.35 kips
18.00 ft	88.46 kips	2.13 kips	90.59 kips
19.00 ft	91.73 kips	2.13 kips	93.86 kips
20.00 ft	95.00 kips	2.13 kips	97.13 kips
21.00 ft	98.27 kips	2.13 kips	100.40 kips
22.00 ft	101.54 kips	2.13 kips	103.67 kips
22.09 ft	101.83 kips	2.13 kips	103.97 kips
22.11 ft	101.92 kips	4.84 kips	106.76 kips
23.10 ft	106.77 kips	4.84 kips	111.61 kips
24.10 ft	111.67 kips	4.84 kips	116.52 kips
25.10 ft	116.58 kips	4.84 kips	121.42 kips
26.10 ft	121.48 kips	4.84 kips	126.32 kips
27.10 ft	126.38 kips	4.84 kips	131.22 kips
27.59 ft	128.78 kips	4.84 kips	133.63 kips
27.61 ft	128.87 kips	3.87 kips	132.75 kips
28.60 ft	132.75 kips	3.87 kips	136.63 kips
29.60 ft	136.68 kips	3.87 kips	140.55 kips
30.60 ft	140.60 kips	3.87 kips	144.47 kips
31.60 ft	144.52 kips	3.87 kips	148.39 kips
32.60 ft	148.44 kips	3.87 kips	152.32 kips
33.60 ft	152.36 kips	3.87 kips	156.24 kips
34.60 ft	156.29 kips	3.87 kips	160.16 kips
35.60 ft	160.21 kips	3.87 kips	164.08 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.60 ft	164.35 kips	3.87 kips	168.22 kips
37.60 ft	168.69 kips	3.87 kips	172.57 kips
38.60 ft	173.12 kips	3.87 kips	176.99 kips
39.60 ft	177.62 kips	3.87 kips	181.50 kips
40.60 ft	182.21 kips	3.87 kips	186.08 kips
41.09 ft	184.48 kips	3.87 kips	188.36 kips
41.11 ft	184.65 kips	51.03 kips	235.67 kips
42.10 ft	196.36 kips	51.03 kips	247.39 kips
43.10 ft	208.36 kips	51.03 kips	259.39 kips
44.10 ft	220.53 kips	51.03 kips	271.55 kips
45.10 ft	232.86 kips	51.03 kips	283.88 kips
46.10 ft	245.36 kips	51.03 kips	296.38 kips
47.10 ft	258.02 kips	51.03 kips	309.05 kips
48.09 ft	270.72 kips	51.03 kips	321.75 kips
48.11 ft	270.98 kips	35.96 kips	306.94 kips
49.10 ft	283.59 kips	35.96 kips	319.55 kips
50.10 ft	296.49 kips	35.96 kips	332.45 kips
51.10 ft	309.53 kips	35.96 kips	345.49 kips
52.10 ft	322.73 kips	35.96 kips	358.69 kips
53.10 ft	336.08 kips	35.96 kips	372.04 kips
54.10 ft	349.58 kips	35.96 kips	385.54 kips
55.10 ft	363.24 kips	35.96 kips	399.20 kips
56.10 ft	377.04 kips	35.96 kips	413.00 kips
57.10 ft	391.00 kips	35.96 kips	426.96 kips
58.09 ft	404.97 kips	35.96 kips	440.93 kips
58.11 ft	405.20 kips	2.23 kips	407.43 kips
59.10 ft	414.59 kips	2.23 kips	416.81 kips
60.10 ft	424.06 kips	2.23 kips	426.29 kips
61.10 ft	433.54 kips	2.23 kips	435.76 kips
62.10 ft	443.01 kips	2.23 kips	445.24 kips
63.10 ft	452.49 kips	2.23 kips	454.72 kips
64.09 ft	461.87 kips	2.23 kips	464.10 kips
64.11 ft	462.11 kips	35.96 kips	498.07 kips
65.10 ft	477.07 kips	35.96 kips	513.03 kips
66.10 ft	492.33 kips	35.96 kips	528.29 kips
67.10 ft	507.74 kips	35.96 kips	543.70 kips
68.10 ft	523.30 kips	35.96 kips	559.26 kips
69.10 ft	539.02 kips	35.96 kips	574.98 kips
70.10 ft	554.89 kips	35.96 kips	590.85 kips
71.10 ft	570.90 kips	35.96 kips	606.86 kips
72.10 ft	587.08 kips	35.96 kips	623.04 kips

Depth	Skin Friction	End Bearing	Total Capacity
72.69 ft	596.69 kips	35.96 kips	632.65 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
0
100
200
300
400
500
600
700
Capacity (kips)

DrivenPiles - Report

General Project Information

Filename: ...nalysis\Driven Piles\Forward Abutment\FRA-70-13.01 - Forward Abutment HP 12x53-B-014-7-20.dvn
Project Name: FRA-70-13.01 Forward Abutment (B-014-7-20)
Project Client: ODOT
Prepared By: Hanu Kulkarni
Project Manager: Brian Trenner

Pile Information

Pile Type: H Pile
Top of Pile: 0.00 ft
Diameter of Pile: 12.00 in

Nominal Considerations

Water Table Depth At Time Of:

Drilling:	41.10 ft
Driving/Restrike:	41.10 ft
Nominal:	41.10 ft

Nominal Considations:

Local Scour:	0.00 ft
Long Term Scour:	0.00 ft
Soft Soil:	0.00 ft

Nominal Profile

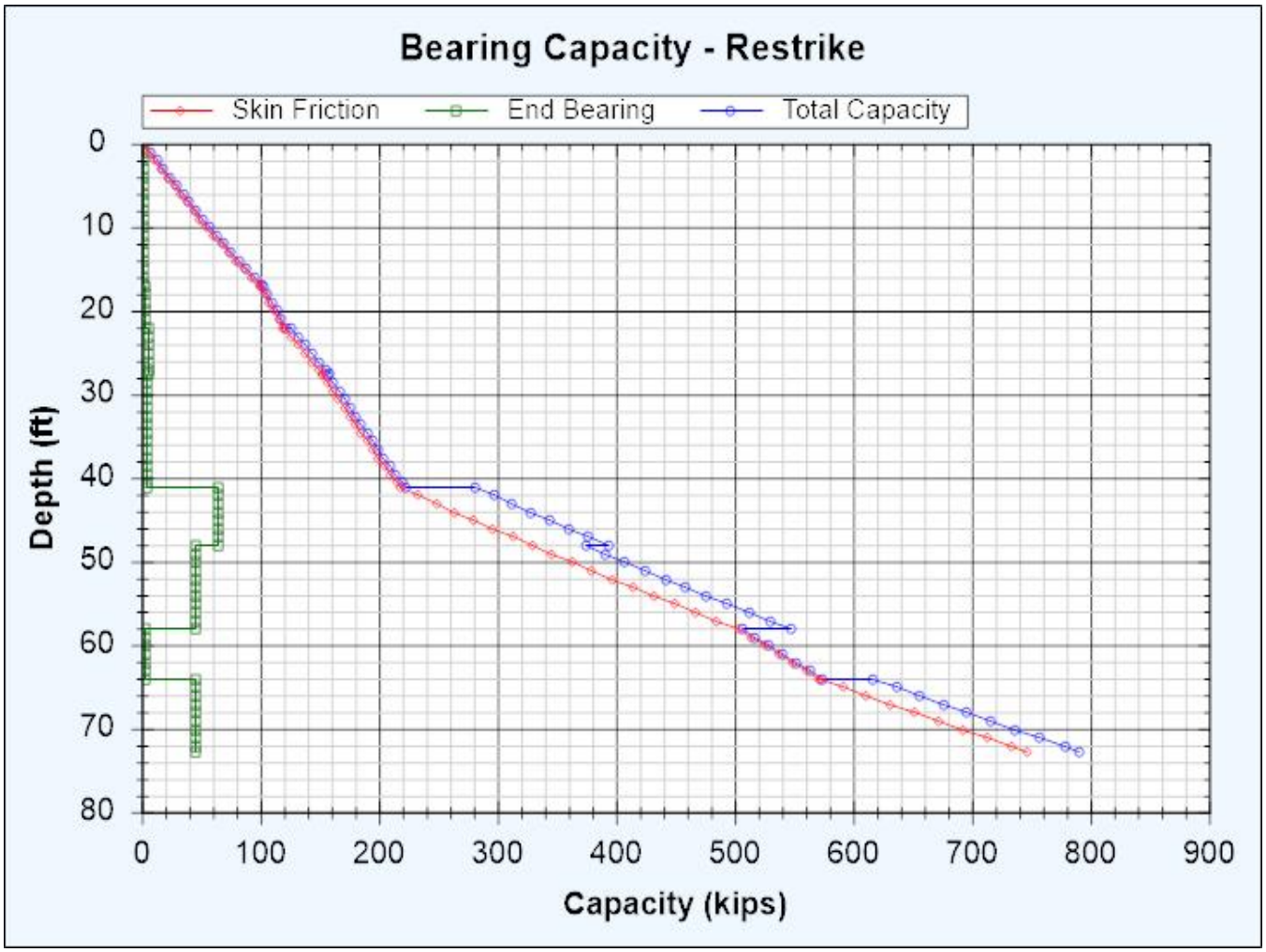
Layer	Soil Type	Thickness	Setup Factor	Unit Weight	Strength	Nominal Curve
1	Cohesive	17.00 ft	1.500	120.00 pcf	2000.00 psf	T-80 Same
2	Cohesive	5.10 ft	1.500	120.00 pcf	2750.00 psf	T-80 Same
3	Cohesive	5.50 ft	1.500	130.00 pcf	6250.00 psf	T-80 Same
4	Cohesive	13.50 ft	2.000	130.00 pcf	5000.00 psf	T-80 Same
5	Cohesionless	7.00 ft	1.000	135.00 pcf	42.0/42.0	Nordlund
6	Cohesionless	10.00 ft	1.000	130.00 pcf	40.0/40.0	Nordlund
7	Cohesive	6.00 ft	1.500	125.00 pcf	2875.00 psf	T-80 Sand
8	Cohesionless	8.60 ft	1.000	130.00 pcf	40.0/40.0	Nordlund

Restrike - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 kips	1.94 kips	1.99 kips
1.00 ft	5.45 kips	1.94 kips	7.39 kips
2.00 ft	10.91 kips	1.94 kips	12.85 kips
3.00 ft	16.36 kips	1.94 kips	18.30 kips
4.00 ft	21.82 kips	1.94 kips	23.76 kips
5.00 ft	27.27 kips	1.94 kips	29.21 kips
6.00 ft	32.73 kips	1.94 kips	34.67 kips
7.00 ft	38.18 kips	1.94 kips	40.12 kips
8.00 ft	43.64 kips	1.94 kips	45.58 kips
9.00 ft	49.09 kips	1.94 kips	51.03 kips
10.00 ft	54.55 kips	1.94 kips	56.49 kips
11.00 ft	60.62 kips	1.94 kips	62.56 kips
12.00 ft	66.81 kips	1.94 kips	68.74 kips
13.00 ft	73.11 kips	1.94 kips	75.04 kips
14.00 ft	79.52 kips	1.94 kips	81.45 kips
15.00 ft	86.04 kips	1.94 kips	87.98 kips
16.00 ft	92.68 kips	1.94 kips	94.61 kips
16.99 ft	99.36 kips	1.94 kips	101.29 kips
17.01 ft	99.46 kips	2.66 kips	102.13 kips
18.00 ft	103.36 kips	2.66 kips	106.02 kips
19.00 ft	107.30 kips	2.66 kips	109.96 kips
20.00 ft	111.23 kips	2.66 kips	113.90 kips
21.00 ft	115.17 kips	2.66 kips	117.83 kips
22.00 ft	119.10 kips	2.66 kips	121.77 kips
22.09 ft	119.46 kips	2.66 kips	122.12 kips
22.11 ft	119.56 kips	6.05 kips	125.61 kips
23.10 ft	125.40 kips	6.05 kips	131.45 kips
24.10 ft	131.30 kips	6.05 kips	137.35 kips
25.10 ft	137.20 kips	6.05 kips	143.25 kips
26.10 ft	143.10 kips	6.05 kips	149.15 kips
27.10 ft	149.00 kips	6.05 kips	155.05 kips
27.59 ft	151.89 kips	6.05 kips	157.94 kips
27.61 ft	152.00 kips	4.84 kips	156.84 kips
28.60 ft	156.67 kips	4.84 kips	161.51 kips
29.60 ft	161.39 kips	4.84 kips	166.23 kips
30.60 ft	166.11 kips	4.84 kips	170.95 kips
31.60 ft	170.83 kips	4.84 kips	175.67 kips
32.60 ft	175.55 kips	4.84 kips	180.39 kips
33.60 ft	180.27 kips	4.84 kips	185.11 kips
34.60 ft	184.99 kips	4.84 kips	189.84 kips
35.60 ft	189.71 kips	4.84 kips	194.56 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.60 ft	194.43 kips	4.84 kips	199.28 kips
37.60 ft	199.15 kips	4.84 kips	204.00 kips
38.60 ft	204.32 kips	4.84 kips	209.16 kips
39.60 ft	209.56 kips	4.84 kips	214.40 kips
40.60 ft	214.89 kips	4.84 kips	219.73 kips
41.09 ft	217.53 kips	4.84 kips	222.37 kips
41.11 ft	217.73 kips	63.78 kips	281.51 kips
42.10 ft	232.92 kips	63.78 kips	296.70 kips
43.10 ft	248.47 kips	63.78 kips	312.25 kips
44.10 ft	264.24 kips	63.78 kips	328.03 kips
45.10 ft	280.23 kips	63.78 kips	344.01 kips
46.10 ft	296.43 kips	63.78 kips	360.21 kips
47.10 ft	312.85 kips	63.78 kips	376.63 kips
48.09 ft	329.32 kips	63.78 kips	393.10 kips
48.11 ft	329.65 kips	44.95 kips	374.60 kips
49.10 ft	345.96 kips	44.95 kips	390.91 kips
50.10 ft	362.64 kips	44.95 kips	407.59 kips
51.10 ft	379.52 kips	44.95 kips	424.47 kips
52.10 ft	396.59 kips	44.95 kips	441.54 kips
53.10 ft	413.86 kips	44.95 kips	458.81 kips
54.10 ft	431.32 kips	44.95 kips	476.27 kips
55.10 ft	448.98 kips	44.95 kips	493.93 kips
56.10 ft	466.84 kips	44.95 kips	511.79 kips
57.10 ft	484.90 kips	44.95 kips	529.85 kips
58.09 ft	502.97 kips	44.95 kips	547.92 kips
58.11 ft	503.26 kips	2.79 kips	506.05 kips
59.10 ft	514.55 kips	2.79 kips	517.34 kips
60.10 ft	525.96 kips	2.79 kips	528.74 kips
61.10 ft	537.36 kips	2.79 kips	540.15 kips
62.10 ft	548.77 kips	2.79 kips	551.55 kips
63.10 ft	560.17 kips	2.79 kips	562.96 kips
64.09 ft	571.46 kips	2.79 kips	574.25 kips
64.11 ft	571.77 kips	44.95 kips	616.72 kips
65.10 ft	591.12 kips	44.95 kips	636.07 kips
66.10 ft	610.85 kips	44.95 kips	655.80 kips
67.10 ft	630.79 kips	44.95 kips	675.74 kips
68.10 ft	650.92 kips	44.95 kips	695.87 kips
69.10 ft	671.25 kips	44.95 kips	716.20 kips
70.10 ft	691.77 kips	44.95 kips	736.72 kips
71.10 ft	712.50 kips	44.95 kips	757.45 kips
72.10 ft	733.41 kips	44.95 kips	778.36 kips

Depth	Skin Friction	End Bearing	Total Capacity
72.69 ft	745.85 kips	44.95 kips	790.80 kips


Bearing Capacity - Restrike
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
0
100
200
300
400
500
600
700
800
900
Capacity (kips)

Driving - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.04 kips	1.94 kips	1.97 kips
1.00 ft	3.64 kips	1.94 kips	5.57 kips
2.00 ft	7.27 kips	1.94 kips	9.21 kips
3.00 ft	10.91 kips	1.94 kips	12.85 kips
4.00 ft	14.55 kips	1.94 kips	16.48 kips
5.00 ft	18.18 kips	1.94 kips	20.12 kips
6.00 ft	21.82 kips	1.94 kips	23.76 kips
7.00 ft	25.46 kips	1.94 kips	27.39 kips
8.00 ft	29.09 kips	1.94 kips	31.03 kips
9.00 ft	32.73 kips	1.94 kips	34.67 kips
10.00 ft	36.37 kips	1.94 kips	38.30 kips
11.00 ft	40.42 kips	1.94 kips	42.35 kips
12.00 ft	44.54 kips	1.94 kips	46.48 kips
13.00 ft	48.74 kips	1.94 kips	50.68 kips
14.00 ft	53.01 kips	1.94 kips	54.95 kips
15.00 ft	57.36 kips	1.94 kips	59.30 kips
16.00 ft	61.79 kips	1.94 kips	63.72 kips
16.99 ft	66.24 kips	1.94 kips	68.18 kips
17.01 ft	66.31 kips	2.66 kips	68.98 kips
18.00 ft	68.91 kips	2.66 kips	71.57 kips
19.00 ft	71.53 kips	2.66 kips	74.20 kips
20.00 ft	74.16 kips	2.66 kips	76.82 kips
21.00 ft	76.78 kips	2.66 kips	79.45 kips
22.00 ft	79.41 kips	2.66 kips	82.07 kips
22.09 ft	79.64 kips	2.66 kips	82.31 kips
22.11 ft	79.71 kips	6.05 kips	85.76 kips
23.10 ft	83.60 kips	6.05 kips	89.66 kips
24.10 ft	87.54 kips	6.05 kips	93.59 kips
25.10 ft	91.47 kips	6.05 kips	97.52 kips
26.10 ft	95.40 kips	6.05 kips	101.46 kips
27.10 ft	99.34 kips	6.05 kips	105.39 kips
27.59 ft	101.27 kips	6.05 kips	107.32 kips
27.61 ft	101.33 kips	4.84 kips	106.17 kips
28.60 ft	103.66 kips	4.84 kips	108.51 kips
29.60 ft	106.02 kips	4.84 kips	110.87 kips
30.60 ft	108.39 kips	4.84 kips	113.23 kips
31.60 ft	110.75 kips	4.84 kips	115.59 kips
32.60 ft	113.11 kips	4.84 kips	117.95 kips
33.60 ft	115.47 kips	4.84 kips	120.31 kips
34.60 ft	117.83 kips	4.84 kips	122.67 kips
35.60 ft	120.19 kips	4.84 kips	125.03 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.60 ft	122.55 kips	4.84 kips	127.39 kips
37.60 ft	124.91 kips	4.84 kips	129.75 kips
38.60 ft	127.49 kips	4.84 kips	132.33 kips
39.60 ft	130.11 kips	4.84 kips	134.95 kips
40.60 ft	132.77 kips	4.84 kips	137.62 kips
41.09 ft	134.09 kips	4.84 kips	138.94 kips
41.11 ft	134.27 kips	63.78 kips	198.05 kips
42.10 ft	149.46 kips	63.78 kips	213.24 kips
43.10 ft	165.01 kips	63.78 kips	228.80 kips
44.10 ft	180.78 kips	63.78 kips	244.57 kips
45.10 ft	196.77 kips	63.78 kips	260.55 kips
46.10 ft	212.97 kips	63.78 kips	276.75 kips
47.10 ft	229.39 kips	63.78 kips	293.17 kips
48.09 ft	245.86 kips	63.78 kips	309.64 kips
48.11 ft	246.19 kips	44.95 kips	291.14 kips
49.10 ft	262.51 kips	44.95 kips	307.46 kips
50.10 ft	279.18 kips	44.95 kips	324.13 kips
51.10 ft	296.06 kips	44.95 kips	341.01 kips
52.10 ft	313.13 kips	44.95 kips	358.08 kips
53.10 ft	330.40 kips	44.95 kips	375.35 kips
54.10 ft	347.86 kips	44.95 kips	392.81 kips
55.10 ft	365.52 kips	44.95 kips	410.47 kips
56.10 ft	383.38 kips	44.95 kips	428.33 kips
57.10 ft	401.44 kips	44.95 kips	446.39 kips
58.09 ft	419.51 kips	44.95 kips	464.46 kips
58.11 ft	419.77 kips	2.79 kips	422.55 kips
59.10 ft	427.29 kips	2.79 kips	430.08 kips
60.10 ft	434.90 kips	2.79 kips	437.68 kips
61.10 ft	442.50 kips	2.79 kips	445.28 kips
62.10 ft	450.10 kips	2.79 kips	452.89 kips
63.10 ft	457.71 kips	2.79 kips	460.49 kips
64.09 ft	465.23 kips	2.79 kips	468.02 kips
64.11 ft	465.50 kips	44.95 kips	510.45 kips
65.10 ft	484.85 kips	44.95 kips	529.80 kips
66.10 ft	504.59 kips	44.95 kips	549.54 kips
67.10 ft	524.52 kips	44.95 kips	569.47 kips
68.10 ft	544.66 kips	44.95 kips	589.61 kips
69.10 ft	564.98 kips	44.95 kips	609.93 kips
70.10 ft	585.51 kips	44.95 kips	630.46 kips
71.10 ft	606.23 kips	44.95 kips	651.18 kips
72.10 ft	627.15 kips	44.95 kips	672.10 kips

Depth	Skin Friction	End Bearing	Total Capacity
72.69 ft	639.58 kips	44.95 kips	684.53 kips


Bearing Capacity - Driving
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
0
100
200
300
400
500
600
700
800
900
Capacity (kips)

Nominal - Summary of Capacities

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.05 kips	1.94 kips	1.99 kips
1.00 ft	5.45 kips	1.94 kips	7.39 kips
2.00 ft	10.91 kips	1.94 kips	12.85 kips
3.00 ft	16.36 kips	1.94 kips	18.30 kips
4.00 ft	21.82 kips	1.94 kips	23.76 kips
5.00 ft	27.27 kips	1.94 kips	29.21 kips
6.00 ft	32.73 kips	1.94 kips	34.67 kips
7.00 ft	38.18 kips	1.94 kips	40.12 kips
8.00 ft	43.64 kips	1.94 kips	45.58 kips
9.00 ft	49.09 kips	1.94 kips	51.03 kips
10.00 ft	54.55 kips	1.94 kips	56.49 kips
11.00 ft	60.62 kips	1.94 kips	62.56 kips
12.00 ft	66.81 kips	1.94 kips	68.74 kips
13.00 ft	73.11 kips	1.94 kips	75.04 kips
14.00 ft	79.52 kips	1.94 kips	81.45 kips
15.00 ft	86.04 kips	1.94 kips	87.98 kips
16.00 ft	92.68 kips	1.94 kips	94.61 kips
16.99 ft	99.36 kips	1.94 kips	101.29 kips
17.01 ft	99.46 kips	2.66 kips	102.13 kips
18.00 ft	103.36 kips	2.66 kips	106.02 kips
19.00 ft	107.30 kips	2.66 kips	109.96 kips
20.00 ft	111.23 kips	2.66 kips	113.90 kips
21.00 ft	115.17 kips	2.66 kips	117.83 kips
22.00 ft	119.10 kips	2.66 kips	121.77 kips
22.09 ft	119.46 kips	2.66 kips	122.12 kips
22.11 ft	119.56 kips	6.05 kips	125.61 kips
23.10 ft	125.40 kips	6.05 kips	131.45 kips
24.10 ft	131.30 kips	6.05 kips	137.35 kips
25.10 ft	137.20 kips	6.05 kips	143.25 kips
26.10 ft	143.10 kips	6.05 kips	149.15 kips
27.10 ft	149.00 kips	6.05 kips	155.05 kips
27.59 ft	151.89 kips	6.05 kips	157.94 kips
27.61 ft	152.00 kips	4.84 kips	156.84 kips
28.60 ft	156.67 kips	4.84 kips	161.51 kips
29.60 ft	161.39 kips	4.84 kips	166.23 kips
30.60 ft	166.11 kips	4.84 kips	170.95 kips
31.60 ft	170.83 kips	4.84 kips	175.67 kips
32.60 ft	175.55 kips	4.84 kips	180.39 kips
33.60 ft	180.27 kips	4.84 kips	185.11 kips
34.60 ft	184.99 kips	4.84 kips	189.84 kips
35.60 ft	189.71 kips	4.84 kips	194.56 kips

Depth	Skin Friction	End Bearing	Total Capacity
36.60 ft	194.43 kips	4.84 kips	199.28 kips
37.60 ft	199.15 kips	4.84 kips	204.00 kips
38.60 ft	204.32 kips	4.84 kips	209.16 kips
39.60 ft	209.56 kips	4.84 kips	214.40 kips
40.60 ft	214.89 kips	4.84 kips	219.73 kips
41.09 ft	217.53 kips	4.84 kips	222.37 kips
41.11 ft	217.73 kips	63.78 kips	281.51 kips
42.10 ft	232.92 kips	63.78 kips	296.70 kips
43.10 ft	248.47 kips	63.78 kips	312.25 kips
44.10 ft	264.24 kips	63.78 kips	328.03 kips
45.10 ft	280.23 kips	63.78 kips	344.01 kips
46.10 ft	296.43 kips	63.78 kips	360.21 kips
47.10 ft	312.85 kips	63.78 kips	376.63 kips
48.09 ft	329.32 kips	63.78 kips	393.10 kips
48.11 ft	329.65 kips	44.95 kips	374.60 kips
49.10 ft	345.96 kips	44.95 kips	390.91 kips
50.10 ft	362.64 kips	44.95 kips	407.59 kips
51.10 ft	379.52 kips	44.95 kips	424.47 kips
52.10 ft	396.59 kips	44.95 kips	441.54 kips
53.10 ft	413.86 kips	44.95 kips	458.81 kips
54.10 ft	431.32 kips	44.95 kips	476.27 kips
55.10 ft	448.98 kips	44.95 kips	493.93 kips
56.10 ft	466.84 kips	44.95 kips	511.79 kips
57.10 ft	484.90 kips	44.95 kips	529.85 kips
58.09 ft	502.97 kips	44.95 kips	547.92 kips
58.11 ft	503.26 kips	2.79 kips	506.05 kips
59.10 ft	514.55 kips	2.79 kips	517.34 kips
60.10 ft	525.96 kips	2.79 kips	528.74 kips
61.10 ft	537.36 kips	2.79 kips	540.15 kips
62.10 ft	548.77 kips	2.79 kips	551.55 kips
63.10 ft	560.17 kips	2.79 kips	562.96 kips
64.09 ft	571.46 kips	2.79 kips	574.25 kips
64.11 ft	571.77 kips	44.95 kips	616.72 kips
65.10 ft	591.12 kips	44.95 kips	636.07 kips
66.10 ft	610.85 kips	44.95 kips	655.80 kips
67.10 ft	630.79 kips	44.95 kips	675.74 kips
68.10 ft	650.92 kips	44.95 kips	695.87 kips
69.10 ft	671.25 kips	44.95 kips	716.20 kips
70.10 ft	691.77 kips	44.95 kips	736.72 kips
71.10 ft	712.50 kips	44.95 kips	757.45 kips
72.10 ft	733.41 kips	44.95 kips	778.36 kips

Depth	Skin Friction	End Bearing	Total Capacity
72.69 ft	745.85 kips	44.95 kips	790.80 kips


Bearing Capacity - Nominal
Skin Friction
End Bearing
Total Capacity
Depth (ft)
0
10
20
30
40
50
60
70
80
0
100
200
300
400
500
600
700
800
900
Capacity (kips)

APPENDIX VIII

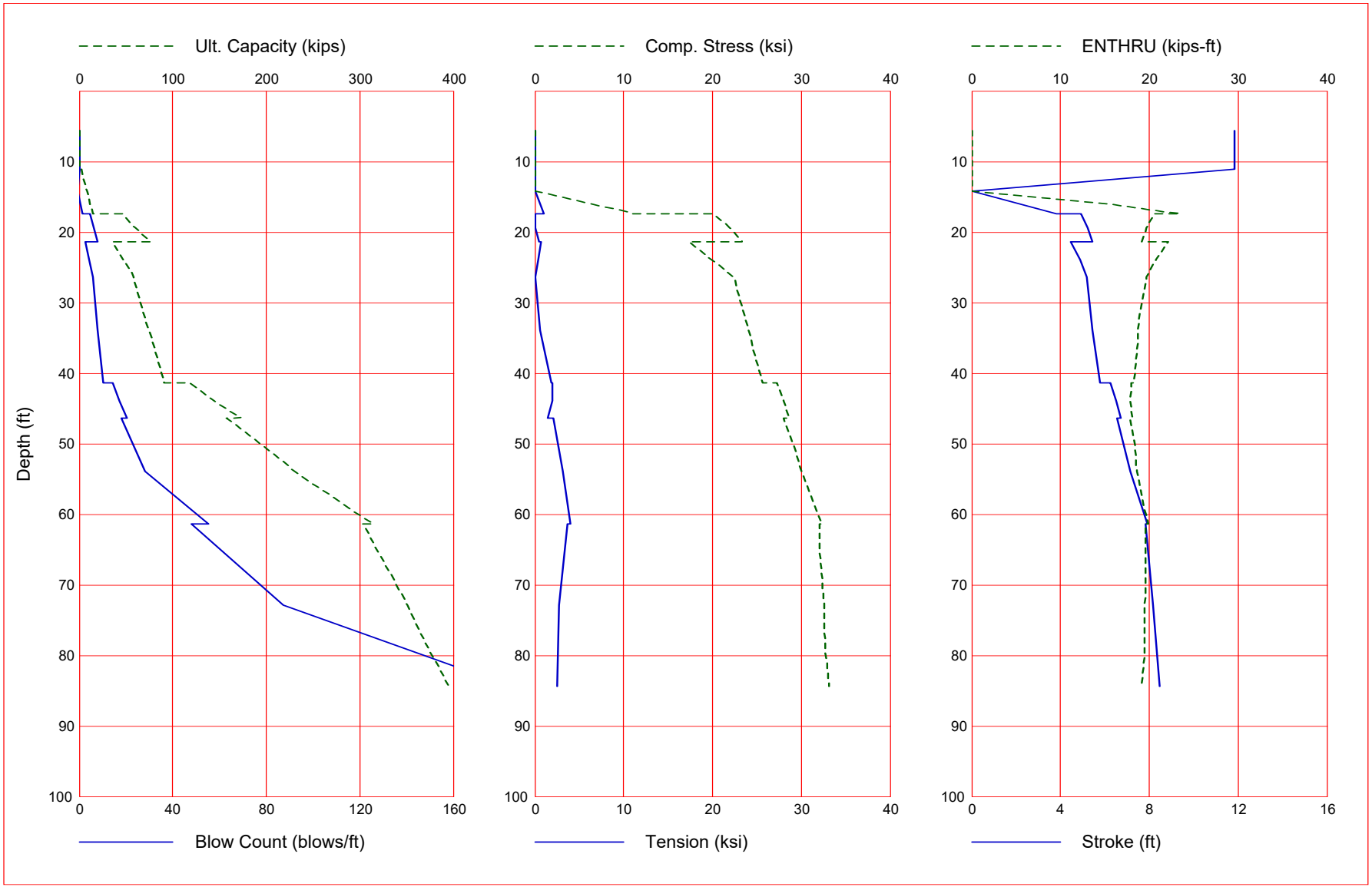
GRLWEAP DRIVEABILITY ANALYSIS OUTPUTS

Rear Abutment
(B-015-1-13)

Resource International Inc
FRA-70-13.01 Rear Abutment (B-015-1-13)

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.571 / 1.000



Resource International Inc
FRA-70-13.01 Rear Abutment (B-015-1-13)

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.571 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
5.6	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
11.1	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
11.1	2.5	0.0	2.4	0.0	0.000	0.000	11.86	0.0
14.2	8.5	6.1	2.4	-1.0	0.000	0.000	0.00	0.0
17.4	14.5	12.1	2.4	1.6	11.154	-1.005	3.82	23.5
17.4	46.2	12.2	34.0	4.7	20.133	0.000	4.94	20.5
19.4	60.7	22.3	38.3	6.2	21.959	0.000	5.21	19.7
21.4	76.3	33.6	42.7	7.7	23.318	-0.522	5.44	19.1
21.4	35.7	33.9	1.8	2.8	17.338	-0.736	4.47	22.1
23.9	46.8	44.9	1.8	4.3	19.872	-0.382	4.87	20.7
26.4	57.9	56.0	1.8	6.0	22.329	0.000	5.18	19.7
26.4	58.4	56.2	2.2	6.0	22.418	0.000	5.19	19.7
33.9	74.0	71.8	2.2	8.0	24.014	-0.583	5.45	18.7
41.4	90.8	88.5	2.2	10.2	25.600	-1.897	5.80	18.3
41.4	117.9	88.8	29.2	14.5	27.271	-1.925	6.23	18.0
43.9	144.8	115.6	29.2	17.3	27.948	-1.974	6.49	17.9
46.4	173.3	144.1	29.2	20.4	28.597	-1.492	6.72	18.1
46.4	157.6	144.6	13.1	17.9	28.037	-2.113	6.55	17.9
53.9	230.7	217.6	13.1	28.2	29.990	-3.155	7.15	18.6
61.4	314.6	301.6	13.1	55.1	32.331	-4.022	7.93	19.9
61.4	303.4	301.9	1.5	48.0	32.006	-3.653	7.81	19.6
72.9	350.4	349.0	1.5	87.2	32.610	-2.723	8.16	19.5
84.4	395.2	393.8	1.5	184.7	33.151	-2.503	8.49	19.1

Total Continuous Driving Time 73.00 minutes; Total Number of Blows 3082

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\REAR ABUTMENT\FRA-70-13.01 - REAR ABUTMENT HP 10X42-B-015-1-13-CASE-1.GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 Rear Abutment (B-015-1-13)

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	12.400	10.070	H Pile

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.900	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
84.380	12.40	29000.0	492.000	3.295	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
1.00	0.00	0.02	0.10	0.10	0.05	0.15	1.00	6.00	24.0
2.00	0.00	0.04	0.10	0.10	0.05	0.15	1.00	6.00	24.0
3.00	0.00	0.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
4.00	0.00	0.07	0.10	0.10	0.05	0.15	1.00	6.00	24.0
5.00	0.00	0.09	0.10	0.10	0.05	0.15	1.00	6.00	24.0
6.00	0.00	0.11	0.10	0.10	0.05	0.15	1.00	6.00	24.0
7.00	0.00	0.13	0.10	0.10	0.05	0.15	1.00	6.00	24.0
8.00	0.00	0.14	0.10	0.10	0.05	0.15	1.00	6.00	24.0
9.00	0.00	0.16	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.00	0.00	0.18	0.10	0.10	0.05	0.15	1.00	6.00	24.0
11.00	0.00	0.20	0.10	0.10	0.05	0.15	1.00	6.00	24.0
11.09	0.00	0.20	0.10	0.10	0.05	0.15	1.00	6.00	24.0
11.11	0.88	2.42	0.10	0.10	0.20	0.15	1.50	6.00	336.0
17.39	0.88	2.42	0.10	0.10	0.20	0.15	1.50	6.00	336.0

17.41	1.45	33.98	0.10	0.10	0.05	0.15	1.00	6.00	24.0
18.40	1.55	36.15	0.10	0.10	0.05	0.15	1.00	6.00	24.0
19.40	1.64	38.35	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.40	1.74	40.54	0.10	0.10	0.05	0.15	1.00	6.00	24.0
21.39	1.83	42.72	0.10	0.10	0.05	0.15	1.00	6.00	24.0
21.41	2.38	1.84	0.10	0.10	0.20	0.15	1.75	6.00	720.0
26.39	2.38	1.84	0.10	0.10	0.20	0.15	1.75	6.00	720.0
26.41	0.95	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
35.40	0.96	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
36.40	0.99	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
37.40	1.01	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
38.40	1.03	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
39.40	1.06	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
40.40	1.08	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
41.39	1.11	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
41.41	3.18	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.0
42.40	3.26	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.0
43.40	3.35	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.0
44.40	3.43	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.0
45.40	3.52	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.0
46.39	3.60	29.17	0.10	0.10	0.05	0.15	1.00	6.00	24.0
46.41	2.73	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
47.40	2.79	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
48.40	2.86	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
49.40	2.92	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
50.40	2.98	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
51.40	3.04	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
52.40	3.10	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
53.40	3.17	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
54.40	3.23	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
55.40	3.29	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
56.40	3.35	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
57.40	3.41	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
57.99	3.45	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
58.01	3.45	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
59.00	3.48	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
60.00	3.52	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
61.00	3.55	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
61.39	3.56	13.05	0.10	0.10	0.05	0.15	1.00	6.00	24.0
61.41	1.88	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
70.40	1.87	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
71.40	1.86	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
72.40	1.86	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
73.40	1.85	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
74.40	1.84	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
75.40	1.83	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
76.40	1.83	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
77.40	1.82	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
78.40	1.81	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
79.40	1.78	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0

80.40	1.75	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
81.40	1.72	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
82.40	1.70	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
83.40	1.67	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0
84.38	1.64	1.45	0.10	0.10	0.15	0.15	1.50	6.00	336.0

Gain/Loss factors: shaft and toe

0.48600	0.52800	0.57100	0.61400	0.65700
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
5.55	0.00	0.00	0.000	0.000	0.000	0.000	0.000
11.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
11.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
14.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.38	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.42	0.00	0.00	0.000	0.000	0.000	0.000	0.000
19.40	0.00	0.00	0.000	0.000	0.000	0.000	0.000
21.38	0.00	0.00	0.000	0.000	0.000	0.000	0.000
21.42	0.00	0.00	0.000	0.000	0.000	0.000	0.000
23.90	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.38	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.42	0.00	0.00	0.000	0.000	0.000	0.000	0.000
33.90	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.38	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.42	0.00	0.00	0.000	0.000	0.000	0.000	0.000
43.90	0.00	0.00	0.000	0.000	0.000	0.000	0.000
46.38	0.00	0.00	0.000	0.000	0.000	0.000	0.000
46.42	0.00	0.00	0.000	0.000	0.000	0.000	0.000
53.90	0.00	0.00	0.000	0.000	0.000	0.000	0.000
61.38	0.00	0.00	0.000	0.000	0.000	0.000	0.000
61.42	0.00	0.00	0.000	0.000	0.000	0.000	0.000
72.88	0.00	0.00	0.000	0.000	0.000	0.000	0.000
84.38	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

FRA-70-13.01 Rear Abutment (B-015-1-13)

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	

Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		8878.5			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	5.6		
Shaft Gain/Loss Factor		0.486	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	H Pile
Pile Size	(inch)	10.070		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

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        Pile and Soil Model            Total Capacity Rut  (kips)       0.1
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft        kips    s/ft  inch     ft    ft     in2
  1  0.143     8878 0.010 0.000 0.85     0.0   0.000 0.100   3.38   3.3    12.4
  2  0.143     8878 0.000 0.000 1.00     0.0   0.000 0.100   6.75   3.3    12.4
 24  0.143     8878 0.000 0.000 1.00     0.0   0.050 0.100  81.00   3.3    12.4
 25  0.143     8878 0.000 0.000 1.00     0.0   0.050 0.100  84.38   3.3    12.4
Toe                                      0.1   0.150 0.100

     3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
     3.575 kips total reduced pile weight   (g= 32.17 ft/s2)

 PILE, SOIL, ANALYSIS OPTIONS:
 Uniform pile                           Pile Segments: Automatic
 No. of Slacks/Splices             0  Pile Damping           (%)        1
                                        Pile Damping Fact.(k/ft/s)     0.435
 Driveability Analysis
 Soil Damping Option            Smith
 Max No Analysis Iterations        0  Time Increment/Critical          160
 Output Time Interval              1  Analysis Time-Input   (ms)         0
 Output Level: Normal
 Gravity Mass, Pile, Hammer:   32.170    32.170    32.170
 Output Segment Generation: Automatic

    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     5.55     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     0.1
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     0.1
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     0.1
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     0.1
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     0.1
 Hammer+Pile Weight > Rult: Pile Runs
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Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
0.1	0.0	10.81	0.00	0.00	1	0	0.00	1	0	0.0	78.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.1	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 11.1
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 0.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	74.25	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	84.38	3.3	12.4
Toe						0.2	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
11.08	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.2 0.2
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.2 0.2

Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.2 0.2
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.2 0.2
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 6.2 0.2
Hammer+Pile Weight > Rult: Pile Runs

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
0.2	0.0	10.81	0.00	0.00	1	0	0.00	1	0	0.0	78.4
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4
0.2	0.0	11.86	0.00	0.00	1	0	0.00	1	0	0.0	74.4

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 11.1
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 2.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	74.25	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	0.0	0.162	0.100	84.38	3.3	12.4

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Toe                                      2.4   0.150 0.100

     3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
     3.575 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    11.12     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     2.5
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     2.5
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     2.5
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     2.5
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     6.2     2.5
 Hammer+Pile Weight > Rult: Pile Runs
🡅
FRA-70-13.01  Rear Abutment (B-015-1-13)                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips     b/ft  down      up     ksi              ksi          kip-ft   b/min
    2.5     0.0  10.81   0.00    0.00   1   0     0.00   1   0    0.0    78.4
    2.5     0.0  11.86   0.00    0.00   1   0     0.00   1   0    0.0    74.4
    2.5     0.0  11.86   0.00    0.00   1   0     0.00   1   0    0.0    74.4
    2.5     0.0  11.86   0.00    0.00   1   0     0.00   1   0    0.0    74.4
    2.5     0.0  11.86   0.00    0.00   1   0     0.00   1   0    0.0    74.4
          1           0   10.81000       11.86000
🡅
FRA-70-13.01  Rear Abutment (B-015-1-13)                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      14.2
 Shaft Gain/Loss Factor         0.486  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    12.400  Pile Type                     H Pile
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Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model — Total Capacity Rut (kips) 7.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	70.88	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	5.5	0.200	0.100	84.38	3.3	12.4
Toe						2.4	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
14.25	10.81	1.00	0.800

↑

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
7.9	Hammer did not run										
8.2	Hammer did not run										
8.5	Hammer did not run										
8.8	Hammer did not run										
9.1	Hammer did not run										
1		0	10.81000		11.86000						

↑

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 17.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s

0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model — Total Capacity Rut (kips) 13.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	67.50	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	5.0	0.200	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	84.38	3.3	12.4
Toe						2.4	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.38	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
13.3	1.5	3.75	3.77	-0.91	9	15	10.84	1	7	23.2	61.0
13.9	1.5	3.79	3.80	-0.97	9	15	11.01	1	7	23.4	60.7
14.5	1.6	3.82	3.84	-1.00	9	15	11.15	1	7	23.5	60.5
15.1	1.6	3.86	3.87	-1.00	9	15	11.31	1	7	23.6	60.2
15.7	1.6	3.89	3.90	-0.97	9	15	11.67	1	2	23.7	60.0

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 17.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 45.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	67.50	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	5.1	0.200	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	5.9	0.199	0.100	84.38	3.3	12.4
Toe						34.0	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.42	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
45.0	4.6	4.91	4.88	0.00	1	0	19.94	16	5	20.6	53.4
45.6	4.6	4.92	4.90	0.00	1	0	20.03	16	5	20.5	53.3
46.2	4.7	4.94	4.92	0.00	1	0	20.13	17	5	20.5	53.2
46.8	4.8	4.96	4.93	0.00	1	0	20.26	17	5	20.4	53.1
47.4	4.9	4.97	4.95	0.00	1	0	20.34	17	5	20.3	53.0

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 19.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 59.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	67.50	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	2.7	0.200	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	12.6	0.092	0.100	84.38	3.3	12.4
Toe						38.3	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.40	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
59.5	6.0	5.18	5.15	0.00	1	0	21.79	21	6	19.8	51.8
60.1	6.1	5.20	5.17	0.00	1	0	21.87	21	6	19.8	51.7
60.7	6.2	5.21	5.19	0.00	1	0	21.96	21	6	19.7	51.7
61.3	6.3	5.23	5.19	0.00	1	0	22.04	22	6	19.7	51.6
61.9	6.4	5.24	5.21	0.00	1	0	22.12	22	6	19.6	51.5

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 21.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 75.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	64.13	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	0.3	0.195	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	7.8	0.160	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	18.6	0.050	0.100	84.38	3.3	12.4
Toe						42.7	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
21.38	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
75.1	7.6	5.42	5.40	-0.41	23	50	23.16	22	6	19.2	50.6
75.7	7.6	5.43	5.41	-0.46	23	50	23.23	22	6	19.2	50.5
76.3	7.7	5.44	5.43	-0.52	23	50	23.32	22	6	19.1	50.5
76.9	7.8	5.46	5.44	-0.58	23	50	23.39	22	6	19.1	50.4
77.6	7.9	5.47	5.45	-0.64	23	50	23.50	22	6	19.1	50.3

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 21.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 34.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4

2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	64.13	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	0.3	0.196	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	7.9	0.157	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	18.6	0.051	0.100	84.38	3.3	12.4
Toe						1.8	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
21.42	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
34.5	2.7	4.38	4.42	-0.67	2	12	16.85	7	3	22.1	56.4
35.1	2.7	4.40	4.44	-0.66	2	12	17.00	8	4	22.0	56.3
35.7	2.8	4.47	4.45	-0.74	2	12	17.34	9	4	22.1	56.0
36.3	2.9	4.49	4.48	-0.70	2	12	17.50	9	4	22.0	55.9
36.9	2.9	4.52	4.50	-0.70	2	12	17.65	10	4	21.9	55.8

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 23.9
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 43.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4

18	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	60.75	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	4.6	0.200	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	16.9	0.056	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	14.7	0.169	0.100	84.38	3.3	12.4
Toe						1.8	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
23.90	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
43.9	4.0	4.78	4.76	-0.39	3	15	19.34	15	5	21.0	54.2
45.3	4.2	4.83	4.80	-0.39	3	15	19.62	16	5	20.8	53.9
46.8	4.3	4.87	4.84	-0.38	3	15	19.87	17	5	20.7	53.7
48.2	4.5	4.91	4.88	-0.34	3	14	20.15	21	6	20.6	53.4
49.7	4.7	4.94	4.92	-0.25	4	14	20.45	21	6	20.4	53.2

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 26.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 53.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	60.75	3.3	12.4

21	0.143	8878	0.000	0.000	1.00	3.1	0.200	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	13.4	0.084	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	16.3	0.133	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	12.8	0.200	0.100	84.38	3.3	12.4
Toe						1.8	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
26.38	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
53.3	5.3	5.07	5.04	-0.04	4	14	21.55	21	6	20.1	52.5
55.6	5.6	5.13	5.10	0.00	1	0	21.98	21	6	19.9	52.1
57.9	6.0	5.18	5.16	0.00	1	0	22.33	21	6	19.7	51.8
60.1	6.3	5.24	5.21	0.00	1	0	22.71	21	6	19.6	51.5
62.4	6.6	5.28	5.26	0.00	1	0	23.01	21	6	19.5	51.3
1		0	10.81000		11.86000						

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 26.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 53.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	60.75	3.3	12.4

21	0.143	8878	0.000	0.000	1.00	3.2	0.200	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	13.6	0.082	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	16.2	0.134	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	12.8	0.200	0.100	84.38	3.3	12.4
Toe						2.2	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
26.42	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
53.8	5.4	5.08	5.06	-0.01	4	14	21.62	21	6	20.0	52.4
56.1	5.7	5.14	5.11	0.00	1	0	22.08	21	6	19.9	52.1
58.4	6.0	5.19	5.17	0.00	1	0	22.42	21	6	19.7	51.8
60.7	6.4	5.25	5.22	0.00	1	0	22.76	21	6	19.6	51.5
63.0	6.7	5.30	5.28	0.00	1	0	23.06	21	6	19.4	51.2

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 33.9
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 67.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
15	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	50.63	3.3	12.4

19	0.143	8878	0.000	0.000	1.00	4.4	0.200	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	16.4	0.060	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	14.9	0.164	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	11.4	0.195	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	6.3	0.150	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	84.38	3.3	12.4
Toe						2.2	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
33.90	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
67.9	7.2	5.39	5.37	-0.52	24	18	23.56	19	6	19.2	50.8
70.9	7.6	5.45	5.43	-0.53	24	18	23.89	19	6	19.0	50.4
74.0	8.0	5.45	5.51	-0.58	24	17	24.01	19	6	18.7	50.3
77.1	8.4	5.52	5.57	-0.74	20	49	24.37	19	6	18.6	50.0
80.2	8.8	5.58	5.63	-1.14	19	49	24.69	19	6	18.5	49.7

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 41.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 83.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4

2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
13	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	43.88	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	5.7	0.200	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	6.9	0.176	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	18.3	0.050	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	13.4	0.191	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	10.0	0.188	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	6.3	0.150	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	6.6	0.150	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	7.1	0.150	0.100	84.38	3.3	12.4
Toe						2.2	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.38	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
83.0	9.0	5.63	5.67	-1.43	22	17	24.80	17	5	18.4	49.5
86.8	9.5	5.71	5.75	-1.74	8	46	25.21	17	5	18.3	49.1
90.8	10.2	5.80	5.83	-1.90	8	46	25.60	17	5	18.3	48.8
94.7	10.8	5.87	5.90	-1.97	17	44	25.97	17	5	18.2	48.5
98.6	11.6	5.96	5.98	-2.11	17	44	26.34	17	5	18.1	48.1

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 41.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 110.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
13	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	43.88	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	5.8	0.200	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	7.1	0.173	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	18.3	0.050	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	13.3	0.192	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	9.9	0.188	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	6.6	0.150	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	7.3	0.149	0.100	84.38	3.3	12.4
Toe						29.2	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.42	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
110.2	13.3	6.11	6.13	-1.64	17	43	26.72	17	5	18.0	47.5
114.0	13.9	6.18	6.19	-1.71	17	39	27.02	17	5	18.0	47.3
117.9	14.5	6.23	6.24	-1.93	17	38	27.27	17	5	18.0	47.1
121.9	15.0	6.34	6.28	-2.04	17	38	27.71	17	5	18.0	46.8
125.8	15.7	6.38	6.33	-2.06	17	38	27.88	17	5	17.9	46.7

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 43.9
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8

84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model — Total Capacity Rut (kips) 137.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
12	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	40.50	3.3	12.4
16	0.143	8878	0.000	0.000	1.00	4.2	0.200	0.100	54.00	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	15.9	0.063	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	15.1	0.159	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	11.6	0.196	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	6.3	0.150	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	6.5	0.150	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	7.0	0.150	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	28.9	0.061	0.100	84.38	3.3	12.4
Toe						29.2	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
43.90	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
137.0	16.3	6.42	6.36	-2.33	16	38	27.57	16	5	17.9	46.5
140.8	16.7	6.45	6.40	-2.16	16	38	27.78	16	5	17.9	46.4
144.8	17.3	6.49	6.45	-1.97	16	37	27.95	16	5	17.9	46.3
148.7	17.8	6.53	6.49	-1.76	15	37	28.16	16	5	17.9	46.1
152.6	18.3	6.57	6.53	-1.60	11	37	28.36	16	5	17.9	46.0

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 46.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile

Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model — Total Capacity Rut (kips) 165.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
12	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	40.50	3.3	12.4
15	0.143	8878	0.000	0.000	1.00	2.7	0.200	0.100	50.63	3.3	12.4
16	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	54.00	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	12.5	0.093	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	16.7	0.122	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	12.8	0.200	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	6.9	0.159	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	6.8	0.150	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	20.9	0.077	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	38.4	0.050	0.100	84.38	3.3	12.4
Toe						29.2	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
46.38	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
165.6	19.2	6.62	6.58	-1.63	15	34	28.19	16	5	17.9	45.8
169.4	19.8	6.66	6.62	-1.56	15	34	28.37	16	5	18.0	45.7
173.3	20.4	6.72	6.67	-1.49	14	30	28.60	16	5	18.1	45.5
177.2	21.1	6.76	6.73	-1.74	14	30	28.74	16	5	18.1	45.3
181.2	21.7	6.80	6.78	-1.97	14	30	28.93	16	5	18.2	45.1

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 46.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 149.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
12	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	40.50	3.3	12.4
15	0.143	8878	0.000	0.000	1.00	2.7	0.200	0.100	50.63	3.3	12.4
16	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	54.00	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	12.6	0.091	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	16.6	0.123	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	12.8	0.200	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	6.8	0.158	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	6.8	0.150	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	21.3	0.076	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	38.4	0.050	0.100	84.38	3.3	12.4
Toe						13.1	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
46.42	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
149.9	16.9	6.47	6.41	-2.31	12	37	27.68	16	5	17.9	46.4
153.7	17.4	6.51	6.46	-2.23	11	36	27.85	16	5	17.9	46.2
157.6	17.9	6.55	6.50	-2.11	11	36	28.04	16	5	17.9	46.1

161.5	18.5	6.59	6.55	-1.96	11	36	28.21	16	5	17.8	45.9
165.5	19.1	6.64	6.59	-1.78	10	36	28.39	16	5	17.9	45.8

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 53.9
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 222.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
10	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	33.75	3.3	12.4
13	0.143	8878	0.000	0.000	1.00	4.0	0.200	0.100	43.88	3.3	12.4
14	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	47.25	3.3	12.4
15	0.143	8878	0.000	0.000	1.00	15.4	0.067	0.100	50.63	3.3	12.4
16	0.143	8878	0.000	0.000	1.00	15.4	0.154	0.100	54.00	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	11.9	0.197	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	6.3	0.150	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	6.5	0.150	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	7.0	0.150	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	27.8	0.062	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	37.0	0.050	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	32.1	0.050	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	34.4	0.050	0.100	84.38	3.3	12.4
Toe						13.1	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
53.90	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
222.9	26.4	7.07	7.03	-3.10	13	28	29.60	13	4	18.5	44.3
226.8	27.3	7.12	7.08	-3.16	13	28	29.81	13	4	18.6	44.2
230.7	28.2	7.15	7.12	-3.16	13	28	29.99	13	4	18.6	44.0
234.6	29.2	7.22	7.17	-3.09	13	28	30.23	13	4	18.7	43.8
238.5	30.1	7.27	7.22	-2.95	13	27	30.45	13	4	18.8	43.7

1 0 10.81000 11.86000

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FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 61.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 306.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
7	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	23.63	3.3	12.4
11	0.143	8878	0.000	0.000	1.00	5.3	0.200	0.100	37.13	3.3	12.4
12	0.143	8878	0.000	0.000	1.00	6.2	0.193	0.100	40.50	3.3	12.4
13	0.143	8878	0.000	0.000	1.00	18.0	0.050	0.100	43.88	3.3	12.4
14	0.143	8878	0.000	0.000	1.00	14.0	0.182	0.100	47.25	3.3	12.4
15	0.143	8878	0.000	0.000	1.00	10.5	0.191	0.100	50.63	3.3	12.4
16	0.143	8878	0.000	0.000	1.00	6.3	0.150	0.100	54.00	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	6.5	0.150	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	7.1	0.150	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	34.4	0.053	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	35.5	0.050	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	32.6	0.050	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	34.9	0.050	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	37.2	0.050	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	39.0	0.050	0.100	84.38	3.3	12.4

Toe 13.1 0.150 0.100

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
61.38	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
306.9	49.8	7.85	7.82	-3.93	11	24	31.97	11	4	19.8	42.1
310.7	52.6	7.89	7.88	-3.98	11	24	32.13	11	4	19.8	42.0
314.6	55.1	7.93	7.92	-4.02	11	24	32.33	11	4	19.9	41.9
318.6	57.8	7.97	7.96	-4.05	11	24	32.53	11	4	20.0	41.7
322.5	59.9	8.02	7.99	-4.07	11	24	32.76	11	4	20.2	41.6

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 61.4
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 295.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
7	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	23.63	3.3	12.4
11	0.143	8878	0.000	0.000	1.00	5.3	0.200	0.100	37.13	3.3	12.4
12	0.143	8878	0.000	0.000	1.00	6.3	0.190	0.100	40.50	3.3	12.4
13	0.143	8878	0.000	0.000	1.00	18.1	0.050	0.100	43.88	3.3	12.4
14	0.143	8878	0.000	0.000	1.00	13.9	0.183	0.100	47.25	3.3	12.4
15	0.143	8878	0.000	0.000	1.00	10.4	0.190	0.100	50.63	3.3	12.4

16	0.143	8878	0.000	0.000	1.00	6.3	0.150	0.100	54.00	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	6.6	0.150	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	7.1	0.150	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	34.8	0.052	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	35.4	0.050	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	32.6	0.050	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	34.9	0.050	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	37.3	0.050	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	38.8	0.050	0.100	84.38	3.3	12.4
Toe						1.5	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
61.42	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
295.6	43.7	7.71	7.67	-3.47	11	24	31.58	11	4	19.5	42.5
299.4	45.9	7.76	7.73	-3.57	11	24	31.80	11	4	19.5	42.3
303.4	48.0	7.81	7.78	-3.65	11	24	32.01	11	4	19.6	42.2
307.3	49.9	7.84	7.82	-3.75	11	24	32.17	11	4	19.7	42.1
311.2	52.8	7.88	7.88	-3.77	11	24	32.36	11	4	19.7	42.0

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 72.9
Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 338.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.000	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.000	0.100	6.75	3.3	12.4
4	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	13.50	3.3	12.4
7	0.143	8878	0.000	0.000	1.00	1.8	0.199	0.100	23.63	3.3	12.4
8	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	27.00	3.3	12.4
9	0.143	8878	0.000	0.000	1.00	10.7	0.114	0.100	30.38	3.3	12.4
10	0.143	8878	0.000	0.000	1.00	17.5	0.098	0.100	33.75	3.3	12.4
11	0.143	8878	0.000	0.000	1.00	12.8	0.200	0.100	37.13	3.3	12.4
12	0.143	8878	0.000	0.000	1.00	7.8	0.171	0.100	40.50	3.3	12.4
13	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	43.88	3.3	12.4
14	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	47.25	3.3	12.4
15	0.143	8878	0.000	0.000	1.00	6.7	0.150	0.100	50.63	3.3	12.4
16	0.143	8878	0.000	0.000	1.00	16.6	0.091	0.100	54.00	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	38.0	0.050	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	32.7	0.050	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	33.5	0.050	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	35.8	0.050	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	38.1	0.050	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	28.5	0.076	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	12.5	0.150	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	12.5	0.150	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	12.4	0.150	0.100	84.38	3.3	12.4
Toe						1.5	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
72.88	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
338.0	71.8	8.11	8.10	-2.92	9	22	32.34	8	3	19.5	41.4
344.1	79.8	8.09	8.15	-2.83	9	22	32.35	8	3	19.4	41.4
350.4	87.2	8.16	8.22	-2.72	9	22	32.61	8	3	19.5	41.2
356.7	95.4	8.22	8.27	-2.62	9	22	32.81	8	3	19.6	41.1
363.0	105.1	8.28	8.31	-2.52	9	21	33.03	8	3	19.8	41.0

1 0 10.81000 11.86000

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 84.4

Shaft Gain/Loss Factor 0.486 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
84.4	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 10.213

Pile and Soil Model Total Capacity Rut (kips) 378.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.143	8878	0.010	0.000	0.85	0.0	0.050	0.100	3.38	3.3	12.4
2	0.143	8878	0.000	0.000	1.00	0.0	0.050	0.100	6.75	3.3	12.4
4	0.143	8878	0.000	0.000	1.00	4.2	0.200	0.100	13.50	3.3	12.4
5	0.143	8878	0.000	0.000	1.00	5.9	0.200	0.100	16.88	3.3	12.4
6	0.143	8878	0.000	0.000	1.00	15.8	0.064	0.100	20.25	3.3	12.4
7	0.143	8878	0.000	0.000	1.00	15.2	0.158	0.100	23.63	3.3	12.4
8	0.143	8878	0.000	0.000	1.00	11.7	0.196	0.100	27.00	3.3	12.4
9	0.143	8878	0.000	0.000	1.00	6.3	0.150	0.100	30.38	3.3	12.4
10	0.143	8878	0.000	0.000	1.00	6.4	0.150	0.100	33.75	3.3	12.4
11	0.143	8878	0.000	0.000	1.00	6.5	0.150	0.100	37.13	3.3	12.4
12	0.143	8878	0.000	0.000	1.00	7.0	0.150	0.100	40.50	3.3	12.4
13	0.143	8878	0.000	0.000	1.00	28.7	0.061	0.100	43.88	3.3	12.4
14	0.143	8878	0.000	0.000	1.00	36.8	0.050	0.100	47.25	3.3	12.4
15	0.143	8878	0.000	0.000	1.00	32.1	0.050	0.100	50.63	3.3	12.4
16	0.143	8878	0.000	0.000	1.00	34.5	0.050	0.100	54.00	3.3	12.4
17	0.143	8878	0.000	0.000	1.00	36.8	0.050	0.100	57.38	3.3	12.4
18	0.143	8878	0.000	0.000	1.00	38.8	0.050	0.100	60.75	3.3	12.4
19	0.143	8878	0.000	0.000	1.00	17.7	0.119	0.100	64.13	3.3	12.4
20	0.143	8878	0.000	0.000	1.00	12.5	0.150	0.100	67.50	3.3	12.4
21	0.143	8878	0.000	0.000	1.00	12.5	0.150	0.100	70.88	3.3	12.4
22	0.143	8878	0.000	0.000	1.00	12.4	0.150	0.100	74.25	3.3	12.4
23	0.143	8878	0.000	0.000	1.00	12.2	0.150	0.100	77.63	3.3	12.4
24	0.143	8878	0.000	0.000	1.00	11.9	0.150	0.100	81.00	3.3	12.4
25	0.143	8878	0.000	0.000	1.00	11.3	0.150	0.100	84.38	3.3	12.4
Toe						1.5	0.150	0.100			

3.575 kips total unreduced pile weight (g= 32.17 ft/s2)
3.575 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
84.38	10.81	1.00	0.800

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
378.4	127.7	8.36	8.36	-2.44	24	7	32.69	4	3	19.0	40.8
386.7	150.1	8.43	8.40	-2.48	24	7	32.92	4	3	19.1	40.7
395.2	184.7	8.49	8.44	-2.50	24	7	33.15	4	3	19.1	40.6
403.8	233.9	8.54	8.48	-2.53	24	7	33.35	4	3	19.2	40.5
412.3	314.4	8.57	8.52	-2.56	24	7	33.53	4	3	19.2	40.4

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.486 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.6	0.1	0.0	0.1	0.0	0.000	0.000	10.81	0.0
11.1	0.2	0.0	0.2	0.0	0.000	0.000	10.81	0.0
11.1	2.5	0.0	2.4	0.0	0.000	0.000	10.81	0.0
14.2	7.9	5.5	2.4	Hammer did not run				
17.4	13.3	10.9	2.4	1.5	10.838	-0.907	3.75	23.2
17.4	45.0	11.0	34.0	4.6	19.938	0.000	4.91	20.6
19.4	59.5	21.1	38.3	6.0	21.795	0.000	5.18	19.8
21.4	75.1	32.4	42.7	7.6	23.164	-0.411	5.42	19.2
21.4	34.5	32.6	1.8	2.7	16.848	-0.673	4.38	22.1
23.9	43.9	42.1	1.8	4.0	19.343	-0.390	4.78	21.0
26.4	53.3	51.5	1.8	5.3	21.553	-0.038	5.07	20.1
26.4	53.8	51.6	2.2	5.4	21.620	-0.008	5.08	20.0
33.9	67.9	65.7	2.2	7.2	23.557	-0.520	5.39	19.2
41.4	83.0	80.8	2.2	9.0	24.804	-1.434	5.63	18.4
41.4	110.2	81.0	29.2	13.3	26.716	-1.639	6.11	18.0
43.9	137.0	107.8	29.2	16.3	27.570	-2.326	6.42	17.9
46.4	165.6	136.4	29.2	19.2	28.189	-1.629	6.62	17.9
46.4	149.9	136.8	13.1	16.9	27.678	-2.313	6.47	17.9
53.9	222.9	209.9	13.1	26.4	29.602	-3.100	7.07	18.5
61.4	306.9	293.8	13.1	49.8	31.970	-3.927	7.85	19.8
61.4	295.6	294.1	1.5	43.7	31.580	-3.468	7.71	19.5
72.9	338.0	336.5	1.5	71.8	32.337	-2.924	8.11	19.5
84.4	378.4	376.9	1.5	127.7	32.685	-2.445	8.36	19.0

Total Driving Time 59 minutes; Total No. of Blows 2492

G/L at Shaft and Toe: 0.528 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.6	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
11.1	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0

11.1	2.5	0.0	2.4	0.0	0.000	0.000	11.86	0.0
14.2	8.2	5.8	2.4	Hammer did not run				
17.4	13.9	11.5	2.4	1.5	11.014	-0.974	3.79	23.4
17.4	45.6	11.6	34.0	4.6	20.027	0.000	4.92	20.5
19.4	60.1	21.7	38.3	6.1	21.869	0.000	5.20	19.8
21.4	75.7	33.0	42.7	7.6	23.226	-0.464	5.43	19.2
21.4	35.1	33.2	1.8	2.7	16.998	-0.660	4.40	22.0
23.9	45.3	43.5	1.8	4.2	19.620	-0.389	4.83	20.8
26.4	55.6	53.7	1.8	5.6	21.976	0.000	5.13	19.9
26.4	56.1	53.9	2.2	5.7	22.076	0.000	5.14	19.9
33.9	70.9	68.7	2.2	7.6	23.891	-0.532	5.45	19.0
41.4	86.8	84.6	2.2	9.5	25.210	-1.738	5.71	18.3
41.4	114.0	84.9	29.2	13.9	27.021	-1.714	6.18	18.0
43.9	140.8	111.7	29.2	16.7	27.783	-2.158	6.45	17.9
46.4	169.4	140.2	29.2	19.8	28.374	-1.557	6.66	18.0
46.4	153.7	140.6	13.1	17.4	27.853	-2.225	6.51	17.9
53.9	226.8	213.7	13.1	27.3	29.811	-3.164	7.12	18.6
61.4	310.7	297.7	13.1	52.6	32.128	-3.975	7.89	19.8
61.4	299.4	298.0	1.5	45.9	31.805	-3.566	7.76	19.5
72.9	344.1	342.7	1.5	79.8	32.352	-2.829	8.09	19.4
84.4	386.7	385.3	1.5	150.1	32.923	-2.480	8.43	19.1

Total Driving Time 65 minutes; Total No. of Blows 2756

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.571 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.6	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
11.1	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
11.1	2.5	0.0	2.4	0.0	0.000	0.000	11.86	0.0
14.2	8.5	6.1	2.4	Hammer did not run				
17.4	14.5	12.1	2.4	1.6	11.154	-1.005	3.82	23.5
17.4	46.2	12.2	34.0	4.7	20.133	0.000	4.94	20.5
19.4	60.7	22.3	38.3	6.2	21.959	0.000	5.21	19.7
21.4	76.3	33.6	42.7	7.7	23.318	-0.522	5.44	19.1
21.4	35.7	33.9	1.8	2.8	17.338	-0.736	4.47	22.1
23.9	46.8	44.9	1.8	4.3	19.872	-0.382	4.87	20.7
26.4	57.9	56.0	1.8	6.0	22.329	0.000	5.18	19.7
26.4	58.4	56.2	2.2	6.0	22.418	0.000	5.19	19.7
33.9	74.0	71.8	2.2	8.0	24.014	-0.583	5.45	18.7
41.4	90.8	88.5	2.2	10.2	25.600	-1.897	5.80	18.3
41.4	117.9	88.8	29.2	14.5	27.271	-1.925	6.23	18.0
43.9	144.8	115.6	29.2	17.3	27.948	-1.974	6.49	17.9
46.4	173.3	144.1	29.2	20.4	28.597	-1.492	6.72	18.1
46.4	157.6	144.6	13.1	17.9	28.037	-2.113	6.55	17.9

53.9	230.7	217.6	13.1	28.2	29.990	-3.155	7.15	18.6
61.4	314.6	301.6	13.1	55.1	32.331	-4.022	7.93	19.9
61.4	303.4	301.9	1.5	48.0	32.006	-3.653	7.81	19.6
72.9	350.4	349.0	1.5	87.2	32.610	-2.723	8.16	19.5
84.4	395.2	393.8	1.5	184.7	33.151	-2.503	8.49	19.1

Total Driving Time 73 minutes; Total No. of Blows 3082

G/L at Shaft and Toe: 0.614 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.6	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
11.1	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
11.1	2.5	0.0	2.4	0.0	0.000	0.000	11.86	0.0
14.2	8.8	6.4	2.4	Hammer did not run				
17.4	15.1	12.7	2.4	1.6	11.308	-1.002	3.86	23.6
17.4	46.8	12.8	34.0	4.8	20.257	0.000	4.96	20.4
19.4	61.3	22.9	38.3	6.3	22.038	0.000	5.23	19.7
21.4	76.9	34.2	42.7	7.8	23.394	-0.581	5.46	19.1
21.4	36.3	34.5	1.8	2.9	17.499	-0.702	4.49	22.0
23.9	48.2	46.4	1.8	4.5	20.154	-0.339	4.91	20.6
26.4	60.1	58.3	1.8	6.3	22.715	0.000	5.24	19.6
26.4	60.7	58.4	2.2	6.4	22.764	0.000	5.25	19.6
33.9	77.1	74.9	2.2	8.4	24.372	-0.739	5.52	18.6
41.4	94.7	92.4	2.2	10.8	25.966	-1.973	5.87	18.2
41.4	121.9	92.7	29.2	15.0	27.706	-2.044	6.34	18.0
43.9	148.7	119.5	29.2	17.8	28.159	-1.756	6.53	17.9
46.4	177.2	148.1	29.2	21.1	28.738	-1.739	6.76	18.1
46.4	161.5	148.5	13.1	18.5	28.207	-1.957	6.59	17.8
53.9	234.6	221.5	13.1	29.2	30.233	-3.095	7.22	18.7
61.4	318.6	305.5	13.1	57.8	32.532	-4.047	7.97	20.0
61.4	307.3	305.8	1.5	49.9	32.174	-3.747	7.84	19.7
72.9	356.7	355.3	1.5	95.4	32.805	-2.624	8.22	19.6
84.4	403.8	402.3	1.5	233.9	33.348	-2.533	8.54	19.2

Total Driving Time 84 minutes; Total No. of Blows 3498

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.657 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
5.6	0.1	0.0	0.1	0.0	0.000	0.000	11.86	0.0
11.1	0.2	0.0	0.2	0.0	0.000	0.000	11.86	0.0
11.1	2.5	0.0	2.4	0.0	0.000	0.000	11.86	0.0
14.2	9.1	6.7	2.4	Hammer did not run				
17.4	15.7	13.3	2.4	1.6	11.667	-0.966	3.89	23.7

17.4	47.4	13.4	34.0	4.9	20.341	0.000	4.97	20.3
19.4	61.9	23.5	38.3	6.4	22.115	0.000	5.24	19.6
21.4	77.6	34.9	42.7	7.9	23.498	-0.638	5.47	19.1
21.4	36.9	35.1	1.8	2.9	17.654	-0.697	4.52	21.9
23.9	49.7	47.8	1.8	4.7	20.455	-0.246	4.94	20.4
26.4	62.4	60.6	1.8	6.6	23.006	0.000	5.28	19.5
26.4	63.0	60.7	2.2	6.7	23.065	0.000	5.30	19.4
33.9	80.2	77.9	2.2	8.8	24.690	-1.140	5.58	18.5
41.4	98.6	96.4	2.2	11.6	26.336	-2.112	5.96	18.1
41.4	125.8	96.6	29.2	15.7	27.883	-2.057	6.38	17.9
43.9	152.6	123.4	29.2	18.3	28.360	-1.599	6.57	17.9
46.4	181.2	152.0	29.2	21.7	28.928	-1.966	6.80	18.2
46.4	165.5	152.4	13.1	19.1	28.392	-1.783	6.64	17.9
53.9	238.5	225.5	13.1	30.1	30.449	-2.952	7.27	18.8
61.4	322.5	309.4	13.1	59.9	32.759	-4.065	8.02	20.2
61.4	311.2	309.8	1.5	52.8	32.359	-3.768	7.88	19.7
72.9	363.0	361.5	1.5	105.1	33.031	-2.524	8.28	19.8
84.4	412.3	410.9	1.5	314.4	33.531	-2.563	8.57	19.2

Total Driving Time 99 minutes; Total No. of Blows 4119

FRA-70-13.01 Rear Abutment (B-015-1-13) 06/27/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
5.55	84.38	0.00	10.81	1.00	0.80	1.00	1.00
11.08	84.38	0.00	10.81	1.00	0.80	1.00	1.00
11.12	84.38	0.00	10.81	1.00	0.80	1.00	1.00
14.25	84.38	0.00	10.81	1.00	0.80	1.00	1.00
17.38	84.38	0.00	10.81	1.00	0.80	1.00	1.00
17.42	84.38	0.00	10.81	1.00	0.80	1.00	1.00
19.40	84.38	0.00	10.81	1.00	0.80	1.00	1.00
21.38	84.38	0.00	10.81	1.00	0.80	1.00	1.00
21.42	84.38	0.00	10.81	1.00	0.80	1.00	1.00
23.90	84.38	0.00	10.81	1.00	0.80	1.00	1.00
26.38	84.38	0.00	10.81	1.00	0.80	1.00	1.00
26.42	84.38	0.00	10.81	1.00	0.80	1.00	1.00
33.90	84.38	0.00	10.81	1.00	0.80	1.00	1.00
41.38	84.38	0.00	10.81	1.00	0.80	1.00	1.00
41.42	84.38	0.00	10.81	1.00	0.80	1.00	1.00
43.90	84.38	0.00	10.81	1.00	0.80	1.00	1.00
46.38	84.38	0.00	10.81	1.00	0.80	1.00	1.00
46.42	84.38	0.00	10.81	1.00	0.80	1.00	1.00
53.90	84.38	0.00	10.81	1.00	0.80	1.00	1.00
61.38	84.38	0.00	10.81	1.00	0.80	1.00	1.00

61.42	84.38	0.00	10.81	1.00	0.80	1.00	1.00
72.88	84.38	0.00	10.81	1.00	0.80	1.00	1.00
84.38	84.38	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

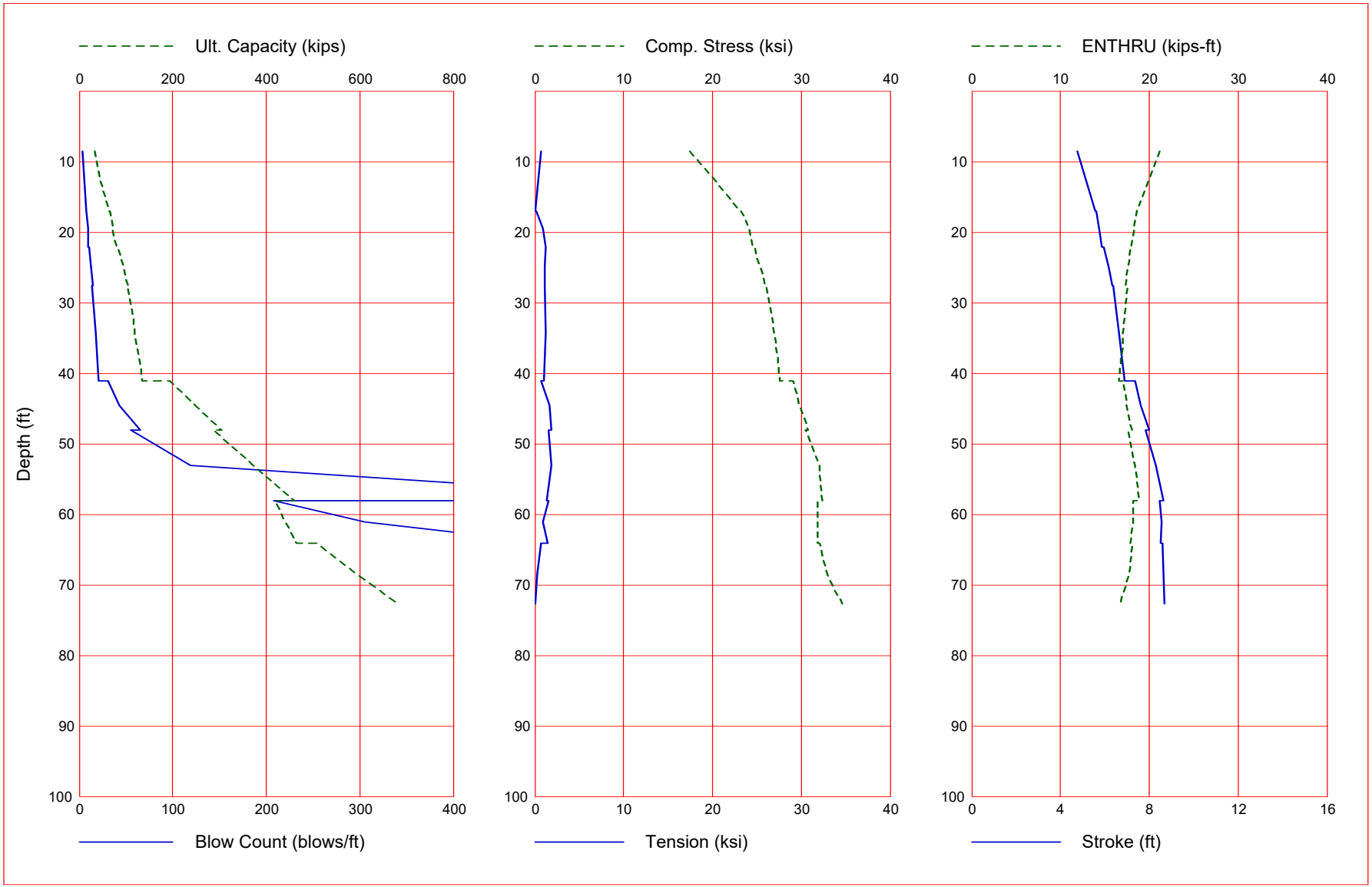
Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
1.00	0.00	0.02	0.100	0.100	0.050	0.150	0.000	6.000	24.000
2.00	0.00	0.04	0.100	0.100	0.050	0.150	0.000	6.000	24.000
3.00	0.00	0.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
4.00	0.00	0.07	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.00	0.00	0.09	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.00	0.00	0.11	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.00	0.00	0.13	0.100	0.100	0.050	0.150	0.000	6.000	24.000
8.00	0.00	0.14	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.00	0.16	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.00	0.00	0.18	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.00	0.00	0.20	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.09	0.00	0.20	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.11	0.88	2.42	0.100	0.100	0.200	0.150	0.778	6.000	336.000
17.39	0.88	2.42	0.100	0.100	0.200	0.150	0.778	6.000	336.000
17.41	1.45	33.98	0.100	0.100	0.050	0.150	0.000	6.000	24.000
18.40	1.55	36.15	0.100	0.100	0.050	0.150	0.000	6.000	24.000
19.40	1.64	38.35	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.40	1.74	40.54	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.39	1.83	42.72	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.41	2.38	1.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
26.39	2.38	1.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
26.41	0.95	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
35.40	0.96	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
36.40	0.99	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
37.40	1.01	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
38.40	1.03	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
39.40	1.06	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
40.40	1.08	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
41.39	1.11	2.23	0.100	0.100	0.150	0.150	0.778	6.000	336.000
41.41	3.18	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
42.40	3.26	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
43.40	3.35	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
44.40	3.43	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.40	3.52	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
46.39	3.60	29.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
46.41	2.73	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.40	2.79	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
48.40	2.86	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
49.40	2.92	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
50.40	2.98	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000

51.40	3.04	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
52.40	3.10	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
53.40	3.17	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
54.40	3.23	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
55.40	3.29	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
56.40	3.35	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.40	3.41	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.99	3.45	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.01	3.45	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
59.00	3.48	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
60.00	3.52	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
61.00	3.55	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
61.39	3.56	13.05	0.100	0.100	0.050	0.150	0.000	6.000	24.000
61.41	1.88	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
70.40	1.87	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
71.40	1.86	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
72.40	1.86	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
73.40	1.85	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
74.40	1.84	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
75.40	1.83	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
76.40	1.83	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
77.40	1.82	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
78.40	1.81	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
79.40	1.78	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
80.40	1.75	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
81.40	1.72	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
82.40	1.70	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
83.40	1.67	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000
84.38	1.64	1.45	0.100	0.100	0.150	0.150	0.778	6.000	336.000

Resource International Inc
FRA-70-13.01 Forward Abutment (B-014-7-

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.500 / 1.000



Resource International Inc
FRA-70-13.01 Forward Abutment (B-014-7-

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
8.5	33.0	31.0	1.9	3.5	17.430	-0.696	4.74	21.2
17.0	64.8	62.9	1.9	8.0	23.143	-0.051	5.57	18.6
17.0	65.7	63.0	2.7	8.1	23.219	-0.184	5.59	18.6
19.5	72.3	69.7	2.7	9.2	24.148	-0.902	5.74	18.3
22.1	79.0	76.3	2.7	10.1	24.543	-1.202	5.88	18.0
22.1	82.5	76.4	6.1	10.6	24.779	-1.260	5.94	17.9
24.9	93.2	87.2	6.1	12.3	25.384	-1.075	6.15	17.6
27.6	104.0	97.9	6.1	14.4	25.997	-1.141	6.34	17.3
27.6	102.9	98.1	4.8	14.1	26.123	-1.105	6.39	17.5
34.3	118.8	114.0	4.8	17.7	26.944	-1.263	6.65	17.0
41.1	134.9	130.1	4.8	20.7	27.615	-0.973	6.89	16.6
41.1	194.2	130.4	63.8	31.0	29.072	-0.699	7.36	17.1
44.6	248.5	184.8	63.8	43.3	29.844	-1.617	7.62	17.4
48.1	305.5	241.8	63.8	65.4	30.816	-1.895	7.98	18.1
48.1	287.4	242.4	45.0	55.5	30.428	-1.581	7.83	17.7
53.1	371.5	326.5	45.0	119.1	32.073	-1.840	8.31	18.4
58.1	460.5	415.5	45.0	687.1	32.321	-1.383	8.66	18.8
58.1	418.8	416.0	2.8	208.1	31.799	-1.503	8.45	18.2
61.1	441.5	438.7	2.8	305.5	31.839	-0.931	8.54	18.2
64.1	464.2	461.4	2.8	503.4	31.881	-1.398	8.51	17.9
64.1	506.9	461.9	45.0	9999.0	32.081	-0.655	8.60	18.1
68.4	591.8	546.8	45.0	9999.0	32.871	-0.270	8.63	17.8
72.7	680.9	636.0	45.0	9999.0	34.660	0.000	8.67	16.7

Refusal occurred; no driving time output possible

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\FORWARD ABUTMENT\FRA-70-13.01 FORWARD ABUTMENT HP 12X53 (B-014-7-20).GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 Forward Abutment (B-014-7-

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	15.500	12.040	H Pile

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.900	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
72.690	15.50	29000.0	492.000	3.970	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	1.38	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
11.00	1.39	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
12.00	1.40	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
13.00	1.42	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
14.00	1.43	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
15.00	1.45	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
16.00	1.46	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
16.99	1.47	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
17.01	0.99	2.66	0.10	0.10	0.20	0.15	1.50	6.00	336.0
22.09	0.99	2.66	0.10	0.10	0.20	0.15	1.50	6.00	336.0
22.11	1.49	6.05	0.10	0.10	0.20	0.15	1.50	6.00	336.0
27.59	1.49	6.05	0.10	0.10	0.20	0.15	1.50	6.00	336.0
27.61	1.19	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0
38.60	1.20	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0
39.60	1.21	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0

40.60	1.22	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0
41.09	1.23	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0
41.11	3.84	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
42.10	3.89	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
43.10	3.95	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
44.10	4.00	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
45.10	4.06	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
46.10	4.11	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
47.10	4.17	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
48.09	4.22	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
48.11	4.13	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
49.10	4.18	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
50.10	4.23	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
51.10	4.28	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
52.10	4.33	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
53.10	4.38	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
54.10	4.43	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
55.10	4.48	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
56.10	4.53	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
57.10	4.58	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
58.09	4.63	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
58.11	2.88	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.0
64.09	2.88	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.0
64.11	4.90	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
65.10	4.95	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
66.10	5.00	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
67.10	5.05	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
68.10	5.10	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
69.10	5.15	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
70.10	5.20	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
71.10	5.25	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
72.10	5.30	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
72.69	5.33	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0

Gain/Loss factors: shaft and toe

0.40000	0.45000	0.50000	0.55000	0.60000
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
8.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
16.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
19.55	0.00	0.00	0.000	0.000	0.000	0.000	0.000
22.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
22.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.85	0.00	0.00	0.000	0.000	0.000	0.000	0.000
27.58	0.00	0.00	0.000	0.000	0.000	0.000	0.000
27.62	0.00	0.00	0.000	0.000	0.000	0.000	0.000
34.35	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
44.60	0.00	0.00	0.000	0.000	0.000	0.000	0.000

48.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
48.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
53.10	0.00	0.00	0.000	0.000	0.000	0.000	0.000
58.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
58.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
61.10	0.00	0.00	0.000	0.000	0.000	0.000	0.000
64.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
64.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
68.39	0.00	0.00	0.000	0.000	0.000	0.000	0.000
72.69	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

FRA-70-13.01 Forward Abutment (B-014-7-

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		11337.0			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	8.5			
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type		H Pile
Pile Size	(inch)	12.040			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 29.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	6.2	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	72.69	4.0	15.5
Toe						1.9	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile			Pile Segments: Automatic	
No. of Slacks/Splices		0	Pile Damping	(%) 1
			Pile Damping Fact.	(k/ft/s) 0.544
Driveability Analysis				
Soil Damping Option		Smith		
Max No Analysis Iterations		0	Time Increment/Critical	160
Output Time Interval		1	Analysis Time-Input	(ms) 0
Output Level: Normal				

Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.50	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
29.9	3.1	4.63	4.61	-0.81	3	11	16.70	1	2	21.6	55.1
31.4	3.3	4.69	4.67	-0.77	3	11	17.07	5	3	21.4	54.7
33.0	3.5	4.74	4.73	-0.70	2	11	17.43	6	3	21.2	54.4
34.5	3.7	4.80	4.78	-0.63	2	11	17.76	8	3	21.0	54.1
36.1	3.9	4.85	4.83	-0.56	2	11	18.08	8	3	20.9	53.8

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 17.0
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 58.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	1.5	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	72.69	4.0	15.5
Toe						1.9	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)

3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
16.98	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
58.5	7.0	5.42	5.47	0.00	1	0	22.30	18	5	18.9	50.5
61.7	7.5	5.50	5.54	0.00	1	0	22.73	18	5	18.7	50.2
64.8	8.0	5.57	5.61	-0.05	18	50	23.14	18	5	18.6	49.8
68.0	8.5	5.64	5.68	-0.52	18	50	23.54	18	5	18.5	49.5
71.1	9.0	5.71	5.74	-0.84	17	50	23.90	18	5	18.3	49.2

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 17.0
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 59.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	1.6	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	72.69	4.0	15.5
Toe						2.7	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)

3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.02	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
59.4	7.1	5.44	5.48	0.00	1	0	22.36	18	6	18.9	50.4
62.5	7.6	5.51	5.56	0.00	1	0	22.79	18	5	18.7	50.1
65.7	8.1	5.59	5.62	-0.18	18	50	23.22	18	5	18.6	49.7
68.8	8.6	5.66	5.69	-0.62	17	50	23.59	18	5	18.4	49.4
72.0	9.1	5.73	5.75	-0.89	17	50	23.99	18	5	18.4	49.1

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 19.5
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 65.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	9.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	8.7	0.200	0.100	72.69	4.0	15.5
Toe						2.7	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)

3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.55	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
65.3	8.1	5.59	5.63	-0.15	22	16	23.32	17	5	18.5	49.7
68.8	8.6	5.67	5.70	-0.59	17	50	23.74	17	5	18.5	49.4
72.3	9.2	5.74	5.77	-0.90	17	50	24.15	17	5	18.3	49.1
75.8	9.7	5.81	5.84	-0.95	17	47	24.51	17	5	18.2	48.8
79.3	10.2	5.88	5.91	-1.13	17	46	24.90	17	5	18.0	48.5

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 22.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 71.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	7.4	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	9.5	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	72.69	4.0	15.5
Toe						2.7	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
71.3	9.0	5.73	5.76	-0.68	16	47	23.78	16	5	18.3	49.1
75.1	9.6	5.81	5.83	-0.99	16	47	24.15	16	5	18.2	48.8
79.0	10.1	5.88	5.91	-1.20	16	47	24.54	16	5	18.0	48.5
82.8	10.6	5.96	5.97	-1.30	16	47	24.89	16	5	17.9	48.2
86.6	11.2	6.03	6.04	-1.31	16	46	25.25	16	5	17.8	47.9

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 22.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 74.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	7.5	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	9.5	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	72.69	4.0	15.5
Toe						6.1	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
74.8	9.5	5.79	5.82	-0.93	16	47	24.02	16	5	18.2	48.9
78.7	10.0	5.87	5.89	-1.15	16	47	24.43	16	5	18.1	48.6
82.5	10.6	5.94	5.96	-1.26	16	47	24.78	16	5	17.9	48.3
86.3	11.1	6.02	6.03	-1.28	16	46	25.17	16	5	17.8	48.0
90.1	11.7	6.08	6.10	-1.22	16	46	25.49	16	5	17.8	47.7

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 24.9
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 84.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	5.6	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	10.1	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	69.39	4.0	15.5

22	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	72.69	4.0	15.5
Toe						6.1	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.85	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
84.5	10.9	5.99	6.00	-1.25	15	47	24.65	15	5	17.8	48.1
88.9	11.5	6.07	6.08	-1.22	15	46	25.04	15	5	17.7	47.8
93.2	12.3	6.15	6.16	-1.08	15	46	25.38	15	5	17.6	47.5
97.6	13.1	6.22	6.24	-0.86	15	46	25.74	15	5	17.5	47.2
101.9	14.0	6.30	6.31	-1.04	9	40	26.09	15	5	17.4	46.9

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 27.6
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 94.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	3.7	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	59.47	4.0	15.5

19	0.175	11337	0.000	0.000	1.00	10.7	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	72.69	4.0	15.5
Toe						6.1	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
27.58	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
94.2	12.5	6.17	6.19	-0.98	14	46	25.23	15	5	17.5	47.4
99.1	13.4	6.25	6.27	-0.89	10	40	25.60	15	5	17.4	47.1
104.0	14.4	6.34	6.35	-1.14	10	40	26.00	15	5	17.3	46.8
108.9	15.3	6.48	6.42	-1.28	9	40	26.53	15	5	17.4	46.4
113.8	16.4	6.55	6.50	-1.29	14	38	26.84	15	5	17.3	46.1

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 27.6
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 93.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	3.9	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	49.56	4.0	15.5

16	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.7	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	72.69	4.0	15.5
Toe						4.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
27.62	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
93.1	12.3	6.15	6.17	-1.04	14	46	25.16	15	5	17.6	47.5
98.0	13.2	6.24	6.25	-0.85	10	40	25.55	15	5	17.5	47.1
102.9	14.1	6.39	6.33	-1.11	10	40	26.12	15	5	17.5	46.7
107.8	15.1	6.47	6.41	-1.27	9	40	26.47	15	5	17.4	46.4
112.7	16.2	6.54	6.49	-1.30	9	40	26.80	15	5	17.3	46.2

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 34.3
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 105.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5

2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	4.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.5	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.5	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	72.69	4.0	15.5
Toe						4.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
34.35	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
105.8	14.6	6.46	6.40	-1.42	10	39	26.15	13	4	17.3	46.5
112.3	16.1	6.56	6.51	-1.39	10	39	26.58	13	4	17.1	46.1
118.8	17.7	6.65	6.62	-1.26	10	39	26.94	13	4	17.0	45.7
125.3	18.9	6.74	6.71	-1.08	10	39	27.32	13	4	16.9	45.4
131.8	20.0	6.81	6.79	-0.87	9	39	27.62	13	4	16.8	45.2

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 41.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 118.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	4.7	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.7	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	72.69	4.0	15.5
Toe						4.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
118.7	17.7	6.68	6.65	-1.40	19	15	26.82	10	4	16.9	45.7
126.8	19.5	6.80	6.76	-1.20	19	15	27.25	10	4	16.8	45.3
134.9	20.7	6.89	6.87	-0.97	19	15	27.61	10	4	16.6	45.0
143.0	22.0	6.98	6.97	-0.74	19	15	27.96	11	4	16.4	44.6
151.1	23.1	7.07	7.05	-0.56	20	15	28.34	11	4	16.5	44.4

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 41.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model — Total Capacity Rut (kips) 177.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	4.8	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	6.6	0.198	0.100	72.69	4.0	15.5
Toe						63.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
177.9	27.5	7.22	7.21	0.00	1	0	28.51	11	4	16.9	43.9
186.1	29.2	7.30	7.29	-0.08	10	50	28.81	11	4	17.0	43.6
194.2	31.0	7.36	7.36	-0.70	10	50	29.07	10	4	17.1	43.5
202.3	32.9	7.45	7.44	-1.14	10	50	29.41	11	4	17.2	43.2
210.4	35.2	7.44	7.51	-1.39	10	49	29.46	11	4	17.1	43.1

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 44.6
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 232.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	5.4	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	10.2	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	8.9	0.175	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	51.7	0.050	0.100	72.69	4.0	15.5
Toe						63.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
44.60	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
232.3	37.7	7.54	7.54	-1.40	9	49	29.44	9	3	17.4	43.0

240.4	40.6	7.54	7.61	-1.56	9	48	29.53	9	3	17.3	42.9
248.5	43.3	7.62	7.67	-1.62	9	47	29.84	9	3	17.4	42.7
256.7	46.2	7.71	7.74	-1.65	9	46	30.16	9	3	17.6	42.4
264.8	49.6	7.79	7.82	-1.73	9	45	30.44	9	3	17.7	42.2

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 48.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 289.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	6.0	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.0	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.3	0.157	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	51.8	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	54.2	0.050	0.100	72.69	4.0	15.5
Toe						63.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy

ft	ft	Ratio	
48.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
289.3	56.1	7.82	7.86	-1.88	8	45	30.21	8	3	17.8	42.1
297.4	60.9	7.90	7.93	-1.89	8	45	30.50	8	3	17.9	41.9
305.5	65.4	7.98	7.98	-1.89	8	44	30.82	8	3	18.1	41.8
313.6	71.0	8.06	8.05	-1.93	8	43	31.09	8	3	18.2	41.6
321.8	78.1	8.14	8.14	-2.00	8	43	31.36	8	3	18.3	41.4

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 48.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 271.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	6.1	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.0	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.8	0.154	0.100	66.08	4.0	15.5

21	0.175	11337	0.000	0.000	1.00	51.8	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	54.2	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
48.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
271.1	47.7	7.66	7.72	-1.56	8	46	29.78	8	3	17.4	42.5
279.3	51.7	7.75	7.80	-1.58	8	45	30.11	8	3	17.5	42.3
287.4	55.5	7.83	7.87	-1.58	8	45	30.43	8	3	17.7	42.1
295.5	60.1	7.91	7.94	-1.61	8	44	30.71	8	3	17.8	41.9
303.6	65.1	7.99	8.01	-1.74	8	43	31.00	8	3	17.9	41.7
1		0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 53.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 355.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	0.8	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	29.74	4.0	15.5

10	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	8.1	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	9.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	34.6	0.073	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	53.0	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	54.8	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	56.4	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
53.10	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
355.3	94.6	8.17	8.18	-1.74	7	42	31.52	7	3	18.3	41.3
363.4	105.9	8.24	8.24	-1.79	7	42	31.80	7	3	18.3	41.1
371.5	119.1	8.31	8.30	-1.84	7	41	32.07	7	3	18.4	41.0
379.6	135.7	8.37	8.36	-1.88	7	41	32.37	7	3	18.5	40.8
387.7	158.0	8.43	8.41	-1.92	7	40	32.63	7	3	18.5	40.7

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 58.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 444.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	6.2	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	9.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.5	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	12.5	0.149	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	51.9	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	54.2	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	55.3	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	57.4	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	59.6	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
58.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
444.3	353.3	8.58	8.54	-1.26	5	39	31.94	5	3	18.8	40.4
452.4	494.7	8.63	8.58	-1.31	5	39	32.14	5	3	18.8	40.3
460.5	687.1	8.66	8.61	-1.38	5	38	32.32	5	3	18.8	40.2
468.6	979.4	8.70	8.63	-1.46	5	38	32.50	5	3	18.9	40.1
476.7	1830.0	8.66	8.65	-1.51	5	37	32.48	5	3	18.6	40.2
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 58.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 402.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	6.4	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	9.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	13.0	0.146	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	51.9	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	54.2	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	55.3	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	57.5	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	59.4	0.050	0.100	72.69	4.0	15.5
Toe						2.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
58.12	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
402.6	149.2	8.33	8.34	-1.51	5	20	31.32	5	3	18.1	40.9
410.7	173.2	8.39	8.38	-1.47	5	39	31.57	5	3	18.2	40.8
418.8	208.1	8.45	8.44	-1.50	5	39	31.80	5	3	18.2	40.7
427.0	250.5	8.51	8.47	-1.49	5	38	32.04	5	3	18.4	40.6
435.1	318.0	8.56	8.52	-1.46	5	38	32.27	5	3	18.4	40.4
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 61.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 423.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	5.3	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	10.2	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	8.7	0.178	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	51.7	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	54.0	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	55.2	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	57.3	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	59.4	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	26.1	0.136	0.100	72.69	4.0	15.5

Toe 2.8 0.150 0.100

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
61.10	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
423.0	190.8	8.44	8.41	-1.25	4	20	31.41	4	3	18.2	40.7
432.3	237.0	8.49	8.44	-1.07	4	20	31.62	4	3	18.2	40.6
441.5	305.5	8.54	8.48	-0.93	4	37	31.84	4	3	18.2	40.5
450.8	411.9	8.59	8.52	-0.94	22	6	32.06	4	3	18.3	40.4
460.0	567.5	8.55	8.55	-0.98	22	6	32.05	4	3	18.1	40.4

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 64.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 443.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
3	0.175	11337	0.000	0.000	1.00	4.3	0.200	0.100	9.91	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	26.43	4.0	15.5

9	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	11.5	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	49.4	0.052	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	53.8	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	55.1	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	57.1	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	59.2	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	29.8	0.123	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	22.6	0.150	0.100	72.69	4.0	15.5
Toe						2.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
64.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
443.4	264.9	8.52	8.44	-1.37	22	6	31.72	4	3	18.1	40.6
453.8	365.9	8.57	8.48	-1.38	22	6	31.91	4	3	18.1	40.5
464.2	503.4	8.51	8.51	-1.40	22	6	31.88	4	3	17.9	40.5
474.6	675.5	8.54	8.54	-1.41	22	6	32.05	4	3	17.9	40.5
485.0	945.3	8.57	8.56	-1.43	22	6	32.21	4	3	17.8	40.4
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 64.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 486.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
3	0.175	11337	0.000	0.000	1.00	4.4	0.200	0.100	9.91	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.5	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	50.0	0.052	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	53.8	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	55.1	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	57.1	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	59.2	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	29.4	0.124	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	22.9	0.149	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
64.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
486.1	1139.2	8.57	8.57	-0.65	3	36	31.82	4	2	18.2	40.4
496.5	2378.7	8.58	8.57	-0.64	3	36	31.94	4	3	18.1	40.4
506.9	9999.0	8.60	8.59	-0.65	3	35	32.08	4	3	18.1	40.3
517.3	9999.0	8.62	8.61	-0.66	3	35	32.21	4	3	18.0	40.3
527.7	9999.0	8.64	8.62	-0.62	3	35	32.35	4	3	18.0	40.3

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 68.4
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 571.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	7.6	0.200	0.100	6.61	4.0	15.5
3	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	9.91	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	9.5	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	9.8	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	17.8	0.121	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	52.2	0.050	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	54.3	0.050	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	55.6	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	57.7	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	55.5	0.058	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	22.6	0.150	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	35.1	0.108	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	66.0	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy

68.39 10.81 1.00 0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
571.0	9999.0	8.61	8.60	-0.30	2	34	32.55	2	2	17.9	40.3
581.4	9999.0	8.62	8.61	-0.23	2	34	32.72	2	2	17.8	40.3
591.8	9999.0	8.63	8.61	-0.27	2	33	32.87	2	2	17.8	40.3
602.2	9999.0	8.63	8.62	-0.33	2	33	33.04	2	2	17.7	40.3
612.6	9999.0	8.64	8.63	-0.35	2	32	33.19	2	2	17.5	40.3

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 72.7
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 660.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	10.8	0.200	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	6.61	4.0	15.5
3	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	9.91	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	8.4	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	9.0	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	8.2	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	31.4	0.080	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	52.9	0.050	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	54.7	0.050	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	56.2	0.050	0.100	52.87	4.0	15.5

17	0.175	11337	0.000	0.000	1.00	58.4	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	44.5	0.081	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	22.6	0.150	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	48.0	0.078	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	66.7	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	68.8	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
72.69	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
660.1	9999.0	8.64	8.63	0.00	1	0	34.14	1	2	16.9	40.3
670.5	9999.0	8.66	8.64	0.00	1	0	34.44	1	2	16.9	40.2
680.9	9999.0	8.67	8.66	0.00	1	0	34.66	1	2	16.7	40.2
691.3	9999.0	8.70	8.67	0.00	1	0	34.96	1	2	16.7	40.1
701.7	9999.0	8.70	8.69	0.00	1	0	35.19	1	2	16.6	40.1

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.400 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	29.9	27.9	1.9	3.1	16.698	-0.812	4.63	21.6
17.0	58.5	56.6	1.9	7.0	22.298	0.000	5.42	18.9
17.0	59.4	56.7	2.7	7.1	22.360	0.000	5.44	18.9
19.5	65.3	62.7	2.7	8.1	23.318	-0.147	5.59	18.5
22.1	71.3	68.7	2.7	9.0	23.780	-0.682	5.73	18.3
22.1	74.8	68.8	6.1	9.5	24.019	-0.933	5.79	18.2
24.9	84.5	78.5	6.1	10.9	24.651	-1.248	5.99	17.8
27.6	94.2	88.1	6.1	12.5	25.235	-0.983	6.17	17.5
27.6	93.1	88.2	4.8	12.3	25.162	-1.035	6.15	17.6
34.3	105.8	101.0	4.8	14.6	26.147	-1.420	6.46	17.3
41.1	118.7	113.9	4.8	17.7	26.820	-1.397	6.68	16.9
41.1	177.9	114.2	63.8	27.5	28.506	0.000	7.22	16.9
44.6	232.3	168.5	63.8	37.7	29.441	-1.397	7.54	17.4
48.1	289.3	225.5	63.8	56.1	30.212	-1.875	7.82	17.8
48.1	271.1	226.2	45.0	47.7	29.780	-1.555	7.66	17.4

53.1	355.3	310.3	45.0	94.6	31.517	-1.744	8.17	18.3
58.1	444.3	399.3	45.0	353.3	31.936	-1.257	8.58	18.8
58.1	402.6	399.8	2.8	149.2	31.320	-1.512	8.33	18.1
61.1	423.0	420.2	2.8	190.8	31.406	-1.251	8.44	18.2
64.1	443.4	440.6	2.8	264.9	31.717	-1.369	8.52	18.1
64.1	486.1	441.1	45.0	1139.2	31.818	-0.647	8.57	18.2
68.4	571.0	526.0	45.0	9999.0	32.552	-0.303	8.61	17.9
72.7	660.1	615.2	45.0	9999.0	34.139	0.000	8.64	16.9

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.450 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	31.4	29.5	1.9	3.3	17.073	-0.772	4.69	21.4
17.0	61.7	59.7	1.9	7.5	22.732	0.000	5.50	18.7
17.0	62.5	59.9	2.7	7.6	22.792	0.000	5.51	18.7
19.5	68.8	66.2	2.7	8.6	23.739	-0.591	5.67	18.5
22.1	75.1	72.5	2.7	9.6	24.151	-0.995	5.81	18.2
22.1	78.7	72.6	6.1	10.0	24.434	-1.149	5.87	18.1
24.9	88.9	82.8	6.1	11.5	25.041	-1.216	6.07	17.7
27.6	99.1	93.0	6.1	13.4	25.595	-0.894	6.25	17.4
27.6	98.0	93.1	4.8	13.2	25.547	-0.849	6.24	17.5
34.3	112.3	107.5	4.8	16.1	26.576	-1.390	6.56	17.1
41.1	126.8	122.0	4.8	19.5	27.252	-1.205	6.80	16.8
41.1	186.1	122.3	63.8	29.2	28.815	-0.081	7.30	17.0
44.6	240.4	176.7	63.8	40.6	29.533	-1.564	7.54	17.3
48.1	297.4	233.6	63.8	60.9	30.504	-1.894	7.90	17.9
48.1	279.3	234.3	45.0	51.7	30.107	-1.578	7.75	17.5
53.1	363.4	318.4	45.0	105.9	31.804	-1.787	8.24	18.3
58.1	452.4	407.4	45.0	494.7	32.141	-1.314	8.63	18.8
58.1	410.7	407.9	2.8	173.2	31.569	-1.466	8.39	18.2
61.1	432.3	429.5	2.8	237.0	31.621	-1.074	8.49	18.2
64.1	453.8	451.0	2.8	365.9	31.915	-1.378	8.57	18.1
64.1	496.5	451.5	45.0	2378.7	31.940	-0.641	8.58	18.1
68.4	581.4	536.4	45.0	9999.0	32.723	-0.226	8.62	17.8
72.7	670.5	625.6	45.0	9999.0	34.437	0.000	8.66	16.9

Refusal occurred; no driving time output possible

↑

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.500 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	33.0	31.0	1.9	3.5	17.430	-0.696	4.74	21.2
17.0	64.8	62.9	1.9	8.0	23.143	-0.051	5.57	18.6

17.0	65.7	63.0	2.7	8.1	23.219	-0.184	5.59	18.6
19.5	72.3	69.7	2.7	9.2	24.148	-0.902	5.74	18.3
22.1	79.0	76.3	2.7	10.1	24.543	-1.202	5.88	18.0
22.1	82.5	76.4	6.1	10.6	24.779	-1.260	5.94	17.9
24.9	93.2	87.2	6.1	12.3	25.384	-1.075	6.15	17.6
27.6	104.0	97.9	6.1	14.4	25.997	-1.141	6.34	17.3
27.6	102.9	98.1	4.8	14.1	26.123	-1.105	6.39	17.5
34.3	118.8	114.0	4.8	17.7	26.944	-1.263	6.65	17.0
41.1	134.9	130.1	4.8	20.7	27.615	-0.973	6.89	16.6
41.1	194.2	130.4	63.8	31.0	29.072	-0.699	7.36	17.1
44.6	248.5	184.8	63.8	43.3	29.844	-1.617	7.62	17.4
48.1	305.5	241.8	63.8	65.4	30.816	-1.895	7.98	18.1
48.1	287.4	242.4	45.0	55.5	30.428	-1.581	7.83	17.7
53.1	371.5	326.5	45.0	119.1	32.073	-1.840	8.31	18.4
58.1	460.5	415.5	45.0	687.1	32.321	-1.383	8.66	18.8
58.1	418.8	416.0	2.8	208.1	31.799	-1.503	8.45	18.2
61.1	441.5	438.7	2.8	305.5	31.839	-0.931	8.54	18.2
64.1	464.2	461.4	2.8	503.4	31.881	-1.398	8.51	17.9
64.1	506.9	461.9	45.0	9999.0	32.081	-0.655	8.60	18.1
68.4	591.8	546.8	45.0	9999.0	32.871	-0.270	8.63	17.8
72.7	680.9	636.0	45.0	9999.0	34.660	0.000	8.67	16.7

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.550 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	34.5	32.6	1.9	3.7	17.757	-0.627	4.80	21.0
17.0	68.0	66.0	1.9	8.5	23.542	-0.519	5.64	18.5
17.0	68.8	66.2	2.7	8.6	23.594	-0.616	5.66	18.4
19.5	75.8	73.1	2.7	9.7	24.510	-0.951	5.81	18.2
22.1	82.8	80.1	2.7	10.6	24.894	-1.303	5.96	17.9
22.1	86.3	80.2	6.1	11.1	25.166	-1.284	6.02	17.8
24.9	97.6	91.5	6.1	13.1	25.737	-0.859	6.22	17.5
27.6	108.9	102.8	6.1	15.3	26.527	-1.281	6.48	17.4
27.6	107.8	103.0	4.8	15.1	26.469	-1.274	6.47	17.4
34.3	125.3	120.5	4.8	18.9	27.325	-1.078	6.74	16.9
41.1	143.0	138.2	4.8	22.0	27.962	-0.738	6.98	16.4
41.1	202.3	138.5	63.8	32.9	29.409	-1.139	7.45	17.2
44.6	256.7	192.9	63.8	46.2	30.164	-1.649	7.71	17.6
48.1	313.6	249.9	63.8	71.0	31.095	-1.933	8.06	18.2
48.1	295.5	250.5	45.0	60.1	30.714	-1.614	7.91	17.8
53.1	379.6	334.6	45.0	135.7	32.370	-1.877	8.37	18.5
58.1	468.6	423.7	45.0	979.4	32.502	-1.458	8.70	18.9
58.1	427.0	424.2	2.8	250.5	32.037	-1.490	8.51	18.4
61.1	450.8	448.0	2.8	411.9	32.060	-0.940	8.59	18.3
64.1	474.6	471.8	2.8	675.5	32.052	-1.410	8.54	17.9
64.1	517.3	472.3	45.0	9999.0	32.209	-0.659	8.62	18.0
68.4	602.2	557.2	45.0	9999.0	33.045	-0.332	8.63	17.7
72.7	691.3	646.4	45.0	9999.0	34.961	0.000	8.70	16.7

Refusal occurred; no driving time output possible

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.600 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	36.1	34.1	1.9	3.9	18.076	-0.564	4.85	20.9
17.0	71.1	69.2	1.9	9.0	23.905	-0.836	5.71	18.3
17.0	72.0	69.3	2.7	9.1	23.987	-0.893	5.73	18.4
19.5	79.3	76.6	2.7	10.2	24.896	-1.134	5.88	18.0
22.1	86.6	83.9	2.7	11.2	25.250	-1.313	6.03	17.8
22.1	90.1	84.1	6.1	11.7	25.494	-1.218	6.08	17.8
24.9	101.9	95.9	6.1	14.0	26.090	-1.037	6.30	17.4
27.6	113.8	107.7	6.1	16.4	26.836	-1.287	6.55	17.3
27.6	112.7	107.9	4.8	16.2	26.797	-1.297	6.54	17.3
34.3	131.8	127.0	4.8	20.0	27.624	-0.867	6.81	16.8
41.1	151.1	146.3	4.8	23.1	28.338	-0.557	7.07	16.5
41.1	210.4	146.6	63.8	35.2	29.465	-1.394	7.44	17.1
44.6	264.8	201.0	63.8	49.6	30.444	-1.732	7.79	17.7
48.1	321.8	258.0	63.8	78.1	31.363	-1.997	8.14	18.3
48.1	303.6	258.6	45.0	65.1	31.003	-1.745	7.99	17.9
53.1	387.7	342.8	45.0	158.0	32.630	-1.917	8.43	18.5
58.1	476.7	431.8	45.0	1830.0	32.482	-1.510	8.66	18.6
58.1	435.1	432.3	2.8	318.0	32.274	-1.455	8.56	18.4
61.1	460.0	457.2	2.8	567.5	32.054	-0.983	8.55	18.1
64.1	485.0	482.2	2.8	945.3	32.206	-1.435	8.57	17.8
64.1	527.7	482.7	45.0	9999.0	32.349	-0.624	8.64	18.0
68.4	612.6	567.6	45.0	9999.0	33.187	-0.353	8.64	17.5
72.7	701.7	656.8	45.0	9999.0	35.192	0.000	8.70	16.6

Refusal occurred; no driving time output possible

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
8.50	72.69	0.00	10.81	1.00	0.80	1.00	1.00
16.98	72.69	0.00	10.81	1.00	0.80	1.00	1.00
17.02	72.69	0.00	10.81	1.00	0.80	1.00	1.00
19.55	72.69	0.00	10.81	1.00	0.80	1.00	1.00

22.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
22.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
24.85	72.69	0.00	10.81	1.00	0.80	1.00	1.00
27.58	72.69	0.00	10.81	1.00	0.80	1.00	1.00
27.62	72.69	0.00	10.81	1.00	0.80	1.00	1.00
34.35	72.69	0.00	10.81	1.00	0.80	1.00	1.00
41.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
41.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
44.60	72.69	0.00	10.81	1.00	0.80	1.00	1.00
48.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
48.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
53.10	72.69	0.00	10.81	1.00	0.80	1.00	1.00
58.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
58.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
61.10	72.69	0.00	10.81	1.00	0.80	1.00	1.00
64.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
64.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
68.39	72.69	0.00	10.81	1.00	0.80	1.00	1.00
72.69	72.69	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	1.38	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
11.00	1.39	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
12.00	1.40	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
13.00	1.42	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
14.00	1.43	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
15.00	1.45	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
16.00	1.46	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
16.99	1.47	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
17.01	0.99	2.66	0.100	0.100	0.200	0.150	0.667	6.000	336.000
22.09	0.99	2.66	0.100	0.100	0.200	0.150	0.667	6.000	336.000
22.11	1.49	6.05	0.100	0.100	0.200	0.150	0.667	6.000	336.000
27.59	1.49	6.05	0.100	0.100	0.200	0.150	0.667	6.000	336.000
27.61	1.19	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
38.60	1.20	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
39.60	1.21	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
40.60	1.22	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
41.09	1.23	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
41.11	3.84	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
42.10	3.89	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
43.10	3.95	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
44.10	4.00	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.10	4.06	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
46.10	4.11	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.10	4.17	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
48.09	4.22	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000

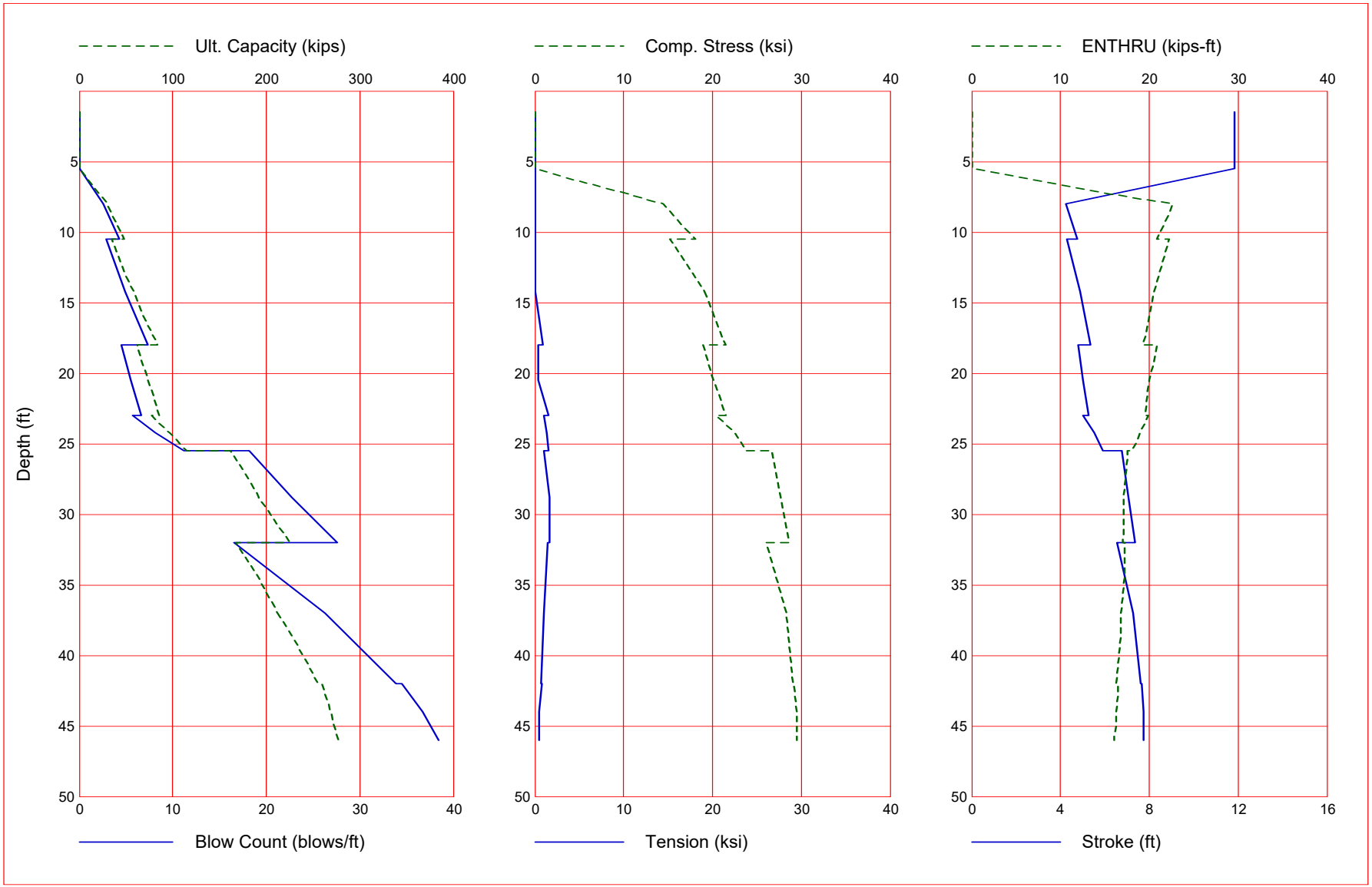
48.11	4.13	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
49.10	4.18	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
50.10	4.23	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
51.10	4.28	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
52.10	4.33	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
53.10	4.38	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
54.10	4.43	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
55.10	4.48	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
56.10	4.53	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.10	4.58	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.09	4.63	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.11	2.88	2.79	0.100	0.100	0.150	0.150	0.667	6.000	336.000
64.09	2.88	2.79	0.100	0.100	0.150	0.150	0.667	6.000	336.000
64.11	4.90	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
65.10	4.95	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
66.10	5.00	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
67.10	5.05	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
68.10	5.10	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
69.10	5.15	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
70.10	5.20	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
71.10	5.25	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
72.10	5.30	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
72.69	5.33	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000

Pier 1
(B-014-3-19)

Resource International Inc
FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.667 / 1.000



Resource International Inc
FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.667 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.4	5.6	5.7	20.472	-1.032	5.03	19.9
24.2	96.7	91.1	5.6	8.2	22.568	-1.344	5.54	18.9
25.5	115.4	109.8	5.6	11.2	23.866	-1.530	5.91	18.1
25.5	161.5	110.3	51.2	18.2	26.752	-1.009	6.76	17.5
28.8	192.0	135.7	56.3	22.7	27.656	-1.701	7.06	17.1
32.0	224.9	163.5	61.4	27.6	28.488	-1.635	7.34	17.0
32.0	167.2	163.9	3.3	16.6	26.072	-1.492	6.55	17.2
37.0	211.7	208.4	3.3	26.3	28.372	-1.037	7.27	16.8
42.0	256.2	252.9	3.3	33.9	29.100	-0.682	7.63	16.3
42.0	260.0	253.2	6.8	34.5	29.191	-0.790	7.67	16.5
44.0	268.6	261.8	6.8	36.7	29.485	-0.531	7.73	16.3
46.0	277.4	270.7	6.8	38.4	29.507	-0.469	7.76	16.1

Total Continuous Driving Time 15.00 minutes; Total Number of Blows 649

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\PIER 1\FRA-70-13.01 - PIER 1 HP 12X53-B-014-3-19.GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	15.500	12.040	H Pile

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.900	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
45.980	15.50	29000.0	492.000	3.970	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.05	0.15	1.20	6.00	168.0
1.49	0.00	0.00	0.10	0.10	0.05	0.15	1.20	6.00	168.0
1.51	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
2.99	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
5.49	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
7.14	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
7.16	0.71	24.52	0.10	0.10	0.05	0.15	1.00	6.00	24.0
8.15	0.82	27.99	0.10	0.10	0.05	0.15	1.00	6.00	24.0
9.15	0.92	31.48	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.15	1.02	34.98	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.49	1.05	36.17	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.51	1.04	23.18	0.10	0.10	0.05	0.15	1.00	6.00	24.0
11.50	1.13	25.31	0.10	0.10	0.05	0.15	1.00	6.00	24.0
11.99	1.18	26.36	0.10	0.10	0.05	0.15	1.00	6.00	24.0
12.01	1.18	26.40	0.10	0.10	0.05	0.15	1.00	6.00	24.0

13.00	1.23	27.50	0.10	0.10	0.05	0.15	1.00	6.00	24.0
14.00	1.28	28.62	0.10	0.10	0.05	0.15	1.00	6.00	24.0
15.00	1.33	29.74	0.10	0.10	0.05	0.15	1.00	6.00	24.0
16.00	1.38	30.87	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.00	1.43	31.98	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.99	1.48	33.09	0.10	0.10	0.05	0.15	1.00	6.00	24.0
18.01	1.02	11.58	0.10	0.10	0.05	0.15	1.00	6.00	24.0
19.00	1.05	11.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.00	1.09	12.35	0.10	0.10	0.05	0.15	1.00	6.00	24.0
21.00	1.12	12.74	0.10	0.10	0.05	0.15	1.00	6.00	24.0
22.00	1.16	13.12	0.10	0.10	0.05	0.15	1.00	6.00	24.0
22.99	1.19	13.51	0.10	0.10	0.05	0.15	1.00	6.00	24.0
23.01	5.75	5.57	0.10	0.10	0.15	0.15	1.50	6.00	336.0
25.49	5.75	5.57	0.10	0.10	0.15	0.15	1.50	6.00	336.0
25.51	1.89	51.19	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.50	1.95	52.76	0.10	0.10	0.05	0.15	1.00	6.00	24.0
27.50	2.00	54.33	0.10	0.10	0.05	0.15	1.00	6.00	24.0
28.50	2.06	55.91	0.10	0.10	0.05	0.15	1.00	6.00	24.0
29.50	2.12	57.49	0.10	0.10	0.05	0.15	1.00	6.00	24.0
30.50	2.18	59.07	0.10	0.10	0.05	0.15	1.00	6.00	24.0
31.50	2.24	60.64	0.10	0.10	0.05	0.15	1.00	6.00	24.0
31.99	2.27	61.42	0.10	0.10	0.05	0.15	1.00	6.00	24.0
32.01	3.38	3.27	0.10	0.10	0.15	0.15	1.50	6.00	336.0
41.99	3.38	3.27	0.10	0.10	0.15	0.15	1.50	6.00	336.0
42.01	1.67	6.78	0.10	0.10	0.15	0.15	1.50	6.00	336.0
45.98	1.67	6.78	0.10	0.10	0.15	0.15	1.50	6.00	336.0

Gain/Loss factors: shaft and toe

0.60000	0.63300	0.66700	0.70000	0.73300
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
1.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
1.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
3.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
4.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
5.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
5.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
8.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
14.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
18.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
22.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
23.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000

28.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
31.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
32.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
37.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
42.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
43.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
45.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		11405.3			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	1.5			
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type		H Pile
Pile Size	(inch)	12.040			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model — Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.544
Driveability Analysis			
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0

Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth	Stroke	Pressure	Efficy

```
       ft        ft     Ratio
     1.48     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs
🡅
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                          06/27/2021
Resource International Inc                                  GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
          1           0   10.81000       11.86000
🡅
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                          06/27/2021
Resource International Inc                                  GRLWEAP Version 2010

 Depth                 (ft)       1.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

       Pile and Soil Model            Total Capacity Rut  (kips)       0.0
No. Weight    Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
```

```
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  45.98   4.0    15.5
Toe                                      0.0   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     1.52     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

    Rut    Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips     b/ft   down     up     ksi             ksi         kip-ft   b/min
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

 Depth                 (ft)       2.2
 Shaft Gain/Loss Factor        0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040
```

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
2.25	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
	1	0	10.81000		11.86000						

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 3.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
2.98	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i t Comp Str ksi	i t ENTHRU kip-ft	Bl Rt b/min
	1	0	10.81000	11.86000			

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 3.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
3.02	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

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INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs
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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000		11.86000						

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

```
 Depth                 (ft)       4.2
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                      H Pile
 Pile Size           (inch)    12.040
```

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

```
 Wave Travel Time 2L/c (ms)     5.565
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Pile and Soil Model Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

```
     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)
```

```
    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     4.25     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)       5.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                      H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)       0.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
```

```
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
 13  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  42.70   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  45.98   4.0    15.5
Toe                                      0.0   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     5.48     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.1     0.0
 Hammer+Pile Weight > Rult: Pile Runs
🡅
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up     ksi              ksi         kip-ft   b/min
          1           0   10.81000       11.86000
🡅
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)       5.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
```

Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	45.98	4.0	15.5
Toe						0.0	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
5.52	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.1 0.0
Hammer+Pile Weight > Rult: Pile Runs

Rut	Bl Ct	Stroke (ft)	Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt

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   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

 Depth                 (ft)       8.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                    H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)      30.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
 12  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  39.41   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00     2.6   0.050 0.100  45.98   4.0    15.5
Toe                                     27.5   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     8.00     10.81      1.00     0.800
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

    Rut    Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
   30.0     2.6   4.23   4.21    0.00   1   0    14.45   1   2   22.7    57.6
   30.0     2.6   4.23   4.21    0.00   1   0    14.45   1   2   22.7    57.6
   30.0     2.6   4.23   4.21    0.00   1   0    14.45   1   2   22.7    57.6
   30.0     2.6   4.23   4.21    0.00   1   0    14.45   1   2   22.7    57.6
   30.0     2.6   4.23   4.21    0.00   1   0    14.45   1   2   22.7    57.6
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
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Resource International Inc                             GRLWEAP Version 2010

 Depth                 (ft)      10.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                    H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)      47.8
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
 11  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  36.13   4.0    15.5
 13  0.174    11405 0.000 0.000 1.00     0.1   0.050 0.100  42.70   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00    11.6   0.050 0.100  45.98   4.0    15.5
Toe                                     36.1   0.150 0.100

    2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
    2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


   Depth    Stroke  Pressure    Efficy
      ft        ft     Ratio
   10.48     10.81      1.00     0.800
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                             06/27/2021
Resource International Inc                             GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU    Bl Rt
   kips     b/ft    down      up     ksi                 ksi           kip-ft    b/min
   47.8      4.3    4.76    4.73    0.00    1    0    18.12    7    3   20.9     54.3
   47.8      4.3    4.76    4.73    0.00    1    0    18.12    7    3   20.9     54.3
   47.8      4.3    4.76    4.73    0.00    1    0    18.12    7    3   20.9     54.3
   47.8      4.3    4.76    4.73    0.00    1    0    18.12    7    3   20.9     54.3
   47.8      4.3    4.76    4.73    0.00    1    0    18.12    7    3   20.9     54.3
         1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                             06/27/2021
Resource International Inc                             GRLWEAP Version 2010

 Depth                 (ft)      10.5
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 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                    H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)      35.1
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
 11  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  36.13   4.0    15.5
 13  0.174    11405 0.000 0.000 1.00     0.2   0.050 0.100  42.70   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00    11.6   0.050 0.100  45.98   4.0    15.5
Toe                                     23.2   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    10.52     10.81      1.00     0.800
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                          06/27/2021
Resource International Inc                                GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips     b/ft    down     up     ksi               ksi          kip-ft   b/min
   35.1      2.9    4.28   4.31    0.00   1   0    15.21   1   2   22.2    57.1
   35.1      2.9    4.28   4.31    0.00   1   0    15.21   1   2   22.2    57.1
   35.1      2.9    4.28   4.31    0.00   1   0    15.21   1   2   22.2    57.1
   35.1      2.9    4.28   4.31    0.00   1   0    15.21   1   2   22.2    57.1
   35.1      2.9    4.28   4.31    0.00   1   0    15.21   1   2   22.2    57.1
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                          06/27/2021
Resource International Inc                                GRLWEAP Version 2010

 Depth                 (ft)      14.2
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
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```
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)      58.3
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft        kips    s/ft  inch      ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
 10  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  32.84   4.0    15.5
 12  0.174    11405 0.000 0.000 1.00     1.6   0.050 0.100  39.41   4.0    15.5
 13  0.174    11405 0.000 0.000 1.00    12.2   0.050 0.100  42.70   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00    15.7   0.050 0.100  45.98   4.0    15.5
Toe                                     28.9   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    14.25     10.81      1.00     0.800
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                                GRLWEAP Version 2010

    Rut   Bl Ct    Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft    down    up      ksi              ksi         kip-ft   b/min
   58.3     4.9    4.90    4.86     0.00   1   0    19.16  10    4   20.5    53.4
   58.3     4.9    4.90    4.86     0.00   1   0    19.16  10    4   20.5    53.4
   58.3     4.9    4.90    4.86     0.00   1   0    19.16  10    4   20.5    53.4
   58.3     4.9    4.90    4.86     0.00   1   0    19.16  10    4   20.5    53.4
   58.3     4.9    4.90    4.86     0.00   1   0    19.16  10    4   20.5    53.4
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                                GRLWEAP Version 2010

 Depth                 (ft)      18.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040
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```
  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)      83.1
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft        kips    s/ft  inch      ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
  9  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  29.56   4.0    15.5
 11  0.174    11405 0.000 0.000 1.00     3.0   0.050 0.100  36.13   4.0    15.5
 12  0.174    11405 0.000 0.000 1.00    12.7   0.050 0.100  39.41   4.0    15.5
 13  0.174    11405 0.000 0.000 1.00    16.1   0.050 0.100  42.70   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00    18.2   0.050 0.100  45.98   4.0    15.5
Toe                                     33.1   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    17.98     10.81      1.00     0.800
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips   b/ft    down      up     ksi              ksi         kip-ft   b/min
   83.1     7.3   5.37   5.34   -0.94  11  45    21.53  11   4   19.3    50.9
   83.1     7.3   5.37   5.34   -0.94  11  45    21.53  11   4   19.3    50.9
   83.1     7.3   5.37   5.34   -0.94  11  45    21.53  11   4   19.3    50.9
   83.1     7.3   5.37   5.34   -0.94  11  45    21.53  11   4   19.3    50.9
   83.1     7.3   5.37   5.34   -0.94  11  45    21.53  11   4   19.3    50.9
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      18.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                    H Pile
 Pile Size           (inch)    12.040
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  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)      61.8
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
  9  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  29.56   4.0    15.5
 11  0.174    11405 0.000 0.000 1.00     3.1   0.050 0.100  36.13   4.0    15.5
 12  0.174    11405 0.000 0.000 1.00    12.8   0.050 0.100  39.41   4.0    15.5
 13  0.174    11405 0.000 0.000 1.00    16.1   0.050 0.100  42.70   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00    18.2   0.050 0.100  45.98   4.0    15.5
Toe                                     11.6   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    18.02     10.81      1.00     0.800
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                          06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips     b/ft    down     up     ksi              ksi          kip-ft   b/min
   61.8      4.5    4.81   4.77   -0.36   2   8    18.92  10   4   20.8    54.0
   61.8      4.5    4.81   4.77   -0.36   2   8    18.92  10   4   20.8    54.0
   61.8      4.5    4.81   4.77   -0.36   2   8    18.92  10   4   20.8    54.0
   61.8      4.5    4.81   4.77   -0.36   2   8    18.92  10   4   20.8    54.0
   61.8      4.5    4.81   4.77   -0.36   2   8    18.92  10   4   20.8    54.0
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                          06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

 Depth                (ft)      20.5
 Shaft Gain/Loss Factor        0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area            (in2)    15.500  Pile Type                      H Pile
 Pile Size          (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
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       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)      73.2
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85      0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00      0.0   0.000 0.100   6.57   4.0    15.5
  8  0.174    11405 0.000 0.000 1.00      0.0   0.050 0.100  26.27   4.0    15.5
 10  0.174    11405 0.000 0.000 1.00      0.6   0.050 0.100  32.84   4.0    15.5
 11  0.174    11405 0.000 0.000 1.00     11.8   0.050 0.100  36.13   4.0    15.5
 12  0.174    11405 0.000 0.000 1.00     15.4   0.050 0.100  39.41   4.0    15.5
 13  0.174    11405 0.000 0.000 1.00     17.7   0.050 0.100  42.70   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00     15.1   0.050 0.100  45.98   4.0    15.5
Toe                                     12.5   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    20.50     10.81      1.00     0.800
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down   up      ksi              ksi         kip-ft   b/min
   73.2     5.5   5.00   5.01   -0.34   5  47    20.10  11   4   20.0    52.7
   73.2     5.5   5.00   5.01   -0.34   5  47    20.10  11   4   20.0    52.7
   73.2     5.5   5.00   5.01   -0.34   5  47    20.10  11   4   20.0    52.7
   73.2     5.5   5.00   5.01   -0.34   5  47    20.10  11   4   20.0    52.7
   73.2     5.5   5.00   5.01   -0.34   5  47    20.10  11   4   20.0    52.7
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      23.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area            (in2)    15.500  Pile Type                    H Pile
 Pile Size          (inch)    12.040

  L b Top     Area     E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
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       ft       in2       ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     46.0    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     5.565

        Pile and Soil Model            Total Capacity Rut  (kips)      85.4
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips      k/in     ft    ft      kips    s/ft  inch     ft    ft     in2
  1  0.174    11405 0.010 0.000 0.85     0.0   0.000 0.100   3.28   4.0    15.5
  2  0.174    11405 0.000 0.000 1.00     0.0   0.000 0.100   6.57   4.0    15.5
  8  0.174    11405 0.000 0.000 1.00     0.0   0.050 0.100  26.27   4.0    15.5
 10  0.174    11405 0.000 0.000 1.00     9.1   0.050 0.100  32.84   4.0    15.5
 11  0.174    11405 0.000 0.000 1.00    14.7   0.050 0.100  36.13   4.0    15.5
 12  0.174    11405 0.000 0.000 1.00    17.2   0.050 0.100  39.41   4.0    15.5
 13  0.174    11405 0.000 0.000 1.00    16.2   0.050 0.100  42.70   4.0    15.5
 14  0.174    11405 0.000 0.000 1.00    14.8   0.050 0.100  45.98   4.0    15.5
Toe                                     13.5   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    22.98     10.81      1.00     0.800
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft    down      up     ksi              ksi       kip-ft   b/min
   85.4     6.6    5.28    5.24   -1.58   8  45    21.53  10   4   19.6    51.4
   85.4     6.6    5.28    5.24   -1.58   8  45    21.53  10   4   19.6    51.4
   85.4     6.6    5.28    5.24   -1.58   8  45    21.53  10   4   19.6    51.4
   85.4     6.6    5.28    5.24   -1.58   8  45    21.53  10   4   19.6    51.4
   85.4     6.6    5.28    5.24   -1.58   8  45    21.53  10   4   19.6    51.4
          1           0   10.81000       11.86000
↑
FRA-70-13.01  Pier 1 (B-014-3-19) : 06/2                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      23.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
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ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model — Total Capacity Rut (kips) 77.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	22.99	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	9.3	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	14.7	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	16.1	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	15.0	0.052	0.100	45.98	4.0	15.5
Toe						5.6	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
23.02	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
77.9	5.7	5.03	5.05	-1.02	7	47	20.47	10	4	19.9	52.5
77.9	5.7	5.03	5.05	-1.01	7	47	20.50	10	4	19.9	52.5
77.9	5.7	5.03	5.05	-1.03	7	47	20.47	10	4	19.9	52.5
77.9	5.7	5.03	5.05	-1.02	7	47	20.48	10	4	19.9	52.5
78.0	5.7	5.03	5.05	-1.02	7	47	20.50	10	4	19.9	52.5

1 0 10.81000 11.86000

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 24.2
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c

ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model — Total Capacity Rut (kips) 94.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	22.99	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	2.0	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	12.3	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	15.8	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	18.0	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	14.5	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.5	0.125	0.100	45.98	4.0	15.5
Toe						5.6	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.25	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 — 06/27/2021
Resource International Inc — GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
94.8	8.0	5.50	5.48	-1.31	9	45	22.41	10	4	19.0	50.3
95.7	8.1	5.52	5.49	-1.30	10	41	22.49	10	4	19.0	50.2
96.7	8.2	5.54	5.52	-1.34	10	41	22.57	10	4	18.9	50.1
97.6	8.4	5.56	5.53	-1.39	10	41	22.66	10	4	18.9	50.0
98.5	8.5	5.58	5.56	-1.41	10	41	22.73	10	4	18.8	49.9

1 0 10.81000 11.86000

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 — 06/27/2021
Resource International Inc — GRLWEAP Version 2010

Depth (ft) 25.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model — Total Capacity Rut (kips) 111.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	22.99	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	6.1	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	13.8	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	17.1	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	37.8	0.144	0.100	45.98	4.0	15.5
Toe						5.6	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.48	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
111.6	10.6	5.82	5.87	-1.32	9	35	23.55	9	4	18.1	48.7
113.5	10.9	5.86	5.91	-1.44	9	35	23.71	9	4	18.1	48.5
115.4	11.2	5.91	5.95	-1.53	9	35	23.87	9	4	18.1	48.4
117.3	11.5	5.94	5.98	-1.57	9	35	23.96	9	4	17.9	48.2
119.1	11.8	5.97	6.01	-1.58	9	35	24.09	9	4	17.9	48.1

1 0 10.81000 11.86000

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 25.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model — Total Capacity Rut (kips) 157.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	22.99	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	6.3	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	13.9	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	17.1	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	38.0	0.144	0.100	45.98	4.0	15.5
Toe						51.2	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.52	10.81	1.00	0.800

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 — 06/27/2021
Resource International Inc — GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
157.7	17.8	6.64	6.65	-1.02	9	30	26.36	9	3	17.3	45.7
159.6	18.1	6.67	6.68	-1.02	9	30	26.46	10	4	17.3	45.6
161.5	18.2	6.76	6.70	-1.01	9	29	26.75	9	3	17.5	45.4
163.4	18.6	6.79	6.73	-0.99	9	29	26.83	10	4	17.4	45.3
165.3	18.9	6.81	6.75	-1.00	9	29	26.89	10	4	17.4	45.2

1 0 10.81000 11.86000

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 — 06/27/2021
Resource International Inc — GRLWEAP Version 2010

Depth (ft) 28.8
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile

Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model — Total Capacity Rut (kips) 188.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	19.71	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	6.1	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	13.8	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	37.6	0.143	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.1	0.053	0.100	45.98	4.0	15.5
Toe						56.3	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
28.75	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
188.2	22.0	7.01	6.98	-1.72	8	50	27.55	9	3	17.2	44.6
190.1	22.3	7.04	7.00	-1.72	8	49	27.62	9	3	17.2	44.5
192.0	22.7	7.06	7.03	-1.70	8	49	27.66	9	3	17.1	44.4
193.9	22.9	7.07	7.05	-1.71	8	49	27.74	9	3	17.2	44.4
195.8	23.2	7.10	7.07	-1.70	8	49	27.82	9	3	17.2	44.3

1 0 10.81000 11.86000

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 32.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 221.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	16.42	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	5.9	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	13.8	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	37.1	0.143	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	26.4	0.057	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	28.3	0.050	0.100	45.98	4.0	15.5
Toe						61.4	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
31.98	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
221.1	26.8	7.31	7.28	-1.67	7	46	28.39	8	3	17.1	43.7
223.0	27.2	7.33	7.30	-1.65	7	45	28.45	8	3	17.0	43.6
224.9	27.6	7.34	7.33	-1.64	7	45	28.49	8	3	17.0	43.5
226.8	27.8	7.36	7.34	-1.65	7	45	28.55	8	3	17.1	43.5
228.7	28.2	7.38	7.36	-1.64	7	45	28.62	8	3	17.1	43.4

1 0 10.81000 11.86000

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 32.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 163.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	16.42	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	6.0	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	13.8	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	16.7	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	37.5	0.143	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	26.1	0.054	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	28.3	0.051	0.100	45.98	4.0	15.5
Toe						3.3	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
32.02	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
163.4	16.0	6.48	6.51	-1.57	8	30	25.82	8	3	17.2	46.2
165.2	16.3	6.51	6.54	-1.54	8	30	25.93	8	3	17.2	46.1
167.2	16.6	6.55	6.56	-1.49	8	30	26.07	8	3	17.2	46.0
169.1	17.0	6.58	6.60	-1.43	8	30	26.13	8	3	17.1	45.9
171.0	17.4	6.61	6.63	-1.36	8	30	26.24	8	3	17.1	45.8

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 37.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 203.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.000	0.100	6.57	4.0	15.5
3	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	9.85	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	0.8	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	11.9	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	15.5	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	17.8	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	15.0	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	22.9	0.114	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	35.1	0.125	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	27.1	0.050	0.100	39.41	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	27.6	0.112	0.100	42.70	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	45.98	4.0	15.5
Toe						3.3	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
37.00	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
203.4	24.8	7.20	7.16	-1.31	6	47	28.15	6	3	16.9	44.0
207.5	25.5	7.23	7.20	-1.20	6	47	28.23	6	3	16.8	43.9

211.7	26.3	7.27	7.25	-1.04	6	46	28.37	6	3	16.8	43.8
215.8	27.0	7.30	7.28	-1.01	6	44	28.47	6	3	16.8	43.7
219.9	27.7	7.34	7.32	-1.05	6	44	28.55	6	3	16.7	43.6

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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 42.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 243.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	6.57	4.0	15.5
4	0.174	11405	0.000	0.000	1.00	6.4	0.050	0.100	13.14	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	13.9	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	16.8	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	17.0	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	14.5	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	38.1	0.143	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	25.9	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	28.3	0.056	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	39.41	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	45.98	4.0	15.5
Toe						3.3	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.98	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
243.4	31.5	7.54	7.53	-0.43	4	42	28.85	5	3	16.2	43.0
249.7	32.5	7.58	7.57	-0.47	4	38	28.96	5	3	16.3	42.9
256.2	33.9	7.63	7.63	-0.68	4	38	29.10	5	3	16.3	42.7
262.5	35.2	7.68	7.67	-0.83	4	38	29.21	5	3	16.4	42.6
268.8	36.2	7.72	7.71	-0.86	4	37	29.36	5	3	16.6	42.5

1 0 10.81000 11.86000

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 42.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 247.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.000	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	6.57	4.0	15.5
4	0.174	11405	0.000	0.000	1.00	6.6	0.050	0.100	13.14	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	14.0	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	16.8	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	17.0	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	14.5	0.050	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	38.3	0.143	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	25.9	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	28.3	0.058	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	39.41	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	26.3	0.150	0.100	45.98	4.0	15.5
Toe						6.8	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
42.02	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
247.2	32.2	7.57	7.56	-0.36	4	39	28.91	5	3	16.3	42.9
253.5	33.4	7.62	7.61	-0.59	4	38	29.05	5	3	16.3	42.8
260.0	34.5	7.67	7.65	-0.79	4	38	29.19	5	3	16.5	42.7
266.3	35.8	7.71	7.69	-0.86	4	38	29.31	5	3	16.5	42.6
272.6	37.1	7.75	7.74	-0.83	4	37	29.44	5	3	16.6	42.4

1 0 10.81000 11.86000

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 44.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 255.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.050	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	6.57	4.0	15.5
3	0.174	11405	0.000	0.000	1.00	2.1	0.050	0.100	9.85	4.0	15.5
4	0.174	11405	0.000	0.000	1.00	12.4	0.050	0.100	13.14	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	15.8	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	18.1	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	14.4	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	26.7	0.126	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	32.7	0.114	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	27.4	0.050	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	27.4	0.123	0.100	36.13	4.0	15.5
12	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	39.41	4.0	15.5
14	0.174	11405	0.000	0.000	1.00	18.3	0.150	0.100	45.98	4.0	15.5
Toe						6.8	0.150	0.100			

2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
2.435 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
43.98	10.81	1.00	0.800

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
255.0	33.9	7.64	7.62	-0.56	4	38	29.23	4	3	16.2	42.8
261.7	35.2	7.68	7.67	-0.63	4	38	29.35	4	3	16.3	42.6
268.6	36.7	7.73	7.72	-0.53	4	37	29.49	4	2	16.3	42.5
275.3	38.1	7.77	7.76	-0.48	4	36	29.60	4	3	16.4	42.4
282.1	39.6	7.82	7.81	-0.46	4	36	29.73	4	2	16.5	42.3

1 0 10.81000 11.86000

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 46.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
46.0	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 5.565

Pile and Soil Model Total Capacity Rut (kips) 262.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.174	11405	0.010	0.000	0.85	0.0	0.050	0.100	3.28	4.0	15.5
2	0.174	11405	0.000	0.000	1.00	0.0	0.050	0.100	6.57	4.0	15.5
3	0.174	11405	0.000	0.000	1.00	9.1	0.050	0.100	9.85	4.0	15.5
4	0.174	11405	0.000	0.000	1.00	14.7	0.050	0.100	13.14	4.0	15.5
5	0.174	11405	0.000	0.000	1.00	17.2	0.050	0.100	16.42	4.0	15.5
6	0.174	11405	0.000	0.000	1.00	16.1	0.050	0.100	19.71	4.0	15.5
7	0.174	11405	0.000	0.000	1.00	14.8	0.050	0.100	22.99	4.0	15.5
8	0.174	11405	0.000	0.000	1.00	40.2	0.140	0.100	26.27	4.0	15.5
9	0.174	11405	0.000	0.000	1.00	26.4	0.050	0.100	29.56	4.0	15.5
10	0.174	11405	0.000	0.000	1.00	28.1	0.085	0.100	32.84	4.0	15.5
11	0.174	11405	0.000	0.000	1.00	26.4	0.150	0.100	36.13	4.0	15.5
13	0.174	11405	0.000	0.000	1.00	23.6	0.150	0.100	42.70	4.0	15.5

```
 14  0.174    11405 0.000 0.000 1.00    13.0   0.150 0.100  45.98   4.0    15.5
Toe                                       6.8   0.150 0.100

     2.435 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.435 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    45.98     10.81      1.00     0.800
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FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
262.9	35.1	7.68	7.67	-0.62	13	10	29.28	3	2	16.1	42.7
270.1	36.7	7.73	7.72	-0.53	14	10	29.42	3	2	16.1	42.5
277.4	38.4	7.76	7.77	-0.47	14	10	29.51	3	2	16.1	42.4
284.6	40.1	7.81	7.82	-0.40	14	10	29.62	3	2	16.2	42.3
291.8	41.6	7.86	7.85	-0.52	3	34	29.76	3	2	16.3	42.1

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.600 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.3	5.6	5.7	20.466	-1.025	5.03	19.9
24.2	94.8	89.2	5.6	8.0	22.412	-1.313	5.50	19.0
25.5	111.6	106.0	5.6	10.6	23.551	-1.320	5.82	18.1
25.5	157.7	106.5	51.2	17.8	26.359	-1.015	6.64	17.3

28.8	188.2	131.9	56.3	22.0	27.546	-1.725	7.01	17.2
32.0	221.1	159.7	61.4	26.8	28.394	-1.673	7.31	17.1
32.0	163.4	160.1	3.3	16.0	25.820	-1.568	6.48	17.2
37.0	203.4	200.1	3.3	24.8	28.150	-1.308	7.20	16.9
42.0	243.4	240.2	3.3	31.5	28.847	-0.431	7.54	16.2
42.0	247.2	240.4	6.8	32.2	28.914	-0.362	7.57	16.3
44.0	255.0	248.2	6.8	33.9	29.231	-0.564	7.64	16.2
46.0	262.9	256.1	6.8	35.1	29.283	-0.621	7.68	16.1

Total Driving Time 14 minutes; Total No. of Blows 616

G/L at Shaft and Toe: 0.633 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.3	5.6	5.7	20.501	-1.011	5.03	19.9
24.2	95.7	90.1	5.6	8.1	22.486	-1.297	5.52	19.0
25.5	113.5	107.9	5.6	10.9	23.712	-1.442	5.86	18.1
25.5	159.6	108.4	51.2	18.1	26.460	-1.019	6.67	17.3
28.8	190.1	133.8	56.3	22.3	27.623	-1.717	7.04	17.2
32.0	223.0	161.6	61.4	27.2	28.451	-1.652	7.33	17.0
32.0	165.2	162.0	3.3	16.3	25.926	-1.538	6.51	17.2
37.0	207.5	204.2	3.3	25.5	28.234	-1.197	7.23	16.8
42.0	249.7	246.4	3.3	32.5	28.963	-0.469	7.58	16.3
42.0	253.5	246.7	6.8	33.4	29.048	-0.590	7.62	16.3
44.0	261.7	254.9	6.8	35.2	29.353	-0.625	7.68	16.3
46.0	270.1	263.3	6.8	36.7	29.420	-0.534	7.73	16.1

Total Driving Time 14 minutes; Total No. of Blows 632

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.667 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.4	5.6	5.7	20.472	-1.032	5.03	19.9
24.2	96.7	91.1	5.6	8.2	22.568	-1.344	5.54	18.9
25.5	115.4	109.8	5.6	11.2	23.866	-1.530	5.91	18.1
25.5	161.5	110.3	51.2	18.2	26.752	-1.009	6.76	17.5
28.8	192.0	135.7	56.3	22.7	27.656	-1.701	7.06	17.1
32.0	224.9	163.5	61.4	27.6	28.488	-1.635	7.34	17.0
32.0	167.2	163.9	3.3	16.6	26.072	-1.492	6.55	17.2
37.0	211.7	208.4	3.3	26.3	28.372	-1.037	7.27	16.8
42.0	256.2	252.9	3.3	33.9	29.100	-0.682	7.63	16.3
42.0	260.0	253.2	6.8	34.5	29.191	-0.790	7.67	16.5
44.0	268.6	261.8	6.8	36.7	29.485	-0.531	7.73	16.3
46.0	277.4	270.7	6.8	38.4	29.507	-0.469	7.76	16.1

Total Driving Time 15 minutes; Total No. of Blows 649

G/L at Shaft and Toe: 0.700 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3

18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	77.9	72.4	5.6	5.7	20.484	-1.025	5.03	19.9
24.2	97.6	92.0	5.6	8.4	22.662	-1.386	5.56	18.9
25.5	117.3	111.7	5.6	11.5	23.961	-1.567	5.94	17.9
25.5	163.4	112.2	51.2	18.6	26.826	-0.995	6.79	17.4
28.8	193.9	137.6	56.3	22.9	27.737	-1.708	7.07	17.2
32.0	226.8	165.4	61.4	27.8	28.552	-1.645	7.36	17.1
32.0	169.1	165.8	3.3	17.0	26.133	-1.432	6.58	17.1
37.0	215.8	212.5	3.3	27.0	28.475	-1.006	7.30	16.8
42.0	262.5	259.2	3.3	35.2	29.214	-0.828	7.68	16.4
42.0	266.3	259.5	6.8	35.8	29.310	-0.859	7.71	16.5
44.0	275.3	268.6	6.8	38.1	29.596	-0.484	7.77	16.4
46.0	284.6	277.8	6.8	40.1	29.616	-0.404	7.81	16.2

Total Driving Time 15 minutes; Total No. of Blows 664

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.733 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
4.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
5.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
8.0	30.0	2.6	27.5	2.6	14.448	0.000	4.23	22.7
10.5	47.8	11.7	36.1	4.3	18.124	0.000	4.76	20.9
10.5	35.1	11.9	23.2	2.9	15.211	0.000	4.28	22.2
14.2	58.3	29.4	28.9	4.9	19.163	0.000	4.90	20.5
18.0	83.1	50.0	33.1	7.3	21.532	-0.940	5.37	19.3
18.0	61.8	50.2	11.6	4.5	18.916	-0.355	4.81	20.8
20.5	73.2	60.6	12.5	5.5	20.098	-0.336	5.00	20.0
23.0	85.4	71.9	13.5	6.6	21.534	-1.583	5.28	19.6
23.0	78.0	72.4	5.6	5.7	20.497	-1.023	5.03	19.9
24.2	98.5	93.0	5.6	8.5	22.727	-1.415	5.58	18.8
25.5	119.1	113.5	5.6	11.8	24.093	-1.582	5.97	17.9
25.5	165.3	114.1	51.2	18.9	26.895	-0.997	6.81	17.4
28.8	195.8	139.5	56.3	23.2	27.818	-1.705	7.10	17.2
32.0	228.7	167.3	61.4	28.2	28.621	-1.641	7.38	17.1
32.0	171.0	167.7	3.3	17.4	26.241	-1.359	6.61	17.1
37.0	219.9	216.6	3.3	27.7	28.546	-1.053	7.34	16.7

42.0	268.8	265.5	3.3	36.2	29.356	-0.861	7.72	16.6
42.0	272.6	265.8	6.8	37.1	29.443	-0.828	7.75	16.6
44.0	282.1	275.3	6.8	39.6	29.725	-0.459	7.82	16.5
46.0	291.8	285.0	6.8	41.6	29.763	-0.521	7.86	16.3

Total Driving Time 15 minutes; Total No. of Blows 678

FRA-70-13.01 Pier 1 (B-014-3-19) : 06/2 06/27/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
1.48	45.98	0.00	10.81	1.00	0.80	1.00	1.00
1.52	45.98	0.00	10.81	1.00	0.80	1.00	1.00
2.25	45.98	0.00	10.81	1.00	0.80	1.00	1.00
2.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
3.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
4.25	45.98	0.00	10.81	1.00	0.80	1.00	1.00
5.48	45.98	0.00	10.81	1.00	0.80	1.00	1.00
5.52	45.98	0.00	10.81	1.00	0.80	1.00	1.00
8.00	45.98	0.00	10.81	1.00	0.80	1.00	1.00
10.48	45.98	0.00	10.81	1.00	0.80	1.00	1.00
10.52	45.98	0.00	10.81	1.00	0.80	1.00	1.00
14.25	45.98	0.00	10.81	1.00	0.80	1.00	1.00
17.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
18.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
20.50	45.98	0.00	10.81	1.00	0.80	1.00	1.00
22.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
23.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
24.25	45.98	0.00	10.81	1.00	0.80	1.00	1.00
25.48	45.98	0.00	10.81	1.00	0.80	1.00	1.00
25.52	45.98	0.00	10.81	1.00	0.80	1.00	1.00
28.75	45.98	0.00	10.81	1.00	0.80	1.00	1.00
31.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
32.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
37.00	45.98	0.00	10.81	1.00	0.80	1.00	1.00
41.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
42.02	45.98	0.00	10.81	1.00	0.80	1.00	1.00
43.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00
45.98	45.98	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs

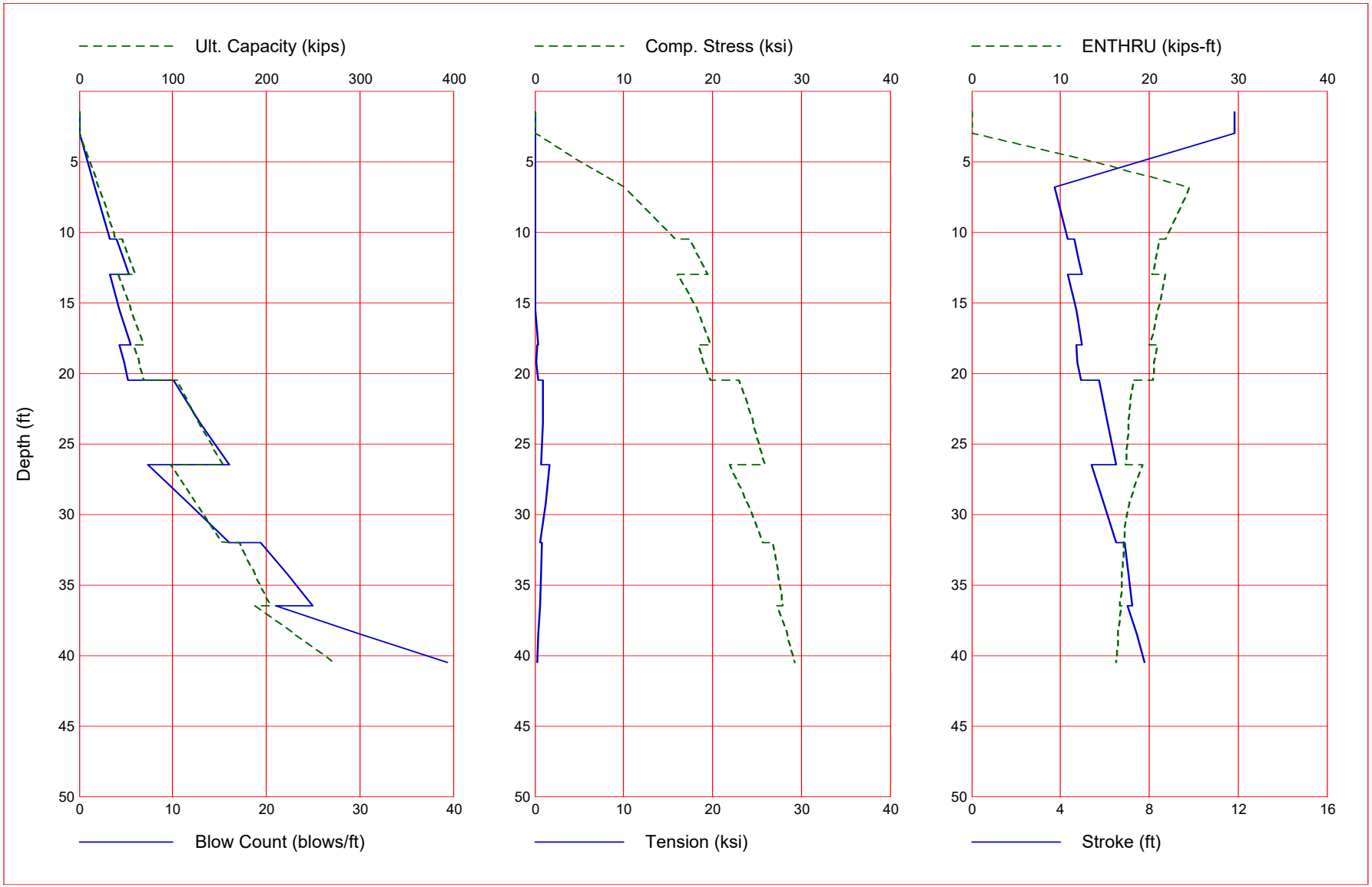
0.01	0.00	0.00	0.100	0.100	0.050	0.150	0.500	6.000	168.000
1.49	0.00	0.00	0.100	0.100	0.050	0.150	0.500	6.000	168.000
1.51	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
2.99	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.49	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.14	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.16	0.71	24.52	0.100	0.100	0.050	0.150	0.000	6.000	24.000
8.15	0.82	27.99	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.15	0.92	31.48	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.15	1.02	34.98	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.49	1.05	36.17	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.51	1.04	23.18	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.50	1.13	25.31	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.99	1.18	26.36	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.01	1.18	26.40	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.00	1.23	27.50	0.100	0.100	0.050	0.150	0.000	6.000	24.000
14.00	1.28	28.62	0.100	0.100	0.050	0.150	0.000	6.000	24.000
15.00	1.33	29.74	0.100	0.100	0.050	0.150	0.000	6.000	24.000
16.00	1.38	30.87	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.00	1.43	31.98	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.99	1.48	33.09	0.100	0.100	0.050	0.150	0.000	6.000	24.000
18.01	1.02	11.58	0.100	0.100	0.050	0.150	0.000	6.000	24.000
19.00	1.05	11.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.00	1.09	12.35	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.00	1.12	12.74	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.00	1.16	13.12	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.99	1.19	13.51	0.100	0.100	0.050	0.150	0.000	6.000	24.000
23.01	5.75	5.57	0.100	0.100	0.150	0.150	1.000	6.000	336.000
25.49	5.75	5.57	0.100	0.100	0.150	0.150	1.000	6.000	336.000
25.51	1.89	51.19	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.50	1.95	52.76	0.100	0.100	0.050	0.150	0.000	6.000	24.000
27.50	2.00	54.33	0.100	0.100	0.050	0.150	0.000	6.000	24.000
28.50	2.06	55.91	0.100	0.100	0.050	0.150	0.000	6.000	24.000
29.50	2.12	57.49	0.100	0.100	0.050	0.150	0.000	6.000	24.000
30.50	2.18	59.07	0.100	0.100	0.050	0.150	0.000	6.000	24.000
31.50	2.24	60.64	0.100	0.100	0.050	0.150	0.000	6.000	24.000
31.99	2.27	61.42	0.100	0.100	0.050	0.150	0.000	6.000	24.000
32.01	3.38	3.27	0.100	0.100	0.150	0.150	1.000	6.000	336.000
41.99	3.38	3.27	0.100	0.100	0.150	0.150	1.000	6.000	336.000
42.01	1.67	6.78	0.100	0.100	0.150	0.150	1.000	6.000	336.000
45.98	1.67	6.78	0.100	0.100	0.150	0.150	1.000	6.000	336.000

Pier 2
(B-014-4-19)

Resource International Inc
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.667 / 1.000



Gain/Loss 3 at Shaft and Toe 0.667 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.3	21.868	-1.626	5.39	19.3
29.2	125.0	121.4	3.6	11.7	23.998	-1.196	5.95	17.8
32.0	152.1	148.5	3.6	16.0	25.697	-0.569	6.49	17.1
32.0	171.8	148.8	23.0	19.4	26.869	-0.778	6.87	17.1
34.2	188.3	164.0	24.3	22.2	27.347	-0.723	7.06	16.9
36.5	205.5	180.0	25.6	25.0	27.864	-0.625	7.22	16.7
36.5	188.3	180.6	7.8	21.0	27.208	-0.635	7.00	16.9
38.5	230.1	222.3	7.8	30.1	28.388	-0.409	7.45	16.5
40.5	272.4	264.7	7.8	39.3	29.320	-0.287	7.78	16.3

Total Continuous Driving Time 9.00 minutes; Total Number of Blows 417

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins
and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: J:\GEOTECH\PROJECTS\2020\W-20-025
FRA-70-13.01\ANALYSIS\DRIVEABILITY\PIER 2\FRA-70-13.01 - PIER 2 HP
12X53-B-014-4-19.GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	15.500	12.040	H Pile

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.900	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
40.490	15.50	29000.0	492.000	3.970	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
1.49	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
3.01	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
5.39	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
5.41	0.52	14.14	0.10	0.10	0.05	0.15	1.00	6.00	24.0
6.40	0.62	16.76	0.10	0.10	0.05	0.15	1.00	6.00	24.0
7.40	0.72	19.40	0.10	0.10	0.05	0.15	1.00	6.00	24.0
7.99	0.77	20.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
8.01	0.77	21.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
9.00	0.82	22.36	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.00	0.88	23.74	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.49	0.90	24.41	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.51	0.91	31.15	0.10	0.10	0.05	0.15	1.00	6.00	24.0
11.50	0.96	32.88	0.10	0.10	0.05	0.15	1.00	6.00	24.0

12.50	1.01	34.63	0.10	0.10	0.05	0.15	1.00	6.00	24.0
12.99	1.03	35.49	0.10	0.10	0.05	0.15	1.00	6.00	24.0
13.01	1.01	17.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
14.00	1.05	18.51	0.10	0.10	0.05	0.15	1.00	6.00	24.0
15.00	1.10	19.32	0.10	0.10	0.05	0.15	1.00	6.00	24.0
16.00	1.14	20.13	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.00	1.19	20.94	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.99	1.24	21.74	0.10	0.10	0.05	0.15	1.00	6.00	24.0
18.01	0.95	11.70	0.10	0.10	0.05	0.15	1.00	6.00	24.0
19.00	0.99	12.13	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.00	1.02	12.56	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.49	1.04	12.77	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.51	1.39	47.69	0.10	0.10	0.05	0.15	1.00	6.00	24.0
21.50	1.45	49.68	0.10	0.10	0.05	0.15	1.00	6.00	24.0
22.50	1.51	51.69	0.10	0.10	0.05	0.15	1.00	6.00	24.0
23.50	1.57	53.70	0.10	0.10	0.05	0.15	1.00	6.00	24.0
24.50	1.62	55.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
25.50	1.68	57.72	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.49	1.74	59.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.51	3.75	3.63	0.10	0.10	0.15	0.15	1.50	6.00	336.0
31.99	3.75	3.63	0.10	0.10	0.15	0.15	1.50	6.00	336.0
32.01	1.66	22.98	0.10	0.10	0.05	0.15	1.00	6.00	24.0
33.00	1.71	23.55	0.10	0.10	0.05	0.15	1.00	6.00	24.0
34.00	1.75	24.13	0.10	0.10	0.05	0.15	1.00	6.00	24.0
35.00	1.79	24.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.00	1.83	25.29	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.49	1.85	25.58	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.51	8.00	7.75	0.10	0.10	0.15	0.15	1.50	6.00	336.0
40.49	8.00	7.75	0.10	0.10	0.15	0.15	1.50	6.00	336.0

Gain/Loss factors: shaft and toe

0.60000	0.63300	0.66700	0.70000	0.73300
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
1.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
1.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
3.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
6.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
11.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
12.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
13.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
15.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
18.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
19.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000

23.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
29.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
31.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
32.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
34.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
38.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
40.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		11101.5			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	1.5			
Shaft Gain/Loss Factor		0.600	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type		H Pile
Pile Size	(inch)	12.040			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model — Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	40.49	4.0	15.5
Toe						0.0	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile			Pile Segments: Automatic	
No. of Slacks/Splices		0	Pile Damping	(%) 1
			Pile Damping Fact.(k/ft/s)	0.544
Driveability Analysis				
Soil Damping Option		Smith		
Max No Analysis Iterations		0	Time Increment/Critical	160
Output Time Interval		1	Analysis Time-Input (ms)	0
Output Level: Normal				
Gravity Mass, Pile, Hammer:	32.170	32.170	32.170	

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 Output Segment Generation: Automatic

    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     1.48     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                          06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                          06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)       1.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                    H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901
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        Pile and Soil Model            Total Capacity Rut  (kips)       0.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft        kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  40.49   4.0    15.5
Toe                                      0.0   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     1.52     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                                GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
         1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                                GRLWEAP Version 2010

 Depth                 (ft)       2.2
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
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```
 Toe Area            (in2)    15.500  Pile Type                   H Pile
 Pile Size          (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
      ft       in2      ksi   lb/ft3       ft              ft/s    k/ft/s
     0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
    40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

       Pile and Soil Model            Total Capacity Rut  (kips)       0.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  40.49   4.0    15.5
Toe                                      0.0   0.150 0.100

    2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
    2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     2.25     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                        06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
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   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
         1           0   10.81000       11.86000
```

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

```
 Depth                 (ft)       3.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model            Total Capacity Rut  (kips)       0.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  40.49   4.0    15.5
Toe                                      0.0   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     2.98     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
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Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000	11.86000							

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 3.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	40.49	4.0	15.5
Toe						0.0	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
3.02	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 4.8 0.0
Hammer+Pile Weight > Rult: Pile Runs

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INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     4.8     0.0
 Hammer+Pile Weight > Rult: Pile Runs
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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i t	Comp Str ksi	i t	ENTHRU kip-ft	Bl Rt b/min
	1	0	10.81000	11.86000					

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 6.8
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model Total Capacity Rut (kips) 20.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	3.1	0.050	0.100	40.49	4.0	15.5
Toe						17.7	0.150	0.100			

```
     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     6.75     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                       06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU    Bl Rt
   kips     b/ft    down     up     ksi              ksi           kip-ft    b/min
   20.8      1.7    3.75   3.74    0.00    1    0    10.06    1    2   24.5     61.2
   20.8      1.7    3.75   3.74    0.00    1    0    10.06    1    2   24.5     61.2
   20.8      1.7    3.75   3.74    0.00    1    0    10.06    1    2   24.5     61.2
   20.8      1.7    3.75   3.74    0.00    1    0    10.06    1    2   24.5     61.2
   20.8      1.7    3.75   3.74    0.00    1    0    10.06    1    2   24.5     61.2
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                       06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                (ft)      10.5
 Shaft Gain/Loss Factor        0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area            (in2)    15.500  Pile Type                    H Pile
 Pile Size          (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi  lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

       Pile and Soil Model           Total Capacity Rut  (kips)      39.3
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00     4.1   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    10.8   0.050 0.100  40.49   4.0    15.5
Toe                                     24.4   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)
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    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    10.48     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                         06/27/2021
Resource International Inc                                  GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi             ksi          kip-ft   b/min
   39.3     3.3   4.34   4.38    0.00   1   0    15.87   1   2   21.8    56.6
   39.3     3.3   4.34   4.38    0.00   1   0    15.87   1   2   21.8    56.6
   39.3     3.3   4.34   4.38    0.00   1   0    15.87   1   2   21.8    56.6
   39.3     3.3   4.34   4.38    0.00   1   0    15.87   1   2   21.8    56.6
   39.3     3.3   4.34   4.38    0.00   1   0    15.87   1   2   21.8    56.6
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                         06/27/2021
Resource International Inc                                  GRLWEAP Version 2010

 Depth                 (ft)      10.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                    H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi  lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

       Pile and Soil Model            Total Capacity Rut  (kips)      46.2
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim     Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft      in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0     15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0     15.5
  9  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  30.37   4.0     15.5
 10  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  33.74   4.0     15.5
 11  0.179    11102 0.000 0.000 1.00     4.2   0.050 0.100  37.12   4.0     15.5
 12  0.179    11102 0.000 0.000 1.00    10.9   0.050 0.100  40.49   4.0     15.5
Toe                                     31.2   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)
```

```
    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    10.52     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up     ksi              ksi        kip-ft   b/min
   46.2     4.0   4.63   4.61    0.00   1   0    17.49   5   3   21.2    55.0
   46.2     4.0   4.63   4.61    0.00   1   0    17.49   5   3   21.2    55.0
   46.2     4.0   4.63   4.61    0.00   1   0    17.49   5   3   21.2    55.0
   46.2     4.0   4.63   4.61    0.00   1   0    17.49   5   3   21.2    55.0
   46.2     4.0   4.63   4.61    0.00   1   0    17.49   5   3   21.2    55.0
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      11.8
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.     492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.     492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model            Total Capacity Rut  (kips)      53.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft          kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00     7.9   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    11.8   0.050 0.100  40.49   4.0    15.5
Toe                                     33.3   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
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    11.75     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                                GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi               ksi           kip-ft   b/min
   53.0     4.7   4.80   4.77    0.00    1    0    18.51    7    3   20.7    54.0
   53.0     4.7   4.80   4.77    0.00    1    0    18.51    7    3   20.7    54.0
   53.0     4.7   4.80   4.77    0.00    1    0    18.51    7    3   20.7    54.0
   53.0     4.7   4.80   4.77    0.00    1    0    18.51    7    3   20.7    54.0
   53.0     4.7   4.80   4.77    0.00    1    0    18.51    7    3   20.7    54.0
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                                GRLWEAP Version 2010

 Depth                 (ft)      13.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

       Pile and Soil Model            Total Capacity Rut  (kips)      60.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S   Soil-D Quake  LbTop Perim     Area
      kips     k/in    ft    ft         kips     s/ft  inch     ft    ft      in2
  1  0.179    11102 0.010 0.000 0.85     0.0    0.000 0.100   3.37   4.0     15.5
  2  0.179    11102 0.000 0.000 1.00     0.0    0.000 0.100   6.75   4.0     15.5
  9  0.179    11102 0.000 0.000 1.00     0.0    0.200 0.100  30.37   4.0     15.5
 10  0.179    11102 0.000 0.000 1.00     1.9    0.050 0.100  33.74   4.0     15.5
 11  0.179    11102 0.000 0.000 1.00    10.0    0.050 0.100  37.12   4.0     15.5
 12  0.179    11102 0.000 0.000 1.00    12.7    0.050 0.100  40.49   4.0     15.5
Toe                                     35.5    0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    12.98     10.81      1.00     0.800
↑
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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up     ksi              ksi         kip-ft   b/min
   60.0     5.3   4.96   4.92    0.00   1   0    19.41   9   4   20.3    53.1
   60.0     5.3   4.96   4.92    0.00   1   0    19.41   9   4   20.3    53.1
   60.0     5.3   4.96   4.92    0.00   1   0    19.41   9   4   20.3    53.1
   60.0     5.3   4.96   4.92    0.00   1   0    19.41   9   4   20.3    53.1
   60.0     5.3   4.96   4.92    0.00   1   0    19.41   9   4   20.3    53.1
          1           0   10.81000       11.86000
🡅
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      13.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                    H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model            Total Capacity Rut  (kips)      42.4
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft        kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00     1.9   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    10.1   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    12.7   0.050 0.100  40.49   4.0    15.5
Toe                                     17.7   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    13.02     10.81      1.00     0.800
🡅
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010
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     Rut    Bl Ct    Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU    Bl Rt
    kips     b/ft    down      up     ksi              ksi           kip-ft    b/min
    42.4      3.3    4.34    4.38    0.00    1    0    16.04    1    2    21.8     56.7
    42.4      3.3    4.34    4.38    0.00    1    0    16.04    1    2    21.8     56.7
    42.4      3.3    4.34    4.38    0.00    1    0    16.04    1    2    21.8     56.7
    42.4      3.3    4.34    4.38    0.00    1    0    16.04    1    2    21.8     56.7
    42.4      3.3    4.34    4.38    0.00    1    0    16.04    1    2    21.8     56.7
           1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                              06/27/2021
Resource International Inc                                     GRLWEAP Version 2010

 Depth                 (ft)      15.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

       Pile and Soil Model            Total Capacity Rut  (kips)      54.9
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips      k/in    ft    ft        kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00     9.1   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    12.1   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    14.1   0.050 0.100  40.49   4.0    15.5
Toe                                     19.7   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    15.50     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                              06/27/2021
Resource International Inc                                     GRLWEAP Version 2010
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    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up     ksi              ksi          kip-ft   b/min
   54.9     4.3   4.71    4.67    0.00   1   0    18.25   8   3    21.0    54.6
   54.9     4.3   4.71    4.67    0.00   1   0    18.25   8   3    21.0    54.6
   54.9     4.3   4.71    4.67    0.00   1   0    18.25   8   3    21.0    54.6
   54.9     4.3   4.71    4.67    0.00   1   0    18.25   8   3    21.0    54.6
   54.9     4.3   4.71    4.67    0.00   1   0    18.25   8   3    21.0    54.6
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      18.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi  lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model            Total Capacity Rut  (kips)      68.5
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  7  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  23.62   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00     6.2   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00    11.4   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    13.6   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    15.5   0.050 0.100  40.49   4.0    15.5
Toe                                     21.7   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    17.98     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010
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    Rut    Bl Ct    Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU    Bl Rt
   kips     b/ft    down      up     ksi              ksi          kip-ft    b/min
   68.5      5.5    4.95    4.97   -0.40    9   49    19.76    9    4   20.0     53.0
   68.5      5.5    4.95    4.97   -0.40    9   49    19.76    9    4   20.0     53.0
   68.5      5.5    4.95    4.97   -0.40    9   49    19.76    9    4   20.0     53.0
   68.5      5.5    4.95    4.97   -0.40    9   49    19.76    9    4   20.0     53.0
   68.5      5.5    4.95    4.97   -0.40    9   49    19.76    9    4   20.0     53.0
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                                   GRLWEAP Version 2010

 Depth                  (ft)      18.0
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area              (in2)    15.500  Pile Type                      H Pile
 Pile Size            (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

       Pile and Soil Model            Total Capacity Rut  (kips)      58.7
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  7  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  23.62   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00     6.4   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00    11.5   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    13.6   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    15.5   0.050 0.100  40.49   4.0    15.5
Toe                                     11.7   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    18.02     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                                   GRLWEAP Version 2010
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    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up      ksi              ksi          kip-ft   b/min
   58.7     4.3   4.70   4.66   -0.22   3   9    18.44   9   4   21.0    54.7
   58.7     4.3   4.70   4.66   -0.22   3   9    18.44   9   4   21.0    54.7
   58.7     4.3   4.70   4.66   -0.22   3   9    18.44   9   4   21.0    54.7
   58.7     4.3   4.70   4.66   -0.22   3   9    18.44   9   4   21.0    54.7
   58.7     4.3   4.70   4.66   -0.22   3   9    18.44   9   4   21.0    54.7
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      19.2
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model            Total Capacity Rut  (kips)      63.9
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  7  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  23.62   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00     0.8   0.050 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00     9.5   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00    12.3   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    14.3   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    14.8   0.050 0.100  40.49   4.0    15.5
Toe                                     12.2   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    19.25     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010
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    Rut    Bl Ct    Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU    Bl Rt
   kips     b/ft    down      up     ksi                ksi          kip-ft    b/min
   63.9      4.8    4.77    4.79   -0.13    3    9    18.93    9    4    20.5     54.0
   63.9      4.8    4.77    4.79   -0.13    3    9    18.93    9    4    20.5     54.0
   63.9      4.8    4.77    4.79   -0.13    3    9    18.93    9    4    20.5     54.0
   63.9      4.8    4.77    4.79   -0.13    3    9    18.93    9    4    20.5     54.0
   63.9      4.8    4.77    4.79   -0.13    3    9    18.93    9    4    20.5     54.0
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                              06/27/2021
Resource International Inc                                   GRLWEAP Version 2010

 Depth                  (ft)      20.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model           Total Capacity Rut  (kips)      69.4
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  6  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  20.25   4.0    15.5
  7  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  23.62   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00     3.8   0.050 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00    10.7   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00    13.1   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    15.0   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    14.1   0.050 0.100  40.49   4.0    15.5
Toe                                     12.8   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    20.48     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                              06/27/2021
Resource International Inc                                   GRLWEAP Version 2010
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    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up     ksi              ksi         kip-ft   b/min
   69.4     5.2   4.94   4.89   -0.32   9  49    19.76   8   3   20.4    53.2
   69.4     5.2   4.94   4.89   -0.32   9  49    19.76   8   3   20.4    53.2
   69.4     5.2   4.94   4.89   -0.32   9  49    19.76   8   3   20.4    53.2
   69.4     5.2   4.94   4.89   -0.32   9  49    19.76   8   3   20.4    53.2
   69.4     5.2   4.94   4.89   -0.32   9  49    19.76   8   3   20.4    53.2
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      20.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                      H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model            Total Capacity Rut  (kips)     104.6
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft        kips     s/ft inch      ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  6  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  20.25   4.0    15.5
  7  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  23.62   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00     3.9   0.050 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00    10.8   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00    13.1   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    15.0   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    14.1   0.050 0.100  40.49   4.0    15.5
Toe                                     47.7   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    20.52     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
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Resource International Inc                                  GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi             ksi          kip-ft   b/min
  104.6    10.1   5.72   5.78   -0.87   8  40    23.02   8   3   18.2    49.1
  104.6    10.1   5.72   5.78   -0.87   8  40    23.02   8   3   18.2    49.1
  104.6    10.1   5.72   5.78   -0.87   8  40    23.02   8   3   18.2    49.1
  104.6    10.1   5.72   5.78   -0.87   8  40    23.02   8   3   18.2    49.1
  104.6    10.1   5.72   5.78   -0.87   8  40    23.02   8   3   18.2    49.1
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                               06/27/2021
Resource International Inc                                  GRLWEAP Version 2010

 Depth                (ft)      23.5
 Shaft Gain/Loss Factor        0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area            (in2)    15.500  Pile Type                    H Pile
 Pile Size          (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

       Pile and Soil Model            Total Capacity Rut  (kips)     128.1
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  6  0.179    11102 0.000 0.000 1.00     0.0   0.050 0.100  20.25   4.0    15.5
  7  0.179    11102 0.000 0.000 1.00     2.8   0.050 0.100  23.62   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00    10.4   0.050 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00    12.9   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00    14.7   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    14.3   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    19.1   0.050 0.100  40.49   4.0    15.5
Toe                                     53.7   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    23.50     10.81      1.00     0.800
↑
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FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                                   GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft    down      up     ksi              ksi         kip-ft   b/min
  128.1    12.9    6.13    6.16   -0.92   7  32    24.58   8   3   17.7    47.5
  128.1    12.9    6.13    6.16   -0.92   7  32    24.58   8   3   17.7    47.5
  128.1    12.9    6.13    6.16   -0.92   7  32    24.58   8   3   17.7    47.5
  128.1    12.9    6.13    6.16   -0.92   7  32    24.58   8   3   17.7    47.5
  128.1    12.9    6.13    6.16   -0.92   7  32    24.58   8   3   17.7    47.5
          1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                           06/27/2021
Resource International Inc                                   GRLWEAP Version 2010

 Depth                (ft)      26.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                     H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
     40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model            Total Capacity Rut  (kips)     153.6
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  5  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  16.87   4.0    15.5
  6  0.179    11102 0.000 0.000 1.00     1.9   0.050 0.100  20.25   4.0    15.5
  7  0.179    11102 0.000 0.000 1.00    10.0   0.050 0.100  23.62   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00    12.7   0.050 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00    14.5   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00    14.6   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    18.3   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    22.0   0.050 0.100  40.49   4.0    15.5
Toe                                     59.7   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
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    26.48     10.81      1.00     0.800
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                          06/27/2021
Resource International Inc                                   GRLWEAP Version 2010

    Rut    Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi          kip-ft   b/min
  153.6    16.0   6.49   6.50   -0.68   6  30    25.83   7   3   17.3    46.2
  153.6    16.0   6.49   6.50   -0.68   6  30    25.83   7   3   17.3    46.2
  153.6    16.0   6.49   6.50   -0.68   6  30    25.83   7   3   17.3    46.2
  153.6    16.0   6.49   6.50   -0.68   6  30    25.83   7   3   17.3    46.2
  153.6    16.0   6.49   6.50   -0.68   6  30    25.83   7   3   17.3    46.2
        1           0   10.81000       11.86000
↑
FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21                          06/27/2021
Resource International Inc                                   GRLWEAP Version 2010

 Depth                 (ft)      26.5
 Shaft Gain/Loss Factor         0.600  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    15.500  Pile Type                    H Pile
 Pile Size           (inch)    12.040

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
      ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
     0.0    15.50   29000.    492.0      4.0        0    16524.     27.2
    40.5    15.50   29000.    492.0      4.0        0    16524.     27.2

 Wave Travel Time 2L/c (ms)     4.901

        Pile and Soil Model            Total Capacity Rut  (kips)      97.9
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.179    11102 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.0    15.5
  2  0.179    11102 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.0    15.5
  5  0.179    11102 0.000 0.000 1.00     0.0   0.200 0.100  16.87   4.0    15.5
  6  0.179    11102 0.000 0.000 1.00     2.0   0.050 0.100  20.25   4.0    15.5
  7  0.179    11102 0.000 0.000 1.00    10.1   0.050 0.100  23.62   4.0    15.5
  8  0.179    11102 0.000 0.000 1.00    12.7   0.050 0.100  26.99   4.0    15.5
  9  0.179    11102 0.000 0.000 1.00    14.5   0.050 0.100  30.37   4.0    15.5
 10  0.179    11102 0.000 0.000 1.00    14.5   0.050 0.100  33.74   4.0    15.5
 11  0.179    11102 0.000 0.000 1.00    18.4   0.050 0.100  37.12   4.0    15.5
 12  0.179    11102 0.000 0.000 1.00    22.1   0.051 0.100  40.49   4.0    15.5
Toe                                      3.6   0.150 0.100

     2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.144 kips total reduced pile weight   (g= 32.17 ft/s2)
```

Depth ft	Stroke ft	Pressure Ratio	Efficy
26.52	10.81	1.00	0.800

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
97.9	7.3	5.39	5.34	-1.62	6	41	21.87	7	3	19.3	50.8
97.9	7.3	5.39	5.34	-1.63	6	41	21.87	7	3	19.3	50.8
97.9	7.3	5.39	5.34	-1.63	6	41	21.87	7	3	19.3	50.8
97.9	7.4	5.39	5.35	-1.64	6	41	21.87	7	3	19.3	50.8
97.9	7.3	5.39	5.34	-1.63	6	41	21.87	7	3	19.3	50.8

1 0 10.81000 11.86000

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 29.2
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model Total Capacity Rut (kips) 122.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	0.5	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	9.4	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	12.3	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	14.2	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	14.9	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	17.0	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	21.5	0.050	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	28.9	0.140	0.100	40.49	4.0	15.5
Toe						3.6	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)

2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
29.25	10.81	1.00	0.800

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
122.3	11.2	5.95	5.93	-1.03	6	32	23.99	6	3	18.1	48.3
123.6	11.4	5.98	5.96	-1.11	6	32	24.08	6	3	18.1	48.2
125.0	11.7	5.95	6.00	-1.20	6	32	24.00	6	3	17.8	48.2
126.4	12.0	5.99	6.03	-1.24	6	32	24.14	6	3	17.8	48.0
127.7	12.2	6.02	6.06	-1.27	6	32	24.23	6	3	17.8	47.9

1 0 10.81000 11.86000

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 32.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model Total Capacity Rut (kips) 146.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	7.8	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	11.8	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	13.9	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	15.3	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	15.7	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	21.0	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	27.4	0.128	0.100	37.12	4.0	15.5

12	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	40.49	4.0	15.5
Toe						3.6	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
31.98	10.81	1.00	0.800

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
146.6	15.1	6.40	6.42	-0.82	5	31	25.43	5	3	17.3	46.5
149.3	15.5	6.45	6.47	-0.70	5	31	25.57	5	3	17.2	46.4
152.1	16.0	6.49	6.51	-0.57	5	31	25.70	5	3	17.1	46.2
154.8	16.4	6.54	6.55	-0.54	5	50	25.87	5	3	17.2	46.1
157.5	16.9	6.58	6.59	-0.77	5	50	25.97	5	3	17.1	45.9

1 0 10.81000 11.86000

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 32.0
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model Total Capacity Rut (kips) 166.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	7.9	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	11.8	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	13.9	0.050	0.100	23.62	4.0	15.5

8	0.179	11102	0.000	0.000	1.00	15.2	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	15.8	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	21.0	0.050	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	27.5	0.129	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	40.49	4.0	15.5
Toe						23.0	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
32.02	10.81	1.00	0.800

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
166.3	18.4	6.79	6.73	-0.78	5	49	26.63	5	3	17.1	45.3
169.0	18.8	6.83	6.77	-0.78	5	49	26.74	5	3	17.2	45.2
171.8	19.4	6.87	6.81	-0.78	5	48	26.87	5	3	17.1	45.1
174.5	19.8	6.91	6.84	-0.80	5	48	26.99	5	3	17.1	44.9
177.2	20.3	6.94	6.88	-0.85	5	47	27.10	5	3	17.1	44.8

1 0 10.81000 11.86000

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 34.2
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model Total Capacity Rut (kips) 182.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	10.12	4.0	15.5

4	0.179	11102	0.000	0.000	1.00	4.5	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	11.0	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	13.3	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	15.1	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	14.3	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	20.1	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	24.7	0.099	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	25.3	0.102	0.100	40.49	4.0	15.5
Toe						24.3	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
34.25	10.81	1.00	0.800

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
182.8	21.0	6.99	6.93	-0.72	4	46	27.14	5	3	17.0	44.7
185.5	21.6	7.02	6.97	-0.73	4	46	27.22	5	3	17.0	44.6
188.3	22.2	7.06	7.01	-0.72	4	46	27.35	5	3	16.9	44.4
191.0	22.8	7.09	7.05	-0.71	4	46	27.42	5	3	16.8	44.3
193.7	23.2	7.12	7.08	-0.69	4	46	27.51	5	3	16.9	44.2

1 0 10.81000 11.86000

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 36.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model Total Capacity Rut (kips) 200.1

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area

	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	1.6	0.050	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	9.9	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	12.6	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	14.4	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	14.6	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	18.0	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	21.9	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	29.9	0.148	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	27.7	0.132	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	23.9	0.050	0.100	40.49	4.0	15.5
Toe						25.6	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
36.48	10.81	1.00	0.800

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
200.1	23.9	7.17	7.12	-0.59	4	44	27.69	4	2	16.8	44.1
202.8	24.4	7.19	7.15	-0.61	4	44	27.76	4	3	16.8	44.0
205.5	25.0	7.22	7.19	-0.62	4	42	27.86	4	2	16.7	43.9
208.2	25.4	7.25	7.21	-0.68	4	42	27.95	4	3	16.8	43.9
210.9	25.9	7.27	7.24	-0.73	4	42	28.03	4	3	16.8	43.8

1 0 10.81000 11.86000

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 36.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model Total Capacity Rut (kips) 182.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	1.7	0.050	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	9.9	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	12.6	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	14.5	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	14.6	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	18.1	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	21.9	0.050	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	29.9	0.148	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	27.6	0.131	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	24.2	0.052	0.100	40.49	4.0	15.5
Toe						7.8	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
36.52	10.81	1.00	0.800

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
182.8	20.0	6.84	6.86	-0.68	4	46	26.78	4	3	16.8	45.0
185.5	20.3	6.96	6.89	-0.67	4	46	27.10	4	3	17.0	44.8
188.3	21.0	7.00	6.94	-0.63	4	46	27.21	4	3	16.9	44.7
191.0	21.6	7.04	6.98	-0.59	4	46	27.32	4	2	16.9	44.5
193.8	22.2	7.08	7.02	-0.57	4	44	27.47	4	3	16.9	44.4

1 0 10.81000 11.86000

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 38.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c

ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model — Total Capacity Rut (kips) 220.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.200	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	0.0	0.050	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	7.1	0.050	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	11.6	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	13.7	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	15.4	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	15.3	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	20.8	0.050	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	26.9	0.123	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	23.7	0.065	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	48.0	0.136	0.100	40.49	4.0	15.5
Toe						7.8	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
38.49	10.81	1.00	0.800

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
220.3	28.5	7.38	7.37	-0.53	3	41	28.19	3	2	16.5	43.5
225.1	29.3	7.42	7.40	-0.48	3	41	28.29	3	2	16.5	43.4
230.1	30.1	7.45	7.43	-0.41	3	41	28.39	3	2	16.5	43.3
234.8	31.2	7.49	7.48	-0.46	3	39	28.50	3	2	16.4	43.1
239.6	32.1	7.53	7.52	-0.49	3	39	28.61	3	2	16.4	43.0

1 0 10.81000 11.86000

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 40.5
Shaft Gain/Loss Factor 0.600 Toe Gain/Loss Factor 1.000

PILE PROFILE:

Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
40.5	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 4.901

Pile and Soil Model — Total Capacity Rut (kips) 258.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.179	11102	0.010	0.000	0.85	0.0	0.050	0.100	3.37	4.0	15.5
2	0.179	11102	0.000	0.000	1.00	3.1	0.050	0.100	6.75	4.0	15.5
3	0.179	11102	0.000	0.000	1.00	10.5	0.050	0.100	10.12	4.0	15.5
4	0.179	11102	0.000	0.000	1.00	13.0	0.050	0.100	13.50	4.0	15.5
5	0.179	11102	0.000	0.000	1.00	14.8	0.050	0.100	16.87	4.0	15.5
6	0.179	11102	0.000	0.000	1.00	14.2	0.050	0.100	20.25	4.0	15.5
7	0.179	11102	0.000	0.000	1.00	19.4	0.050	0.100	23.62	4.0	15.5
8	0.179	11102	0.000	0.000	1.00	23.4	0.078	0.100	26.99	4.0	15.5
9	0.179	11102	0.000	0.000	1.00	30.1	0.150	0.100	30.37	4.0	15.5
10	0.179	11102	0.000	0.000	1.00	26.4	0.117	0.100	33.74	4.0	15.5
11	0.179	11102	0.000	0.000	1.00	31.4	0.100	0.100	37.12	4.0	15.5
12	0.179	11102	0.000	0.000	1.00	64.3	0.150	0.100	40.49	4.0	15.5
Toe						7.8	0.150	0.100			

2.144 kips total unreduced pile weight (g= 32.17 ft/s2)
2.144 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
40.49	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
258.5	36.2	7.68	7.66	-0.29	3	36	29.04	3	2	16.3	42.7
265.3	37.8	7.73	7.72	-0.27	3	36	29.17	3	2	16.3	42.5
272.4	39.3	7.78	7.78	-0.29	3	35	29.32	3	2	16.3	42.4
279.3	40.8	7.82	7.82	-0.39	3	35	29.43	3	2	16.4	42.3
286.2	42.4	7.87	7.87	-0.48	3	34	29.56	3	2	16.5	42.1

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.600 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.2	3.6	7.3	21.874	-1.625	5.39	19.3
29.2	122.3	118.6	3.6	11.2	23.986	-1.025	5.95	18.1
32.0	146.6	143.0	3.6	15.1	25.426	-0.821	6.40	17.3
32.0	166.3	143.3	23.0	18.4	26.627	-0.776	6.79	17.1
34.2	182.8	158.5	24.3	21.0	27.137	-0.721	6.99	17.0
36.5	200.1	174.5	25.6	23.9	27.695	-0.594	7.17	16.8
36.5	182.8	175.1	7.8	20.0	26.781	-0.683	6.84	16.8
38.5	220.3	212.6	7.8	28.5	28.190	-0.528	7.38	16.5
40.5	258.5	250.7	7.8	36.2	29.037	-0.290	7.68	16.3

Total Driving Time 9 minutes; Total No. of Blows 403

G/L at Shaft and Toe: 0.633 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0

18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.3	21.867	-1.626	5.39	19.3
29.2	123.6	120.0	3.6	11.4	24.085	-1.114	5.98	18.1
32.0	149.3	145.7	3.6	15.5	25.575	-0.701	6.45	17.2
32.0	169.0	146.0	23.0	18.8	26.744	-0.776	6.83	17.2
34.2	185.5	161.2	24.3	21.6	27.216	-0.729	7.02	17.0
36.5	202.8	177.2	25.6	24.4	27.760	-0.614	7.19	16.8
36.5	185.5	177.8	7.8	20.3	27.102	-0.668	6.96	17.0
38.5	225.1	217.4	7.8	29.3	28.291	-0.477	7.42	16.5
40.5	265.3	257.6	7.8	37.8	29.174	-0.270	7.73	16.3

Total Driving Time 9 minutes; Total No. of Blows 410

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.667 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.3	21.868	-1.626	5.39	19.3
29.2	125.0	121.4	3.6	11.7	23.998	-1.196	5.95	17.8
32.0	152.1	148.5	3.6	16.0	25.697	-0.569	6.49	17.1
32.0	171.8	148.8	23.0	19.4	26.869	-0.778	6.87	17.1

34.2	188.3	164.0	24.3	22.2	27.347	-0.723	7.06	16.9
36.5	205.5	180.0	25.6	25.0	27.864	-0.625	7.22	16.7
36.5	188.3	180.6	7.8	21.0	27.208	-0.635	7.00	16.9
38.5	230.1	222.3	7.8	30.1	28.388	-0.409	7.45	16.5
40.5	272.4	264.7	7.8	39.3	29.320	-0.287	7.78	16.3

Total Driving Time 9 minutes; Total No. of Blows 417

G/L at Shaft and Toe: 0.700 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.4	21.874	-1.637	5.39	19.3
29.2	126.4	122.7	3.6	12.0	24.137	-1.238	5.99	17.8
32.0	154.8	151.2	3.6	16.4	25.870	-0.542	6.54	17.2
32.0	174.5	151.5	23.0	19.8	26.988	-0.799	6.91	17.1
34.2	191.0	166.7	24.3	22.8	27.419	-0.711	7.09	16.8
36.5	208.2	182.7	25.6	25.4	27.952	-0.683	7.25	16.8
36.5	191.0	183.3	7.8	21.6	27.317	-0.587	7.04	16.9
38.5	234.8	227.1	7.8	31.2	28.502	-0.463	7.49	16.4
40.5	279.3	271.5	7.8	40.8	29.429	-0.388	7.82	16.4

Total Driving Time 9 minutes; Total No. of Blows 426

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.733 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft

1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	20.8	3.1	17.7	1.7	10.065	0.000	3.75	24.5
10.5	39.3	14.9	24.4	3.3	15.867	0.000	4.34	21.8
10.5	46.2	15.1	31.2	4.0	17.487	0.000	4.63	21.2
11.8	53.0	19.7	33.3	4.7	18.514	0.000	4.80	20.7
13.0	60.0	24.6	35.5	5.3	19.414	0.000	4.96	20.3
13.0	42.4	24.7	17.7	3.3	16.036	0.000	4.34	21.8
15.5	54.9	35.2	19.7	4.3	18.248	0.000	4.71	21.0
18.0	68.5	46.8	21.7	5.5	19.765	-0.398	4.95	20.0
18.0	58.7	46.9	11.7	4.3	18.437	-0.217	4.70	21.0
19.2	63.9	51.7	12.2	4.8	18.933	-0.131	4.77	20.5
20.5	69.4	56.7	12.8	5.2	19.759	-0.320	4.94	20.4
20.5	104.6	56.9	47.7	10.1	23.022	-0.873	5.72	18.2
23.5	128.1	74.4	53.7	12.9	24.581	-0.915	6.13	17.7
26.5	153.6	93.9	59.7	16.0	25.833	-0.683	6.49	17.3
26.5	97.9	94.3	3.6	7.3	21.872	-1.628	5.39	19.3
29.2	127.7	124.1	3.6	12.2	24.225	-1.267	6.02	17.8
32.0	157.5	153.9	3.6	16.9	25.970	-0.766	6.58	17.1
32.0	177.2	154.2	23.0	20.3	27.100	-0.846	6.94	17.1
34.2	193.7	169.4	24.3	23.2	27.512	-0.692	7.12	16.9
36.5	210.9	185.4	25.6	25.9	28.028	-0.735	7.27	16.8
36.5	193.8	186.0	7.8	22.2	27.467	-0.570	7.08	16.9
38.5	239.6	231.9	7.8	32.1	28.609	-0.486	7.53	16.4
40.5	286.2	278.4	7.8	42.4	29.565	-0.477	7.87	16.5

Total Driving Time 9 minutes; Total No. of Blows 433

FRA-70-13.01 Pier 2 (B-014-4-19) : 06/21 06/27/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
1.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
1.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
2.25	40.49	0.00	10.81	1.00	0.80	1.00	1.00
2.98	40.49	0.00	10.81	1.00	0.80	1.00	1.00
3.02	40.49	0.00	10.81	1.00	0.80	1.00	1.00
6.75	40.49	0.00	10.81	1.00	0.80	1.00	1.00
10.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
10.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
11.75	40.49	0.00	10.81	1.00	0.80	1.00	1.00
12.98	40.49	0.00	10.81	1.00	0.80	1.00	1.00

13.02	40.49	0.00	10.81	1.00	0.80	1.00	1.00
15.50	40.49	0.00	10.81	1.00	0.80	1.00	1.00
17.98	40.49	0.00	10.81	1.00	0.80	1.00	1.00
18.02	40.49	0.00	10.81	1.00	0.80	1.00	1.00
19.25	40.49	0.00	10.81	1.00	0.80	1.00	1.00
20.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
20.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
23.50	40.49	0.00	10.81	1.00	0.80	1.00	1.00
26.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
26.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
29.25	40.49	0.00	10.81	1.00	0.80	1.00	1.00
31.98	40.49	0.00	10.81	1.00	0.80	1.00	1.00
32.02	40.49	0.00	10.81	1.00	0.80	1.00	1.00
34.25	40.49	0.00	10.81	1.00	0.80	1.00	1.00
36.48	40.49	0.00	10.81	1.00	0.80	1.00	1.00
36.52	40.49	0.00	10.81	1.00	0.80	1.00	1.00
38.49	40.49	0.00	10.81	1.00	0.80	1.00	1.00
40.49	40.49	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

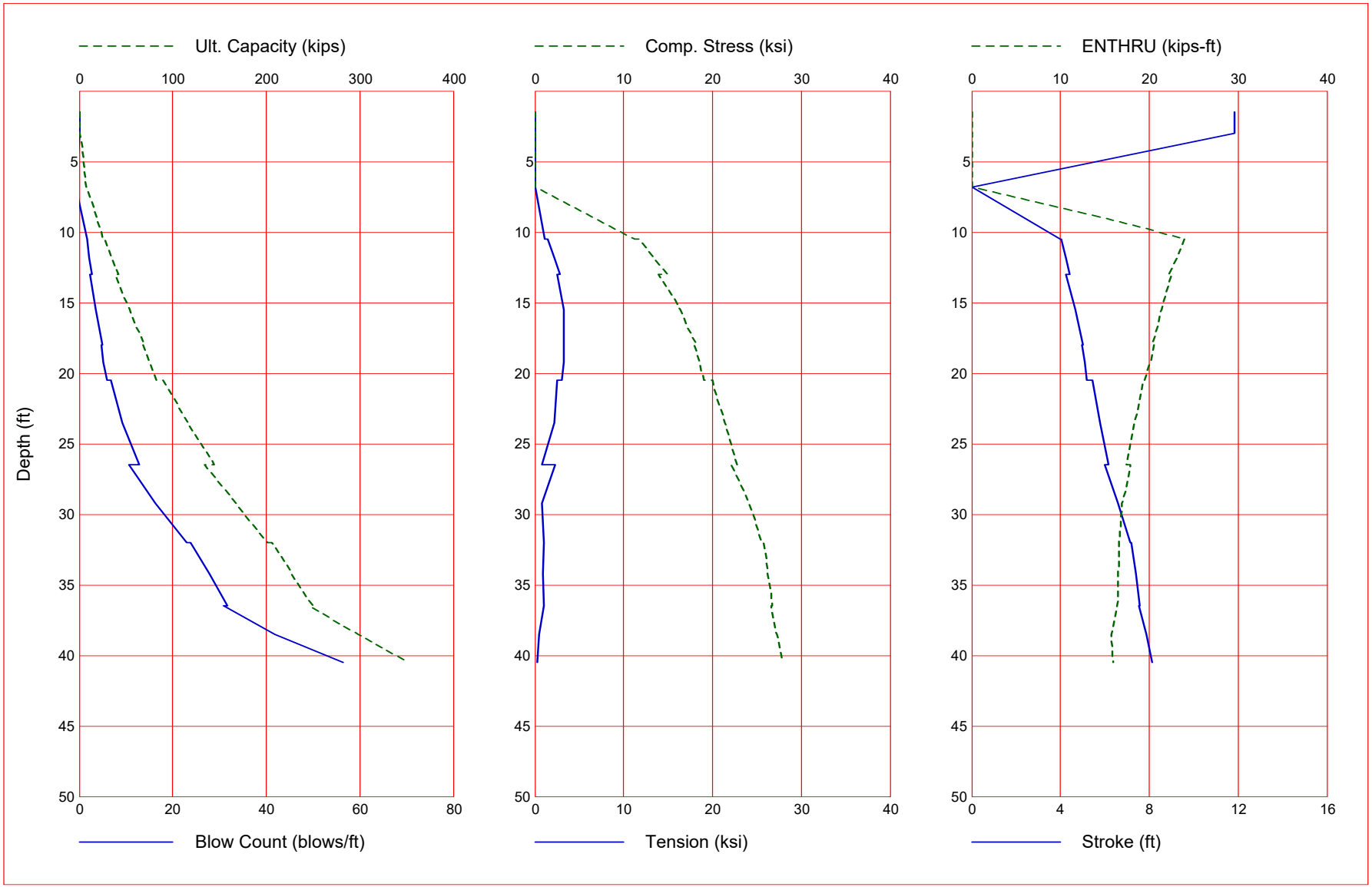
Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
1.49	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
3.01	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.39	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.41	0.52	14.14	0.100	0.100	0.050	0.150	0.000	6.000	24.000
6.40	0.62	16.76	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.40	0.72	19.40	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.99	0.77	20.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
8.01	0.77	21.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
9.00	0.82	22.36	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.00	0.88	23.74	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.49	0.90	24.41	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.51	0.91	31.15	0.100	0.100	0.050	0.150	0.000	6.000	24.000
11.50	0.96	32.88	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.50	1.01	34.63	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.99	1.03	35.49	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.01	1.01	17.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
14.00	1.05	18.51	0.100	0.100	0.050	0.150	0.000	6.000	24.000
15.00	1.10	19.32	0.100	0.100	0.050	0.150	0.000	6.000	24.000
16.00	1.14	20.13	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.00	1.19	20.94	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.99	1.24	21.74	0.100	0.100	0.050	0.150	0.000	6.000	24.000
18.01	0.95	11.70	0.100	0.100	0.050	0.150	0.000	6.000	24.000
19.00	0.99	12.13	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.00	1.02	12.56	0.100	0.100	0.050	0.150	0.000	6.000	24.000

20.49	1.04	12.77	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.51	1.39	47.69	0.100	0.100	0.050	0.150	0.000	6.000	24.000
21.50	1.45	49.68	0.100	0.100	0.050	0.150	0.000	6.000	24.000
22.50	1.51	51.69	0.100	0.100	0.050	0.150	0.000	6.000	24.000
23.50	1.57	53.70	0.100	0.100	0.050	0.150	0.000	6.000	24.000
24.50	1.62	55.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
25.50	1.68	57.72	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.49	1.74	59.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.51	3.75	3.63	0.100	0.100	0.150	0.150	1.000	6.000	336.000
31.99	3.75	3.63	0.100	0.100	0.150	0.150	1.000	6.000	336.000
32.01	1.66	22.98	0.100	0.100	0.050	0.150	0.000	6.000	24.000
33.00	1.71	23.55	0.100	0.100	0.050	0.150	0.000	6.000	24.000
34.00	1.75	24.13	0.100	0.100	0.050	0.150	0.000	6.000	24.000
35.00	1.79	24.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.00	1.83	25.29	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.49	1.85	25.58	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.51	8.00	7.75	0.100	0.100	0.150	0.150	1.000	6.000	336.000
40.49	8.00	7.75	0.100	0.100	0.150	0.150	1.000	6.000	336.000

Resource International Inc
FRA-70-13.01 : 06/25/2021 : HSK

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 4 at Shaft and Toe 0.703 / 1.000



Resource International Inc
FRA-70-13.01 : 06/25/2021 : HSK

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 4 at Shaft and Toe 0.703 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	-1.0	0.000	0.000	0.00	0.0
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.7	22.166	-2.253	6.00	17.9
29.2	167.6	166.8	0.8	16.3	24.111	-0.841	6.60	16.9
32.0	201.4	200.6	0.8	22.9	25.579	-1.059	7.15	16.6
32.0	205.8	201.1	4.7	23.8	25.753	-1.063	7.20	16.6
34.2	227.2	222.2	5.0	27.9	26.159	-0.902	7.41	16.5
36.5	249.7	244.4	5.2	31.7	26.670	-0.969	7.57	16.4
36.5	246.8	245.2	1.6	30.9	26.584	-0.987	7.54	16.4
38.5	298.6	297.0	1.6	41.8	27.295	-0.526	7.87	15.7
40.5	351.5	349.9	1.6	56.4	27.909	-0.254	8.12	15.9

Total Continuous Driving Time 11.00 minutes; Total Number of Blows 480

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins
and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

↑

Input File: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\PIER 2\DOWNDRAG\FRA-70-13.01 - PIER 2 HP 14X73 - B-014-4-19-WDD.GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 : 06/25/2021 : HSK

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	21.400	14.580	H Pile

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.900	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
40.480	21.40	29000.0	492.000	4.699	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
1.49	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
1.51	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.50	6.00	336.0
3.01	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
5.39	0.00	0.00	0.10	0.10	0.05	0.15	1.00	6.00	24.0
5.40	0.62	2.90	0.10	0.10	0.05	0.15	1.00	6.00	24.0
7.99	0.92	4.30	0.10	0.10	0.05	0.15	1.00	6.00	24.0
8.01	0.93	4.31	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.49	1.08	5.01	0.10	0.10	0.05	0.15	1.00	6.00	24.0
10.51	1.09	6.39	0.10	0.10	0.05	0.15	1.00	6.00	24.0
12.99	1.24	7.28	0.10	0.10	0.05	0.15	1.00	6.00	24.0
13.01	1.20	3.63	0.10	0.10	0.05	0.15	1.00	6.00	24.0
17.99	1.47	4.46	0.10	0.10	0.05	0.15	1.00	6.00	24.0
18.01	1.11	2.40	0.10	0.10	0.05	0.15	1.00	6.00	24.0

20.49	1.21	2.62	0.10	0.10	0.05	0.15	1.00	6.00	24.0
20.51	1.66	9.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.49	2.08	12.25	0.10	0.10	0.05	0.15	1.00	6.00	24.0
26.51	3.75	0.75	0.10	0.10	0.15	0.15	1.50	6.00	336.0
31.99	3.75	0.75	0.10	0.10	0.15	0.15	1.50	6.00	336.0
32.01	1.96	4.71	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.49	2.18	5.25	0.10	0.10	0.05	0.15	1.00	6.00	24.0
36.51	8.00	1.59	0.10	0.10	0.15	0.15	1.50	6.00	336.0
40.48	8.00	1.59	0.10	0.10	0.15	0.15	1.50	6.00	336.0

Gain/Loss factors: shaft and toe

0.60400	0.63700	0.67000	0.70300	0.73600
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
1.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
1.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
2.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
3.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
6.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
10.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
11.75	0.00	0.00	0.000	0.000	0.000	0.000	0.000
12.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
13.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
15.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
18.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
19.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
20.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
23.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
26.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
29.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
31.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
32.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
34.25	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
36.52	0.00	0.00	0.000	0.000	0.000	0.000	0.000
38.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
40.48	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

FRA-70-13.01 : 06/25/2021 : HSK

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		15331.0			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

Depth	(ft)	1.5			
Shaft Gain/Loss Factor		0.604	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	21.400	Pile Type		H Pile

```
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)       0.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  40.48   4.7    21.4
Toe                                      0.0   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)

 PILE, SOIL, ANALYSIS OPTIONS:
 Uniform pile                          Pile Segments: Automatic
 No. of Slacks/Splices              0  Pile Damping           (%)         1
                                       Pile Damping Fact.(k/ft/s)     0.751
 Driveability Analysis
 Soil Damping Option            Smith
 Max No Analysis Iterations         0  Time Increment/Critical          160
 Output Time Interval               1  Analysis Time-Input   (ms)         0
 Output Level: Normal
 Gravity Mass, Pile, Hammer:   32.170    32.170    32.170
 Output Segment Generation: Automatic

    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     1.48     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
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Hammer+Pile Weight > Rult: Pile Runs

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000		11.86000						

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 1.5
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	40.48	4.7	21.4
Toe						0.0	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
1.52	10.81	1.00	0.800

INITIAL STATIC ANALYSIS: Total Wt, Sum(R) 5.6 0.0
Hammer+Pile Weight > Rult: Pile Runs

```
INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs
```

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i t	Comp Str ksi	i t	ENTHRU kip-ft	Bl Rt b/min
1		0	10.81000		11.86000				

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

```
 Depth                 (ft)       2.2
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                     H Pile
 Pile Size           (inch)    14.580
```

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

```
 Wave Travel Time 2L/c (ms)     4.899
```

Pile and Soil Model — Total Capacity Rut (kips) 0.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	40.48	4.7	21.4
Toe						0.0	0.150	0.100			

```
     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)
```

```
    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     2.25     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs
🡅
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                              GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
         1          0   10.81000       11.86000
🡅
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                              GRLWEAP Version 2010

 Depth                 (ft)       3.0
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                   H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi  lb/ft3       ft             ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899
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```
        Pile and Soil Model            Total Capacity Rut  (kips)       0.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  40.48   4.7    21.4
Toe                                      0.0   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     2.98     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs
↑
FRA-70-13.01 : 06/25/2021 : HSK                               06/27/2021
Resource International Inc                              GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                               06/27/2021
Resource International Inc                              GRLWEAP Version 2010

 Depth                 (ft)       3.0
 Shaft Gain/Loss Factor        0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
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```
 Toe Area             (in2)    21.400  Pile Type                    H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)       0.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  40.48   4.7    21.4
Toe                                      0.0   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     3.02     10.81      1.00     0.800


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs


INITIAL STATIC ANALYSIS: Total Wt, Sum(R)     5.6     0.0
 Hammer+Pile Weight > Rult: Pile Runs
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
```

```
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
         1           0   10.81000       11.86000
```



```
 Depth                 (ft)       6.8
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                     H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)       8.1
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00     4.5   0.050 0.100  40.48   4.7    21.4
Toe                                      3.6   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
     6.75     10.81      1.00     0.800
```



```
    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
    8.1  Hammer did not run
    8.1  Hammer did not run
    8.1  Hammer did not run
    8.1  Hammer did not run
    8.1  Hammer did not run
         1           0   10.81000       11.86000
```

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FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      10.5
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                    H Pile
 Pile Size           (inch)    14.580

  L b Top     Area     E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2       ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)      26.1
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in     ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00     5.8   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    15.3   0.050 0.100  40.48   4.7    21.4
Toe                                      5.0   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    10.48     10.81      1.00     0.800
⬆
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up      ksi              ksi         kip-ft   b/min
   26.1     1.7   3.97    3.93   -1.16   5   6    11.26   1   2    24.1    59.7
   26.1     1.7   3.97    3.93   -1.16   5   6    11.26   1   2    24.1    59.7
   26.1     1.7   3.97    3.93   -1.16   5   6    11.26   1   2    24.1    59.7
   26.1     1.7   3.97    3.93   -1.16   5   6    11.26   1   2    24.1    59.7
   26.1     1.7   3.97    3.93   -1.16   5   6    11.26   1   2    24.1    59.7
          1           0   10.81000       11.86000
⬆
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010
```

```
 Depth                 (ft)      10.5
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                     H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)      27.7
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00     6.0   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    15.4   0.050 0.100  40.48   4.7    21.4
Toe                                      6.4   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    10.52     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                              GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips   b/ft   down      up     ksi              ksi        kip-ft    b/min
   27.7    1.8   4.02    4.00   -1.39   5   6    11.72   1   2    23.9    59.2
   27.7    1.8   4.02    4.00   -1.39   5   6    11.72   1   2    23.9    59.2
   27.7    1.8   4.02    4.00   -1.39   5   6    11.72   1   2    23.9    59.2
   27.7    1.8   4.02    4.00   -1.39   5   6    11.72   1   2    23.9    59.2
   27.7    1.8   4.02    4.00   -1.39   5   6    11.72   1   2    23.9    59.2
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                              GRLWEAP Version 2010

 Depth                 (ft)      11.8
```

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 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                     H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)      34.7
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    11.1   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    16.7   0.050 0.100  40.48   4.7    21.4
Toe                                      6.8   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    11.75     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
   34.7     2.2   4.23   4.21   -2.24   4   6    13.42   1   2   23.1    57.7
   34.7     2.2   4.23   4.21   -2.24   4   6    13.42   1   2   23.1    57.7
   34.7     2.2   4.23   4.21   -2.24   4   6    13.42   1   2   23.1    57.7
   34.7     2.2   4.23   4.21   -2.24   4   6    13.42   1   2   23.1    57.7
   34.7     2.2   4.23   4.21   -2.24   4   6    13.42   1   2   23.1    57.7
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      13.0
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000
```

```
 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                    H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
      ft      in2      ksi  lb/ft3       ft             ft/s    k/ft/s
     0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
    40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

       Pile and Soil Model           Total Capacity Rut  (kips)      42.0
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00     2.6   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    14.2   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    17.9   0.050 0.100  40.48   4.7    21.4
Toe                                      7.3   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    12.98     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                              GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU    Bl Rt
   kips     b/ft    down      up     ksi               ksi           kip-ft    b/min
   42.0      2.8    4.42    4.41   -2.84    4    6    14.83    1    2   22.2     56.4
   42.0      2.8    4.42    4.41   -2.84    4    6    14.83    1    2   22.2     56.4
   42.0      2.8    4.42    4.41   -2.84    4    6    14.83    1    2   22.2     56.4
   42.0      2.8    4.42    4.41   -2.84    4    6    14.83    1    2   22.2     56.4
   42.0      2.8    4.42    4.41   -2.84    4    6    14.83    1    2   22.2     56.4
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                              GRLWEAP Version 2010

 Depth                  (ft)      13.0
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                    H Pile
```

```
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

       Pile and Soil Model            Total Capacity Rut  (kips)      38.6
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips      k/in    ft    ft        kips    s/ft  inch     ft    ft     in2
  1  0.247     15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247     15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  9  0.247     15331 0.000 0.000 1.00     0.0   0.200 0.100  30.36   4.7    21.4
 10  0.247     15331 0.000 0.000 1.00     2.8   0.050 0.100  33.73   4.7    21.4
 11  0.247     15331 0.000 0.000 1.00    14.2   0.050 0.100  37.11   4.7    21.4
 12  0.247     15331 0.000 0.000 1.00    18.0   0.050 0.100  40.48   4.7    21.4
Toe                                       3.6   0.150 0.100

    2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
    2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


   Depth    Stroke  Pressure    Efficy
      ft        ft     Ratio
   13.02     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

   Rut    Bl Ct   Stroke (ft) Ten Str   i    t Comp Str   i    t ENTHRU    Bl Rt
  kips    b/ft   down      up     ksi              ksi          kip-ft    b/min
  38.6     2.4   4.26    4.29   -2.55   4    6    13.88   1    2   22.6     57.3
  38.6     2.4   4.26    4.29   -2.55   4    6    13.88   1    2   22.6     57.3
  38.6     2.4   4.26    4.29   -2.55   4    6    13.88   1    2   22.6     57.3
  38.6     2.4   4.26    4.29   -2.55   4    6    13.88   1    2   22.6     57.3
  38.6     2.4   4.26    4.29   -2.55   4    6    13.88   1    2   22.6     57.3
        1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

 Depth                 (ft)      15.5
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area              (in2)    21.400  Pile Type                     H Pile
 Pile Size           (inch)    14.580
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  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)      53.8
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00    12.8   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    17.1   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    19.8   0.050 0.100  40.48   4.7    21.4
Toe                                      4.0   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    15.50     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU    Bl Rt
   kips     b/ft    down      up     ksi              ksi            kip-ft    b/min
   53.8      3.5    4.68    4.64   -3.29    4    6    16.32    7    3   21.4     54.8
   53.8      3.5    4.68    4.64   -3.29    4    6    16.32    7    3   21.4     54.8
   53.8      3.5    4.68    4.64   -3.29    4    6    16.32    7    3   21.4     54.8
   53.8      3.5    4.68    4.64   -3.29    4    6    16.32    7    3   21.4     54.8
   53.8      3.5    4.68    4.64   -3.29    4    6    16.32    7    3   21.4     54.8
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                (ft)      18.0
 Shaft Gain/Loss Factor        0.604  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area            (in2)    21.400  Pile Type                    H Pile
 Pile Size          (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
```

```
       ft      in2      ksi   lb/ft3       ft                ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)      70.6
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  7  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  23.61   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00     8.9   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00    16.2   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    19.2   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    21.8   0.050 0.100  40.48   4.7    21.4
Toe                                      4.5   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    17.98     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut    Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up     ksi               ksi         kip-ft   b/min
   70.6     4.9   5.03    4.98   -3.20   4   6    18.21   9   4   20.3    52.9
   70.6     4.9   5.03    4.98   -3.20   4   6    18.21   9   4   20.3    52.9
   70.6     4.9   5.03    4.98   -3.20   4   6    18.21   9   4   20.3    52.9
   70.6     4.9   5.03    4.98   -3.20   4   6    18.21   9   4   20.3    52.9
   70.6     4.9   5.03    4.98   -3.20   4   6    18.21   9   4   20.3    52.9
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      18.0
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area            (in2)    21.400  Pile Type                     H Pile
 Pile Size          (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
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```
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)      68.7
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85      0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00      0.0   0.000 0.100   6.75   4.7    21.4
  7  0.247    15331 0.000 0.000 1.00      0.0   0.200 0.100  23.61   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00      0.0   0.050 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00      9.0   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00     16.2   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00     19.2   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00     21.8   0.050 0.100  40.48   4.7    21.4
Toe                                       2.4   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    18.02     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str    i   t Comp Str    i   t ENTHRU    Bl Rt
   kips    b/ft    down      up     ksi               ksi           kip-ft    b/min
   68.7     4.7    4.97    4.93   -3.28    4   6    17.98    9   4    20.5     53.2
   68.7     4.7    4.97    4.93   -3.28    4   6    17.98    9   4    20.5     53.2
   68.7     4.7    4.97    4.93   -3.28    4   6    17.98    9   4    20.5     53.2
   68.7     4.7    4.97    4.93   -3.28    4   6    17.98    9   4    20.5     53.2
   68.7     4.7    4.97    4.93   -3.28    4   6    17.98    9   4    20.5     53.2
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      19.2
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                     H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
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       ft      in2      ksi   lb/ft3       ft             ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7         0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7         0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)      75.4
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips      k/in    ft    ft        kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  7  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  23.61   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00     1.1   0.050 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00    13.5   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00    17.5   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    20.1   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    20.8   0.050 0.100  40.48   4.7    21.4
Toe                                      2.5   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    19.25     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str    i    t Comp Str    i    t ENTHRU    Bl Rt
   kips    b/ft    down      up     ksi              ksi           kip-ft    b/min
   75.4      5.2    5.10    5.05   -3.23    4    6    18.56    9    4   20.1     52.5
   75.4      5.2    5.10    5.05   -3.23    4    6    18.56    9    4   20.1     52.5
   75.4      5.2    5.10    5.05   -3.23    4    6    18.56    9    4   20.1     52.5
   75.4      5.2    5.10    5.05   -3.23    4    6    18.56    9    4   20.1     52.5
   75.4      5.2    5.10    5.05   -3.23    4    6    18.56    9    4   20.1     52.5
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      20.5
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                    H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
```

```
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)      82.4
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  6  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  20.24   4.7    21.4
  7  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  23.61   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00     5.3   0.050 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00    15.2   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00    18.6   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    21.1   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    19.6   0.050 0.100  40.48   4.7    21.4
Toe                                      2.6   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    20.48     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up      ksi              ksi         kip-ft   b/min
   82.4     5.9   5.19   5.21   -3.03   4   6    19.02   8   3   19.5    51.8
   82.4     5.9   5.19   5.21   -3.03   4   6    19.02   8   3   19.5    51.8
   82.4     5.9   5.19   5.21   -3.03   4   6    19.02   8   3   19.5    51.8
   82.4     5.9   5.19   5.21   -3.03   4   6    19.02   8   3   19.5    51.8
   82.4     5.9   5.19   5.21   -3.03   4   6    19.02   8   3   19.5    51.8
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
Resource International Inc                               GRLWEAP Version 2010

 Depth                 (ft)      20.5
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                     H Pile
 Pile Size           (inch)    14.580
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```
  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi  lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

       Pile and Soil Model           Total Capacity Rut  (kips)      89.8
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  6  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  20.24   4.7    21.4
  7  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  23.61   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00     5.5   0.050 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00    15.2   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00    18.6   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    21.1   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    19.6   0.050 0.100  40.48   4.7    21.4
Toe                                      9.8   0.150 0.100

    2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
    2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    20.52     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

    Rut    Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips     b/ft   down     up     ksi              ksi          kip-ft   b/min
   89.8      6.8   5.43   5.39   -2.53   4   6    19.95   8   3   19.4    50.7
   89.8      6.8   5.43   5.39   -2.53   4   6    19.95   8   3   19.4    50.7
   89.8      6.8   5.43   5.39   -2.53   4   6    19.95   8   3   19.4    50.7
   89.8      6.8   5.43   5.39   -2.53   4   6    19.95   8   3   19.4    50.7
   89.8      6.8   5.43   5.39   -2.53   4   6    19.95   8   3   19.4    50.7
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

 Depth                 (ft)      23.5
 Shaft Gain/Loss Factor        0.604  Toe Gain/Loss Factor          1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                    H Pile
 Pile Size           (inch)    14.580
```

```
  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

       Pile and Soil Model            Total Capacity Rut  (kips)     115.8
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  6  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  20.24   4.7    21.4
  7  0.247    15331 0.000 0.000 1.00     4.0   0.050 0.100  23.61   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00    14.7   0.050 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00    18.3   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00    20.8   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    20.0   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    27.0   0.050 0.100  40.48   4.7    21.4
Toe                                     11.0   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    23.50     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

    Rut    Bl Ct    Stroke (ft) Ten Str    i   t Comp Str    i   t ENTHRU    Bl Rt
   kips     b/ft    down      up     ksi                ksi          kip-ft    b/min
  115.8      9.3    5.80    5.78   -2.14    8  38    21.40    8   3   18.3     49.0
  115.8      9.3    5.80    5.78   -2.14    8  38    21.40    8   3   18.3     49.0
  115.8      9.3    5.80    5.78   -2.14    8  38    21.40    8   3   18.3     49.0
  115.8      9.3    5.80    5.78   -2.14    8  38    21.40    8   3   18.3     49.0
  115.8      9.3    5.80    5.78   -2.14    8  38    21.40    8   3   18.3     49.0
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                   06/27/2021
Resource International Inc                                 GRLWEAP Version 2010

 Depth                (ft)      26.5
 Shaft Gain/Loss Factor        0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                      H Pile
```

```
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3      ft            ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7         0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7         0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)     144.8
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  5  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  16.87   4.7    21.4
  6  0.247    15331 0.000 0.000 1.00     2.7   0.050 0.100  20.24   4.7    21.4
  7  0.247    15331 0.000 0.000 1.00    14.2   0.050 0.100  23.61   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00    18.0   0.050 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00    20.4   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00    20.3   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    25.8   0.050 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    31.1   0.050 0.100  40.48   4.7    21.4
Toe                                     12.2   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    26.48     10.81      1.00     0.800
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
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    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down      up      ksi              ksi       kip-ft    b/min
  144.8    12.8   6.18    6.23    -0.79   5  31    22.79   7   3   17.4    47.4
  144.8    12.8   6.18    6.23    -0.79   5  31    22.79   7   3   17.4    47.4
  144.8    12.8   6.18    6.23    -0.79   5  31    22.79   7   3   17.4    47.4
  144.8    12.8   6.18    6.23    -0.79   5  31    22.79   7   3   17.4    47.4
  144.8    12.8   6.18    6.23    -0.79   5  31    22.79   7   3   17.4    47.4
          1           0   10.81000       11.86000
↑
FRA-70-13.01 : 06/25/2021 : HSK                                    06/27/2021
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 Depth                 (ft)      26.5
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor          1.000
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PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 133.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	2.8	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	14.2	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	18.0	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	20.5	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	20.3	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	25.9	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	31.2	0.051	0.100	40.48	4.7	21.4
Toe						0.8	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
26.52	10.81	1.00	0.800

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
133.7	10.7	6.00	5.99	-2.25	10	5	22.16	7	3	17.9	48.2
133.7	10.8	6.01	5.99	-2.31	10	5	22.20	7	3	17.9	48.1
133.7	10.7	6.00	5.99	-2.26	10	5	22.17	7	3	17.9	48.2
133.7	10.7	6.00	5.99	-2.25	10	5	22.17	7	3	17.9	48.2
133.8	10.8	6.00	5.99	-2.27	10	5	22.19	7	3	17.9	48.2

1 0 10.81000 11.86000

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 29.2

Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 162.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	0.7	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	13.3	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	17.3	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	20.0	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	20.9	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	24.0	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	30.5	0.050	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	35.3	0.139	0.100	40.48	4.7	21.4
Toe						0.8	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
29.25	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
162.8	15.6	6.53	6.55	-0.73	6	29	23.88	6	3	17.0	46.1
164.4	15.9	6.55	6.57	-0.94	6	50	23.94	6	3	16.9	46.0
166.0	16.1	6.58	6.59	-0.94	6	50	24.04	6	3	16.9	46.0
167.6	16.3	6.60	6.61	-0.84	5	49	24.11	6	3	16.9	45.9
169.2	16.6	6.62	6.63	-0.73	6	29	24.14	6	3	16.8	45.8

1 0 10.81000 11.86000

Resource International Inc GRLWEAP Version 2010

Depth (ft) 32.0
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 191.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.000	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	11.1	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	16.7	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	19.6	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	21.5	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	22.0	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	29.8	0.050	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	34.6	0.125	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	40.48	4.7	21.4
Toe						0.8	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
31.98	10.81	1.00	0.800

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
191.8	21.0	6.96	6.97	-0.97	5	45	25.04	5	3	16.5	44.7
195.0	21.4	7.07	7.00	-1.01	5	45	25.35	5	3	16.7	44.5
198.2	22.2	7.11	7.05	-1.04	5	44	25.45	5	3	16.6	44.4
201.4	22.9	7.15	7.10	-1.06	5	44	25.58	5	3	16.6	44.2

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  204.6    23.6   7.19   7.14   -1.07   5  44    25.68   5   3   16.5    44.1
         1           0   10.81000       11.86000
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 Depth                 (ft)      32.0
 Shaft Gain/Loss Factor         0.604  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    21.400  Pile Type                     H Pile
 Pile Size           (inch)    14.580

  L b Top     Area    E-Mod  Spec Wt    Perim  C Index  Wave Sp      EA/c
       ft      in2      ksi   lb/ft3       ft              ft/s    k/ft/s
      0.0    21.40   29000.    492.0      4.7        0    16524.     37.6
     40.5    21.40   29000.    492.0      4.7        0    16524.     37.6

 Wave Travel Time 2L/c (ms)     4.899

        Pile and Soil Model            Total Capacity Rut  (kips)     196.2
No. Weight   Stiffn C-Slk T-Slk  CoR  Soil-S  Soil-D Quake  LbTop Perim    Area
      kips     k/in    ft    ft         kips    s/ft  inch     ft    ft     in2
  1  0.247    15331 0.010 0.000 0.85     0.0   0.000 0.100   3.37   4.7    21.4
  2  0.247    15331 0.000 0.000 1.00     0.0   0.000 0.100   6.75   4.7    21.4
  3  0.247    15331 0.000 0.000 1.00     0.0   0.200 0.100  10.12   4.7    21.4
  4  0.247    15331 0.000 0.000 1.00     0.0   0.050 0.100  13.49   4.7    21.4
  5  0.247    15331 0.000 0.000 1.00    11.3   0.050 0.100  16.87   4.7    21.4
  6  0.247    15331 0.000 0.000 1.00    16.7   0.050 0.100  20.24   4.7    21.4
  7  0.247    15331 0.000 0.000 1.00    19.6   0.050 0.100  23.61   4.7    21.4
  8  0.247    15331 0.000 0.000 1.00    21.4   0.050 0.100  26.99   4.7    21.4
  9  0.247    15331 0.000 0.000 1.00    22.2   0.050 0.100  30.36   4.7    21.4
 10  0.247    15331 0.000 0.000 1.00    29.8   0.050 0.100  33.73   4.7    21.4
 11  0.247    15331 0.000 0.000 1.00    34.6   0.126 0.100  37.11   4.7    21.4
 12  0.247    15331 0.000 0.000 1.00    35.9   0.150 0.100  40.48   4.7    21.4
Toe                                     4.7   0.150 0.100

     2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
     2.960 kips total reduced pile weight   (g= 32.17 ft/s2)


    Depth    Stroke  Pressure    Efficy
       ft        ft     Ratio
    32.02     10.81      1.00     0.800
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    Rut   Bl Ct   Stroke (ft) Ten Str   i   t Comp Str   i   t ENTHRU   Bl Rt
   kips    b/ft   down     up     ksi              ksi         kip-ft   b/min
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196.2	21.9	7.01	7.03	-1.01	5	44	25.23	5	3	16.5	44.5
199.4	22.5	7.12	7.07	-1.04	5	44	25.51	5	3	16.6	44.3
202.6	23.2	7.16	7.11	-1.06	5	44	25.63	5	3	16.6	44.2
205.8	23.8	7.20	7.15	-1.06	5	44	25.75	5	3	16.6	44.1
209.0	24.6	7.25	7.20	-1.06	5	44	25.88	5	3	16.5	43.9

1 0 10.81000 11.86000

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 34.2
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 217.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	6.4	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	15.5	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	18.8	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	21.3	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	19.9	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	28.5	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	33.0	0.094	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	33.3	0.098	0.100	40.48	4.7	21.4
Toe						5.0	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
34.25	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
217.6	25.7	7.30	7.25	-0.95	4	42	25.87	5	3	16.5	43.8
220.8	26.5	7.34	7.29	-0.96	5	42	25.98	5	3	16.5	43.6
224.0	27.1	7.37	7.33	-0.92	4	42	26.08	5	3	16.5	43.5
227.2	27.9	7.41	7.37	-0.90	4	42	26.16	5	3	16.5	43.4
230.4	28.7	7.44	7.41	-0.88	4	42	26.27	5	3	16.4	43.3

1 0 10.81000 11.86000

Depth (ft) 36.5
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 240.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	2.3	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	14.0	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	17.8	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	25.4	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	31.0	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	35.8	0.148	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	34.5	0.129	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	33.2	0.050	0.100	40.48	4.7	21.4
Toe						5.2	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy

ft	ft	Ratio	
36.48	10.81	1.00	0.800

↑

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
240.1	29.4	7.48	7.45	-0.88	4	24	26.39	4	2	16.4	43.2
243.3	30.2	7.51	7.48	-0.91	4	24	26.47	4	2	16.4	43.1
246.5	31.0	7.54	7.52	-0.95	4	24	26.57	4	2	16.3	43.0
249.7	31.7	7.57	7.54	-0.97	4	24	26.67	4	2	16.4	43.0
252.9	32.4	7.59	7.57	-0.97	4	24	26.71	4	2	16.3	42.9

1 0 10.81000 11.86000

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FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 36.5
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 237.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.000	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.200	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	2.4	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	14.1	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	17.9	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	20.4	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	25.6	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	31.1	0.050	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	35.8	0.148	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	34.4	0.128	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	33.6	0.052	0.100	40.48	4.7	21.4
Toe						1.6	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)

2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
36.52	10.81	1.00	0.800

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
237.2	28.6	7.44	7.41	-0.90	12	5	26.32	4	2	16.4	43.3
240.4	29.4	7.48	7.45	-0.92	4	24	26.39	4	2	16.4	43.2
243.6	30.2	7.51	7.49	-0.96	4	24	26.46	4	2	16.4	43.1
246.8	30.9	7.54	7.51	-0.99	4	24	26.58	4	2	16.4	43.0
250.0	31.7	7.57	7.54	-1.01	4	24	26.65	4	2	16.4	43.0

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FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 38.5
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 281.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.200	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	0.0	0.050	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	10.0	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	16.4	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	19.4	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	21.7	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	21.3	0.050	0.100	23.61	4.7	21.4
8	0.247	15331	0.000	0.000	1.00	29.5	0.050	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	34.3	0.119	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	32.6	0.064	0.100	37.11	4.7	21.4

12	0.247	15331	0.000	0.000	1.00	59.1	0.134	0.100	40.48	4.7	21.4
Toe						1.6	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
38.48	10.81	1.00	0.800

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
281.7	38.4	7.79	7.78	-0.60	3	39	27.09	3	2	15.9	42.4
287.3	39.6	7.82	7.82	-0.49	3	39	27.15	3	2	15.8	42.3
293.0	40.7	7.84	7.84	-0.43	3	35	27.21	3	2	15.7	42.2
298.6	41.8	7.87	7.87	-0.53	3	35	27.29	3	2	15.7	42.1
304.3	43.0	7.90	7.90	-0.60	3	34	27.38	3	2	15.8	42.0

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FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 40.5
Shaft Gain/Loss Factor 0.604 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 21.400 Pile Type H Pile
Pile Size (inch) 14.580

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.40	29000.	492.0	4.7	0	16524.	37.6
40.5	21.40	29000.	492.0	4.7	0	16524.	37.6

Wave Travel Time 2L/c (ms) 4.899

Pile and Soil Model Total Capacity Rut (kips) 327.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.247	15331	0.010	0.000	0.85	0.0	0.050	0.100	3.37	4.7	21.4
2	0.247	15331	0.000	0.000	1.00	4.4	0.050	0.100	6.75	4.7	21.4
3	0.247	15331	0.000	0.000	1.00	14.9	0.050	0.100	10.12	4.7	21.4
4	0.247	15331	0.000	0.000	1.00	18.4	0.050	0.100	13.49	4.7	21.4
5	0.247	15331	0.000	0.000	1.00	20.9	0.050	0.100	16.87	4.7	21.4
6	0.247	15331	0.000	0.000	1.00	19.9	0.050	0.100	20.24	4.7	21.4
7	0.247	15331	0.000	0.000	1.00	27.4	0.050	0.100	23.61	4.7	21.4

8	0.247	15331	0.000	0.000	1.00	32.1	0.074	0.100	26.99	4.7	21.4
9	0.247	15331	0.000	0.000	1.00	35.9	0.150	0.100	30.36	4.7	21.4
10	0.247	15331	0.000	0.000	1.00	33.8	0.114	0.100	33.73	4.7	21.4
11	0.247	15331	0.000	0.000	1.00	41.3	0.095	0.100	37.11	4.7	21.4
12	0.247	15331	0.000	0.000	1.00	76.6	0.150	0.100	40.48	4.7	21.4
Toe						1.6	0.150	0.100			

2.960 kips total unreduced pile weight (g= 32.17 ft/s2)
2.960 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
40.48	10.81	1.00	0.800

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
327.1	50.1	7.97	8.05	-0.22	2	33	27.53	3	2	15.7	41.8
335.2	51.9	8.02	8.08	-0.28	3	32	27.67	3	2	15.8	41.6
343.3	54.1	8.07	8.13	-0.27	3	32	27.79	3	2	15.9	41.5
351.5	56.4	8.12	8.18	-0.25	3	32	27.91	3	2	15.9	41.4
359.6	58.7	8.17	8.22	-0.32	3	31	28.03	3	2	16.0	41.3

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.604 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	10.81	0.0
6.8	8.1	4.5	3.6	Hammer did not run				
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5

20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.7	22.164	-2.250	6.00	17.9
29.2	162.8	162.0	0.8	15.6	23.876	-0.730	6.53	17.0
32.0	191.8	191.1	0.8	21.0	25.044	-0.972	6.96	16.5
32.0	196.2	191.5	4.7	21.9	25.231	-1.014	7.01	16.5
34.2	217.6	212.6	5.0	25.7	25.868	-0.947	7.30	16.5
36.5	240.1	234.9	5.2	29.4	26.388	-0.879	7.48	16.4
36.5	237.2	235.6	1.6	28.6	26.324	-0.896	7.44	16.4
38.5	281.7	280.1	1.6	38.4	27.093	-0.595	7.79	15.9
40.5	327.1	325.5	1.6	50.1	27.530	-0.222	7.97	15.7

Total Driving Time 10 minutes; Total No. of Blows 451

G/L at Shaft and Toe: 0.637 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	Hammer did not run				
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.8	22.198	-2.309	6.01	17.9
29.2	164.4	163.6	0.8	15.9	23.942	-0.944	6.55	16.9
32.0	195.0	194.3	0.8	21.4	25.352	-1.015	7.07	16.7
32.0	199.4	194.7	4.7	22.5	25.514	-1.042	7.12	16.6
34.2	220.8	215.8	5.0	26.5	25.981	-0.958	7.34	16.5
36.5	243.3	238.1	5.2	30.2	26.466	-0.913	7.51	16.4
36.5	240.4	238.8	1.6	29.4	26.388	-0.916	7.48	16.4
38.5	287.3	285.7	1.6	39.6	27.152	-0.489	7.82	15.8
40.5	335.2	333.6	1.6	51.9	27.669	-0.283	8.02	15.8

Total Driving Time 10 minutes; Total No. of Blows 461

Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.670 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	Hammer did not run				
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.7	22.174	-2.260	6.00	17.9
29.2	166.0	165.2	0.8	16.1	24.044	-0.941	6.58	16.9
32.0	198.2	197.4	0.8	22.2	25.446	-1.042	7.11	16.6
32.0	202.6	197.9	4.7	23.2	25.628	-1.057	7.16	16.6
34.2	224.0	219.0	5.0	27.1	26.083	-0.922	7.37	16.5
36.5	246.5	241.3	5.2	31.0	26.571	-0.948	7.54	16.3
36.5	243.6	242.0	1.6	30.2	26.463	-0.956	7.51	16.4
38.5	293.0	291.4	1.6	40.7	27.214	-0.426	7.84	15.7
40.5	343.3	341.7	1.6	54.1	27.790	-0.266	8.07	15.9

Total Driving Time 11 minutes; Total No. of Blows 471

G/L at Shaft and Toe: 0.703 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	Hammer did not run				
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1

13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.7	133.0	0.8	10.7	22.166	-2.253	6.00	17.9
29.2	167.6	166.8	0.8	16.3	24.111	-0.841	6.60	16.9
32.0	201.4	200.6	0.8	22.9	25.579	-1.059	7.15	16.6
32.0	205.8	201.1	4.7	23.8	25.753	-1.063	7.20	16.6
34.2	227.2	222.2	5.0	27.9	26.159	-0.902	7.41	16.5
36.5	249.7	244.4	5.2	31.7	26.670	-0.969	7.57	16.4
36.5	246.8	245.2	1.6	30.9	26.584	-0.987	7.54	16.4
38.5	298.6	297.0	1.6	41.8	27.295	-0.526	7.87	15.7
40.5	351.5	349.9	1.6	56.4	27.909	-0.254	8.12	15.9

Total Driving Time 11 minutes; Total No. of Blows 480

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.736 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
1.5	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
2.2	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
3.0	0.0	0.0	0.0	0.0	0.000	0.000	11.86	0.0
6.8	8.1	4.5	3.6	Hammer did not run				
10.5	26.1	21.1	5.0	1.7	11.256	-1.163	3.97	24.1
10.5	27.7	21.3	6.4	1.8	11.721	-1.387	4.02	23.9
11.8	34.7	27.8	6.8	2.2	13.422	-2.235	4.23	23.1
13.0	42.0	34.8	7.3	2.8	14.827	-2.841	4.42	22.2
13.0	38.6	35.0	3.6	2.4	13.883	-2.548	4.26	22.6
15.5	53.8	49.8	4.0	3.5	16.322	-3.293	4.68	21.4
18.0	70.6	66.1	4.5	4.9	18.210	-3.201	5.03	20.3
18.0	68.7	66.3	2.4	4.7	17.976	-3.282	4.97	20.5
19.2	75.4	72.9	2.5	5.2	18.557	-3.233	5.10	20.1
20.5	82.4	79.8	2.6	5.9	19.015	-3.028	5.19	19.5
20.5	89.8	80.1	9.8	6.8	19.951	-2.525	5.43	19.4
23.5	115.8	104.8	11.0	9.3	21.397	-2.139	5.80	18.3
26.5	144.8	132.5	12.2	12.8	22.788	-0.788	6.18	17.4
26.5	133.8	133.0	0.8	10.8	22.190	-2.266	6.00	17.9

29.2	169.2	168.4	0.8	16.6	24.139	-0.728	6.62	16.8
32.0	204.6	203.8	0.8	23.6	25.683	-1.067	7.19	16.5
32.0	209.0	204.3	4.7	24.6	25.879	-1.062	7.25	16.5
34.2	230.4	225.4	5.0	28.7	26.270	-0.882	7.44	16.4
36.5	252.9	247.6	5.2	32.4	26.710	-0.969	7.59	16.3
36.5	250.0	248.4	1.6	31.7	26.653	-1.010	7.57	16.4
38.5	304.3	302.7	1.6	43.0	27.377	-0.604	7.90	15.8
40.5	359.6	358.0	1.6	58.7	28.030	-0.320	8.17	16.0

Total Driving Time 11 minutes; Total No. of Blows 491

FRA-70-13.01 : 06/25/2021 : HSK 06/27/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
1.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
1.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
2.25	40.48	0.00	10.81	1.00	0.80	1.00	1.00
2.98	40.48	0.00	10.81	1.00	0.80	1.00	1.00
3.02	40.48	0.00	10.81	1.00	0.80	1.00	1.00
6.75	40.48	0.00	10.81	1.00	0.80	1.00	1.00
10.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
10.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
11.75	40.48	0.00	10.81	1.00	0.80	1.00	1.00
12.98	40.48	0.00	10.81	1.00	0.80	1.00	1.00
13.02	40.48	0.00	10.81	1.00	0.80	1.00	1.00
15.50	40.48	0.00	10.81	1.00	0.80	1.00	1.00
17.98	40.48	0.00	10.81	1.00	0.80	1.00	1.00
18.02	40.48	0.00	10.81	1.00	0.80	1.00	1.00
19.25	40.48	0.00	10.81	1.00	0.80	1.00	1.00
20.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
20.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
23.50	40.48	0.00	10.81	1.00	0.80	1.00	1.00
26.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
26.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
29.25	40.48	0.00	10.81	1.00	0.80	1.00	1.00
31.98	40.48	0.00	10.81	1.00	0.80	1.00	1.00
32.02	40.48	0.00	10.81	1.00	0.80	1.00	1.00
34.25	40.48	0.00	10.81	1.00	0.80	1.00	1.00
36.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
36.52	40.48	0.00	10.81	1.00	0.80	1.00	1.00
38.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00
40.48	40.48	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

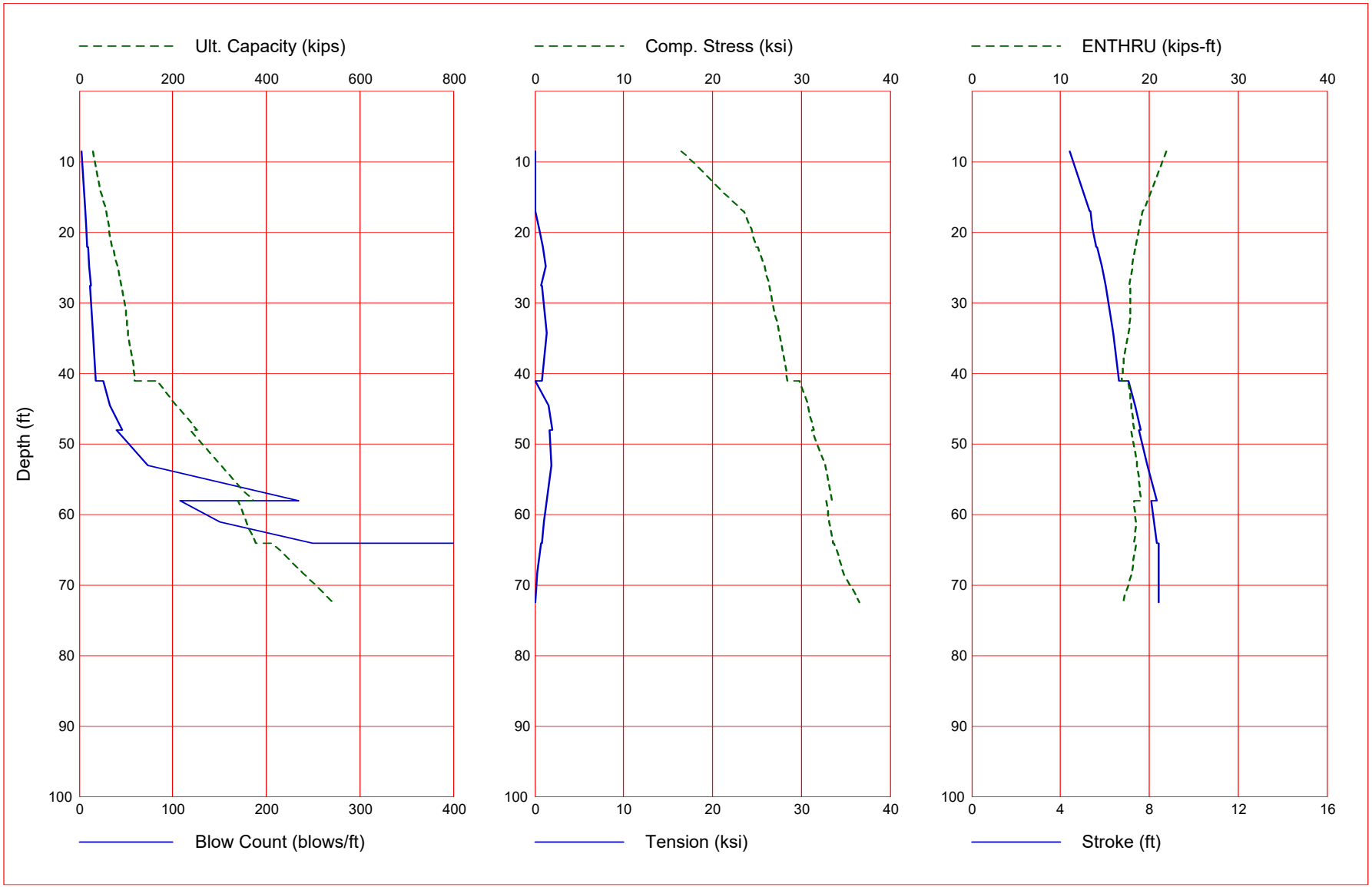
Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
1.49	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
1.51	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	6.000	336.000
3.01	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.39	0.00	0.00	0.100	0.100	0.050	0.150	0.000	6.000	24.000
5.40	0.62	2.90	0.100	0.100	0.050	0.150	0.000	6.000	24.000
7.99	0.92	4.30	0.100	0.100	0.050	0.150	0.000	6.000	24.000
8.01	0.93	4.31	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.49	1.08	5.01	0.100	0.100	0.050	0.150	0.000	6.000	24.000
10.51	1.09	6.39	0.100	0.100	0.050	0.150	0.000	6.000	24.000
12.99	1.24	7.28	0.100	0.100	0.050	0.150	0.000	6.000	24.000
13.01	1.20	3.63	0.100	0.100	0.050	0.150	0.000	6.000	24.000
17.99	1.47	4.46	0.100	0.100	0.050	0.150	0.000	6.000	24.000
18.01	1.11	2.40	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.49	1.21	2.62	0.100	0.100	0.050	0.150	0.000	6.000	24.000
20.51	1.66	9.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.49	2.08	12.25	0.100	0.100	0.050	0.150	0.000	6.000	24.000
26.51	3.75	0.75	0.100	0.100	0.150	0.150	1.000	6.000	336.000
31.99	3.75	0.75	0.100	0.100	0.150	0.150	1.000	6.000	336.000
32.01	1.96	4.71	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.49	2.18	5.25	0.100	0.100	0.050	0.150	0.000	6.000	24.000
36.51	8.00	1.59	0.100	0.100	0.150	0.150	1.000	6.000	336.000
40.48	8.00	1.59	0.100	0.100	0.150	0.150	1.000	6.000	336.000

Forward Abutment
(B-014-7-20)

Resource International Inc
FRA-70-13.01 Forward Abutment (B-014-7-

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 4 at Shaft and Toe 0.550 / 1.000



Resource International Inc
FRA-70-13.01 Forward Abutment (B-014-7-

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 4 at Shaft and Toe 0.550 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
8.5	28.6	27.0	1.5	3.0	16.513	-0.038	4.40	21.9
17.0	56.9	55.4	1.5	6.9	23.420	0.000	5.32	19.3
17.0	57.6	55.5	2.1	7.0	23.500	0.000	5.34	19.3
19.5	63.4	61.3	2.1	7.9	24.352	-0.512	5.44	18.8
22.1	69.2	67.1	2.1	8.8	24.855	-0.958	5.59	18.5
22.1	72.0	67.2	4.8	9.2	25.120	-0.916	5.64	18.4
24.9	81.4	76.5	4.8	10.6	25.838	-1.175	5.85	18.1
27.6	90.8	85.9	4.8	12.2	26.420	-0.685	6.05	17.8
27.6	89.9	86.0	3.9	12.1	26.388	-0.749	6.04	17.9
34.3	104.5	100.6	3.9	15.0	27.610	-1.375	6.39	17.6
41.1	119.3	115.4	3.9	18.0	28.374	-0.769	6.62	16.9
41.1	166.7	115.7	51.0	25.4	29.859	0.000	7.08	17.6
44.6	208.6	157.6	51.0	33.2	30.732	-1.503	7.37	18.0
48.1	252.5	201.5	51.0	46.4	31.466	-1.944	7.62	18.3
48.1	237.9	202.0	36.0	40.1	31.248	-1.677	7.54	18.0
53.1	302.9	266.9	36.0	73.2	32.651	-1.827	7.92	18.6
58.1	371.6	335.7	36.0	234.6	33.411	-1.303	8.34	19.0
58.1	338.3	336.1	2.2	107.7	32.747	-1.362	8.07	18.3
61.1	358.1	355.8	2.2	150.2	33.149	-0.973	8.22	18.5
64.1	377.8	375.6	2.2	250.0	33.498	-0.839	8.33	18.3
64.1	412.0	376.0	36.0	5565.1	33.693	-0.661	8.41	18.5
68.3	476.0	440.0	36.0	9999.0	34.772	-0.284	8.44	18.1
72.5	543.3	507.3	36.0	9999.0	36.520	0.000	8.43	17.0

Refusal occurred; no driving time output possible

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\FORWARD ABUTMENT\FRA-70-13.01 FORWARD ABUTMENT HP 10X42 (B-014-7-20).GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 Forward Abutment (B-014-7-

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	12.400	10.070	H Pile

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.900	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
72.500	12.40	29000.0	492.000	3.295	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	1.38	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
9.00	1.38	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
10.00	1.40	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
11.00	1.42	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
12.00	1.44	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
13.00	1.45	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
14.00	1.47	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
15.00	1.49	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
16.00	1.50	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
16.99	1.52	1.55	0.10	0.10	0.20	0.15	1.50	6.00	336.0
17.01	0.99	2.13	0.10	0.10	0.20	0.15	1.50	6.00	336.0
22.09	0.99	2.13	0.10	0.10	0.20	0.15	1.50	6.00	336.0
22.11	1.49	4.84	0.10	0.10	0.20	0.15	1.50	6.00	336.0
27.59	1.49	4.84	0.10	0.10	0.20	0.15	1.50	6.00	336.0
27.61	1.19	3.88	0.10	0.10	0.20	0.15	2.00	6.00	720.0

36.60	1.20	3.88	0.10	0.10	0.20	0.15	2.00	6.00	720.0
37.60	1.21	3.88	0.10	0.10	0.20	0.15	2.00	6.00	720.0
38.60	1.22	3.88	0.10	0.10	0.20	0.15	2.00	6.00	720.0
39.60	1.23	3.88	0.10	0.10	0.20	0.15	2.00	6.00	720.0
40.60	1.25	3.88	0.10	0.10	0.20	0.15	2.00	6.00	720.0
41.09	1.25	3.88	0.10	0.10	0.20	0.15	2.00	6.00	720.0
41.11	3.57	51.03	0.10	0.10	0.05	0.15	1.00	6.00	24.0
42.10	3.62	51.03	0.10	0.10	0.05	0.15	1.00	6.00	24.0
43.10	3.67	51.03	0.10	0.10	0.05	0.15	1.00	6.00	24.0
44.10	3.72	51.03	0.10	0.10	0.05	0.15	1.00	6.00	24.0
45.10	3.77	51.03	0.10	0.10	0.05	0.15	1.00	6.00	24.0
46.10	3.82	51.03	0.10	0.10	0.05	0.15	1.00	6.00	24.0
47.10	3.87	51.03	0.10	0.10	0.05	0.15	1.00	6.00	24.0
48.09	3.92	51.03	0.10	0.10	0.05	0.15	1.00	6.00	24.0
48.11	3.84	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
49.10	3.89	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
50.10	3.93	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
51.10	3.98	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
52.10	4.03	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
53.10	4.07	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
54.10	4.12	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
55.10	4.17	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
56.10	4.21	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
57.10	4.26	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
58.09	4.30	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
58.11	2.88	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
64.09	2.88	2.23	0.10	0.10	0.15	0.15	1.50	6.00	336.0
64.11	4.56	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
65.10	4.61	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
66.10	4.65	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
67.10	4.70	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
68.10	4.74	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
69.10	4.79	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
70.10	4.84	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
71.10	4.88	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
72.10	4.93	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0
72.50	4.95	35.96	0.10	0.10	0.05	0.15	1.00	6.00	24.0

Gain/Loss factors: shaft and toe

0.40000	0.45000	0.50000	0.55000	0.60000
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
8.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
16.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
19.55	0.00	0.00	0.000	0.000	0.000	0.000	0.000
22.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
22.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.85	0.00	0.00	0.000	0.000	0.000	0.000	0.000
27.58	0.00	0.00	0.000	0.000	0.000	0.000	0.000
27.62	0.00	0.00	0.000	0.000	0.000	0.000	0.000

34.35	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
44.60	0.00	0.00	0.000	0.000	0.000	0.000	0.000
48.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
48.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
53.10	0.00	0.00	0.000	0.000	0.000	0.000	0.000
58.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
58.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
61.10	0.00	0.00	0.000	0.000	0.000	0.000	0.000
64.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
64.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
68.29	0.00	0.00	0.000	0.000	0.000	0.000	0.000
72.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

FRA-70-13.01 Forward Abutment (B-014-7-

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		9093.3			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	8.5		
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor	1.000

PILE PROFILE:

Toe Area	(in2)	12.400	Pile Type	H Pile
Pile Size	(inch)	10.070		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model — Total Capacity Rut (kips) 24.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	72.50	3.3	12.4
Toe						1.5	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.435

Driveability Analysis

Soil Damping Option Smith
Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.50	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
24.7	2.5	4.28	4.24	-0.29	4	13	15.41	1	2	22.7	57.3
26.0	2.7	4.30	4.31	-0.19	4	13	15.69	1	2	22.3	57.1
27.3	2.8	4.34	4.37	-0.09	4	13	16.07	1	2	22.1	56.7
28.6	3.0	4.40	4.43	-0.04	4	13	16.51	1	2	21.9	56.4
29.9	3.2	4.44	4.48	0.00	1	0	16.87	1	2	21.7	56.0

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 17.0
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 49.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	1.4	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	9.4	0.200	0.100	69.20	3.3	12.4

22	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	72.50	3.3	12.4
Toe						1.5	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
16.98	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
49.0	5.7	5.12	5.09	0.00	1	0	21.93	18	6	19.9	52.1
51.6	6.1	5.19	5.17	0.00	1	0	22.48	18	6	19.7	51.8
54.3	6.5	5.26	5.24	0.00	1	0	22.98	18	5	19.4	51.4
56.9	6.9	5.32	5.31	0.00	1	0	23.42	18	5	19.3	51.0
59.6	7.3	5.39	5.38	0.00	1	0	23.84	18	5	19.1	50.7
1		0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 17.0
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 49.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	1.5	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	9.4	0.200	0.100	69.20	3.3	12.4

22	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	72.50	3.3	12.4
Toe						2.1	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.02	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
49.7	5.8	5.14	5.11	0.00	1	0	22.06	18	5	19.8	52.0
52.3	6.2	5.21	5.19	0.00	1	0	22.60	18	5	19.6	51.7
55.0	6.6	5.28	5.26	0.00	1	0	23.06	18	5	19.4	51.3
57.6	7.0	5.34	5.33	0.00	1	0	23.50	18	5	19.3	51.0
60.3	7.4	5.41	5.39	-0.01	17	50	23.90	18	5	19.1	50.6

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 19.5
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 54.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	8.3	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	9.3	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	9.6	0.200	0.100	69.20	3.3	12.4

22	0.140	9093	0.000	0.000	1.00	7.2	0.200	0.100	72.50	3.3	12.4
Toe						2.1	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.55	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
54.7	6.5	5.27	5.25	0.00	1	0	23.20	17	5	19.4	51.3
57.6	7.0	5.35	5.33	0.00	1	0	23.69	17	5	19.3	51.0
60.5	7.5	5.36	5.42	-0.11	17	50	23.91	17	5	18.9	50.7
63.4	7.9	5.44	5.49	-0.51	17	50	24.35	17	5	18.8	50.3
66.3	8.3	5.51	5.55	-0.86	17	50	24.76	17	5	18.7	50.0
1		0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 22.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 59.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	6.3	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	9.6	0.200	0.100	65.91	3.3	12.4

21	0.140	9093	0.000	0.000	1.00	8.0	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	72.50	3.3	12.4
Toe						2.1	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
59.6	7.3	5.41	5.39	-0.28	21	15	23.75	16	5	19.2	50.7
62.8	7.8	5.43	5.48	-0.37	16	50	23.99	16	5	18.8	50.4
66.0	8.3	5.51	5.55	-0.74	16	50	24.43	16	5	18.6	50.0
69.2	8.8	5.59	5.62	-0.96	16	50	24.85	16	5	18.5	49.7
72.4	9.3	5.66	5.69	-0.91	16	50	25.26	16	5	18.4	49.4

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 22.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 62.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	6.4	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	62.61	3.3	12.4

20	0.140	9093	0.000	0.000	1.00	9.6	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	8.0	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	72.50	3.3	12.4
Toe						4.8	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
62.4	7.7	5.41	5.46	-0.32	16	50	23.83	16	5	18.8	50.5
65.6	8.2	5.49	5.53	-0.68	16	50	24.29	16	5	18.7	50.1
68.8	8.7	5.57	5.60	-0.92	16	50	24.71	16	5	18.6	49.8
72.0	9.2	5.64	5.68	-0.92	16	50	25.12	16	5	18.4	49.4
75.2	9.7	5.72	5.75	-1.05	16	46	25.52	16	5	18.3	49.1

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 24.9
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 70.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	4.8	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	56.02	3.3	12.4

18	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	8.5	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	72.50	3.3	12.4
Toe						4.8	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.85	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
70.5	9.0	5.61	5.65	-0.77	15	50	24.61	15	5	18.5	49.6
74.1	9.5	5.70	5.73	-0.92	15	46	25.03	15	5	18.3	49.2
77.7	10.0	5.78	5.80	-1.13	15	46	25.45	15	5	18.2	48.9
81.4	10.6	5.85	5.87	-1.18	15	46	25.84	15	5	18.1	48.6
85.0	11.2	5.93	5.95	-1.11	15	46	26.22	15	5	18.0	48.3

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 27.6
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 78.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	3.3	0.200	0.100	46.14	3.3	12.4

15	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.4	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	8.6	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	72.50	3.3	12.4
Toe						4.8	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
27.58	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
78.5	10.1	5.80	5.82	-1.09	14	46	25.24	15	5	18.2	48.8
82.6	10.8	5.88	5.91	-1.10	14	46	25.62	15	5	18.0	48.5
86.7	11.5	5.97	5.99	-0.97	14	46	26.04	14	5	17.9	48.1
90.8	12.2	6.05	6.07	-0.69	14	46	26.42	14	5	17.8	47.8
94.8	13.0	6.13	6.14	-0.91	14	41	26.79	15	5	17.8	47.5

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 27.6
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 77.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2

1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	3.4	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.4	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	8.6	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	72.50	3.3	12.4
Toe						3.9	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
27.62	10.81	1.00	0.800

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
77.6	10.0	5.79	5.81	-1.07	14	46	25.17	14	5	18.2	48.9
81.7	10.7	5.87	5.89	-1.12	14	46	25.60	14	5	18.1	48.5
85.8	11.4	5.96	5.97	-1.01	14	46	25.97	14	5	18.0	48.2
89.9	12.1	6.04	6.05	-0.75	14	46	26.39	14	5	17.9	47.9
94.0	12.9	6.11	6.13	-0.86	14	41	26.71	14	5	17.8	47.6

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 34.3
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 88.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	3.8	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	8.9	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	8.8	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	72.50	3.3	12.4
Toe						3.9	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
34.35	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
88.2	11.8	6.02	6.04	-0.89	12	46	26.11	12	4	17.8	47.9
93.6	12.8	6.13	6.14	-1.01	12	39	26.56	12	4	17.7	47.5
99.0	13.9	6.24	6.24	-1.28	12	39	27.02	12	4	17.5	47.1
104.5	15.0	6.39	6.33	-1.37	12	39	27.61	12	4	17.6	46.7
109.9	16.0	6.46	6.42	-1.22	11	39	27.95	12	4	17.4	46.4

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 41.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s

0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model — Total Capacity Rut (kips) 99.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	4.2	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	8.8	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	8.9	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.3	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	5.4	0.200	0.100	72.50	3.3	12.4
Toe						3.9	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
99.0	13.9	6.26	6.27	-1.22	10	39	26.92	10	4	17.5	47.0
105.7	15.4	6.45	6.39	-1.35	10	39	27.61	10	4	17.4	46.5
112.5	16.9	6.55	6.50	-1.27	10	38	28.02	10	4	17.2	46.1
119.3	18.0	6.62	6.60	-0.77	10	38	28.37	10	4	16.9	45.8
126.0	18.9	6.71	6.68	-0.13	10	38	28.73	10	4	16.9	45.5

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 41.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model — Total Capacity Rut (kips) 146.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	4.3	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	8.7	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	5.5	0.198	0.100	72.50	3.3	12.4
Toe						51.0	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
146.4	21.6	6.85	6.83	0.00	1	0	28.88	10	4	17.3	45.0
153.1	22.8	6.93	6.91	0.00	1	0	29.22	10	4	17.4	44.7
159.9	24.0	7.01	7.00	0.00	1	0	29.52	10	4	17.5	44.5
166.7	25.4	7.08	7.08	0.00	1	0	29.86	10	4	17.6	44.3
173.5	26.8	7.16	7.15	-0.28	10	50	30.15	10	4	17.7	44.0

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         1           0   10.81000       11.86000
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 Depth                 (ft)      44.6
 Shaft Gain/Loss Factor         0.400  Toe Gain/Loss Factor           1.000

 PILE PROFILE:
 Toe Area             (in2)    12.400  Pile Type                     H Pile
 Pile Size           (inch)    10.070
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L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

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 Wave Travel Time 2L/c (ms)     8.775
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Pile and Soil Model Total Capacity Rut (kips) 188.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	4.8	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	8.5	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	7.4	0.176	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	39.7	0.050	0.100	72.50	3.3	12.4
Toe						51.0	0.150	0.100			

```
     3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
     3.072 kips total reduced pile weight   (g= 32.17 ft/s2)
```

Depth ft	Stroke ft	Pressure Ratio	Efficy
44.60	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
188.3	27.8	7.15	7.14	-0.29	9	26	29.83	9	4	17.7	44.1
195.0	29.5	7.22	7.22	-0.80	9	50	30.12	9	4	17.8	43.9
201.8	31.4	7.29	7.30	-1.29	9	50	30.41	9	3	17.8	43.6
208.6	33.2	7.37	7.37	-1.50	9	50	30.73	9	3	18.0	43.4
215.4	35.6	7.37	7.43	-1.69	9	49	30.81	9	4	17.9	43.3

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 48.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 232.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	5.3	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	8.4	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	9.3	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	8.7	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	9.3	0.158	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	39.8	0.050	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	41.6	0.050	0.100	72.50	3.3	12.4
Toe						51.0	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)

3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
48.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
232.2	37.8	7.46	7.46	-1.57	8	24	30.72	8	3	18.1	43.2
238.9	40.8	7.45	7.52	-1.79	8	24	30.80	8	3	18.0	43.1
245.7	43.5	7.53	7.59	-1.88	8	23	31.13	8	3	18.1	42.9
252.5	46.4	7.62	7.65	-1.94	8	23	31.47	8	3	18.3	42.7
259.3	49.5	7.70	7.72	-2.06	8	46	31.80	8	3	18.4	42.5

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 48.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 217.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	5.4	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	8.3	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	9.4	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	8.7	0.200	0.100	52.73	3.3	12.4

17	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	9.7	0.155	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	39.8	0.050	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	41.6	0.050	0.100	72.50	3.3	12.4
Toe						36.0	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
48.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
217.6	33.1	7.33	7.33	-1.11	8	50	30.37	8	3	17.8	43.5
224.4	35.3	7.40	7.40	-1.24	8	49	30.65	8	3	17.9	43.3
231.2	37.5	7.46	7.47	-1.46	8	48	30.94	8	3	17.9	43.2
237.9	40.1	7.54	7.54	-1.68	8	47	31.25	8	3	18.0	42.9
244.7	43.3	7.55	7.61	-1.88	8	47	31.37	8	3	17.9	42.8

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 53.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 282.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4

6	0.140	9093	0.000	0.000	1.00	1.0	0.200	0.100	19.77	3.3	12.4
7	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	23.07	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	9.3	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	6.6	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	7.8	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	6.4	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	5.3	0.200	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	27.1	0.074	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	40.8	0.050	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	42.1	0.050	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	43.4	0.050	0.100	72.50	3.3	12.4
Toe						36.0	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
53.10	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
282.6	56.7	7.70	7.76	-1.84	7	22	31.69	7	3	18.2	42.4
289.3	61.9	7.79	7.83	-1.84	7	22	32.03	7	3	18.3	42.2
296.1	66.9	7.86	7.89	-1.86	7	22	32.38	7	3	18.5	42.0
302.9	73.2	7.92	7.94	-1.83	7	22	32.65	7	3	18.6	41.9
309.7	81.1	8.01	8.02	-1.85	7	43	33.00	7	3	18.6	41.7

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 58.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c

ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model — Total Capacity Rut (kips) 351.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
5	0.140	9093	0.000	0.000	1.00	5.6	0.200	0.100	16.48	3.3	12.4
6	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	19.77	3.3	12.4
7	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	23.07	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	8.3	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	9.4	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	8.6	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	10.4	0.149	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	39.9	0.050	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	41.7	0.050	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	42.6	0.050	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	44.3	0.050	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	45.9	0.050	0.100	72.50	3.3	12.4
Toe						36.0	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
58.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
351.3	132.8	8.17	8.19	-1.23	5	43	32.57	5	3	18.9	41.3
358.1	153.9	8.22	8.23	-1.24	5	42	32.86	5	3	19.0	41.1
364.8	187.5	8.28	8.28	-1.27	5	42	33.13	5	3	19.0	41.0
371.6	234.6	8.34	8.33	-1.30	5	41	33.41	5	3	19.0	40.9
378.4	296.7	8.39	8.37	-1.34	5	41	33.69	5	3	19.1	40.8

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 58.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 318.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
5	0.140	9093	0.000	0.000	1.00	5.7	0.200	0.100	16.48	3.3	12.4
6	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	19.77	3.3	12.4
7	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	23.07	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	8.2	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	8.5	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	10.9	0.146	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	39.9	0.050	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	41.7	0.050	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	42.6	0.050	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	44.3	0.050	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	45.7	0.050	0.100	72.50	3.3	12.4
Toe						2.2	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
58.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
318.0	75.3	7.93	7.93	-1.07	5	43	31.97	5	3	18.3	41.9
324.7	85.3	7.93	7.99	-1.15	5	42	32.10	5	3	18.2	41.8
331.5	94.8	8.00	8.04	-1.29	5	42	32.43	5	3	18.3	41.7
338.3	107.7	8.07	8.10	-1.36	5	41	32.75	5	3	18.3	41.5
345.1	120.6	8.14	8.14	-1.39	5	41	33.06	5	3	18.5	41.4
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 61.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 334.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
4	0.140	9093	0.000	0.000	1.00	4.8	0.200	0.100	13.18	3.3	12.4
5	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	16.48	3.3	12.4
6	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	19.77	3.3	12.4
7	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	23.07	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	8.5	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	8.9	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	7.6	0.174	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	39.7	0.050	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	41.5	0.050	0.100	59.32	3.3	12.4

19	0.140	9093	0.000	0.000	1.00	42.5	0.050	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	44.1	0.050	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	45.8	0.050	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	21.2	0.137	0.100	72.50	3.3	12.4
Toe						2.2	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
61.10	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
334.9	96.6	8.01	8.05	-1.02	4	41	32.21	4	3	18.1	41.6
342.6	110.2	8.09	8.10	-0.98	4	41	32.52	4	3	18.2	41.5
350.3	129.1	8.15	8.16	-0.94	4	40	32.84	4	3	18.3	41.3
358.1	150.2	8.22	8.19	-0.97	4	40	33.15	4	3	18.5	41.2
365.8	187.1	8.28	8.25	-1.03	4	39	33.44	4	3	18.4	41.1
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 64.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 351.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
3	0.140	9093	0.000	0.000	1.00	4.0	0.200	0.100	9.89	3.3	12.4
4	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	13.18	3.3	12.4

5	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	16.48	3.3	12.4
6	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	19.77	3.3	12.4
7	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	23.07	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	8.8	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	8.9	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.4	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	5.3	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	38.6	0.052	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	41.4	0.050	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	42.4	0.050	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	44.0	0.050	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	45.6	0.050	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	23.9	0.125	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	18.7	0.150	0.100	72.50	3.3	12.4
Toe						2.2	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
64.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
351.8	123.8	8.14	8.13	-0.77	22	6	32.60	3	3	18.2	41.4
360.5	149.8	8.20	8.18	-0.78	22	6	32.90	3	3	18.3	41.3
369.2	192.0	8.27	8.24	-0.81	22	6	33.21	3	3	18.2	41.1
377.8	250.0	8.33	8.28	-0.84	22	6	33.50	3	3	18.3	41.0
386.5	358.2	8.38	8.32	-0.86	22	6	33.75	3	3	18.3	40.9
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 64.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 386.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	0.0	0.000	0.100	6.59	3.3	12.4
3	0.140	9093	0.000	0.000	1.00	4.1	0.200	0.100	9.89	3.3	12.4
4	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	13.18	3.3	12.4
5	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	16.48	3.3	12.4
6	0.140	9093	0.000	0.000	1.00	9.1	0.200	0.100	19.77	3.3	12.4
7	0.140	9093	0.000	0.000	1.00	9.5	0.200	0.100	23.07	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	8.8	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	8.9	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	9.3	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	5.3	0.200	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	39.1	0.051	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	41.4	0.050	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	42.4	0.050	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	44.0	0.050	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	45.6	0.050	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	23.5	0.126	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	18.9	0.149	0.100	72.50	3.3	12.4
Toe						36.0	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
64.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
386.0	314.5	8.36	8.33	-0.63	3	39	33.19	3	3	18.7	40.9
394.6	468.0	8.41	8.35	-0.65	3	39	33.45	3	3	18.8	40.8
403.3	886.2	8.45	8.38	-0.65	3	38	33.70	3	3	18.7	40.7

412.0	5565.1	8.41	8.40	-0.66	3	38	33.69	3	3	18.5	40.8
420.6	9999.0	8.42	8.42	-0.66	3	38	33.87	3	3	18.4	40.7

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 68.3
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 450.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	0.0	0.000	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	6.59	3.3	12.4
3	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	9.89	3.3	12.4
4	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	13.18	3.3	12.4
5	0.140	9093	0.000	0.000	1.00	9.2	0.200	0.100	16.48	3.3	12.4
6	0.140	9093	0.000	0.000	1.00	9.6	0.200	0.100	19.77	3.3	12.4
7	0.140	9093	0.000	0.000	1.00	7.9	0.200	0.100	23.07	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	6.5	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	8.1	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	39.55	3.3	12.4
13	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	13.8	0.126	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	40.1	0.050	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	41.8	0.050	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	42.8	0.050	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	44.4	0.050	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	43.5	0.056	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	18.7	0.150	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	27.1	0.113	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	50.8	0.050	0.100	72.50	3.3	12.4
Toe						36.0	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
68.29	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
450.0	9999.0	8.41	8.40	-0.32	2	37	34.16	2	2	18.4	40.7
458.6	9999.0	8.42	8.40	-0.32	2	37	34.38	2	2	18.3	40.7
467.3	9999.0	8.43	8.42	-0.30	2	36	34.57	2	2	18.2	40.7
476.0	9999.0	8.44	8.42	-0.28	2	36	34.77	2	2	18.1	40.7
484.6	9999.0	8.45	8.43	-0.27	2	36	34.97	2	2	18.0	40.7

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 72.5
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 12.400 Pile Type H Pile
Pile Size (inch) 10.070

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	12.40	29000.	492.0	3.3	0	16524.	21.8
72.5	12.40	29000.	492.0	3.3	0	16524.	21.8

Wave Travel Time 2L/c (ms) 8.775

Pile and Soil Model Total Capacity Rut (kips) 517.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.140	9093	0.010	0.000	0.85	9.0	0.200	0.100	3.30	3.3	12.4
2	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	6.59	3.3	12.4
3	0.140	9093	0.000	0.000	1.00	9.0	0.200	0.100	9.89	3.3	12.4
4	0.140	9093	0.000	0.000	1.00	9.3	0.200	0.100	13.18	3.3	12.4
5	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	16.48	3.3	12.4
6	0.140	9093	0.000	0.000	1.00	7.0	0.200	0.100	19.77	3.3	12.4
7	0.140	9093	0.000	0.000	1.00	7.4	0.200	0.100	23.07	3.3	12.4
8	0.140	9093	0.000	0.000	1.00	9.7	0.200	0.100	26.36	3.3	12.4
9	0.140	9093	0.000	0.000	1.00	6.9	0.200	0.100	29.66	3.3	12.4
10	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	32.95	3.3	12.4
11	0.140	9093	0.000	0.000	1.00	5.2	0.200	0.100	36.25	3.3	12.4
12	0.140	9093	0.000	0.000	1.00	5.3	0.200	0.100	39.55	3.3	12.4

13	0.140	9093	0.000	0.000	1.00	23.2	0.085	0.100	42.84	3.3	12.4
14	0.140	9093	0.000	0.000	1.00	40.6	0.050	0.100	46.14	3.3	12.4
15	0.140	9093	0.000	0.000	1.00	42.0	0.050	0.100	49.43	3.3	12.4
16	0.140	9093	0.000	0.000	1.00	43.2	0.050	0.100	52.73	3.3	12.4
17	0.140	9093	0.000	0.000	1.00	44.9	0.050	0.100	56.02	3.3	12.4
18	0.140	9093	0.000	0.000	1.00	36.0	0.078	0.100	59.32	3.3	12.4
19	0.140	9093	0.000	0.000	1.00	18.7	0.150	0.100	62.61	3.3	12.4
20	0.140	9093	0.000	0.000	1.00	35.9	0.084	0.100	65.91	3.3	12.4
21	0.140	9093	0.000	0.000	1.00	51.3	0.050	0.100	69.20	3.3	12.4
22	0.140	9093	0.000	0.000	1.00	52.9	0.050	0.100	72.50	3.3	12.4
Toe						36.0	0.150	0.100			

3.072 kips total unreduced pile weight (g= 32.17 ft/s2)
3.072 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
72.50	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
517.3	9999.0	8.42	8.42	0.00	1	0	35.74	1	2	17.3	40.7
525.9	9999.0	8.43	8.42	0.00	1	0	36.03	1	2	17.1	40.7
534.6	9999.0	8.43	8.42	0.00	1	0	36.24	1	2	17.0	40.7
543.3	9999.0	8.43	8.41	0.00	1	0	36.52	1	2	17.0	40.7
551.9	9999.0	8.44	8.42	0.00	1	0	36.78	1	2	16.9	40.7

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.400 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	24.7	23.2	1.5	2.5	15.406	-0.289	4.28	22.7
17.0	49.0	47.5	1.5	5.7	21.934	0.000	5.12	19.9
17.0	49.7	47.6	2.1	5.8	22.064	0.000	5.14	19.8
19.5	54.7	52.5	2.1	6.5	23.202	0.000	5.27	19.4
22.1	59.6	57.5	2.1	7.3	23.749	-0.282	5.41	19.2
22.1	62.4	57.6	4.8	7.7	23.828	-0.317	5.41	18.8
24.9	70.5	65.6	4.8	9.0	24.614	-0.772	5.61	18.5
27.6	78.5	73.6	4.8	10.1	25.237	-1.087	5.80	18.2
27.6	77.6	73.7	3.9	10.0	25.166	-1.067	5.79	18.2
34.3	88.2	84.3	3.9	11.8	26.105	-0.894	6.02	17.8
41.1	99.0	95.1	3.9	13.9	26.917	-1.224	6.26	17.5

41.1	146.4	95.3	51.0	21.6	28.875	0.000	6.85	17.3
44.6	188.3	137.2	51.0	27.8	29.831	-0.293	7.15	17.7
48.1	232.2	181.1	51.0	37.8	30.720	-1.573	7.46	18.1
48.1	217.6	181.7	36.0	33.1	30.367	-1.113	7.33	17.8
53.1	282.6	246.6	36.0	56.7	31.688	-1.836	7.70	18.2
58.1	351.3	315.3	36.0	132.8	32.571	-1.227	8.17	18.9
58.1	318.0	315.7	2.2	75.3	31.973	-1.065	7.93	18.3
61.1	334.9	332.7	2.2	96.6	32.214	-1.015	8.01	18.1
64.1	351.8	349.6	2.2	123.8	32.601	-0.766	8.14	18.2
64.1	386.0	350.0	36.0	314.5	33.188	-0.633	8.36	18.7
68.3	450.0	414.0	36.0	9999.0	34.159	-0.320	8.41	18.4
72.5	517.3	481.3	36.0	9999.0	35.742	0.000	8.42	17.3

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.450 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	26.0	24.5	1.5	2.7	15.692	-0.190	4.30	22.3
17.0	51.6	50.1	1.5	6.1	22.482	0.000	5.19	19.7
17.0	52.3	50.2	2.1	6.2	22.605	0.000	5.21	19.6
19.5	57.6	55.4	2.1	7.0	23.687	0.000	5.35	19.3
22.1	62.8	60.7	2.1	7.8	23.991	-0.366	5.43	18.8
22.1	65.6	60.8	4.8	8.2	24.290	-0.676	5.49	18.7
24.9	74.1	69.3	4.8	9.5	25.031	-0.921	5.70	18.3
27.6	82.6	77.7	4.8	10.8	25.620	-1.102	5.88	18.0
27.6	81.7	77.8	3.9	10.7	25.596	-1.117	5.87	18.1
34.3	93.6	89.7	3.9	12.8	26.563	-1.009	6.13	17.7
41.1	105.7	101.9	3.9	15.4	27.614	-1.351	6.45	17.4
41.1	153.1	102.1	51.0	22.8	29.216	0.000	6.93	17.4
44.6	195.0	144.0	51.0	29.5	30.115	-0.800	7.22	17.8
48.1	238.9	187.9	51.0	40.8	30.800	-1.787	7.45	18.0
48.1	224.4	188.4	36.0	35.3	30.650	-1.241	7.40	17.9
53.1	289.3	253.4	36.0	61.9	32.031	-1.839	7.79	18.3
58.1	358.1	322.1	36.0	153.9	32.856	-1.244	8.22	19.0
58.1	324.7	322.5	2.2	85.3	32.100	-1.153	7.93	18.2
61.1	342.6	340.4	2.2	110.2	32.521	-0.983	8.09	18.2
64.1	360.5	358.3	2.2	149.8	32.899	-0.782	8.20	18.3
64.1	394.6	358.7	36.0	468.0	33.447	-0.646	8.41	18.8
68.3	458.6	422.7	36.0	9999.0	34.378	-0.322	8.42	18.3
72.5	525.9	490.0	36.0	9999.0	36.025	0.000	8.43	17.1

Refusal occurred; no driving time output possible

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.500 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	27.3	25.7	1.5	2.8	16.068	-0.088	4.34	22.1
17.0	54.3	52.7	1.5	6.5	22.983	0.000	5.26	19.4
17.0	55.0	52.8	2.1	6.6	23.063	0.000	5.28	19.4
19.5	60.5	58.4	2.1	7.5	23.912	-0.114	5.36	18.9
22.1	66.0	63.9	2.1	8.3	24.427	-0.737	5.51	18.6
22.1	68.8	64.0	4.8	8.7	24.705	-0.919	5.57	18.6
24.9	77.7	72.9	4.8	10.0	25.447	-1.126	5.78	18.2
27.6	86.7	81.8	4.8	11.5	26.041	-0.974	5.97	17.9
27.6	85.8	81.9	3.9	11.4	25.975	-1.010	5.96	18.0
34.3	99.0	95.2	3.9	13.9	27.022	-1.280	6.24	17.5
41.1	112.5	108.6	3.9	16.9	28.020	-1.265	6.55	17.2
41.1	159.9	108.9	51.0	24.0	29.521	0.000	7.01	17.5
44.6	201.8	150.8	51.0	31.4	30.414	-1.285	7.29	17.8
48.1	245.7	194.7	51.0	43.5	31.133	-1.884	7.53	18.1
48.1	231.2	195.2	36.0	37.5	30.942	-1.462	7.46	17.9
53.1	296.1	260.2	36.0	66.9	32.379	-1.855	7.86	18.5
58.1	364.8	328.9	36.0	187.5	33.126	-1.268	8.28	19.0
58.1	331.5	329.3	2.2	94.8	32.428	-1.288	8.00	18.3
61.1	350.3	348.1	2.2	129.1	32.836	-0.940	8.15	18.3
64.1	369.2	366.9	2.2	192.0	33.210	-0.806	8.27	18.2
64.1	403.3	367.3	36.0	886.2	33.697	-0.649	8.45	18.7
68.3	467.3	431.3	36.0	9999.0	34.569	-0.302	8.43	18.2
72.5	534.6	498.6	36.0	9999.0	36.237	0.000	8.43	17.0

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.550 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	28.6	27.0	1.5	3.0	16.513	-0.038	4.40	21.9
17.0	56.9	55.4	1.5	6.9	23.420	0.000	5.32	19.3
17.0	57.6	55.5	2.1	7.0	23.500	0.000	5.34	19.3
19.5	63.4	61.3	2.1	7.9	24.352	-0.512	5.44	18.8
22.1	69.2	67.1	2.1	8.8	24.855	-0.958	5.59	18.5
22.1	72.0	67.2	4.8	9.2	25.120	-0.916	5.64	18.4
24.9	81.4	76.5	4.8	10.6	25.838	-1.175	5.85	18.1
27.6	90.8	85.9	4.8	12.2	26.420	-0.685	6.05	17.8
27.6	89.9	86.0	3.9	12.1	26.388	-0.749	6.04	17.9
34.3	104.5	100.6	3.9	15.0	27.610	-1.375	6.39	17.6
41.1	119.3	115.4	3.9	18.0	28.374	-0.769	6.62	16.9
41.1	166.7	115.7	51.0	25.4	29.859	0.000	7.08	17.6
44.6	208.6	157.6	51.0	33.2	30.732	-1.503	7.37	18.0
48.1	252.5	201.5	51.0	46.4	31.466	-1.944	7.62	18.3
48.1	237.9	202.0	36.0	40.1	31.248	-1.677	7.54	18.0
53.1	302.9	266.9	36.0	73.2	32.651	-1.827	7.92	18.6
58.1	371.6	335.7	36.0	234.6	33.411	-1.303	8.34	19.0
58.1	338.3	336.1	2.2	107.7	32.747	-1.362	8.07	18.3
61.1	358.1	355.8	2.2	150.2	33.149	-0.973	8.22	18.5

64.1	377.8	375.6	2.2	250.0	33.498	-0.839	8.33	18.3
64.1	412.0	376.0	36.0	5565.1	33.693	-0.661	8.41	18.5
68.3	476.0	440.0	36.0	9999.0	34.772	-0.284	8.44	18.1
72.5	543.3	507.3	36.0	9999.0	36.520	0.000	8.43	17.0

Refusal occurred; no driving time output possible

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.600 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	29.9	28.3	1.5	3.2	16.867	0.000	4.44	21.7
17.0	59.6	58.0	1.5	7.3	23.835	0.000	5.39	19.1
17.0	60.3	58.1	2.1	7.4	23.896	-0.005	5.41	19.1
19.5	66.3	64.2	2.1	8.3	24.762	-0.858	5.51	18.7
22.1	72.4	70.3	2.1	9.3	25.260	-0.914	5.66	18.4
22.1	75.2	70.4	4.8	9.7	25.515	-1.048	5.72	18.3
24.9	85.0	80.2	4.8	11.2	26.218	-1.113	5.93	18.0
27.6	94.8	90.0	4.8	13.0	26.787	-0.911	6.13	17.8
27.6	94.0	90.1	3.9	12.9	26.710	-0.863	6.11	17.8
34.3	109.9	106.0	3.9	16.0	27.947	-1.216	6.46	17.4
41.1	126.0	122.2	3.9	18.9	28.731	-0.131	6.71	16.9
41.1	173.5	122.4	51.0	26.8	30.150	-0.283	7.16	17.7
44.6	215.4	164.3	51.0	35.6	30.813	-1.693	7.37	17.9
48.1	259.3	208.2	51.0	49.5	31.796	-2.063	7.70	18.4
48.1	244.7	208.7	36.0	43.3	31.374	-1.876	7.55	17.9
53.1	309.7	273.7	36.0	81.1	32.999	-1.853	8.01	18.6
58.1	378.4	342.4	36.0	296.7	33.687	-1.341	8.39	19.1
58.1	345.1	342.8	2.2	120.6	33.063	-1.386	8.14	18.5
61.1	365.8	363.6	2.2	187.1	33.438	-1.028	8.28	18.4
64.1	386.5	384.3	2.2	358.2	33.745	-0.862	8.38	18.3
64.1	420.6	384.7	36.0	9999.0	33.872	-0.660	8.42	18.4
68.3	484.6	448.7	36.0	9999.0	34.972	-0.269	8.45	18.0
72.5	551.9	516.0	36.0	9999.0	36.782	0.000	8.44	16.9

Refusal occurred; no driving time output possible

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR

8.50	72.50	0.00	10.81	1.00	0.80	1.00	1.00
16.98	72.50	0.00	10.81	1.00	0.80	1.00	1.00
17.02	72.50	0.00	10.81	1.00	0.80	1.00	1.00
19.55	72.50	0.00	10.81	1.00	0.80	1.00	1.00
22.08	72.50	0.00	10.81	1.00	0.80	1.00	1.00
22.12	72.50	0.00	10.81	1.00	0.80	1.00	1.00
24.85	72.50	0.00	10.81	1.00	0.80	1.00	1.00
27.58	72.50	0.00	10.81	1.00	0.80	1.00	1.00
27.62	72.50	0.00	10.81	1.00	0.80	1.00	1.00
34.35	72.50	0.00	10.81	1.00	0.80	1.00	1.00
41.08	72.50	0.00	10.81	1.00	0.80	1.00	1.00
41.12	72.50	0.00	10.81	1.00	0.80	1.00	1.00
44.60	72.50	0.00	10.81	1.00	0.80	1.00	1.00
48.08	72.50	0.00	10.81	1.00	0.80	1.00	1.00
48.12	72.50	0.00	10.81	1.00	0.80	1.00	1.00
53.10	72.50	0.00	10.81	1.00	0.80	1.00	1.00
58.08	72.50	0.00	10.81	1.00	0.80	1.00	1.00
58.12	72.50	0.00	10.81	1.00	0.80	1.00	1.00
61.10	72.50	0.00	10.81	1.00	0.80	1.00	1.00
64.08	72.50	0.00	10.81	1.00	0.80	1.00	1.00
64.12	72.50	0.00	10.81	1.00	0.80	1.00	1.00
68.29	72.50	0.00	10.81	1.00	0.80	1.00	1.00
72.50	72.50	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

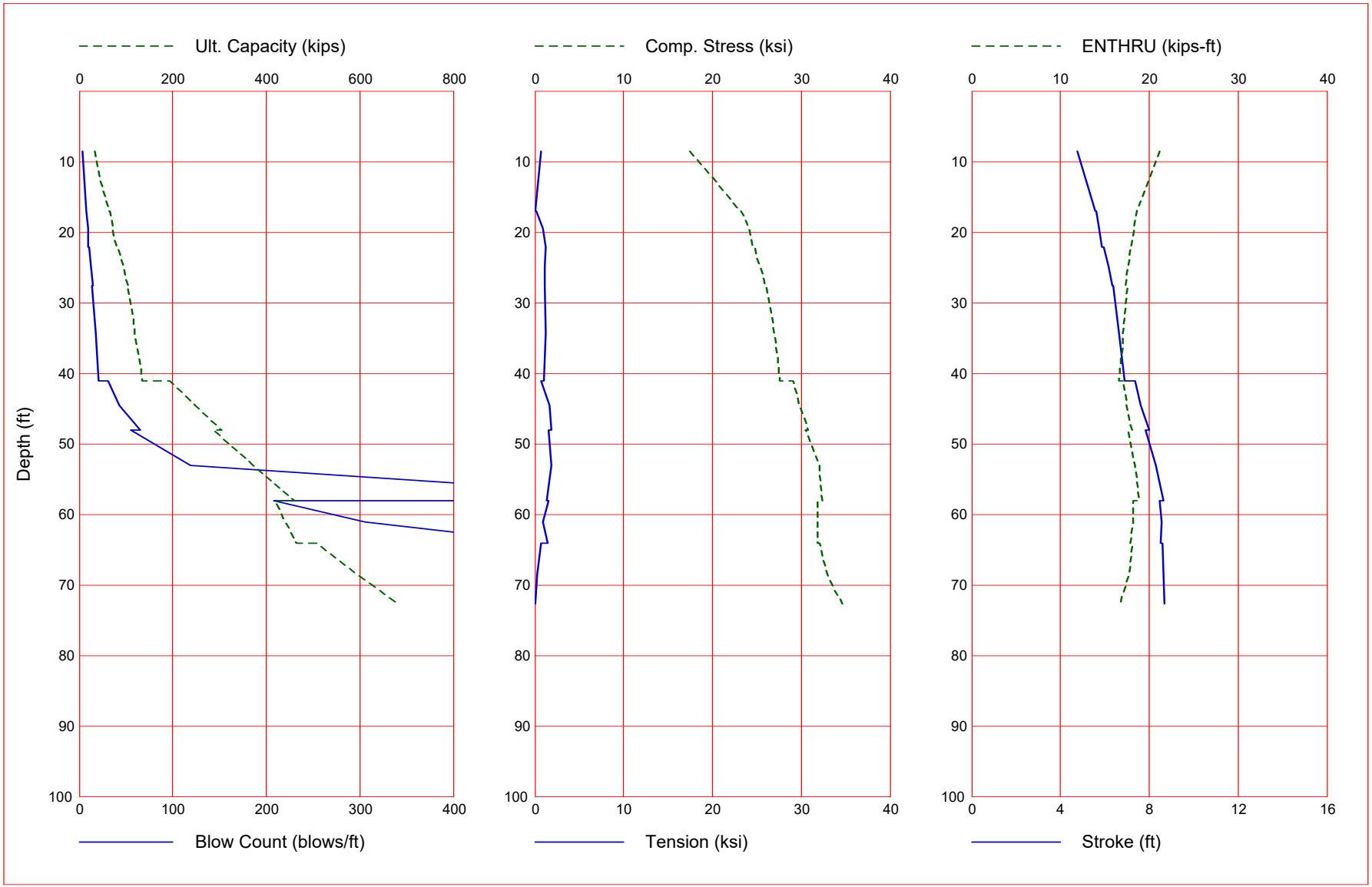
Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	1.38	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
9.00	1.38	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
10.00	1.40	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
11.00	1.42	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
12.00	1.44	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
13.00	1.45	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
14.00	1.47	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
15.00	1.49	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
16.00	1.50	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
16.99	1.52	1.55	0.100	0.100	0.200	0.150	0.667	6.000	336.000
17.01	0.99	2.13	0.100	0.100	0.200	0.150	0.667	6.000	336.000
22.09	0.99	2.13	0.100	0.100	0.200	0.150	0.667	6.000	336.000
22.11	1.49	4.84	0.100	0.100	0.200	0.150	0.667	6.000	336.000
27.59	1.49	4.84	0.100	0.100	0.200	0.150	0.667	6.000	336.000
27.61	1.19	3.88	0.100	0.100	0.200	0.150	1.000	6.000	720.000
36.60	1.20	3.88	0.100	0.100	0.200	0.150	1.000	6.000	720.000
37.60	1.21	3.88	0.100	0.100	0.200	0.150	1.000	6.000	720.000
38.60	1.22	3.88	0.100	0.100	0.200	0.150	1.000	6.000	720.000
39.60	1.23	3.88	0.100	0.100	0.200	0.150	1.000	6.000	720.000
40.60	1.25	3.88	0.100	0.100	0.200	0.150	1.000	6.000	720.000
41.09	1.25	3.88	0.100	0.100	0.200	0.150	1.000	6.000	720.000

41.11	3.57	51.03	0.100	0.100	0.050	0.150	0.000	6.000	24.000
42.10	3.62	51.03	0.100	0.100	0.050	0.150	0.000	6.000	24.000
43.10	3.67	51.03	0.100	0.100	0.050	0.150	0.000	6.000	24.000
44.10	3.72	51.03	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.10	3.77	51.03	0.100	0.100	0.050	0.150	0.000	6.000	24.000
46.10	3.82	51.03	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.10	3.87	51.03	0.100	0.100	0.050	0.150	0.000	6.000	24.000
48.09	3.92	51.03	0.100	0.100	0.050	0.150	0.000	6.000	24.000
48.11	3.84	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
49.10	3.89	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
50.10	3.93	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
51.10	3.98	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
52.10	4.03	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
53.10	4.07	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
54.10	4.12	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
55.10	4.17	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
56.10	4.21	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.10	4.26	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.09	4.30	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.11	2.88	2.23	0.100	0.100	0.150	0.150	0.667	6.000	336.000
64.09	2.88	2.23	0.100	0.100	0.150	0.150	0.667	6.000	336.000
64.11	4.56	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
65.10	4.61	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
66.10	4.65	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
67.10	4.70	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
68.10	4.74	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
69.10	4.79	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
70.10	4.84	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
71.10	4.88	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
72.10	4.93	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000
72.50	4.95	35.96	0.100	0.100	0.050	0.150	0.000	6.000	24.000

Resource International Inc
FRA-70-13.01 Forward Abutment (B-014-7-

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.500 / 1.000



Resource International Inc
FRA-70-13.01 Forward Abutment (B-014-7-

Jun 27 2021
GRLWEAP Version 2010

Gain/Loss 3 at Shaft and Toe 0.500 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
8.5	33.0	31.0	1.9	3.5	17.430	-0.696	4.74	21.2
17.0	64.8	62.9	1.9	8.0	23.143	-0.051	5.57	18.6
17.0	65.7	63.0	2.7	8.1	23.219	-0.184	5.59	18.6
19.5	72.3	69.7	2.7	9.2	24.148	-0.902	5.74	18.3
22.1	79.0	76.3	2.7	10.1	24.543	-1.202	5.88	18.0
22.1	82.5	76.4	6.1	10.6	24.779	-1.260	5.94	17.9
24.9	93.2	87.2	6.1	12.3	25.384	-1.075	6.15	17.6
27.6	104.0	97.9	6.1	14.4	25.997	-1.141	6.34	17.3
27.6	102.9	98.1	4.8	14.1	26.123	-1.105	6.39	17.5
34.3	118.8	114.0	4.8	17.7	26.944	-1.263	6.65	17.0
41.1	134.9	130.1	4.8	20.7	27.615	-0.973	6.89	16.6
41.1	194.2	130.4	63.8	31.0	29.072	-0.699	7.36	17.1
44.6	248.5	184.8	63.8	43.3	29.844	-1.617	7.62	17.4
48.1	305.5	241.8	63.8	65.4	30.816	-1.895	7.98	18.1
48.1	287.4	242.4	45.0	55.5	30.428	-1.581	7.83	17.7
53.1	371.5	326.5	45.0	119.1	32.073	-1.840	8.31	18.4
58.1	460.5	415.5	45.0	687.1	32.321	-1.383	8.66	18.8
58.1	418.8	416.0	2.8	208.1	31.799	-1.503	8.45	18.2
61.1	441.5	438.7	2.8	305.5	31.839	-0.931	8.54	18.2
64.1	464.2	461.4	2.8	503.4	31.881	-1.398	8.51	17.9
64.1	506.9	461.9	45.0	9999.0	32.081	-0.655	8.60	18.1
68.4	591.8	546.8	45.0	9999.0	32.871	-0.270	8.63	17.8
72.7	680.9	636.0	45.0	9999.0	34.660	0.000	8.67	16.7

Refusal occurred; no driving time output possible

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local stresses (e.g., helmet or clamp contact, uneven rock surfaces etc.), prestress effects and others must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: J:\GEOTECH\PROJECTS\2020\W-20-025 FRA-70-13.01\ANALYSIS\DRIVEABILITY\FORWARD ABUTMENT\FRA-70-13.01 FORWARD ABUTMENT HP 12X53 (B-014-7-20).GWW

Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (2/22/2013)

Input File Contents

FRA-70-13.01 Forward Abutment (B-014-7-

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	15.500	12.040	H Pile

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.900	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
72.690	15.50	29000.0	492.000	3.970	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s
DELMAG	D 19-42	1	5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	1.38	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
11.00	1.39	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
12.00	1.40	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
13.00	1.42	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
14.00	1.43	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
15.00	1.45	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
16.00	1.46	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
16.99	1.47	1.94	0.10	0.10	0.20	0.15	1.50	6.00	336.0
17.01	0.99	2.66	0.10	0.10	0.20	0.15	1.50	6.00	336.0
22.09	0.99	2.66	0.10	0.10	0.20	0.15	1.50	6.00	336.0
22.11	1.49	6.05	0.10	0.10	0.20	0.15	1.50	6.00	336.0
27.59	1.49	6.05	0.10	0.10	0.20	0.15	1.50	6.00	336.0
27.61	1.19	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0
38.60	1.20	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0
39.60	1.21	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0

40.60	1.22	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0
41.09	1.23	4.84	0.10	0.10	0.20	0.15	2.00	6.00	720.0
41.11	3.84	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
42.10	3.89	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
43.10	3.95	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
44.10	4.00	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
45.10	4.06	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
46.10	4.11	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
47.10	4.17	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
48.09	4.22	63.78	0.10	0.10	0.05	0.15	1.00	6.00	24.0
48.11	4.13	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
49.10	4.18	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
50.10	4.23	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
51.10	4.28	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
52.10	4.33	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
53.10	4.38	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
54.10	4.43	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
55.10	4.48	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
56.10	4.53	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
57.10	4.58	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
58.09	4.63	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
58.11	2.88	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.0
64.09	2.88	2.79	0.10	0.10	0.15	0.15	1.50	6.00	336.0
64.11	4.90	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
65.10	4.95	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
66.10	5.00	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
67.10	5.05	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
68.10	5.10	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
69.10	5.15	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
70.10	5.20	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
71.10	5.25	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
72.10	5.30	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0
72.69	5.33	44.95	0.10	0.10	0.05	0.15	1.00	6.00	24.0

Gain/Loss factors: shaft and toe

0.40000	0.45000	0.50000	0.55000	0.60000
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
8.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
16.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
17.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
19.55	0.00	0.00	0.000	0.000	0.000	0.000	0.000
22.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
22.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.85	0.00	0.00	0.000	0.000	0.000	0.000	0.000
27.58	0.00	0.00	0.000	0.000	0.000	0.000	0.000
27.62	0.00	0.00	0.000	0.000	0.000	0.000	0.000
34.35	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
41.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
44.60	0.00	0.00	0.000	0.000	0.000	0.000	0.000

48.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
48.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
53.10	0.00	0.00	0.000	0.000	0.000	0.000	0.000
58.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
58.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
61.10	0.00	0.00	0.000	0.000	0.000	0.000	0.000
64.08	0.00	0.00	0.000	0.000	0.000	0.000	0.000
64.12	0.00	0.00	0.000	0.000	0.000	0.000	0.000
68.39	0.00	0.00	0.000	0.000	0.000	0.000	0.000
72.69	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1 0 10.81000 11.86000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

FRA-70-13.01 Forward Abutment (B-014-7-

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.900	60155.0	0.800	0.0100	5.8
Combined Pile Top		11337.0			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth	(ft)	8.5			
Shaft Gain/Loss Factor		0.400	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	15.500	Pile Type		H Pile
Pile Size	(inch)	12.040			

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 29.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	6.2	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	72.69	4.0	15.5
Toe						1.9	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile			Pile Segments: Automatic	
No. of Slacks/Splices		0	Pile Damping	(%) 1
			Pile Damping Fact.	(k/ft/s) 0.544
Driveability Analysis				
Soil Damping Option		Smith		
Max No Analysis Iterations		0	Time Increment/Critical	160
Output Time Interval		1	Analysis Time-Input	(ms) 0
Output Level: Normal				

Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
8.50	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
29.9	3.1	4.63	4.61	-0.81	3	11	16.70	1	2	21.6	55.1
31.4	3.3	4.69	4.67	-0.77	3	11	17.07	5	3	21.4	54.7
33.0	3.5	4.74	4.73	-0.70	2	11	17.43	6	3	21.2	54.4
34.5	3.7	4.80	4.78	-0.63	2	11	17.76	8	3	21.0	54.1
36.1	3.9	4.85	4.83	-0.56	2	11	18.08	8	3	20.9	53.8

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 17.0
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 58.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	1.5	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	72.69	4.0	15.5
Toe						1.9	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)

3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
16.98	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
58.5	7.0	5.42	5.47	0.00	1	0	22.30	18	5	18.9	50.5
61.7	7.5	5.50	5.54	0.00	1	0	22.73	18	5	18.7	50.2
64.8	8.0	5.57	5.61	-0.05	18	50	23.14	18	5	18.6	49.8
68.0	8.5	5.64	5.68	-0.52	18	50	23.54	18	5	18.5	49.5
71.1	9.0	5.71	5.74	-0.84	17	50	23.90	18	5	18.3	49.2

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 17.0
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 59.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	1.6	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	72.69	4.0	15.5
Toe						2.7	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)

3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
17.02	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
59.4	7.1	5.44	5.48	0.00	1	0	22.36	18	6	18.9	50.4
62.5	7.6	5.51	5.56	0.00	1	0	22.79	18	5	18.7	50.1
65.7	8.1	5.59	5.62	-0.18	18	50	23.22	18	5	18.6	49.7
68.8	8.6	5.66	5.69	-0.62	17	50	23.59	18	5	18.4	49.4
72.0	9.1	5.73	5.75	-0.89	17	50	23.99	18	5	18.4	49.1

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 19.5
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 65.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	9.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	8.7	0.200	0.100	72.69	4.0	15.5
Toe						2.7	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)

3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
19.55	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
65.3	8.1	5.59	5.63	-0.15	22	16	23.32	17	5	18.5	49.7
68.8	8.6	5.67	5.70	-0.59	17	50	23.74	17	5	18.5	49.4
72.3	9.2	5.74	5.77	-0.90	17	50	24.15	17	5	18.3	49.1
75.8	9.7	5.81	5.84	-0.95	17	47	24.51	17	5	18.2	48.8
79.3	10.2	5.88	5.91	-1.13	17	46	24.90	17	5	18.0	48.5

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 22.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 71.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	7.4	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	9.5	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	72.69	4.0	15.5
Toe						2.7	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
71.3	9.0	5.73	5.76	-0.68	16	47	23.78	16	5	18.3	49.1
75.1	9.6	5.81	5.83	-0.99	16	47	24.15	16	5	18.2	48.8
79.0	10.1	5.88	5.91	-1.20	16	47	24.54	16	5	18.0	48.5
82.8	10.6	5.96	5.97	-1.30	16	47	24.89	16	5	17.9	48.2
86.6	11.2	6.03	6.04	-1.31	16	46	25.25	16	5	17.8	47.9

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 22.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 74.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	7.5	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	9.5	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	72.69	4.0	15.5
Toe						6.1	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
22.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
74.8	9.5	5.79	5.82	-0.93	16	47	24.02	16	5	18.2	48.9
78.7	10.0	5.87	5.89	-1.15	16	47	24.43	16	5	18.1	48.6
82.5	10.6	5.94	5.96	-1.26	16	47	24.78	16	5	17.9	48.3
86.3	11.1	6.02	6.03	-1.28	16	46	25.17	16	5	17.8	48.0
90.1	11.7	6.08	6.10	-1.22	16	46	25.49	16	5	17.8	47.7

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 24.9
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 84.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	5.6	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	10.1	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	69.39	4.0	15.5

22	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	72.69	4.0	15.5
Toe						6.1	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.85	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
84.5	10.9	5.99	6.00	-1.25	15	47	24.65	15	5	17.8	48.1
88.9	11.5	6.07	6.08	-1.22	15	46	25.04	15	5	17.7	47.8
93.2	12.3	6.15	6.16	-1.08	15	46	25.38	15	5	17.6	47.5
97.6	13.1	6.22	6.24	-0.86	15	46	25.74	15	5	17.5	47.2
101.9	14.0	6.30	6.31	-1.04	9	40	26.09	15	5	17.4	46.9

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 27.6
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 94.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	3.7	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	59.47	4.0	15.5

19	0.175	11337	0.000	0.000	1.00	10.7	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	72.69	4.0	15.5
Toe						6.1	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
27.58	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
94.2	12.5	6.17	6.19	-0.98	14	46	25.23	15	5	17.5	47.4
99.1	13.4	6.25	6.27	-0.89	10	40	25.60	15	5	17.4	47.1
104.0	14.4	6.34	6.35	-1.14	10	40	26.00	15	5	17.3	46.8
108.9	15.3	6.48	6.42	-1.28	9	40	26.53	15	5	17.4	46.4
113.8	16.4	6.55	6.50	-1.29	14	38	26.84	15	5	17.3	46.1

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 27.6
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 93.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	3.9	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	49.56	4.0	15.5

16	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.7	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	72.69	4.0	15.5
Toe						4.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
27.62	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
93.1	12.3	6.15	6.17	-1.04	14	46	25.16	15	5	17.6	47.5
98.0	13.2	6.24	6.25	-0.85	10	40	25.55	15	5	17.5	47.1
102.9	14.1	6.39	6.33	-1.11	10	40	26.12	15	5	17.5	46.7
107.8	15.1	6.47	6.41	-1.27	9	40	26.47	15	5	17.4	46.4
112.7	16.2	6.54	6.49	-1.30	9	40	26.80	15	5	17.3	46.2

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 34.3
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 105.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5

2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	4.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.5	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.5	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	72.69	4.0	15.5
Toe						4.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
34.35	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
105.8	14.6	6.46	6.40	-1.42	10	39	26.15	13	4	17.3	46.5
112.3	16.1	6.56	6.51	-1.39	10	39	26.58	13	4	17.1	46.1
118.8	17.7	6.65	6.62	-1.26	10	39	26.94	13	4	17.0	45.7
125.3	18.9	6.74	6.71	-1.08	10	39	27.32	13	4	16.9	45.4
131.8	20.0	6.81	6.79	-0.87	9	39	27.62	13	4	16.8	45.2

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 41.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 118.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	4.7	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.7	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	72.69	4.0	15.5
Toe						4.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
118.7	17.7	6.68	6.65	-1.40	19	15	26.82	10	4	16.9	45.7
126.8	19.5	6.80	6.76	-1.20	19	15	27.25	10	4	16.8	45.3
134.9	20.7	6.89	6.87	-0.97	19	15	27.61	10	4	16.6	45.0
143.0	22.0	6.98	6.97	-0.74	19	15	27.96	11	4	16.4	44.6
151.1	23.1	7.07	7.05	-0.56	20	15	28.34	11	4	16.5	44.4

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 41.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model — Total Capacity Rut (kips) 177.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	4.8	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	6.6	0.198	0.100	72.69	4.0	15.5
Toe						63.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
41.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
177.9	27.5	7.22	7.21	0.00	1	0	28.51	11	4	16.9	43.9
186.1	29.2	7.30	7.29	-0.08	10	50	28.81	11	4	17.0	43.6
194.2	31.0	7.36	7.36	-0.70	10	50	29.07	10	4	17.1	43.5
202.3	32.9	7.45	7.44	-1.14	10	50	29.41	11	4	17.2	43.2
210.4	35.2	7.44	7.51	-1.39	10	49	29.46	11	4	17.1	43.1

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 44.6
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 232.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	5.4	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	10.2	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	8.9	0.175	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	51.7	0.050	0.100	72.69	4.0	15.5
Toe						63.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
44.60	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
232.3	37.7	7.54	7.54	-1.40	9	49	29.44	9	3	17.4	43.0

240.4	40.6	7.54	7.61	-1.56	9	48	29.53	9	3	17.3	42.9
248.5	43.3	7.62	7.67	-1.62	9	47	29.84	9	3	17.4	42.7
256.7	46.2	7.71	7.74	-1.65	9	46	30.16	9	3	17.6	42.4
264.8	49.6	7.79	7.82	-1.73	9	45	30.44	9	3	17.7	42.2

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 48.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 289.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	6.0	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.0	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.3	0.157	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	51.8	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	54.2	0.050	0.100	72.69	4.0	15.5
Toe						63.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy

ft	ft	Ratio	
48.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
289.3	56.1	7.82	7.86	-1.88	8	45	30.21	8	3	17.8	42.1
297.4	60.9	7.90	7.93	-1.89	8	45	30.50	8	3	17.9	41.9
305.5	65.4	7.98	7.98	-1.89	8	44	30.82	8	3	18.1	41.8
313.6	71.0	8.06	8.05	-1.93	8	43	31.09	8	3	18.2	41.6
321.8	78.1	8.14	8.14	-2.00	8	43	31.36	8	3	18.3	41.4

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 48.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 271.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	6.1	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.0	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	11.8	0.154	0.100	66.08	4.0	15.5

21	0.175	11337	0.000	0.000	1.00	51.8	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	54.2	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
48.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
271.1	47.7	7.66	7.72	-1.56	8	46	29.78	8	3	17.4	42.5
279.3	51.7	7.75	7.80	-1.58	8	45	30.11	8	3	17.5	42.3
287.4	55.5	7.83	7.87	-1.58	8	45	30.43	8	3	17.7	42.1
295.5	60.1	7.91	7.94	-1.61	8	44	30.71	8	3	17.8	41.9
303.6	65.1	7.99	8.01	-1.74	8	43	31.00	8	3	17.9	41.7
1		0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 53.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 355.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	0.8	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	10.8	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	29.74	4.0	15.5

10	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	8.1	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	9.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	34.6	0.073	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	53.0	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	54.8	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	56.4	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
53.10	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
355.3	94.6	8.17	8.18	-1.74	7	42	31.52	7	3	18.3	41.3
363.4	105.9	8.24	8.24	-1.79	7	42	31.80	7	3	18.3	41.1
371.5	119.1	8.31	8.30	-1.84	7	41	32.07	7	3	18.4	41.0
379.6	135.7	8.37	8.36	-1.88	7	41	32.37	7	3	18.5	40.8
387.7	158.0	8.43	8.41	-1.92	7	40	32.63	7	3	18.5	40.7

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 58.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 444.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	6.2	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	9.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.5	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	12.5	0.149	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	51.9	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	54.2	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	55.3	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	57.4	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	59.6	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
58.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
444.3	353.3	8.58	8.54	-1.26	5	39	31.94	5	3	18.8	40.4
452.4	494.7	8.63	8.58	-1.31	5	39	32.14	5	3	18.8	40.3
460.5	687.1	8.66	8.61	-1.38	5	38	32.32	5	3	18.8	40.2
468.6	979.4	8.70	8.63	-1.46	5	38	32.50	5	3	18.9	40.1
476.7	1830.0	8.66	8.65	-1.51	5	37	32.48	5	3	18.6	40.2
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 58.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 402.6

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	6.4	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	9.9	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	10.4	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	13.0	0.146	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	51.9	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	54.2	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	55.3	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	57.5	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	59.4	0.050	0.100	72.69	4.0	15.5
Toe						2.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
58.12	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
402.6	149.2	8.33	8.34	-1.51	5	20	31.32	5	3	18.1	40.9
410.7	173.2	8.39	8.38	-1.47	5	39	31.57	5	3	18.2	40.8
418.8	208.1	8.45	8.44	-1.50	5	39	31.80	5	3	18.2	40.7
427.0	250.5	8.51	8.47	-1.49	5	38	32.04	5	3	18.4	40.6
435.1	318.0	8.56	8.52	-1.46	5	38	32.27	5	3	18.4	40.4
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 61.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 423.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	5.3	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	11.2	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	10.2	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	8.7	0.178	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	51.7	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	54.0	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	55.2	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	57.3	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	59.4	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	26.1	0.136	0.100	72.69	4.0	15.5

Toe 2.8 0.150 0.100

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
61.10	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
423.0	190.8	8.44	8.41	-1.25	4	20	31.41	4	3	18.2	40.7
432.3	237.0	8.49	8.44	-1.07	4	20	31.62	4	3	18.2	40.6
441.5	305.5	8.54	8.48	-0.93	4	37	31.84	4	3	18.2	40.5
450.8	411.9	8.59	8.52	-0.94	22	6	32.06	4	3	18.3	40.4
460.0	567.5	8.55	8.55	-0.98	22	6	32.05	4	3	18.1	40.4

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 64.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 443.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
3	0.175	11337	0.000	0.000	1.00	4.3	0.200	0.100	9.91	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	26.43	4.0	15.5

9	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	11.5	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	49.4	0.052	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	53.8	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	55.1	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	57.1	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	59.2	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	29.8	0.123	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	22.6	0.150	0.100	72.69	4.0	15.5
Toe						2.8	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
64.08	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
443.4	264.9	8.52	8.44	-1.37	22	6	31.72	4	3	18.1	40.6
453.8	365.9	8.57	8.48	-1.38	22	6	31.91	4	3	18.1	40.5
464.2	503.4	8.51	8.51	-1.40	22	6	31.88	4	3	17.9	40.5
474.6	675.5	8.54	8.54	-1.41	22	6	32.05	4	3	17.9	40.5
485.0	945.3	8.57	8.56	-1.43	22	6	32.21	4	3	17.8	40.4
	1	0	10.81000		11.86000						

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 64.1
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 486.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	0.0	0.000	0.100	6.61	4.0	15.5
3	0.175	11337	0.000	0.000	1.00	4.4	0.200	0.100	9.91	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	11.1	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	10.5	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	10.6	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	50.0	0.052	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	53.8	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	55.1	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	57.1	0.050	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	59.2	0.050	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	29.4	0.124	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	22.9	0.149	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
64.12	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
486.1	1139.2	8.57	8.57	-0.65	3	36	31.82	4	2	18.2	40.4
496.5	2378.7	8.58	8.57	-0.64	3	36	31.94	4	3	18.1	40.4
506.9	9999.0	8.60	8.59	-0.65	3	35	32.08	4	3	18.1	40.3
517.3	9999.0	8.62	8.61	-0.66	3	35	32.21	4	3	18.0	40.3
527.7	9999.0	8.64	8.62	-0.62	3	35	32.35	4	3	18.0	40.3

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 68.4
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 571.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	0.0	0.000	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	7.6	0.200	0.100	6.61	4.0	15.5
3	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	9.91	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	11.3	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	9.5	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	7.8	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	9.8	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	17.8	0.121	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	52.2	0.050	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	54.3	0.050	0.100	52.87	4.0	15.5
17	0.175	11337	0.000	0.000	1.00	55.6	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	57.7	0.050	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	55.5	0.058	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	22.6	0.150	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	35.1	0.108	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	66.0	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy

68.39 10.81 1.00 0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
571.0	9999.0	8.61	8.60	-0.30	2	34	32.55	2	2	17.9	40.3
581.4	9999.0	8.62	8.61	-0.23	2	34	32.72	2	2	17.8	40.3
591.8	9999.0	8.63	8.61	-0.27	2	33	32.87	2	2	17.8	40.3
602.2	9999.0	8.63	8.62	-0.33	2	33	33.04	2	2	17.7	40.3
612.6	9999.0	8.64	8.63	-0.35	2	32	33.19	2	2	17.5	40.3

1 0 10.81000 11.86000

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Depth (ft) 72.7
Shaft Gain/Loss Factor 0.400 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 15.500 Pile Type H Pile
Pile Size (inch) 12.040

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	15.50	29000.	492.0	4.0	0	16524.	27.2
72.7	15.50	29000.	492.0	4.0	0	16524.	27.2

Wave Travel Time 2L/c (ms) 8.798

Pile and Soil Model Total Capacity Rut (kips) 660.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.175	11337	0.010	0.000	0.85	10.8	0.200	0.100	3.30	4.0	15.5
2	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	6.61	4.0	15.5
3	0.175	11337	0.000	0.000	1.00	10.9	0.200	0.100	9.91	4.0	15.5
4	0.175	11337	0.000	0.000	1.00	11.0	0.200	0.100	13.22	4.0	15.5
5	0.175	11337	0.000	0.000	1.00	11.4	0.200	0.100	16.52	4.0	15.5
6	0.175	11337	0.000	0.000	1.00	8.4	0.200	0.100	19.82	4.0	15.5
7	0.175	11337	0.000	0.000	1.00	9.0	0.200	0.100	23.13	4.0	15.5
8	0.175	11337	0.000	0.000	1.00	11.7	0.200	0.100	26.43	4.0	15.5
9	0.175	11337	0.000	0.000	1.00	8.2	0.200	0.100	29.74	4.0	15.5
10	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	33.04	4.0	15.5
11	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	36.35	4.0	15.5
12	0.175	11337	0.000	0.000	1.00	6.3	0.200	0.100	39.65	4.0	15.5
13	0.175	11337	0.000	0.000	1.00	31.4	0.080	0.100	42.95	4.0	15.5
14	0.175	11337	0.000	0.000	1.00	52.9	0.050	0.100	46.26	4.0	15.5
15	0.175	11337	0.000	0.000	1.00	54.7	0.050	0.100	49.56	4.0	15.5
16	0.175	11337	0.000	0.000	1.00	56.2	0.050	0.100	52.87	4.0	15.5

17	0.175	11337	0.000	0.000	1.00	58.4	0.050	0.100	56.17	4.0	15.5
18	0.175	11337	0.000	0.000	1.00	44.5	0.081	0.100	59.47	4.0	15.5
19	0.175	11337	0.000	0.000	1.00	22.6	0.150	0.100	62.78	4.0	15.5
20	0.175	11337	0.000	0.000	1.00	48.0	0.078	0.100	66.08	4.0	15.5
21	0.175	11337	0.000	0.000	1.00	66.7	0.050	0.100	69.39	4.0	15.5
22	0.175	11337	0.000	0.000	1.00	68.8	0.050	0.100	72.69	4.0	15.5
Toe						45.0	0.150	0.100			

3.850 kips total unreduced pile weight (g= 32.17 ft/s2)
3.850 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
72.69	10.81	1.00	0.800

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
660.1	9999.0	8.64	8.63	0.00	1	0	34.14	1	2	16.9	40.3
670.5	9999.0	8.66	8.64	0.00	1	0	34.44	1	2	16.9	40.2
680.9	9999.0	8.67	8.66	0.00	1	0	34.66	1	2	16.7	40.2
691.3	9999.0	8.70	8.67	0.00	1	0	34.96	1	2	16.7	40.1
701.7	9999.0	8.70	8.69	0.00	1	0	35.19	1	2	16.6	40.1

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.400 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	29.9	27.9	1.9	3.1	16.698	-0.812	4.63	21.6
17.0	58.5	56.6	1.9	7.0	22.298	0.000	5.42	18.9
17.0	59.4	56.7	2.7	7.1	22.360	0.000	5.44	18.9
19.5	65.3	62.7	2.7	8.1	23.318	-0.147	5.59	18.5
22.1	71.3	68.7	2.7	9.0	23.780	-0.682	5.73	18.3
22.1	74.8	68.8	6.1	9.5	24.019	-0.933	5.79	18.2
24.9	84.5	78.5	6.1	10.9	24.651	-1.248	5.99	17.8
27.6	94.2	88.1	6.1	12.5	25.235	-0.983	6.17	17.5
27.6	93.1	88.2	4.8	12.3	25.162	-1.035	6.15	17.6
34.3	105.8	101.0	4.8	14.6	26.147	-1.420	6.46	17.3
41.1	118.7	113.9	4.8	17.7	26.820	-1.397	6.68	16.9
41.1	177.9	114.2	63.8	27.5	28.506	0.000	7.22	16.9
44.6	232.3	168.5	63.8	37.7	29.441	-1.397	7.54	17.4
48.1	289.3	225.5	63.8	56.1	30.212	-1.875	7.82	17.8
48.1	271.1	226.2	45.0	47.7	29.780	-1.555	7.66	17.4

53.1	355.3	310.3	45.0	94.6	31.517	-1.744	8.17	18.3
58.1	444.3	399.3	45.0	353.3	31.936	-1.257	8.58	18.8
58.1	402.6	399.8	2.8	149.2	31.320	-1.512	8.33	18.1
61.1	423.0	420.2	2.8	190.8	31.406	-1.251	8.44	18.2
64.1	443.4	440.6	2.8	264.9	31.717	-1.369	8.52	18.1
64.1	486.1	441.1	45.0	1139.2	31.818	-0.647	8.57	18.2
68.4	571.0	526.0	45.0	9999.0	32.552	-0.303	8.61	17.9
72.7	660.1	615.2	45.0	9999.0	34.139	0.000	8.64	16.9

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.450 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	31.4	29.5	1.9	3.3	17.073	-0.772	4.69	21.4
17.0	61.7	59.7	1.9	7.5	22.732	0.000	5.50	18.7
17.0	62.5	59.9	2.7	7.6	22.792	0.000	5.51	18.7
19.5	68.8	66.2	2.7	8.6	23.739	-0.591	5.67	18.5
22.1	75.1	72.5	2.7	9.6	24.151	-0.995	5.81	18.2
22.1	78.7	72.6	6.1	10.0	24.434	-1.149	5.87	18.1
24.9	88.9	82.8	6.1	11.5	25.041	-1.216	6.07	17.7
27.6	99.1	93.0	6.1	13.4	25.595	-0.894	6.25	17.4
27.6	98.0	93.1	4.8	13.2	25.547	-0.849	6.24	17.5
34.3	112.3	107.5	4.8	16.1	26.576	-1.390	6.56	17.1
41.1	126.8	122.0	4.8	19.5	27.252	-1.205	6.80	16.8
41.1	186.1	122.3	63.8	29.2	28.815	-0.081	7.30	17.0
44.6	240.4	176.7	63.8	40.6	29.533	-1.564	7.54	17.3
48.1	297.4	233.6	63.8	60.9	30.504	-1.894	7.90	17.9
48.1	279.3	234.3	45.0	51.7	30.107	-1.578	7.75	17.5
53.1	363.4	318.4	45.0	105.9	31.804	-1.787	8.24	18.3
58.1	452.4	407.4	45.0	494.7	32.141	-1.314	8.63	18.8
58.1	410.7	407.9	2.8	173.2	31.569	-1.466	8.39	18.2
61.1	432.3	429.5	2.8	237.0	31.621	-1.074	8.49	18.2
64.1	453.8	451.0	2.8	365.9	31.915	-1.378	8.57	18.1
64.1	496.5	451.5	45.0	2378.7	31.940	-0.641	8.58	18.1
68.4	581.4	536.4	45.0	9999.0	32.723	-0.226	8.62	17.8
72.7	670.5	625.6	45.0	9999.0	34.437	0.000	8.66	16.9

Refusal occurred; no driving time output possible

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FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.500 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	33.0	31.0	1.9	3.5	17.430	-0.696	4.74	21.2
17.0	64.8	62.9	1.9	8.0	23.143	-0.051	5.57	18.6

17.0	65.7	63.0	2.7	8.1	23.219	-0.184	5.59	18.6
19.5	72.3	69.7	2.7	9.2	24.148	-0.902	5.74	18.3
22.1	79.0	76.3	2.7	10.1	24.543	-1.202	5.88	18.0
22.1	82.5	76.4	6.1	10.6	24.779	-1.260	5.94	17.9
24.9	93.2	87.2	6.1	12.3	25.384	-1.075	6.15	17.6
27.6	104.0	97.9	6.1	14.4	25.997	-1.141	6.34	17.3
27.6	102.9	98.1	4.8	14.1	26.123	-1.105	6.39	17.5
34.3	118.8	114.0	4.8	17.7	26.944	-1.263	6.65	17.0
41.1	134.9	130.1	4.8	20.7	27.615	-0.973	6.89	16.6
41.1	194.2	130.4	63.8	31.0	29.072	-0.699	7.36	17.1
44.6	248.5	184.8	63.8	43.3	29.844	-1.617	7.62	17.4
48.1	305.5	241.8	63.8	65.4	30.816	-1.895	7.98	18.1
48.1	287.4	242.4	45.0	55.5	30.428	-1.581	7.83	17.7
53.1	371.5	326.5	45.0	119.1	32.073	-1.840	8.31	18.4
58.1	460.5	415.5	45.0	687.1	32.321	-1.383	8.66	18.8
58.1	418.8	416.0	2.8	208.1	31.799	-1.503	8.45	18.2
61.1	441.5	438.7	2.8	305.5	31.839	-0.931	8.54	18.2
64.1	464.2	461.4	2.8	503.4	31.881	-1.398	8.51	17.9
64.1	506.9	461.9	45.0	9999.0	32.081	-0.655	8.60	18.1
68.4	591.8	546.8	45.0	9999.0	32.871	-0.270	8.63	17.8
72.7	680.9	636.0	45.0	9999.0	34.660	0.000	8.67	16.7

Refusal occurred; no driving time output possible

G/L at Shaft and Toe: 0.550 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	34.5	32.6	1.9	3.7	17.757	-0.627	4.80	21.0
17.0	68.0	66.0	1.9	8.5	23.542	-0.519	5.64	18.5
17.0	68.8	66.2	2.7	8.6	23.594	-0.616	5.66	18.4
19.5	75.8	73.1	2.7	9.7	24.510	-0.951	5.81	18.2
22.1	82.8	80.1	2.7	10.6	24.894	-1.303	5.96	17.9
22.1	86.3	80.2	6.1	11.1	25.166	-1.284	6.02	17.8
24.9	97.6	91.5	6.1	13.1	25.737	-0.859	6.22	17.5
27.6	108.9	102.8	6.1	15.3	26.527	-1.281	6.48	17.4
27.6	107.8	103.0	4.8	15.1	26.469	-1.274	6.47	17.4
34.3	125.3	120.5	4.8	18.9	27.325	-1.078	6.74	16.9
41.1	143.0	138.2	4.8	22.0	27.962	-0.738	6.98	16.4
41.1	202.3	138.5	63.8	32.9	29.409	-1.139	7.45	17.2
44.6	256.7	192.9	63.8	46.2	30.164	-1.649	7.71	17.6
48.1	313.6	249.9	63.8	71.0	31.095	-1.933	8.06	18.2
48.1	295.5	250.5	45.0	60.1	30.714	-1.614	7.91	17.8
53.1	379.6	334.6	45.0	135.7	32.370	-1.877	8.37	18.5
58.1	468.6	423.7	45.0	979.4	32.502	-1.458	8.70	18.9
58.1	427.0	424.2	2.8	250.5	32.037	-1.490	8.51	18.4
61.1	450.8	448.0	2.8	411.9	32.060	-0.940	8.59	18.3
64.1	474.6	471.8	2.8	675.5	32.052	-1.410	8.54	17.9
64.1	517.3	472.3	45.0	9999.0	32.209	-0.659	8.62	18.0
68.4	602.2	557.2	45.0	9999.0	33.045	-0.332	8.63	17.7
72.7	691.3	646.4	45.0	9999.0	34.961	0.000	8.70	16.7

Refusal occurred; no driving time output possible

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.600 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
8.5	36.1	34.1	1.9	3.9	18.076	-0.564	4.85	20.9
17.0	71.1	69.2	1.9	9.0	23.905	-0.836	5.71	18.3
17.0	72.0	69.3	2.7	9.1	23.987	-0.893	5.73	18.4
19.5	79.3	76.6	2.7	10.2	24.896	-1.134	5.88	18.0
22.1	86.6	83.9	2.7	11.2	25.250	-1.313	6.03	17.8
22.1	90.1	84.1	6.1	11.7	25.494	-1.218	6.08	17.8
24.9	101.9	95.9	6.1	14.0	26.090	-1.037	6.30	17.4
27.6	113.8	107.7	6.1	16.4	26.836	-1.287	6.55	17.3
27.6	112.7	107.9	4.8	16.2	26.797	-1.297	6.54	17.3
34.3	131.8	127.0	4.8	20.0	27.624	-0.867	6.81	16.8
41.1	151.1	146.3	4.8	23.1	28.338	-0.557	7.07	16.5
41.1	210.4	146.6	63.8	35.2	29.465	-1.394	7.44	17.1
44.6	264.8	201.0	63.8	49.6	30.444	-1.732	7.79	17.7
48.1	321.8	258.0	63.8	78.1	31.363	-1.997	8.14	18.3
48.1	303.6	258.6	45.0	65.1	31.003	-1.745	7.99	17.9
53.1	387.7	342.8	45.0	158.0	32.630	-1.917	8.43	18.5
58.1	476.7	431.8	45.0	1830.0	32.482	-1.510	8.66	18.6
58.1	435.1	432.3	2.8	318.0	32.274	-1.455	8.56	18.4
61.1	460.0	457.2	2.8	567.5	32.054	-0.983	8.55	18.1
64.1	485.0	482.2	2.8	945.3	32.206	-1.435	8.57	17.8
64.1	527.7	482.7	45.0	9999.0	32.349	-0.624	8.64	18.0
68.4	612.6	567.6	45.0	9999.0	33.187	-0.353	8.64	17.5
72.7	701.7	656.8	45.0	9999.0	35.192	0.000	8.70	16.6

Refusal occurred; no driving time output possible

FRA-70-13.01 Forward Abutment (B-014-7- 06/27/2021
Resource International Inc GRLWEAP Version 2010

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Pressure Stroke ft	Ratio	Efficy.	Stiffn. Factor	Cushion CoR
8.50	72.69	0.00	10.81	1.00	0.80	1.00	1.00
16.98	72.69	0.00	10.81	1.00	0.80	1.00	1.00
17.02	72.69	0.00	10.81	1.00	0.80	1.00	1.00
19.55	72.69	0.00	10.81	1.00	0.80	1.00	1.00

22.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
22.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
24.85	72.69	0.00	10.81	1.00	0.80	1.00	1.00
27.58	72.69	0.00	10.81	1.00	0.80	1.00	1.00
27.62	72.69	0.00	10.81	1.00	0.80	1.00	1.00
34.35	72.69	0.00	10.81	1.00	0.80	1.00	1.00
41.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
41.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
44.60	72.69	0.00	10.81	1.00	0.80	1.00	1.00
48.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
48.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
53.10	72.69	0.00	10.81	1.00	0.80	1.00	1.00
58.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
58.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
61.10	72.69	0.00	10.81	1.00	0.80	1.00	1.00
64.08	72.69	0.00	10.81	1.00	0.80	1.00	1.00
64.12	72.69	0.00	10.81	1.00	0.80	1.00	1.00
68.39	72.69	0.00	10.81	1.00	0.80	1.00	1.00
72.69	72.69	0.00	10.81	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	1.38	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
11.00	1.39	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
12.00	1.40	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
13.00	1.42	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
14.00	1.43	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
15.00	1.45	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
16.00	1.46	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
16.99	1.47	1.94	0.100	0.100	0.200	0.150	0.667	6.000	336.000
17.01	0.99	2.66	0.100	0.100	0.200	0.150	0.667	6.000	336.000
22.09	0.99	2.66	0.100	0.100	0.200	0.150	0.667	6.000	336.000
22.11	1.49	6.05	0.100	0.100	0.200	0.150	0.667	6.000	336.000
27.59	1.49	6.05	0.100	0.100	0.200	0.150	0.667	6.000	336.000
27.61	1.19	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
38.60	1.20	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
39.60	1.21	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
40.60	1.22	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
41.09	1.23	4.84	0.100	0.100	0.200	0.150	1.000	6.000	720.000
41.11	3.84	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
42.10	3.89	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
43.10	3.95	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
44.10	4.00	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
45.10	4.06	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
46.10	4.11	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
47.10	4.17	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000
48.09	4.22	63.78	0.100	0.100	0.050	0.150	0.000	6.000	24.000

48.11	4.13	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
49.10	4.18	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
50.10	4.23	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
51.10	4.28	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
52.10	4.33	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
53.10	4.38	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
54.10	4.43	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
55.10	4.48	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
56.10	4.53	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
57.10	4.58	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.09	4.63	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
58.11	2.88	2.79	0.100	0.100	0.150	0.150	0.667	6.000	336.000
64.09	2.88	2.79	0.100	0.100	0.150	0.150	0.667	6.000	336.000
64.11	4.90	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
65.10	4.95	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
66.10	5.00	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
67.10	5.05	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
68.10	5.10	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
69.10	5.15	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
70.10	5.20	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
71.10	5.25	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
72.10	5.30	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000
72.69	5.33	44.95	0.100	0.100	0.050	0.150	0.000	6.000	24.000

APPNDIX IX

MSE WALL CALCULATIONS

RESOURCE INTERNATIONAL, INC.
6350 PRESIDENTIAL GATEWAY
COLUMBUS, OHIO 43231
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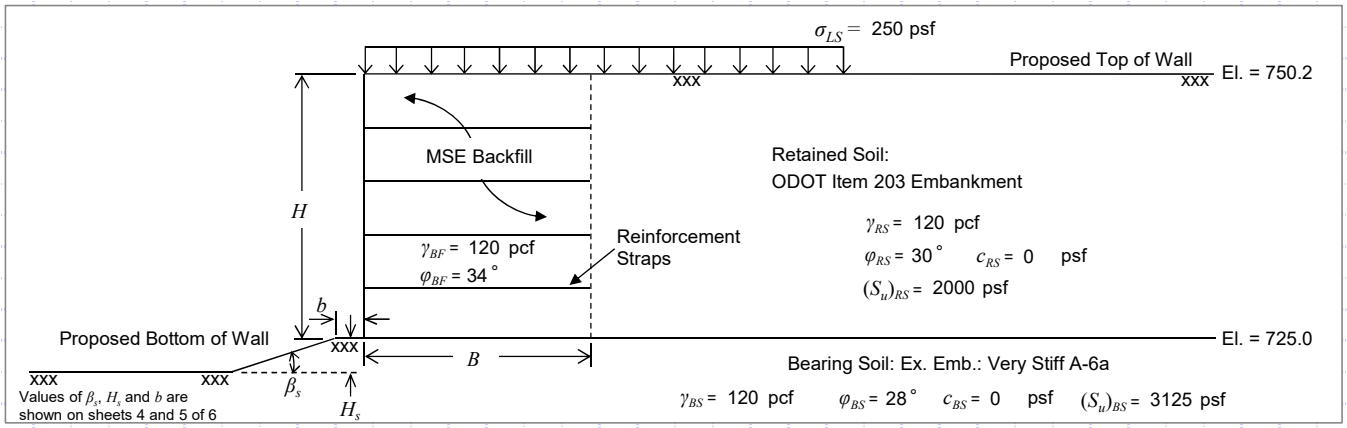
Retaining Wall W4 - FRA-70-1301R - Rear Abutment - B-015-1-13 - Level Backfill - 25.2 ft. Wall Height



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2	ft
MSE Wall Width (Reinforcement Length), (B) =	22.7	ft
MSE Wall Length, (L) =	88	ft
Live Surcharge Load, (σ_{LS}) =	250	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion [1], (c_{BS}) =	0	psf
Retained Soil Undrained Shear Strength, [$(S_u)_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [$(S_u)_{BS}$] =	3125	psf
Embedment Depth, (D_f) =	0.0	ft
Depth to Grounwater (Below Bot. of Wall), (D_W) =	46.8	ft

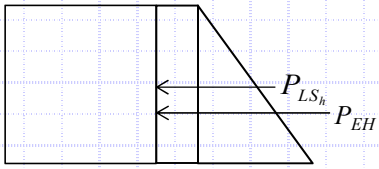
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.3

Sliding Force:



$$P_H = P_{EH} + P_{LS_h}$$

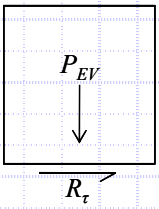
$$P_{EH} = \tfrac{1}{2}\gamma_{RS} H^2 K_a \gamma_{EH} = \tfrac{1}{2}(120\text{ pcf})(25.2\text{ ft})^2(0.297)(1.5) = 16.97 \text{ kip/ft}$$

$$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS} = (250\text{ psf})(25.2\text{ ft})(0.297)(1.75) = 3.27 \text{ kip/ft}$$

$$P_H = 16.97\text{ kip/ft} + 3.27\text{ kip/ft} = 20.24 \text{ kip/ft}$$

Check Sliding Resistance - Drained Condition

Nominal Sliding Resistance:



$$R_\tau = P_{EV} \cdot \tan\delta$$

$$P_{EV} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} = (120\text{ pcf})(25.2\text{ ft})(22.7\text{ ft})(1.00) = 68.64 \text{ kip/ft}$$

$$\tan\delta = (\tan\varphi_{BS} \le \tan\varphi_{BF})$$

$$\tan\delta = \tan(28) \le \tan(34) \longrightarrow 0.53 \le 0.67 \longrightarrow \tan\delta = 0.53$$

$$R_\tau = (68.64\text{ kip/ft})(0.53) = 36.38 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition

$$P_H \le R_\tau \cdot \phi_\tau \longrightarrow 20.24\text{ kip/ft} \le (36.38\text{ kip/ft})(1.0) = 36.38\text{ kip/ft} \longrightarrow 20.24\text{ kip/ft} \le 36.38\text{ kip/ft}$$ **OK**

Use φ_τ = **1.0** *(Per AASHTO LRFD BDM Table 11.5.7-1)*

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MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2	ft
MSE Wall Width (Reinforcement Length), (B) =	22.7	ft
MSE Wall Length, (L) =	88	ft
Live Surcharge Load, (σ_{LS}) =	250	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	3125	psf
Embedment Depth, (D_f) =	0.0	ft
Depth to Grounwater (Below Bot. of Wall), (D_W) =	46.8	ft

LRFD Load Factors

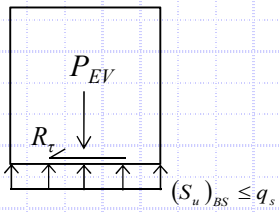
	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.3 ***(Continued)***

Check Sliding Resistance - Undrained Condition

Nominal Sliding Resisting: $R_\tau = \left((S_u)_{BS} \le q_s\right) \cdot B$



$(S_u)_{BS}$ = 3.13 ksf

$q_s = \sigma_v / 2$ = (3.02 ksf) / 2 = 1.51 ksf

$\sigma_v = P_{EV} / B$ = (68.64 kip/ft) / (22.7 ft) = 3.02 ksf

R_τ = (3.13 ksf ≤ 1.51 ksf)(22.7 ft) = 34.28 kip/ft

Verify Sliding Force Less Than Factored Sliding Resistance - Undrained Condition

$P_H \le R_\tau \cdot \phi_\tau$ ⟶ 20.24 kip/ft ≤ (34.28 kip/ft)(1.0) = 34.28 kip/ft ⟶ 20.24 kip/ft ≤ 34.28 kip/ft **OK**

Use φ_τ = **1.0** *(Per AASHTO LRFD BDM Table 11.5.7-1)*

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MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2	ft
MSE Wall Width (Reinforcement Length), (B) =	22.7	ft
MSE Wall Length, (L) =	88	ft
Live Surcharge Load, (σ_{LS}) =	250	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	0	psf
Retained Soil Undrained Shear Strength, $[(S_u)_{RS}]$ =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

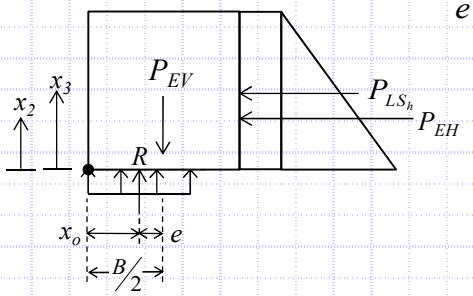
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, $[(s_u)_{BS}]$ =	3125	psf
Embedment Depth, (D_f) =	0.0	ft
Depth to Grounwater (Below Bot. of Wall), (D_W) =	46.8	ft

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.5



$$e = B/2 - x_o$$

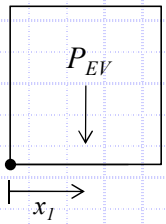
$$x_o = \frac{M_{EV} - M_H}{P_{EV}}$$ = (779.06 kip·ft/ft - 183.75 kip·ft/ft) / (68.64 kip/ft) = 8.67 ft

M_{EV} = 779.06 kip·ft/ft
M_H = 183.75 kip·ft/ft
P_{EV} = 68.64 kip/ft
} Defined below

$e =$ (22.7 ft)/2 - 8.67 ft = 2.68 ft

Resisting Moment, M_{EV}:

$$M_{EV} = P_{EV}(x_1)$$



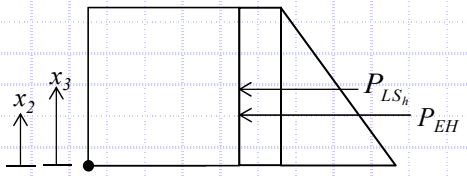
$P_{EV} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV}$ = (120 pcf)(25.2 ft)(22.7 ft)(1.00) = 68.64 kip/ft

$x_1 = B/2$ = (22.7 ft) / 2 = 11.35 ft

$M_{EV} =$ (68.64 kip/ft)(11.35 ft) = 779.06 kip·ft/ft

Overturning Moment, M_H:

$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3)$$



$P_{EH} = \frac{1}{2}\gamma_{RS} H^2 K_a \gamma_{EH}$ = ½(120 pcf)(25.2 ft)²(0.297)(1.5) = 16.97 kip/ft

$P_{LS_h} = \sigma_{LS} H K_a \gamma_{LS}$ = (250 psf)(25.2 ft)(0.297)(1.75) = 3.27 kip/ft

$x_2 = H/3$ = (25.2 ft) / 3 = 8.40 ft

$x_3 = H/2$ = (25.2 ft) / 2 = 12.60 ft

$M_H =$ (16.97 kip/ft)(8.4 ft) + (3.27 kip/ft)(12.60 ft) = 183.75 kip·ft/ft

Check Eccentricity

$e < e_{max} \longrightarrow$ 2.68 ft < 7.57 ft **OK**

Limiting Eccentricity: $e_{max} = B/3 \longrightarrow e_{max} =$ (22.7 ft) / 3 = 7.57 ft

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MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2	ft
MSE Wall Width (Reinforcement Length), (B) =	22.7	ft
MSE Wall Length, (L) =	88	ft
Live Surcharge Load, (σ_{LS}) =	250	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

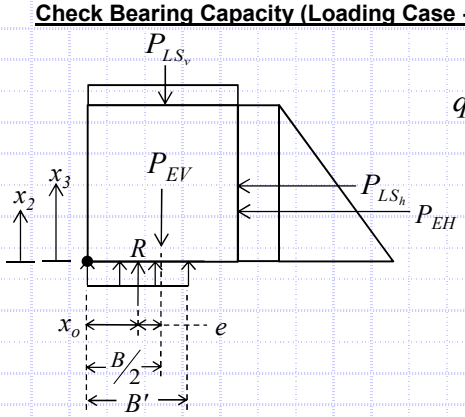
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	3125	psf
Embedment Depth, (D_f) =	0.0	ft
Depth to Grounwater (Below Bot. of Wall), (D_W) =	46.8	ft

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.10.5.4



$$q_{eq} = P_V / B'$$

$$B' = B - 2e = 22.7 \text{ ft} - 2(1.79 \text{ ft}) = 19.12 \text{ ft}$$

$$e = B/2 - x_o = (22.7 \text{ ft}) / 2 - 9.56 \text{ ft} = 1.79 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (1164.53 \text{ kip·ft/ft} - 183.84 \text{ kip·ft/ft}) / 102.6 \text{ kip/ft} = 9.56 \text{ ft}$$

$$q_{eq} = (102.6 \text{ kip/ft}) / (19.12 \text{ ft}) = 5.37 \text{ ksf}$$

$$M_V = P_{EV}(x_1) + P_{LS_v}(x_1) = (\gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV})(x_1) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})(x_1)$$

$$M_V = [(120 \text{ pcf})(25.2 \text{ ft})(22.7 \text{ ft})(1.35)](11.35 \text{ ft}) + [(250 \text{ psf})(22.7 \text{ ft})(1.75)](11.35 \text{ ft}) = 1164.53 \text{ kip·ft/ft}$$

$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3) = (\tfrac{1}{2}\gamma_{RS} H^2 K_a \gamma_{EH})(x_2) + (\sigma_{LS} H K_a \gamma_{LS})(x_3)$$

$$M_H = [\tfrac{1}{2}(120 \text{ pcf})(25.2 \text{ ft})^2(0.297)(1.5)](8.4 \text{ ft}) + [(250 \text{ psf})(25.2 \text{ ft})(0.297)(1.75)](12.6 \text{ ft}) = 183.84 \text{ kip·ft/ft}$$

$$P_V = P_{EV} + P_{LS} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} + \sigma_{LS} \cdot B \cdot \gamma_{LS}$$

$$P_V = (120 \text{ pcf})(25.2 \text{ ft})(22.7 \text{ ft})(1.35) + (250 \text{ psf})(22.7 \text{ ft})(1.75) = 102.6 \text{ kip/ft}$$

Check Bearing Resistance - Drained Condition

Nominal Bearing Resistance: $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \tfrac{1}{2}\gamma B N_{\gamma m} C_{w\gamma}$

$N_{cm} = N_c s_c i_c$ = 29.00 $\quad N_{qm} = N_q s_q d_q i_q$ = 16.43 $\quad N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ = 15.27

N_c = 25.8
s_c = 1+(19.12 ft/88 ft)(14.72/25.8)
= 1.124
i_c = 1.000 (Assumed)

N_q = 14.72
s_q = 1.116
d_q = 1+2tan(28°)[1-sin(28°)]²tan⁻¹(0.0 ft/19.12 ft)
1.000
i_q = 1.000 (Assumed)
C_{wq} = 46.8 ft > 0.0 ft = 1.000

N_γ = 16.72
s_γ = 0.913
i_γ = 1.000 (Assumed)
$C_{w\gamma}$ = 46.8 ft > 1.5(19.12 ft) + 46.8 ft = 1.000

q_n = (0 psf)(28.999) + (120 pcf)(0.0 ft)(16.428)(1.000) + ½(120 pcf)(19.1 ft)(15.265)(1.000) = 17.51 ksf

Use β_s = 23.1 ° $\quad H_s$ = 5.0 ft $\quad b$ = 0.0 ft

Verify Equivalent Pressure Less Than Factored Bearing Resistance

RC_{BC} = **0.50** *(Per AASHTO LRFD BDM Section 10.6.3.1.2c)*

Use φ_b = **0.65** *(Per AASHTO LRFD BDM Table 11.5.7-1)*

$q_{eq} \le q_n \cdot RC_{BC} \cdot \phi_b \longrightarrow$ 5.37 ksf ≤ (17.51 ksf)(0.50)(0.65) = 5.69 ksf $\longrightarrow$ 5.37 ksf ≤ 5.69 ksf **OK**

MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2	ft
MSE Wall Width (Reinforcement Length), (B) =	22.7	ft
MSE Wall Length, (L) =	88	ft
Live Surcharge Load, (σ_{LS}) =	250	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	3125	psf
Embedment Depth, (D_f) =	0.0	ft
Depth to Grounwater (Below Bot. of Wall), (D_W) =	46.8	ft

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.10.5.4 ***(Continued)***

Check Bearing Resistance - Undrained Condition

Nominal Bearing Resistance: $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2}\gamma B N_{\gamma m} C_{w\gamma}$

$N_{cm} = N_c s_c i_c$ = 5.360 $\quad N_{qm} = N_q s_q d_q i_q$ = 1.000 $\quad N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ = 0.000

N_c = 5.140
s_c = 1+(19.12 ft/[(5)(88 ft)]) = 1.043
i_c = 1.000 (Assumed)

N_q = 1.000
s_q = 1.000
d_q = 1+2tan(0°)[1-sin(0°)]²tan⁻¹(0.0 ft/19.12 ft)
1.000
i_q = 1.000 (Assumed)
C_{wq} = 46.8 ft > 0.0 ft = 1.000

N_γ = 0.000
s_γ = 1.000
i_γ = 1.000 (Assumed)
$C_{w\gamma}$ = 46.8 ft > 1.5(19.12 ft) + 46.8 ft = 1.000

q_n = (3125 psf)(5.360) + (120 pcf)(0.0 ft)(1.000)(1.000) + ½(120 pcf)(19.1 ft)(0.000)(1.000) = 16.75 ksf

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$q_{eq} \leq q_n \cdot RC_{BC} \cdot \phi_b \longrightarrow$ 5.37 ksf ≤ (16.75 ksf)(0.85)(0.65) = 9.25 ksf $\longrightarrow$ 5.37 ksf ≤ 9.25 ksf **OK**

RC_{BC} = **0.85** *(Per AASHTO LRFD BDM Section 10.6.3.1.2c)* $\longrightarrow$ Use β_s = 23.1 ° H_s = 5.0 ft b = 0.0 ft
Use φ_b = **0.65** *(Per AASHTO LRFD BDM Table 11.5.7-1)*

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MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	25.2	ft
MSE Wall Width (Reinforcement Length), (B) =	22.7	ft
MSE Wall Length, (L) =	88	ft
Live Surcharge Load, (σ_{LS}) =	250	psf
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{BS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.297	
MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°

Bearing Soil Properties:

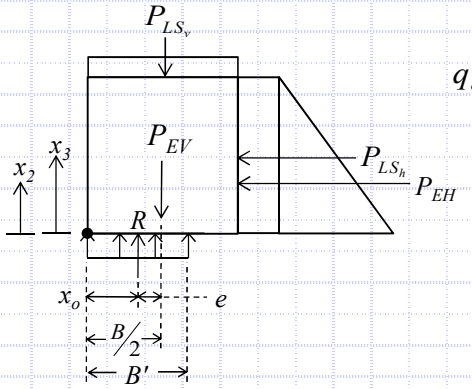
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	3125	psf
Embedment Depth, (D_f) =	0.0	ft
Depth to Grounwater (Below Bot. of Wall), (D_W) =	46.8	ft

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

Settlement Analysis (Loading Case - Service I) - AASHTO LRFD BDM Section 11.10.4.1



$$q_{eq} = P_V / B'$$

$$B' = B - 2e = 22.7 \text{ ft} - 2(1.6 \text{ ft}) = 19.50 \text{ ft}$$

$$e = B/2 - x_o = (22.7 \text{ ft}) / 2 - 9.75 \text{ ft} = 1.60 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (843.53 \text{ kip·ft/ft} - 118.63 \text{ kip·ft/ft}) / 74.32 \text{ kip/ft} = 9.75 \text{ ft}$$

$$q_{eq} = (74.32 \text{ kip/ft}) / (19.5 \text{ ft}) = 3.81 \text{ ksf}$$

$$M_V = P_{EV}(x_1) + P_{LS_v}(x_1) = (\gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV})(x_1) + (\sigma_{LS} \cdot B \cdot \gamma_{LS})(x_1)$$

$$M_V = [(120 \text{ pcf})(25.2 \text{ ft})(22.7 \text{ ft})(1.00)](11.4 \text{ ft}) + [(250 \text{ psf})(22.7 \text{ ft})(1.00)](11.4 \text{ ft}) = 843.53 \text{ kip·ft/ft}$$

$$M_H = P_{EH}(x_2) + P_{LS_h}(x_3) = (\tfrac{1}{2}\gamma_{RS} H^2 K_a \gamma_{EH})(x_2) + (\sigma_{LS} H K_a \gamma_{LS})(x_3)$$

$$M_H = [\tfrac{1}{2}(120 \text{ pcf})(25.2 \text{ ft})^2(0.297)(1.00)](8.4 \text{ ft}) + [(250 \text{ psf})(25.2 \text{ ft})(0.297)(1.00)](12.6 \text{ ft}) = 118.63 \text{ kip·ft/ft}$$

$$P_V = P_{EV} + P_{LS} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} + \sigma_{LS} \cdot B \cdot \gamma_{LS}$$

$$P_V = (120 \text{ pcf})(25.2 \text{ ft})(22.7 \text{ ft})(1.00) + (250 \text{ psf})(22.7 \text{ ft})(1.00) = 74.32 \text{ kip/ft}$$

Settlement (To be calculated at Stage 2 Detailed Design):

Total Settlement at Center of Reinforced Soil Mass:	S_t =	**2.940**	in
Total Settlement at Wall Facing:	S_t =	**1.831**	in

Time Rate of Consolidation and Downdrag Depths and Loads:

Hold Period	Degree of Consolidation	Settlement Remaining at Completion of Hold Period	Depth of Downdrag
21 days	79 %	0.393 in	0.0 ft
51 days	90 %	0.188 in	0.0 ft

W-20-025 - FRA-70-13.01 - Retaining Wall W4

MSE Wall Settlement - Rear Abutment

Calculated By: HSK Date: 6/24/2021

Checked By: BRT Date: 6/24/2021

Boring B-015-1-13

H=	25.2	ft	Total wall height
B'=	19.5	ft	Effective footing width due to eccentricity
D_w =	46.8	ft	Depth below bottom of footing
q_e =	3,810	psf	Equivalent bearing pressure at bottom of wall

																							Total Settlement at Center of Reinforced Soil Mass					Total Settlement at Facing of Wall				
Layer	Soil Class.	Soil Type	Layer Depth (ft)		ELevation (ft msl)		Layer Thickness H (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	S_c (9,10) (ft)	S_c (in)	I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	S_c (9,10) (ft)	S_c (in)
1	A-6a	C	0.0	3.0	725.0	722.0	3.0	1.5	120	360	180	180	2,680	27	0.080	0.016	0.355				0.08	0.998	3,804	3,984	0.072	0.865	0.500	1,905	2,085	0.038	0.452
	A-6a	C	3.0	6.3	722.0	718.7	3.3	4.7	120	756	558	558	3,058	27	0.080	0.016	0.355				0.24	0.964	3,673	4,231	0.056	0.675	0.497	1,895	2,453	0.025	0.301
2	A-1-b	G	6.3	10.3	718.7	714.7	4.0	8.3	135	1,296	1,026	1,026	3,526					69	85	357	0.43	0.865	3,297	4,323	0.007	0.084	0.487	1,854	2,880	0.005	0.060
3	A-6b	C	10.3	12.8	714.7	712.2	2.5	11.6	120	1,596	1,446	1,446	3,946	37	0.109	0.023	0.563				0.59	0.760	2,896	4,342	0.023	0.279	0.469	1,788	3,234	0.013	0.154
	A-6b	C	12.8	15.3	712.2	709.7	2.5	14.1	120	1,896	1,746	1,746	4,246	37	0.109	0.023	0.563				0.72	0.684	2,608	4,354	0.016	0.193	0.452	1,723	3,469	0.011	0.132
4	A-4a	C	15.3	20.3	709.7	704.7	5.0	17.8	120	2,496	2,196	2,196	4,696	26	0.137	0.018	0.698				0.91	0.587	2,237	4,433	0.016	0.194	0.423	1,612	3,808	0.013	0.152
	A-4a	C	20.3	25.3	704.7	699.7	5.0	22.8	120	3,096	2,796	2,796	5,296	26	0.137	0.018	0.698				1.17	0.487	1,857	4,653	0.012	0.141	0.382	1,457	4,253	0.010	0.116
	A-4a	C	25.3	30.3	699.7	694.7	5.0	27.8	120	3,696	3,396	3,396	5,896	26	0.137	0.018	0.698				1.43	0.414	1,576	4,972	0.009	0.105	0.344	1,312	4,708	0.008	0.090
5	A-1-b	G	30.3	35.3	694.7	689.7	5.0	32.8	135	4,371	4,034	4,034	6,534					49	38	122	1.68	0.358	1,363	5,397	0.005	0.062	0.311	1,183	5,217	0.005	0.055
6	A-1-b	G	35.3	42.8	689.7	682.2	7.5	39.1	130	5,346	4,859	4,859	7,359					30	21	77	2.00	0.305	1,164	6,022	0.009	0.109	0.275	1,046	5,905	0.008	0.099
	A-1-b	G	42.8	50.3	682.2	674.7	7.5	46.6	130	6,321	5,834	5,834	8,334					30	19	73	2.39	0.259	987	6,821	0.007	0.084	0.240	913	6,747	0.007	0.078
7	A-4a	C	50.3	58.3	674.7	666.7	8.0	54.3	115	7,241	6,781	6,313	8,813	21	0.099	0.015	0.436				2.78	0.224	853	7,166	0.005	0.055	0.211	804	7,117	0.004	0.052
	A-4a	C	58.3	66.3	666.7	658.7	8.0	62.3	115	8,161	7,701	6,734	9,234	21	0.099	0.015	0.436				3.19	0.196	747	7,481	0.004	0.045	0.187	714	7,447	0.004	0.043
	A-4a	C	66.3	76.6	658.7	648.4	10.3	71.5	115	9,346	8,753	7,215	9,715	21	0.099	0.015	0.436				3.66	0.172	654	7,869	0.004	0.048	0.166	631	7,846	0.004	0.047
																								Total Settlement:		2.940 in			Total Settlement:		1.831 in

1. $\sigma_p' = \sigma_{vo}'+\sigma_m$; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(Cc) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used $e_o = (C_c/1.15)+0.35$; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_nN_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

W-20-025 - FRA-70-13.01 - Retaining Wall W4

MSE Wall Settlement - Rear Abutment

Calculated By: HSK Date: 6/24/2021

Checked By: BRT Date: 6/21/2021

Boring B-015-1-13

H=	25.2	ft	Total wall height
B'=	19.5	ft	Effective footing width due to eccentricity
D_w =	46.8	ft	Depth below bottom of footing
q_e =	3,810	psf	Equivalent bearing pressure at bottom of wall

	A-6a	A-6b	A-4a (Upper)	A-4a (Lower)		
c_v =	200	175	400	400	ft^2/yr	Coefficient of consolitation
t =	51	51	51	51	days	Time following completion of construction
H_{dr} =	3.1	5.0	10.0	26.3	ft	Length of longest drainage path considered
T_v =	2.908	0.978	0.559	0.081		Time factor
U =	100	93	80	32	%	Degree of consolidation

$(S_c)_t$ = 1.643 in Settlement complete at 90% of primary consolidation

Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	Total Settlement at Facing of Wall: S_c (9,10) (ft)	S_c (in)	Layer Settlement (in)	Settlement Complete at 90% of Primary Consolidation: $(S_c)_t$ (11) (in)	Layer Settlement (in)
1	A-6a	C	0.0	3.0	725.0	722.0	3.0	1.5	120	360	180	180	2,680	27	0.080	0.016	0.355				0.08	0.500	1,905	2,085	0.038	0.452	0.753	0.452	0.753
	A-6a	C	3.0	6.3	722.0	718.7	3.3	4.7	120	756	558	558	3,058	27	0.080	0.016	0.355				0.24	0.497	1,895	2,453	0.025	0.301		0.301	
2	A-1-b	G	6.3	10.3	718.7	714.7	4.0	8.3	135	1,296	1,026	1,026	3,526					69	85	357	0.43	0.487	1,854	2,880	0.005	0.060	0.060	0.060	0.060
3	A-6b	C	10.3	12.8	714.7	712.2	2.5	11.6	120	1,596	1,446	1,446	3,946	37	0.109	0.023	0.563				0.59	0.469	1,788	3,234	0.013	0.154	0.286	0.144	0.266
	A-6b	C	12.8	15.3	712.2	709.7	2.5	14.1	120	1,896	1,746	1,746	4,246	37	0.109	0.023	0.563				0.72	0.452	1,723	3,469	0.011	0.132		0.122	
4	A-4a	C	15.3	20.3	709.7	704.7	5.0	17.8	120	2,496	2,196	2,196	4,696	26	0.137	0.018	0.698				0.91	0.423	1,612	3,808	0.013	0.152	0.358	0.122	0.287
	A-4a	C	20.3	25.3	704.7	699.7	5.0	22.8	120	3,096	2,796	2,796	5,296	26	0.137	0.018	0.698				1.17	0.382	1,457	4,253	0.010	0.116		0.093	
	A-4a	C	25.3	30.3	699.7	694.7	5.0	27.8	120	3,696	3,396	3,396	5,896	26	0.137	0.018	0.698				1.43	0.344	1,312	4,708	0.008	0.090		0.072	
5	A-1-b	G	30.3	35.3	694.7	689.7	5.0	32.8	135	4,371	4,034	4,034	6,534					49	38	122	1.68	0.311	1,183	5,217	0.005	0.055	0.055	0.055	0.055
6	A-1-b	G	35.3	42.8	689.7	682.2	7.5	39.1	130	5,346	4,859	4,859	7,359					30	21	77	2.00	0.275	1,046	5,905	0.008	0.099	0.177	0.099	0.177
	A-1-b	G	42.8	50.3	682.2	674.7	7.5	46.6	130	6,321	5,834	5,834	8,334					30	19	73	2.39	0.240	913	6,747	0.007	0.078		0.078	
7	A-4a	C	50.3	58.3	674.7	666.7	8.0	54.3	115	7,241	6,781	6,313	8,813	21	0.099	0.015	0.436				2.78	0.211	804	7,117	0.004	0.052	0.142	0.017	0.045
	A-4a	C	58.3	66.3	666.7	658.7	8.0	62.3	115	8,161	7,701	6,734	9,234	21	0.099	0.015	0.436				3.19	0.187	714	7,447	0.004	0.043		0.014	
	A-4a	C	66.3	76.6	658.7	648.4	10.3	71.5	115	9,346	8,753	7,215	9,715	21	0.099	0.015	0.436				3.66	0.166	631	7,846	0.004	0.047		0.015	

Settlement Remaining After Hold Period: 0.188 in

1. $\sigma_p' = \sigma_{vo}'+\sigma_m$; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(Cc) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used e_o = (C_c/1.15)+0.35; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_nN_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. $(S_c)_t = S_c(U/100)$; U = 100 for all granular soils at time t = 0

W-20-025 - FRA-70-13.01 - Retaining Wall W4

MSE Wall Settlement - Rear Abutment

Calculated By: HSK Date: 6/24/2021

Checked By: BRT Date: 6/21/2021

Boring B-015-1-13

H=	25.2	ft	Total wall height
B'=	19.5	ft	Effective footing width due to eccentricity
D_w =	46.8	ft	Depth below bottom of footing
q_e =	3,810	psf	Equivalent bearing pressure at bottom of wall

	A-6a	A-6b	A-4a (Upper)	A-4a (Lower)		
c_v =	200	175	400	400	ft^2/yr	Coefficient of consolitation
t =	21	21	21	21	days	Time following completion of construction
H_{dr} =	3.1	5.0	10.0	26.3	ft	Length of longest drainage path considered
T_v =	1.197	0.403	0.230	0.033		Time factor
U =	96	70	54	21	%	Degree of consolidation

$(S_c)_t$ = 1.439 in Settlement complete at 79% of primary consolidation

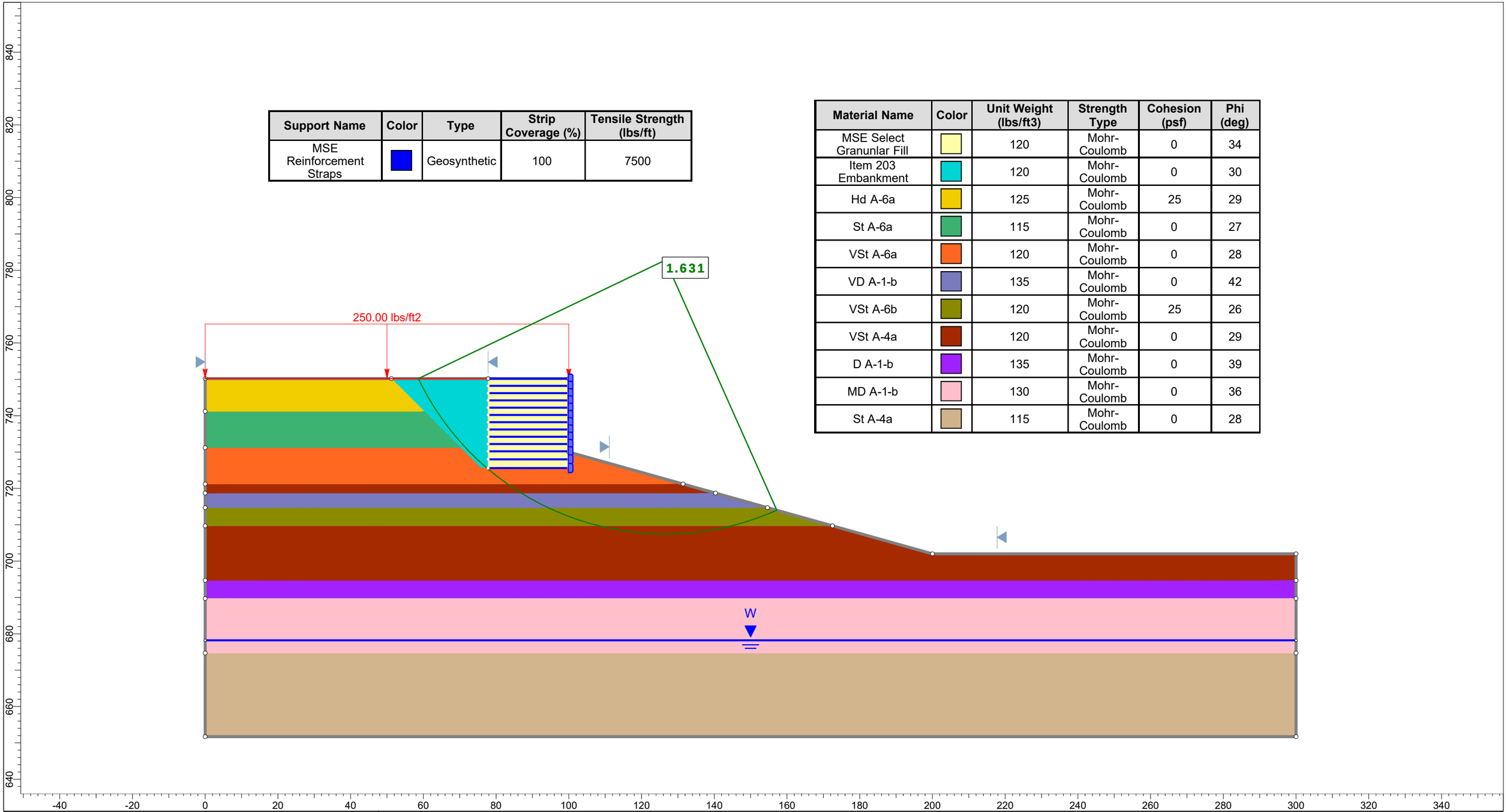
Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	Total Settlement at Facing of Wall: S_c (9,10) (ft)	S_c (in)	Layer Settlement (in)	Settlement Complete at 79% of Primary Consolidation: $(S_c)_t$ (11) (in)	Layer Settlement (in)
1	A-6a	C	0.0	3.0	725.0	722.0	3.0	1.5	120	360	180	180	2,680	27	0.080	0.016	0.355				0.08	0.500	1,905	2,085	0.038	0.452	0.753	0.434	0.723
	A-6a	C	3.0	6.3	722.0	718.7	3.3	4.7	120	756	558	558	3,058	27	0.080	0.016	0.355				0.24	0.497	1,895	2,453	0.025	0.301		0.289	
2	A-1-b	G	6.3	10.3	718.7	714.7	4.0	8.3	135	1,296	1,026	1,026	3,526					69	85	357	0.43	0.487	1,854	2,880	0.005	0.060	0.060	0.060	0.060
3	A-6b	C	10.3	12.8	714.7	712.2	2.5	11.6	120	1,596	1,446	1,446	3,946	37	0.109	0.023	0.563				0.59	0.469	1,788	3,234	0.013	0.154	0.286	0.108	0.200
	A-6b	C	12.8	15.3	712.2	709.7	2.5	14.1	120	1,896	1,746	1,746	4,246	37	0.109	0.023	0.563				0.72	0.452	1,723	3,469	0.011	0.132		0.092	
4	A-4a	C	15.3	20.3	709.7	704.7	5.0	17.8	120	2,496	2,196	2,196	4,696	26	0.137	0.018	0.698				0.91	0.423	1,612	3,808	0.013	0.152	0.358	0.082	0.193
	A-4a	C	20.3	25.3	704.7	699.7	5.0	22.8	120	3,096	2,796	2,796	5,296	26	0.137	0.018	0.698				1.17	0.382	1,457	4,253	0.010	0.116		0.063	
	A-4a	C	25.3	30.3	699.7	694.7	5.0	27.8	120	3,696	3,396	3,396	5,896	26	0.137	0.018	0.698				1.43	0.344	1,312	4,708	0.008	0.090		0.049	
5	A-1-b	G	30.3	35.3	694.7	689.7	5.0	32.8	135	4,371	4,034	4,034	6,534					49	38	122	1.68	0.311	1,183	5,217	0.005	0.055	0.055	0.055	0.055
6	A-1-b	G	35.3	42.8	689.7	682.2	7.5	39.1	130	5,346	4,859	4,859	7,359					30	21	77	2.00	0.275	1,046	5,905	0.008	0.099	0.177	0.099	0.177
	A-1-b	G	42.8	50.3	682.2	674.7	7.5	46.6	130	6,321	5,834	5,834	8,334					30	19	73	2.39	0.240	913	6,747	0.007	0.078		0.078	
7	A-4a	C	50.3	58.3	674.7	666.7	8.0	54.3	115	7,241	6,781	6,313	8,813	21	0.099	0.015	0.436				2.78	0.211	804	7,117	0.004	0.052	0.142	0.011	0.030
	A-4a	C	58.3	66.3	666.7	658.7	8.0	62.3	115	8,161	7,701	6,734	9,234	21	0.099	0.015	0.436				3.19	0.187	714	7,447	0.004	0.043		0.009	
	A-4a	C	66.3	76.6	658.7	648.4	10.3	71.5	115	9,346	8,753	7,215	9,715	21	0.099	0.015	0.436				3.66	0.166	631	7,846	0.004	0.047		0.010	

Settlement Remaining After Hold Period: 0.393 in

1. $\sigma_p' = \sigma_{vo}'+\sigma_m$; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(Cc) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used e_o = (C_c/1.15)+0.35; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_n N_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. $(S_c)_t = S_c(U/100)$; U = 100 for all granular soils at time t = 0

Support Name	Color	Type	Strip Coverage (%)	Tensile Strength (lbs/ft)
MSE Reinforcement Straps		Geosynthetic	100	7500

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
MSE Select Granunlar Fill		120	Mohr-Coulomb	0	34
Item 203 Embankment		120	Mohr-Coulomb	0	30
Hd A-6a		125	Mohr-Coulomb	25	29
St A-6a		115	Mohr-Coulomb	0	27
VSt A-6a		120	Mohr-Coulomb	0	28
VD A-1-b		135	Mohr-Coulomb	0	42
VSt A-6b		120	Mohr-Coulomb	25	26
VSt A-4a		120	Mohr-Coulomb	0	29
D A-1-b		135	Mohr-Coulomb	0	39
MD A-1-b		130	Mohr-Coulomb	0	36
St A-4a		115	Mohr-Coulomb	0	28



Resource International, Inc.
Planning | Engineering | Construction Management | Technology

SLIDEINTERPRET 9.012

Project	FRA-70-13.01 - FRA-70-1301R - Rear Abutment - Retaining Wall W4 - Global Stability		
Analysis Description	25.2 ft Wall Height - B-015-1-13 - Drained - Circular - Spencer		
Drawn By	HSK / BRT	Scale	1:300
Company	Resource International Inc.		
Date	6/22/2021, 11:15:09 PM	File Name	Rear Abutment-Run1.slmd

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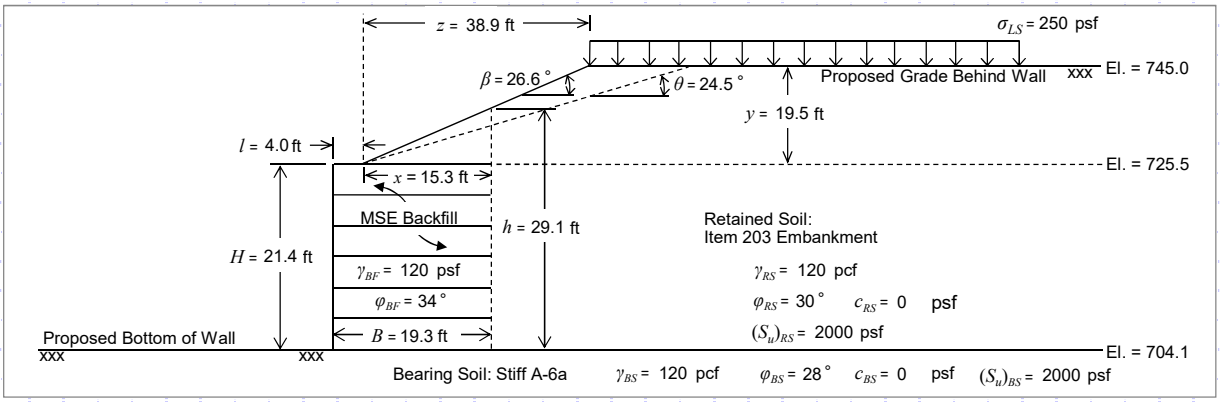
Retaining Wall W6 - FRA-70-1301R - Forward Abutment - B-108-5-13, B-012-E-68 - 2:1 Broken Backslope - 21.4 ft. Wall Height



MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4	ft
MSE Wall Width (Reinforcement Length), (B) =	19.3	ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0	ft
MSE Wall Length, (L) =	68	ft
MSE Wall Effective Height, (h) =	29.1	ft
Retained Soil Backslope, (β) =	26.6	°
Effective Retained Soil Backslope, (θ) =	24.5	°
Distance from Toe to Top of Backslope, (z) =	38.9	ft
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{RS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477	
Live Surcharge Load, (σ_{LS}) =	250	psf

MSE Backfill and Bearing Soil Properties:

MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(S_u)$_{BS}$] =	2000	psf
Embedment Depth, (D_f) =	4.0	ft
Depth to GW (Below Bot. of Wall), (D_W) =	14.1	ft

LRFD Load Factors

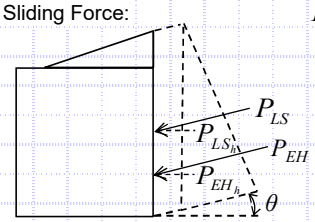
	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Drained cohesion for retained soil not accounted for in external stability analyses. This parameter is utilized in global stability analysis.

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Sections 11.6.3.6 and 11.10.5.3

Sliding Force:



$$P_H = (P_{EH} + P_{LS})\cos\theta$$

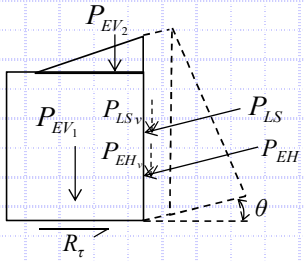
$$P_{EH} = \tfrac{1}{2}\gamma_{RS} h^2 K_a \gamma_{EH} = \text{½(120 pcf)(29.1 ft)}^2\text{(0.477)(1.50)} = 36.26 \text{ kip/ft}$$

$$P_{LS} = \sigma_{LS} h K_a \gamma_{LS} = \text{(250 psf)(29.1 ft)(0.477)(1.75)} = 5.42 \text{ kip/ft}$$

$$P_H = \text{(36.26 kip/ft + 5.42 kip/ft)cos(24.5°)} = 37.93 \text{ kip/ft}$$

Check Sliding Resistance - Drained Condition

Nominal Sliding Resistance: $R_\tau = (P_{EV_1} + P_{EV_2} + P_{EH}\sin\theta)\tan\delta$ (Neglect P_{LSv} for conservatism)



$$P_{EV_1} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV} = \text{(120 pcf)(21.4 ft)(19.3 ft)(1.00)} = 49.56 \text{ kip/ft}$$

$$P_{EV_2} = \tfrac{1}{2}\gamma_{RS}(h - H)(B - l)\gamma_{EV} = \text{½(120 pcf)(29.1 ft - 21.4 ft)(19.3 ft - 4.0 ft)(1.00)} = 7.03 \text{ kip/ft}$$

$$P_{EH} = \tfrac{1}{2}\gamma_{RS} h^2 K_a \gamma_{EH} = \text{½(120 pcf)(29.1 ft)}^2\text{(0.477)(1.50)} = 36.26 \text{ kip/ft}$$

$$\tan\delta = (\tan\varphi_{BS} \le \tan\varphi_{BF}) \longrightarrow \tan(28) \le \tan(34) \longrightarrow 0.53 \le 0.67 = 0.53$$

$$R_\tau = \text{[49.56 kip/ft + 7.03 kip/ft + (36.26 kip/ft)sin(24.5°)](0.53)} = 37.96 \text{ kip/ft}$$

Verify Sliding Force Less Than Factored Sliding Resistance - Drained Condition

$P_H \le R_\tau \cdot \phi_\tau \longrightarrow$ 37.93 kip/ft ≤ (37.96 kip/ft)(1.0) = 37.96 kip/ft $\longrightarrow$ 37.93 kip/ft ≤ 37.96 kip/ft **OK**

Use φ_τ = **1.0** *(Per AASHTO LRFD BDM Table 11.5.6-1)*

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MSE Wall Length, (L) =	68	ft
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Effective Retained Soil Backslope, (θ) =	24.5	°
Distance from Toe to Top of Backslope, (z) =	38.9	ft
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{RS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477	
Live Surcharge Load, (σ_{LS}) =	250	psf

Bearing Soil Properties:

MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	2000	psf
Embedment Depth, (D_f) =	4.0	ft
Depth to GW (Below Bot. of Wall), (D_W) =	14.1	ft

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

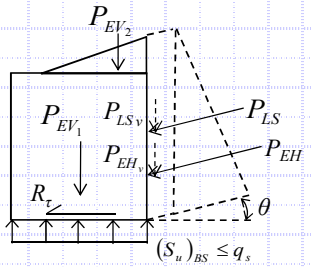
(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Drained cohesion for retained soil not accounted for in external stability analyses. This parameter is utilized in global stability analysis.

Check Sliding (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.10.5.3 ***(Continued)***

Check Sliding Resistance - Undrained Condition

Nominal Sliding Resisting: $R_\tau = \left((S_u)_{BS} \le q_s\right) \cdot B$



(Neglect P_{LS_v} for conservatism)

$(S_u)_{BS}$ = 2.00 ksf

$q_s = \sigma_v / 2$

$\sigma_v = P_V / B$

$P_V = P_{EV_1} + P_{EV_2} + P_{EH} \sin\theta$

$P_{EV_1} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV}$ = (120 pcf)(21.4 ft)(19.3 ft)(1.00) = 49.56 kip/ft

$P_{EV_2} = \frac{1}{2}\gamma_{RS}(h - H)(B - l)\gamma_{EV}$

P_{EV_2} = ½(120 pcf)(29.1 ft - 21.4 ft)(19.3 ft - 4.0 ft)(1.00) = 7.03 kip/ft

$P_{EH} = \frac{1}{2}\gamma_{RS} h^2 K_a \gamma_{EH}$ = ½(120 pcf)(29.1 ft)²(0.477)(1.50) = 36.26 kip/ft

P_V = 49.56 kip/ft + 7.03 kip/ft + (36.26 kip/ft)sin(24.5°) = 71.63 kip/ft

σ_v = (71.63 kip/ft) / (19.3 ft) = 3.71 ksf

q_s = (3.71 ksf) / 2 = 1.86 ksf

R_τ = (2.00 ksf ≤ 1.86 ksf)(19.3 ft) = 38.60 kip/ft

Verify Sliding Force Less Than Factored Sliding Resistance - Undrained Condition

$P_H \le R_\tau \cdot \phi_\tau$ ⟶ 37.93 kip/ft ≤ (38.60 kip/ft)(1.0) = 38.60 kip/ft ⟶ 37.93 kip/ft ≤ 38.60 kip/ft **OK**

Use φ_τ = **1.0** *(Per AASHTO LRFD BDM Table 11.5.6-1)*

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MSE Wall Length, (L) =	68	ft
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Distance from Toe to Top of Backslope, (z) =	38.9	ft
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{RS}) =	0	psf
Retained Soil Undrained Shear Strength, [$(S_u)_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477	
Live Surcharge Load, (σ_{LS}) =	250	psf

Bearing Soil Properties:

MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [$(s_u)_{BS}$] =	2000	psf
Embedment Depth, (D_f) =	4.0	ft
Depth to GW (Below Bot. of Wall), (D_W) =	14.1	ft

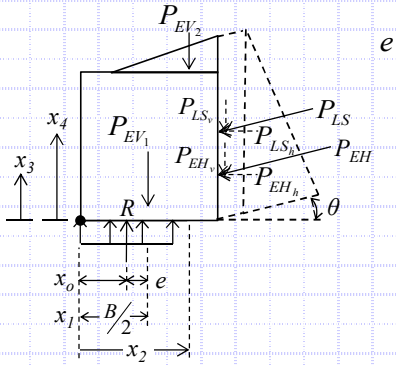
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Drained cohesion for retained soil not accounted for in external stability analyses. This parameter is utilized in global stability analysis.

Check Eccentricity (Loading Case - Strength Ia) - AASHTO LRFD BDM Section 11.6.3.3



$$e = B/2 - x_o$$

$$x_o = \frac{M_V - M_H}{P_V}$$ = (868.29 kip·ft/ft - 399.85 kip·ft/ft) / (71.63 kip/ft) = 6.54 ft

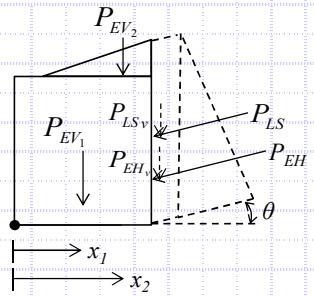
M_V = 868.29 kip·ft/ft
M_H = 399.85 kip·ft/ft } Defined below

$P_V = P_{EV_1} + P_{EV_2} + P_{EH}\sin\theta$ = 49.56 kip/ft + 7.03 kip/ft + (36.26 kip/ft)sin(24.5°) = 71.63 kip/ft

$e =$ (19.3 ft/ 2) - 6.54 ft = 3.11 ft

Resisting Moment, M_V:

$$M_V = P_{EV_1}(x_1) + P_{EV_2}(x_2) + P_{EH}\sin\theta(B)$$ (Neglect P_{LS_v} for conservatism)



$P_{EV_1} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV}$ = (120 pcf)(21.4 ft)(19.3 ft)(1.00) = 49.56 kip/ft

$P_{EV_2} = \frac{1}{2}\gamma_{RS}(h - H)(B - l)\gamma_{EV}$ = ½(120 pcf)(29.1 ft - 21.4 ft)(19.3 ft - 4.0 ft)(1.00) = 7.03 kip/ft

$P_{EH} = \frac{1}{2}\gamma_{RS}h^2K_a\gamma_{EH}$ = ½(120 pcf)(29.1 ft)²(0.477)(1.50) = 36.26 kip/ft

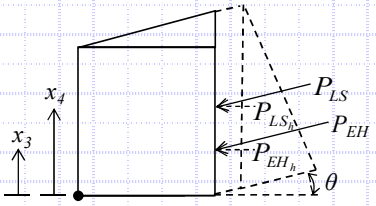
$x_1 = B/2$ = (19.3 ft) / 2 = 9.65 ft

$x_2 = l + \frac{2}{3}(B - l)$ = 4.0 ft + ⅔(19.3 ft - 4.0 ft) = 14.20 ft

M_V = (49.56 kip/ft)(9.65 ft) + (7.03 kip/ft)(14.2 ft) + (36.26 kip/ft)sin(24.5°)(19.3 ft) = 868.29 kip·ft/ft

Overturning Moment, M_H:

$$M_H = P_{EH}\cos\theta(x_3) + P_{LS}\cos\theta(x_4)$$



$P_{EH} = \frac{1}{2}\gamma_{RS}h^2K_a\gamma_{EH}$ = ½(120 pcf)(29.1 ft)²(0.477)(1.50) = 36.26 kip/ft

$P_{LS} = \sigma_{LS}hK_a\gamma_{LS}$ = (250 psf)(29.1 ft)(0.477)(1.75) = 6.06 kip/ft

$x_3 = h/3$ = (29.1 ft) / 3 = 9.69 ft

$x_4 = h/2$ = (29.1 ft) / 2 = 14.53 ft

M_H = (36.26 kip/ft)cos(24.5°)(9.69 ft) + (6.06 kip/ft)cos(24.5°)(14.53 ft) = 399.85 kip·ft/ft

Check Eccentricity Limiting Eccentricity: $e_{max} = B/3 \longrightarrow e_{max} =$ (19.3 ft) / 3 = 6.43 ft

$e < e_{max} \longrightarrow$ 3.11 ft < 6.43 ft **OK**

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Retained Soil Backslope, (β) =	26.6	°
Effective Retained Soil Backslope, (θ) =	24.5	°
Distance from Toe to Top of Backslope, (z) =	38.9	ft
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{RS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477	
Live Surcharge Load, (σ_{LS}) =	250	psf

Bearing Soil Properties:

MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	2000	psf
Embedment Depth, (D_f) =	4.0	ft
Depth to GW (Below Bot. of Wall), (D_W) =	14.1	ft

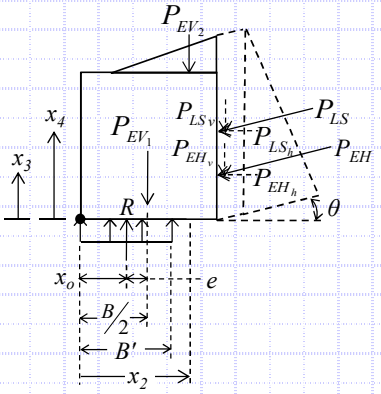
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Drained cohesion for retained soil not accounted for in external stability analyses. This parameter is utilized in global stability analysis.

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.6.3.2



$$q_{eq} = P_V / B'$$

$B' = B - 2e$ = 19.3 ft - 2(2.31 ft) = 14.68 ft

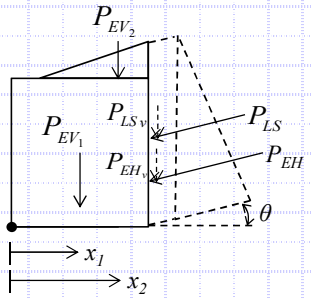
$e = B/2 - x_o$ = (19.3 ft / 2) - 7.34 ft = 2.31 ft

$x_o = \dfrac{M_V - M_H}{P_V}$ = (1070.79 kip·ft/ft - 399.85 kip·ft/ft) / 91.45 kip/ft = 7.34 ft

q_{eq} = (91.45 kip/ft) / (14.68 ft) = 6.23 ksf

Resisting Moment, M_V:

$$M_V = P_{EV_1}(x_1) + P_{EV_2}(x_2) + P_{EH}\sin\theta(B)$$



$P_{EV_1} = \gamma_{BF} \cdot H \cdot B \cdot \gamma_{EV}$ = (120 pcf)(21.4 ft)(19.3 ft)(1.35) = 66.91 kip/ft

$P_{EV_2} = \frac{1}{2}\gamma_{RS}(h - H)(B - l)\gamma_{EV}$ = ½(120 pcf)(29.1 ft - 21.4 ft)(19.3 ft - 4.0 ft)(1.35) = 9.50 kip/ft

$P_{EH} = \frac{1}{2}\gamma_{RS}h^2 K_a \gamma_{EH}$ = ½(120 pcf)(29.1 ft)²(0.477)(1.50) = 36.26 kip/ft

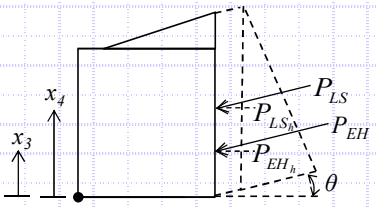
$x_1 = B/2$ = (19.3 ft) / 2 = 9.65 ft

$x_2 = l + \frac{2}{3}(B - l)$ = 4.0 ft + ⅔(19.3 ft - 4.0 ft) = 14.20 ft

M_V = (66.91 kip/ft)(9.65 ft) + (9.50 kip/ft)(14.2 ft) + (36.26 kip/ft)sin(24.5°)(19.3 ft) = 1070.79 kip·ft/ft

Overturning Moment, M_H:

$$M_H = P_{EH}\cos\theta(x_3) + P_{LS}\cos\theta(x_4)$$



$P_{EH} = \frac{1}{2}\gamma_{RS}h^2 K_a \gamma_{EH}$ = ½(120 pcf)(29.1 ft)²(0.477)(1.50) = 36.26 kip/ft

$P_{LS} = \sigma_{LS} h K_a \gamma_{LS}$ = (250 psf)(29.1 ft)(0.477)(1.75) = 6.06 kip/ft

$x_3 = h/3$ = (29.1 ft) / 3 = 9.69 ft

$x_4 = h/2$ = (29.1 ft) / 2 = 14.53 ft

M_H = (36.26 kip/ft)cos(24.5°)(9.69 ft) + (6.06 kip/ft)cos(24.5°)(14.53 ft) = 399.85 kip·ft/ft

Vertical Forces, P_V:

$$P_V = P_{EV_1} + P_{EV_2} + P_{EH}\sin\theta$$

P_V = 66.91 kip/ft + 9.50 kip/ft + (36.26 kip/ft)sin(24.5°) = 91.45 kip/ft

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Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{RS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477	
Live Surcharge Load, (σ_{LS}) =	250	psf

Bearing Soil Properties:

MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
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Embedment Depth, (D_f) =	4.0	ft
Depth to GW (Below Bot. of Wall), (D_W) =	7.9	ft

LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Drained cohesion for retained soil not accounted for in external stability analyses. This parameter is utilized in global stability analysis.

Check Bearing Capacity (Loading Case - Strength Ib) - AASHTO LRFD BDM Section 11.10.5.4 ***(Continued)***

Check Bearing Resistance - Drained Condition

Nominal Bearing Resistance: $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2}\gamma B' N_{\gamma m} C_{w\gamma}$

$N_{cm} = N_c s_c i_c$ = 28.38

N_c = 25.80
s_c = 1+(14.68 ft/68 ft)(14.72/25.8)
= 1.100
i_c = 1.000 (Assumed)

$N_{qm} = N_q s_q d_q i_q$ = 19.4

N_q = 14.72
s_q = 1+(14.68 ft/68 ft)tan(28°) = 1.200
d_q = 1+2tan(28°)[1-sin(28°)]²tan⁻¹(4.0 ft/14.68 ft)
= 1.100
i_q = 1.000 (Assumed)
C_{wq} = 7.9 ft > 4.0 ft = 1.000

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ = 15.0

N_γ = 16.72
s_γ = 1-0.4(14.68 ft/68 ft) = 0.900
i_γ = 1.000 (Assumed)
$C_{w\gamma}$ = 7.9 ft < 1.5(14.68 ft) + 4.0 ft = 0.500

$q_n =$ (0 psf)(28.38) + (120 pcf)(4.0 ft)(19.4)(1.0) + ½(120 pcf)(14.7 ft)(15.0)(0.5) = 15.95 ksf

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$q_{eq} \le q_n \cdot \phi_b$ ⟶ 6.23 ksf ≤ (15.95 ksf)(0.65) = 10.37 ksf ⟶ 6.23 ksf ≤ 10.37 ksf **OK**

Use φ_b = **0.65** *(Per AASHTO LRFD BDM Table 11.5.6-1)*

Check Bearing Resistance - Undrained Condition

Nominal Bearing Resistance: $q_n = cN_{cm} + \gamma D_f N_{qm} C_{wq} + \frac{1}{2}\gamma B' N_{\gamma m} C_{w\gamma}$

$N_{cm} = N_c s_c i_c$ = 5.140

N_c = 5.140
s_c = 1+(14.68 ft/[(5)(68 ft)] = 1.000
i_c = 1.000 (Assumed)

$N_{qm} = N_q s_q d_q i_q$ = 1.000

N_q = 1.000
s_q = 1.000
d_q = 1+2tan(0°)[1-sin(0°)]²tan⁻¹(4.0 ft/14.68 ft)
= 1.000
i_q = 1.000 (Assumed)
C_{wq} = 7.9 ft > 4.0 ft = 1.000

$N_{\gamma m} = N_\gamma s_\gamma i_\gamma$ = 0.000

N_γ = 0.000
s_γ = 1.000
i_γ = 1.000 (Assumed)
$C_{w\gamma}$ = 7.9 ft < 1.5(14.68 ft) + 4.0 ft = 0.500

$q_n =$ (2000 psf)(5.14) + (120 pcf)(4.0 ft)(1.0)(1.0) + ½(120 pcf)(14.7 ft)(0.0)(0.5) = 10.76 ksf

Verify Equivalent Pressure Less Than Factored Bearing Resistance

$q_{eq} \le q_n \cdot \phi_b$ ⟶ 6.23 ksf ≤ (10.76 ksf)(0.65) = 6.99 ksf ⟶ 6.23 ksf ≤ 6.99 ksf **OK**

Use φ_b = **0.65** *(Per AASHTO LRFD BDM Table 11.5.6-1)*

RESOURCE INTERNATIONAL, INC.
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MSE Wall Dimensions and Retained Soil Parameters

MSE Wall Height, (H) =	21.4	ft
MSE Wall Width (Reinforcement Length), (B) =	19.3	ft
Distance from Wall Face to Toe of Backslope, (l) =	4.0	ft
MSE Wall Length, (L) =	68	ft
MSE Wall Effective Height, (h) =	29.1	ft
Retained Soil Backslope, (β) =	26.6	°
Effective Retained Soil Backslope, (θ) =	24.5	°
Distance from Toe to Top of Backslope, (z) =	38.9	ft
Retained Soil Unit Weight, (γ_{RS}) =	120	pcf
Retained Soil Friction Angle, (φ_{RS}) =	30	°
Retained Soil Drained Cohesion, (c_{RS}) =	0	psf
Retained Soil Undrained Shear Strength, [(S_u)$_{RS}$] =	2000	psf
Retained Soil Active Earth Pressure Coeff., (K_a) =	0.477	
Live Surcharge Load, (σ_{LS}) =	250	psf

Bearing Soil Properties:

MSE Backfill Unit Weight, (γ_{BF}) =	120	pcf
MSE Backfill Friction Angle, (φ_{BF}) =	34	°
Bearing Soil Unit Weight, (γ_{BS}) =	120	pcf
Bearing Soil Friction Angle, (φ_{BS}) =	28	°
Bearing Soil Drained Cohesion, (c_{BS}) =	0	psf
Bearing Soil Undrained Shear Strength, [(s_u)$_{BS}$] =	2000	psf
Embedment Depth, (D_f) =	4.0	ft
Depth to GW (Below Bot. of Wall), (D_W) =	14.1	ft

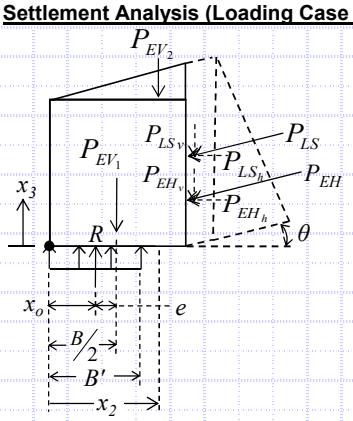
LRFD Load Factors

	EV	EH	LS
Strength Ia	1.00	1.50	1.75
Strength Ib	1.35	1.50	1.75
Service I	1.00	1.00	1.00

(AASHTO LRFD BDM Tables 3.4.1-1 and 3.4.1-2 - Active Earth Pressure)

1. Drained cohesion for retained soil not accounted for in external stability analyses. This parameter is utilized in global stability analysis.

Settlement Analysis (Loading Case - Service I) - AASHTO LRFD BDM Section 11.10.4.1



$$q_{eq} = P_V / B'$$

$$B' = B - 2e = 19.3 \text{ ft} - 2(1.95 \text{ ft}) = 15.40 \text{ ft}$$

$$e = B/2 - x_o = (19.3 \text{ ft} / 2) - 7.7 \text{ ft} = 1.95 \text{ ft}$$

$$x_o = \frac{M_V - M_H}{P_V} = (771.61 \text{ kip·ft/ft} - 258.90 \text{ kip·ft/ft}) / 66.62 \text{ kip/ft} = 7.70 \text{ ft}$$

$$q_{eq} = (66.62 \text{ kip/ft}) / (15.4 \text{ ft}) = 4.33 \text{ ksf}$$

$$M_V = P_{EV_1}(x_1) + P_{EV_2}(x_2) + P_{EH}\sin\theta(B) = (\gamma_{BF} HB\gamma_{EV})(\tfrac{1}{2}B) + (\tfrac{1}{2}\gamma_{RS}(h-H)(B-l)\gamma_{EV})(l + \tfrac{2}{3}(B-l)) + (\tfrac{1}{2}\gamma_{RS}h^2K_a\gamma_{EH}\sin\theta)(B)$$

M_V = [(120 pcf)(21.4 ft)(19.3 ft)(1.00)][½(19.3 ft)] + [½(120 pcf)(29.1 ft - 21.4 ft)(19.3 ft - 4.0 ft)(1.00)][4.0 ft + ⅔(19.3 ft - 4.0 ft)] + [½(120 pcf)(29.1 ft)²(0.477)(1.00)sin(24.5°)](19.3 ft) = 771.61 kip·ft/ft

$$M_H = P_{EH}\cos\theta(x_3) + P_{LS}\cos\theta(x_4) = (\tfrac{1}{2}\gamma_{RS}h^2K_a\gamma_{EH}\cos\theta)(h/3) + (\sigma_{LS}hK_a\gamma_{LS}\cos\theta)(h/2)$$

M_H = ½[(120 pcf)(29.1 ft)²(0.477)(1.00)cos(24.5°)](29.1 ft /3) + [(250 psf)(29.1 ft)(0.477)(1.00)cos(24.5°)](29.1 ft /2) = 258.90 kip·ft/ft

$$P_V = P_{EV_1} + P_{EV_2} + P_{EH}\sin\theta = (\gamma_{BF} HB\gamma_{EV}) + (\tfrac{1}{2}\gamma_{RS}(h-H)(B-l)\gamma_{EV}) + (\tfrac{1}{2}\gamma_{RS}h^2K_a\gamma_{EH}\sin\theta)$$

P_V = (120 pcf)(21.4 ft)(19.3 ft)(1.00) + ½(120 pcf)(29.1 ft - 21.4 ft)(19.3 ft - 4.0 ft)(1.00) + ½(120 pcf)(29.1 ft)²(0.477)(1.00)sin(24.5°) = 66.62 kip/ft

Settlement, Time Rate of Consolidation and Differential Settlement:

Station Along Wall Alignment	Total Settlement at Center of Reinforced Soil Mass	Total Settlement at Wall Facing	Time for 100% Consolidation	Distance Along Wall Facing	Differential Settlement Along Wall Facing
141+77	0.629 in	0.474 in	31 days		
142+23	3.517 in	2.126 in	33 days	50 ft	1 in / 30 ft

W-20-025 - FRA-70-13.01 - Retaining Wall W6

MSE Wall Settlement - South of Forward Abutment

Calculated By: HSK Date: 6/24/2021

Checked By: BRT Date: 6/24/2021

Boring B-108-5-13

H=	21.4	ft	Total wall height
B'=	15.4	ft	Effective footing width due to eccentricity
D_w =	14.1	ft	Depth below bottom of footing
q_e =	4,330	psf	Equivalent bearing pressure at bottom of wall

Layer	Soil Class.	Soil Type	Layer Depth (ft)		ELevation (ft msl)		Layer Thickness H (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	Total Settlement at Center of Reinforced Soil Mass: I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	S_c (9,10) (ft)	S_c (in)	Total Settlement at Facing of Wall: I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	S_c (9,10) (ft)	S_c (in)
1	A-6a	C	0.0	3.0	704.1	701.1	3.0	1.5	120	360	180	180	2,680	30	0.080	0.016	0.355				0.10	0.997	4,317	4,497	0.081	0.976	0.500	2,164	2,344	0.039	0.474
	A-6a	C	3.0	6.0	701.1	698.1	3.0	4.5	120	720	540	540	3,040	30	0.080	0.016	0.355				0.29	0.941	4,073	4,613	0.059	0.704	0.495	2,144	2,684	0.025	0.296
	A-6a	C	6.0	9.3	698.1	694.8	3.3	7.7	120	1,116	918	918	3,418	30	0.080	0.016	0.355				0.50	0.820	3,552	4,470	0.045	0.539	0.480	2,079	2,997	0.020	0.240
2	A-2-6	G	9.3	11.8	694.8	692.3	2.5	10.6	125	1,429	1,272	1,272	3,772					18	21	76	0.69	0.705	3,051	4,323	0.018	0.210	0.457	1,980	3,252	0.013	0.161
	A-2-6	G	11.8	14.3	692.3	689.8	2.5	13.1	125	1,741	1,585	1,585	4,085					18	19	73	0.85	0.618	2,676	4,261	0.015	0.176	0.433	1,876	3,461	0.012	0.139
3	A-1-a	G	14.3	16.8	689.8	687.3	2.5	15.6	130	2,066	1,904	1,813	4,313					29	30	99	1.01	0.546	2,364	4,177	0.009	0.110	0.408	1,765	3,578	0.007	0.090
	A-1-a	G	16.8	19.3	687.3	684.8	2.5	18.1	130	2,391	2,229	1,982	4,482					29	29	97	1.17	0.486	2,106	4,088	0.008	0.098	0.382	1,654	3,636	0.007	0.082
	A-1-a	G	19.3	21.8	684.8	682.3	2.5	20.6	130	2,716	2,554	2,151	4,651					29	28	94	1.33	0.437	1,894	4,045	0.007	0.087	0.357	1,548	3,699	0.006	0.075
4	A-1-b	G	21.8	24.3	682.3	679.8	2.5	23.1	125	3,029	2,872	2,314	4,814					19	18	70	1.50	0.397	1,717	4,031	0.009	0.103	0.335	1,448	3,762	0.007	0.090
	A-1-b	G	24.3	26.8	679.8	677.3	2.5	25.6	125	3,341	3,185	2,470	4,970					19	18	70	1.66	0.362	1,568	4,039	0.008	0.092	0.313	1,357	3,827	0.007	0.082
5	A-1-a	G	26.8	33.8	677.3	670.3	7.0	30.3	130	4,251	3,796	2,785	5,285					37	33	108	1.97	0.310	1,344	4,129	0.011	0.134	0.278	1,205	3,990	0.010	0.122
	A-1-a	G	33.8	40.8	670.3	663.3	7.0	37.3	130	5,161	4,706	3,258	5,758					37	31	102	2.42	0.256	1,107	4,365	0.009	0.105	0.237	1,026	4,284	0.008	0.098
6	A-4a	C	40.8	49.3	663.3	654.8	8.5	45.1	125	6,224	5,692	3,761	6,261	21	0.099	0.015	0.436				2.93	0.213	924	4,685	0.008	0.101	0.202	876	4,637	0.008	0.096
	A-4a	C	49.3	58.3	654.8	645.8	9.0	53.8	125	7,349	6,786	4,309	6,809	21	0.099	0.015	0.436				3.49	0.180	778	5,087	0.007	0.081	0.173	749	5,058	0.006	0.078
																						Total Settlement:				3.515 in	Total Settlement:				2.122 in

1. $\sigma_p' = \sigma_{vo}' + \sigma_m$; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(Cc) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used $e_o = (C_c/1.15)+0.35$; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_n N_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

W-20-025 - FRA-70-13.01 - Retaining Wall W6

MSE Wall Settlement - South of Forward Abutment

Calculated By: HSK Date: 6/24/2021

Checked By: BRT Date: 6/21/2021

Boring B-108-5-13

H=	21.4	ft	Total wall height
B'=	15.4	ft	Effective footing width due to eccentricity
D_w =	14.1	ft	Depth below bottom of footing
q_e =	4,330	psf	Equivalent bearing pressure at bottom of wall

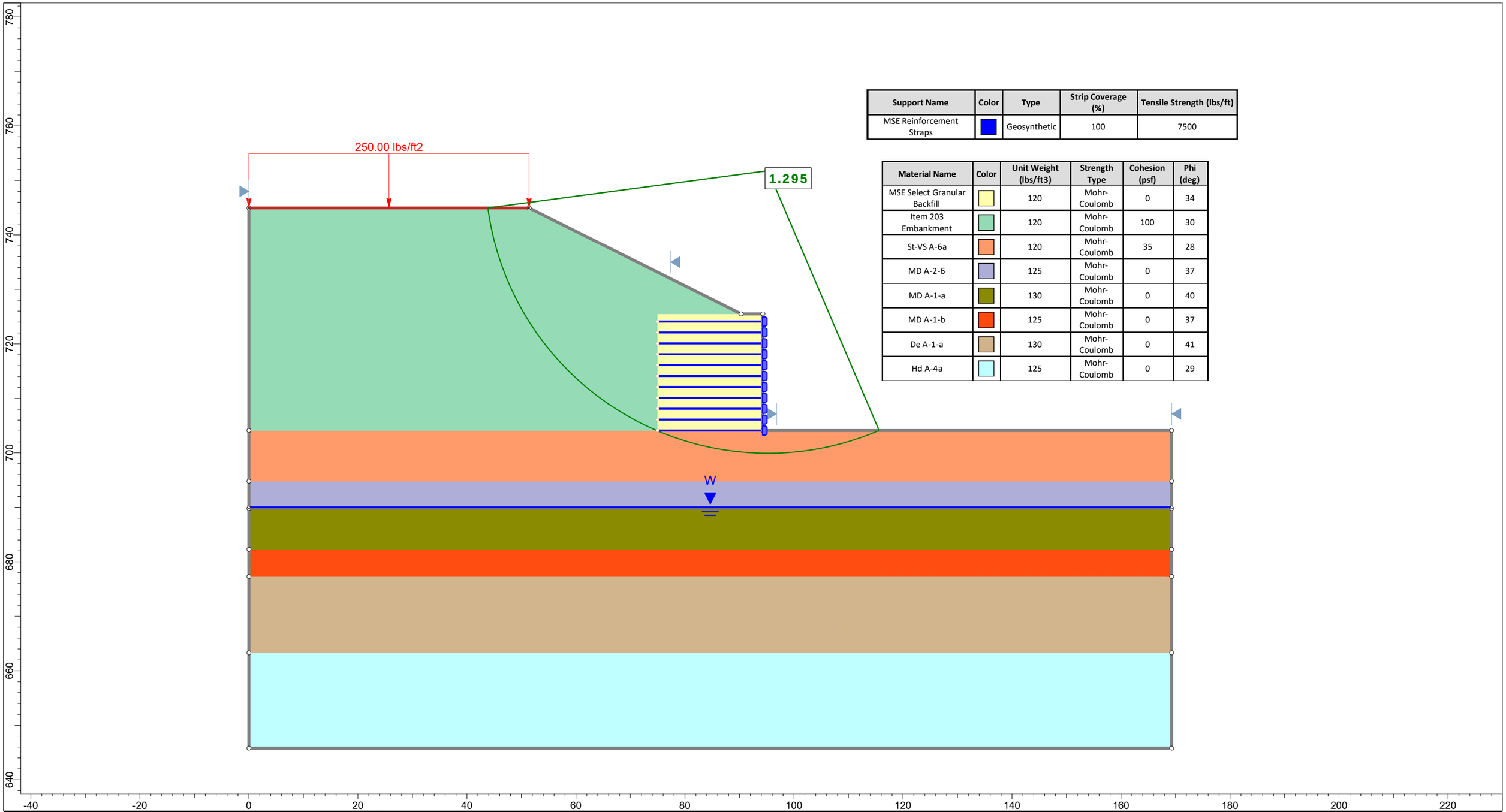
	A-6a	A-4a				
c_v =	200	400			ft^2/yr	Coefficient of consolitation
t =	33	33			days	Time following completion of construction
H_{dr} =	4.6	17.5			ft	Length of longest drainage path considered
T_v =	0.855	0.118				Time factor
U =	90	39			%	Degree of consolidation

$(S_c)_t$ = 1.915 in Settlement complete at 90% of primary consolidation

Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	Total Settlement at Facing of Wall: S_c (9,10) (ft)	S_c (in)	Layer Settlement (in)	Settlement Complete at 90% of Primary Consolidation: $(S_c)_t$ (11) (in)	Layer Settlement (in)
1	A-6a	C	0.0	3.0	704.1	701.1	3.0	1.5	120	360	180	180	2,680	30	0.080	0.016	0.355				0.10	0.500	2,164	2,344	0.039	0.474	1.006	0.426	0.906
	A-6a	C	3.0	6.0	701.1	698.1	3.0	4.5	120	720	540	540	3,040	30	0.080	0.016	0.355				0.29	0.495	2,144	2,684	0.025	0.296		0.266	
	A-6a	C	6.0	9.3	698.1	694.8	3.3	7.7	135	1,166	943	943	3,443	30	0.080	0.016	0.355				0.50	0.480	2,079	3,021	0.020	0.237		0.213	
2	A-2-6	G	9.3	11.8	694.8	692.3	2.5	10.6	120	1,466	1,316	1,316	3,816					18	21	75	0.69	0.457	1,980	3,295	0.013	0.159	0.296	0.159	0.296
	A-2-6	G	11.8	14.3	692.3	689.8	2.5	13.1	120	1,766	1,616	1,616	4,116					18	19	73	0.85	0.433	1,876	3,491	0.011	0.138		0.138	
3	A-1-a	G	14.3	16.8	689.8	687.3	2.5	15.6	120	2,066	1,916	1,825	4,325					29	30	99	1.01	0.408	1,765	3,590	0.007	0.089	0.247	0.089	0.247
	A-1-a	G	16.8	19.3	687.3	684.8	2.5	18.1	120	2,366	2,216	1,969	4,469					29	29	97	1.17	0.382	1,654	3,623	0.007	0.082		0.082	
	A-1-a	G	19.3	21.8	684.8	682.3	2.5	20.6	120	2,666	2,516	2,113	4,613					29	29	95	1.33	0.357	1,548	3,661	0.006	0.076		0.076	
4	A-1-b	G	21.8	24.3	682.3	679.8	2.5	23.1	135	3,003	2,834	2,276	4,776					19	18	71	1.50	0.335	1,448	3,724	0.008	0.091	0.173	0.091	0.173
	A-1-b	G	24.3	26.8	679.8	677.3	2.5	25.6	130	3,328	3,166	2,451	4,951					19	18	70	1.66	0.313	1,357	3,808	0.007	0.082		0.082	
5	A-1-a	G	26.8	33.8	677.3	670.3	7.0	30.3	130	4,238	3,783	2,772	5,272					37	33	108	1.97	0.278	1,205	3,977	0.010	0.122	0.221	0.122	0.221
	A-1-a	G	33.8	40.8	670.3	663.3	7.0	37.3	115	5,043	4,641	3,193	5,693					37	31	103	2.42	0.237	1,026	4,219	0.008	0.099		0.099	
6	A-4a	C	40.8	49.3	663.3	654.8	8.5	45.1	115	6,021	5,532	3,600	6,100	21	0.099	0.015	0.436				2.93	0.202	876	4,476	0.008	0.100	0.182	0.039	0.071
	A-4a	C	49.3	58.3	654.8	645.8	9.0	53.8	115	7,056	6,538	4,061	6,561	21	0.099	0.015	0.436				3.49	0.173	749	4,810	0.007	0.082		0.032	

Settlement Remaining After Hold Period: 0.212 in

1. $\sigma_p' = \sigma_{vo}' + \sigma_m$; Use σ_m = 2,500 psf based on consolidation test results
2. Used actual values from consolidation test results where applicable; For all other layers, used C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. Used actual values from consolidation test results where applicable; For all other layers, used C_r = 0.15(Cc) for natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. Used actual values from consolidation test results where applicable; For all other layers, used $e_o = (C_c/1.15)+0.35$; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_n N_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesive soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. $(S_c)_t = S_c(U/100)$; U = 100 for all granular soils at time t = 0



Support Name	Color	Type	Strip Coverage (%)	Tensile Strength (lbs/ft)
MSE Reinforcement Straps		Geosynthetic	100	7500

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
MSE Select Granular Backfill		120	Mohr-Coulomb	0	34
Item 203 Embankment		120	Mohr-Coulomb	100	30
St-VS A-6a		120	Mohr-Coulomb	35	28
MD A-2-6		125	Mohr-Coulomb	0	37
MD A-1-a		130	Mohr-Coulomb	0	40
MD A-1-b		125	Mohr-Coulomb	0	37
De A-1-a		130	Mohr-Coulomb	0	41
Hd A-4a		125	Mohr-Coulomb	0	29

Resource International, Inc.
Planning | Engineering | Construction Management | Technology

SLIDEINTERPRET 9.012

Project	FRA-70-13.01 - FRA-70-1301R - South of Forward Abutment - Retaining Wall W6 - Global Stability		
Analysis Description	21.4 ft Wall Height - B-108-5-13 - Drained - Circular - Spencer		
Drawn By HSK / BRT	*Scale* 1:200	*Company* Resource International, Inc.	
Date 6/24/2021, 11:36:00 PM		*File Name* Retaining Wall W6 - Global Stability.slmd	

APPENDIX X

EMBANKMENT SETTLEMENT ANALYSIS RESULTS

W-20-025 - FRA-70-13.01

Downdrag Analysis - Pier 2

Calculated By: HSK Date: 6/24/2021

Checked By: BRT Date: 6/24/2021

Boring B-014-4-19 - Ground Surface Elevation @ 698.8 ft msl and Bottom of Footing Elevation @ 693.4 ft msl

H =	22.0	ft	Future embankment height
B =	53.0	ft	Total width of all foundations
D_w =	8.0	ft	Depth below ground surface
q_e =	2,640	psf	

Layer	Soil Class.	Soil Type	Layer Depth (ft)		Elevation (ft msl)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	S_c (9,10) (ft)	S_c (in)	Relative Movement (in)
1	A-6a	C	0.0	1.5	698.8	697.3	1.5	0.8	125	188	94	94	4,094	33	0.109	0.023	0.563				0.01	1.000	2,640	2,734	0.032	0.388	
	A-6a	C	1.5	3.0	697.3	695.8	1.5	2.3	130	383	285	285	4,285	33	0.109	0.023	0.563				0.04	1.000	2,639	2,924	0.022	0.268	
2	A-1-a	G	3.0	5.4	695.8	693.4	2.4	4.2	130	695	539	539	4,539					34	49	165	0.08	0.998	2,636	3,174	0.011	0.134	
	A-1-a	G	5.4	10.5	693.4	688.3	5.1	8.0	130	1,358	1,026	1,026	5,026					34	42	136	0.15	0.990	2,613	3,639	0.021	0.247	1.008
3	A-1-a	G	10.5	13.0	688.3	685.8	2.5	11.8	130	1,683	1,520	1,286	5,286					44	51	172	0.22	0.970	2,561	3,847	0.007	0.083	0.925
4	A-1-a	G	13.0	18.0	685.8	680.8	5.0	15.5	125	2,308	1,995	1,527	5,527					26	28	94	0.29	0.941	2,483	4,010	0.022	0.266	0.659
5	A-1-a	G	18.0	20.5	680.8	678.3	2.5	19.3	125	2,620	2,464	1,762	5,762					15	16	66	0.36	0.903	2,383	4,145	0.014	0.170	0.489
6	A-1-a	G	20.5	26.5	678.3	672.3	6.0	23.5	140	3,460	3,040	2,073	6,073					73	72	281	0.44	0.854	2,255	4,328	0.007	0.082	0.407
7	A-4a	C	26.5	32.0	672.3	666.8	5.5	29.3	130	4,175	3,818	2,492	6,492	20	0.090	0.014	0.428				0.55	0.785	2,073	4,565	0.014	0.164	0.243
8	A-1-b	G	32.0	36.5	666.8	662.3	4.5	34.3	130	4,760	4,468	2,830	6,830					25	22	79	0.65	0.727	1,920	4,750	0.013	0.154	0.090
9	A-4a	C	36.5	40.5	662.3	658.3	4.0	38.5	135	5,300	5,030	3,127	7,127	20	0.090	0.014	0.428				0.73	0.681	1,798	4,925	0.007	0.090	0.000

1. $\sigma_p' = \sigma_{vo}' + \sigma_m$; Estimate σ_m of 2,000 psf in existing fill material and 4,000 psf (moderately overconsolidated) for natural soil deposits; Ref. Table 11.2, Coduto 2003
2. C_c = 0.009(LL-10); Ref. Table 6-9, FHWA GEC 5
3. C_r = 0.15(Cc) for the existing fill and 0.10(Cc) for the natural soil deposits; Ref. Section 8.11, Holtz and Kovacs 1981
4. $e_o = (C_c/1.15)+0.35$; Ref. Table 8-2, Holtz and Kovacs 1981
5. $(N1)_{60} = C_n N_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesiv soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

Total Settlement Below Ground Surface Elevation: 2.045 in

Total Settlement Below Bottom of Footing Elevation: 1.255 in

Depth of Downdrag Below Bottom of Footing: 18.0 ft

W-20-025 FRA-70-13.01

Embankment Settlement - Forward Abutment

Calculated By: LS Date: 6/12/2020

Checked By: BRT Date: 6/13/2020

Boring B-108-6-13

H=	32.0	ft	
B=	88.0	ft	
γ_{BF} =	125	pcf	
D_w =	38.5	ft	Below Ground Surface
$\Delta\sigma$ =	4,000	psf	At Ground Surface

Layer	Soil Class.	Soil Type	Layer Depth (ft)		Layer Thickness H (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	Total Embankment Settlement: I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	S_c (9,10) (ft)	S_c (in)
1	A-2-4	G	0.0	5.5	5.5	2.8	125	688	344	344	3,344					26	41	135	0.03	1.000	4,000	4,343	0.045	0.537
2	A-6a	C	5.5	10.5	5.0	8.0	115	1,263	975	975	3,975	26	0.144	0.014	0.475				0.09	0.998	3,990	4,965	0.077	0.923
	A-6a	C	10.5	15.5	5.0	13.0	115	1,838	1,550	1,550	4,550	26	0.144	0.014	0.475				0.15	0.990	3,960	5,510	0.063	0.761
	A-6a	C	15.5	20.5	5.0	18.0	115	2,413	2,125	2,125	5,125	31	0.189	0.019	0.514				0.20	0.976	3,904	6,029	0.068	0.814
	A-6a	C	20.5	25.5	5.0	23.0	115	2,988	2,700	2,700	5,700	31	0.189	0.019	0.514				0.26	0.955	3,819	6,519	0.057	0.680
3	A-4a	C	25.5	31.0	5.5	28.3	115	3,620	3,304	3,304	6,304	25	0.135	0.014	0.467				0.32	0.926	3,704	7,008	0.037	0.450
	A-4a	C	31.0	37.0	6.0	34.0	115	4,310	3,965	3,965	6,965	25	0.135	0.014	0.467				0.39	0.889	3,557	7,522	0.032	0.383
4	A-1-a	G	37.0	42.0	5.0	39.5	125	4,935	4,623	4,560	7,560					26	19	72	0.45	0.851	3,403	7,963	0.017	0.202
	A-1-a	G	42.0	47.0	5.0	44.5	135	5,610	5,273	4,898	7,898					54	38	123	0.51	0.815	3,259	8,157	0.009	0.108
5	A-4a	C	47.0	57.5	10.5	52.3	130	6,975	6,293	5,435	8,435	20	0.090	0.009	0.428				0.59	0.759	3,037	8,471	0.014	0.167

Total Settlement: 5.024 in

1. $\sigma_p' = \sigma_{vo}'+\sigma_m$; Estimate σ_m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003
2. $C_c = 0.009(LL-10)$; Ref. Table 6-9, FHWA GEC 5
3. $C_r = 0.10(C_c)$; Ref. Chapter 8.11, Holtz and Kovacs 1981
4. $e_o = (C_c/0.54)+0.35$; Ref. Table 6-11, FHWA GEC 5
5. $(N1)_{60} = C_nN_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing; $I = [\beta+\sin(\beta)\cos(\beta+2\delta)]/\pi$, where $\beta = \tan^{-1}[(x+B/2)/Z_f]-\delta$, $\delta = \tan^{-1}[(x-B/2)/Z_f]$ and x = horizontal distance from center of footing; Ref. Figure 6.13 and Equation 6.24, Das 2005
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesiv soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)

W-20-025 FRA-70-13.01

Embankment Settlement - Forward Abutment

Calculated By: LS Date: 06/12/2020

12/24/2014 BRT Date: 06/13/2020

Boring B-108-6-13

H=	32.0	ft	
B=	88.0	ft	
γ_{BF} =	125	psf	
D_w =	38.5	ft	Below Ground Surface
$\Delta\sigma$ =	4,000	psf	At Ground Surface

	A-4a (Upper)	A-4a (Lower)	A-6a		
c_v =	800	800	600	ft^2/yr	Coefficient of consolitation
t =	120	120	120	days	Time following completion of construction
H_{dr} =	11.5	10.5	16	ft	Length of longest drainage path considered
T_v =	1.989	2.386	0.771		Time factor
U =	99	100	88	%	Degree of consolidation

$(S_c)_t$ = 4.635 in Settlement complete at 92% of primary consolidation

Layer	Soil Type	Soil Type	Layer Depth (ft)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	Total Embankment Settlement: S_c (9,10) (ft)	Total Embankment Settlement: S_c (in)	Total Embankment Settlement: Layer Settlement (in)	Settlement Complete at 92% of Primary Consolidation: $(S_c)_t$ (11) (in)	Settlement Complete at 92% of Primary Consolidation: Layer Settlement (in)
1	A-2-4	G	0.0	5.5	5.5	2.8	125	688	344	344	3,344					26	41	135	0.03	1.000	4,000	4,343	0.045	0.537	0.537	0.537	0.537
2	A-6a	C	5.5	10.5	5.0	8.0	115	1,263	975	975	3,975	26	0.144	0.014	0.475				0.09	0.998	3,990	4,965	0.077	0.923	3.178	0.812	2.797
	A-6a	C	10.5	15.5	5.0	13.0	115	1,838	1,550	1,550	4,550	26	0.144	0.014	0.475				0.15	0.990	3,960	5,510	0.063	0.761		0.670	
	A-6a	C	15.5	20.5	5.0	18.0	115	2,413	2,125	2,125	5,125	31	0.189	0.019	0.514				0.20	0.976	3,904	6,029	0.068	0.814		0.717	
	A-6a	C	20.5	25.5	5.0	23.0	115	2,988	2,700	2,700	5,700	31	0.189	0.019	0.514				0.26	0.955	3,819	6,519	0.057	0.680		0.598	
3	A-4a	C	25.5	31.0	5.5	28.3	115	3,620	3,304	3,304	6,304	25	0.135	0.014	0.467				0.32	0.926	3,704	7,008	0.037	0.450	0.833	0.445	0.825
	A-4a	C	31.0	37.0	6.0	34.0	115	4,310	3,965	3,965	6,965	25	0.135	0.014	0.467				0.39	0.889	3,557	7,522	0.032	0.383		0.379	
4	A-1-a	G	37.0	42.0	5.0	39.5	125	4,935	4,623	4,560	7,560					26	19	72	0.45	0.851	3,403	7,963	0.017	0.202	0.310	0.202	0.310
	A-1-a	G	42.0	47.0	5.0	44.5	135	5,610	5,273	4,898	7,898					54	38	123	0.51	0.815	3,259	8,157	0.009	0.108		0.108	
5	A-4a	C	47.0	57.5	10.5	52.3	130	6,975	6,293	5,435	8,435	20	0.090	0.009	0.428				0.59	0.759	3,037	8,471	0.014	0.167	0.167	0.167	0.167

Settlement Remaining After Hold Period: 0.390 in

1. $\sigma_p' = \sigma_{vo}'+\sigma_m$; Estimate σ_m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003
2. $C_c = 0.009(LL-10)$; Ref. Table 6-9, FHWA GEC 5
3. $C_r = 0.10(C_c)$; Ref. Chapter 8.11, Holtz and Kovacs 1981
4. $e_o = (C_c/0.54)+0.35$; Ref. Table 6-11, FHWA GEC 5
5. $(N1)_{60} = C_n N_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing; $I = [\beta+\sin(\beta)\cos(\beta+2\delta)]/\pi$, where $\beta = \tan^{-1}[(x+B/2)/Z_f]-\delta$, $\delta = \tan^{-1}[(x-B/2)/Z_f]$ and x = horizontal distance from center of footing; Ref. Figure 6.13 and Equation 6.24, Das 2005
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesiv soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. $(S_c)_t = S_c(U/100)$; U = 100 for all granular soils at time t = 0

W-20-025 FRA-70-13.01

Embankment Settlement - Forward Abutment

This analysis is not yet finalized. To be completed at Stage 2 Design.

Calculated By: LS Date: 06/12/2020

12/24/2014 BRT Date: 06/13/2020

Boring B-108-6-13

H=	32.0	ft	
B=	88.0	ft	
γ_{BF} =	125	psf	
D_w =	38.5	ft	Below Ground Surface
$\Delta\sigma$ =	4,000	psf	At Ground Surface

	A-4a (Upper)	A-4a (Lower)	A-6a		
c_v =	800	800	600	ft^2/yr	Coefficient of consolitation
t =	0	0	0	days	Time following completion of construction
H_{dr} =	11.5	10.5	16	ft	Length of longest drainage path considered
T_v =	0.000	0.000	0.000		Time factor
U =	0	0	0	%	Degree of consolidation

$(S_c)_t$ = 0.846 in Settlement complete at 17% of primary consolidation

Layer	Soil Type	Soil Type	Layer Depth (ft)		Layer Thickness (ft)	Depth to Midpoint (ft)	γ (pcf)	σ_{vo} Bottom (psf)	σ_{vo} Midpoint (psf)	σ_{vo}' Midpoint (psf)	σ_p' (1) (psf)	LL	C_c (2)	C_r (3)	e_o (4)	N_{60}	$(N1)_{60}$ (5)	C' (6)	Z_f/B	I (7)	$\Delta\sigma_v$ (8) (psf)	σ_{vf}' Midpoint (psf)	Total Embankment Settlement: S_c (9,10) (ft)	Total Embankment Settlement: S_c (in)	Total Embankment Settlement: Layer Settlement (in)	Remaining Settlement at 17% of Primary Consolidation: $(S_c)_t$ (11) (in)	Remaining Settlement at 17% of Primary Consolidation: Layer Settlement (in)
1	A-2-4	G	0.0	5.5	5.5	2.8	125	688	344	344	3,344					26	41	135	0.03	1.000	4,000	4,343	0.045	0.537	0.537	0.000	4.178
2	A-6a	C	5.5	10.5	5.0	8.0	115	1,263	975	975	3,975	26	0.144	0.014	0.475				0.09	0.998	3,990	4,965	0.077	0.923	3.178	0.923	3.255
	A-6a	C	10.5	15.5	5.0	13.0	115	1,838	1,550	1,550	4,550	26	0.144	0.014	0.475				0.15	0.990	3,960	5,510	0.063	0.761		0.761	2.494
	A-6a	C	15.5	20.5	5.0	18.0	115	2,413	2,125	2,125	5,125	31	0.189	0.019	0.514				0.20	0.976	3,904	6,029	0.068	0.814		0.814	1.679
	A-6a	C	20.5	25.5	5.0	23.0	115	2,988	2,700	2,700	5,700	31	0.189	0.019	0.514				0.26	0.955	3,819	6,519	0.057	0.680		0.680	1.000
3	A-4a	C	25.5	31.0	5.5	28.3	115	3,620	3,304	3,304	6,304	25	0.135	0.014	0.467				0.32	0.926	3,704	7,008	0.037	0.450	0.833	0.450	0.550
	A-4a	C	31.0	37.0	6.0	34.0	115	4,310	3,965	3,965	6,965	25	0.135	0.014	0.467				0.39	0.889	3,557	7,522	0.032	0.383		0.383	0.167
4	A-1-a	G	37.0	42.0	5.0	39.5	125	4,935	4,623	4,560	7,560					26	19	72	0.45	0.851	3,403	7,963	0.017	0.202	0.310	0.000	0.167
	A-1-a	G	42.0	47.0	5.0	44.5	135	5,610	5,273	4,898	7,898					54	38	123	0.51	0.815	3,259	8,157	0.009	0.108		0.000	0.167
5	A-4a	C	47.0	57.5	10.5	52.3	130	6,975	6,293	5,435	8,435	20	0.090	0.009	0.428				0.59	0.759	3,037	8,471	0.014	0.167	0.167	0.167	0.000

1. $\sigma_p' = \sigma_{vo}'+\sigma_m$; Estimate σ_m of 3,000 psf for moderately overconsolidated soil deposit; Ref. Table 11.2, Coduto 2003
2. $C_c = 0.009(LL-10)$; Ref. Table 6-9, FHWA GEC 5
3. $C_r = 0.10(C_c)$; Ref. Chapter 8.11, Holtz and Kovacs 1981
4. $e_o = (C_c/0.54)+0.35$; Ref. Table 6-11, FHWA GEC 5
5. $(N1)_{60} = C_nN_{60}$, where $C_N = [0.77\log(40/\sigma_{vo}')] \leq 2.0$ ksf; Ref. Section 10.4.6.2.4, AASHTO LRFD BDS
6. Bearing capacity index; Ref. Figure 10.6.2.4.2-1, AASHTO LRFD BDS
7. Influence factor for strip loaded footing; $I = [\beta+\sin(\beta)\cos(\beta+2\delta)]/\pi$, where $\beta = \tan^{-1}[(x+B/2)/Z_f]-\delta$, $\delta = \tan^{-1}[(x-B/2)/Z_f]$ and x = horizontal distance from center of footing; Ref. Figure 6.13 and Equation 6.24, Das 2005
8. $\Delta\sigma_v = q_e(I)$
9. $S_c = [C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_{vo}')$ for $\sigma_p' \leq \sigma_{vo}' < \sigma_{vf}'$; $[C_r/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')$ for $\sigma_{vo}' < \sigma_{vf}' \leq \sigma_p'$; $[Cr/(1+e_o)](H)\log(\sigma_p'/\sigma_{vo}')+[C_c/(1+e_o)](H)\log(\sigma_{vf}'/\sigma_p')$ for $\sigma_{vo}' < \sigma_p' < \sigma_{vf}'$; Ref. Section 10.6.2.4.3, AASHTO LRFD BDS (Cohesiv soil layers)
10. $S_c = H(1/C')\log(\sigma_{vf}'/\sigma_{vo}')$; Ref. Section 10.6.2.4.2, AASHTO LRFD BDS (Granular soil layers)
11. $(S_c)_t = S_c(U/100)$; U = 100 for all granular soils at time t = 0

Settlement Remaining After Hold Period: 4.178 in

Depth of Downdrag: 32.0 ft

APPENDIX XI

LATERAL DESIGN PARAMETERS

Boring No.	Elevation (feet msl)	Soil Class.	Soil Type	Strata	N_{60}	$N1_{60}$	γ (pcf)	γ' (pcf)	Strength Parameter	k (soil) k_{rm} (rock)	ε_{50} (soil) E_r (rock)	RQD (rock)
B-014-2-19 (Rear Abutment)	744.5 to 736.3	A-4a	C	3	23	23	125 psf	125 psf	Su = 2,875 psf	960 pci	0.0052	-
	736.3 to 729.0	A-6a	C	3	15	15	120 psf	120 psf	Su = 1,875 psf	625 pci	0.0065	-
	729.0 to 724.0	A-6a	C	3	25	25	125 psf	125 psf	Su = 3,125 psf	1,040 pci	0.0050	-
	724.0 to 721.5	A-6a	C	3	17	17	130 psf	130 psf	Su = 2,125 psf	710 pci	0.0062	-
	721.5 to 719.0	A-4a	C	3	33	33	135 psf	135 psf	Su = 4,125 psf	1,375 pci	0.0046	-
	719.0 to 716.5	A-4a	C	3	23	23	130 psf	130 psf	Su = 2,875 psf	960 pci	0.0052	-
	716.5 to 702.5	A-4a	C	3	102	102	140 psf	140 psf	Su = 8,000 psf	2,665 pci	0.0033	-
	702.5 to 695.3	A-7-6	C	3	23	23	135 psf	135 psf	Su = 2,875 psf	960 pci	0.0052	-
	695.3 to 692.5	A-4a	C	3	42	42	140 psf	140 psf	Su = 5,250 psf	1,750 pci	0.0043	-
	692.5 to 682.5	A-1-b	G	4	83	46	140 psf	140 psf	φ = 41°	315 pci	-	-
	682.5 to 672.5	A-1-b	G	4	28	14	135 psf	72.6 psf	φ = 36°	95 pci	-	-
	672.5 to 662.5	A-1-b	G	4	41	20	140 psf	77.6 psf	φ = 37°	110 pci	-	-
	662.5 to 649.9	Boulders	G	4	120	55	140 psf	77.6 psf	φ = 45°	255 pci	-	-
B-015-1-13 (Rear Abubment)	746.7 to 741.2	A-6a	C	3	32	32	125 psf	125 psf	Su = 4,000 psf	1,335 pci	0.0047	-
	741.2 to 731.2	A-6a	C	3	12	12	115 psf	115 psf	Su = 1,500 psf	500 pci	0.0070	-
	731.2 to 718.7	A-6a	C	3	25	25	120 psf	120 psf	Su = 3,125 psf	1,040 pci	0.0050	-
	718.7 to 714.7	A-1-b	G	4	69	56	135 psf	135 psf	φ = 42°	355 pci	-	-
	714.7 to 709.7	A-6b	C	3	19	19	120 psf	120 psf	Su = 2,375 psf	790 pci	0.0058	-
	709.7 to 694.7	A-4a	C	3	23	23	120 psf	120 psf	Su = 2,875 psf	960 pci	0.0052	-
	694.7 to 689.7	A-1-b	G	4	49	29	135 psf	135 psf	φ = 39°	250 pci	-	-
	689.7 to 674.7	A-1-b	G	4	30	16	130 psf	130 psf	φ = 36°	160 pci	-	-
	674.7 to 651.7	A-4a	C	2	15	15	115 psf	52.6 psf	Su = 1,875 psf	625 pci	0.0065	-
B-003-E-68 (Rear Abutment)	718.4 to 710.4	A-4a	C	3	25	25	120 psf	120 psf	Su = 3,125 psf	1,040 pci	0.0050	-
	710.4 to 705.4	A-1-b	G	4	30	34	130 psf	130 psf	φ = 40°	280 pci	-	-
	705.4 to 700.4	A-7-6	C	3	22	22	125 psf	125 psf	Su = 2,750 psf	915 pci	0.0053	-
	700.4 to 685.4	A-1-a	G	4	100	84	135 psf	135 psf	φ = 43°	395 pci	-	-
	685.4 to 675.4	A-1-a	G	4	20	15	125 psf	62.6 psf	φ = 37°	110 pci	-	-
	675.4 to 670.4	A-1-a	G	4	54	38	135 psf	72.6 psf	φ = 41°	175 pci	-	-
	670.4 to 665.4	A-1-b	G	4	26	18	125 psf	62.6 psf	φ = 37°	110 pci	-	-
	665.4 to 648.4	A-4a	C	2	27	27	125 psf	62.6 psf	Su = 3,375 psf	1,125 pci	0.0049	-
	648.4 to 643.4	Limestone	R	9	-	-	165 psf	102.6 psf	Qu = 10,000 psi	0.00005	1,000,000 psi	85
B-014-3-19 (Pier 1)	700.9 to 699.4	A-2-4	G	4	33	66	130 psf	130 psf	φ = 41°	315 pci	-	-
	699.4 to 697.9	A-1-a	G	4	85	139	135 psf	135 psf	φ = 43°	395 pci	-	-
	697.9 to 695.4	A-1-a	G	4	42	60	130 psf	130 psf	φ = 43°	395 pci	-	-
	695.4 to 690.4	A-1-a	G	4	71	86	135 psf	135 psf	φ = 43°	395 pci	-	-
	690.4 to 682.9	A-1-a	G	4	36	38	130 psf	67.6 psf	φ = 41°	175 pci	-	-
	682.9 to 677.9	A-1-b	G	4	16	16	130 psf	67.6 psf	φ = 36°	95 pci	-	-
	677.9 to 675.4	A-4a	C	2	46	46	135 psf	72.6 psf	Su = 5,750 psf	1,915 pci	0.0041	-
	675.4 to 668.9	A-1-b	G	4	101	90	140 psf	77.6 psf	φ = 42°	195 pci	-	-
	668.9 to 658.9	A-4a	C	2	27	27	135 psf	72.6 psf	Su = 3,375 psf	1,125 pci	0.0049	-
	658.9 to 654.9	A-4a	C	2	56	56	140 psf	77.6 psf	Su = 7,000 psf	2,335 pci	0.0037	-
	654.9 to 646.1	Limestone	R	9	-	-	165 psf	102.6 psf	Qu = 10,000 psi	0.00005	1,000,000 psi	32
B-015-2-13 (Pier 1)	700.4 to 694.9	A-2-4	G	4	32	50	130 psf	130 psf	φ = 41°	315 pci	-	-
	694.9 to 689.9	A-1-b	G	4	48	59	130 psf	130 psf	φ = 42°	355 pci	-	-
	689.9 to 682.4	A-1-b	G	4	13	14	125 psf	62.6 psf	φ = 36°	95 pci	-	-
	682.4 to 677.4	A-1-b	G	4	29	29	130 psf	67.6 psf	φ = 39°	140 pci	-	-
	677.4 to 668.4	A-1-a	G	4	36	33	130 psf	67.6 psf	φ = 41°	175 pci	-	-
	668.4 to 658.4	A-4a	C	2	45	45	130 psf	67.6 psf	Su = 5,625 psf	1,875 pci	0.0041	-
	658.4 to 641.9	A-4a	C	2	32	32	125 psf	62.6 psf	Su = 4,000 psf	1,335 pci	0.0047	-
	641.9 to 631.9	Limestone	R	9	-	-	165 psf	102.6 psf	Qu = 10,000 psi	0.00005	1,000,000 psi	63
B-014-4-19 (Pier 2)	698.8 to 697.3	A-6a	C	3	25	25	125 psf	125 psf	Su = 3,125 psf	1,040 pci	0.0050	-
	697.3 to 695.8	A-6a	C	3	37	37	130 psf	130 psf	Su = 4,625 psf	1,540 pci	0.0045	-
	695.8 to 688.3	A-1-a	G	4	34	44	130 psf	130 psf	φ = 42°	355 pci	-	-
	688.3 to 685.8	A-1-a	G	4	44	51	130 psf	67.6 psf	φ = 43°	215 pci	-	-
	685.8 to 680.8	A-1-a	G	4	26	28	125 psf	62.6 psf	φ = 40°	155 pci	-	-
	680.8 to 678.3	A-1-a	G	4	15	16	125 psf	62.6 psf	φ = 37°	110 pci	-	-
	678.3 to 672.3	A-1-a	G	4	73	72	140 psf	77.6 psf	φ = 43°	215 pci	-	-
	672.3 to 666.8	A-4a	C	2	30	30	130 psf	67.6 psf	Su = 3,750 psf	1,250 pci	0.0048	-
	666.8 to 662.3	A-1-b	G	4	25	22	130 psf	67.6 psf	φ = 38°	125 pci	-	-
	662.3 to 658.3	A-4a	C	2	120	120	135 psf	72.6 psf	Su = 8,000 psf	2,665 pci	0.0033	-
	658.3 to 649.1	Limestone	R	9	-	-	165 psf	102.6 psf	Qu = 10,000 psi	0.00005	1,000,000 psi	72
B-108-5-13 (Forward Abutment)	700.3 to 694.8	A-6a	C	3	18	18	120 psf	120 psf	Su = 2,250 psf	750 pci	0.0060	-
	694.8 to 689.8	A-2-6	G	4	18	22	125 psf	125 psf	φ = 37°	190 pci	-	-
	689.8 to 682.3	A-1-a	G	4	29	31	130 psf	67.6 psf	φ = 40°	155 pci	-	-
	682.3 to 677.3	A-1-b	G	4	19	19	125 psf	62.6 psf	φ = 37°	110 pci	-	-
	677.3 to 663.3	A-1-a	G	4	37	34	130 psf	67.6 psf	φ = 41°	175 pci	-	-
	663.3 to 645.8	A-4a	C	2	29	29	125 psf	62.6 psf	Su = 3,625 psf	1,210 pci	0.0048	-
	645.8 to 637.3	Limestone	R	9	-	-	165 psf	102.6 psf	Qu = 10,000 psi	0.00005	1,000,000 psi	79
B-108-6-13 (Forward Abutment)	714.5 to 709.0	A-2-4	G	4	26	41	125 psf	125 psf	φ = 40°	280 pci	-	-
	709.0 to 689.0	A-6a	C	3	9	9	115 psf	115 psf	Su = 1,125 psf	300 pci	0.0085	-
	689.0 to 677.5	A-4a	C	3	10	10	115 psf	115 psf	Su = 1,250 psf	365 pci	0.0080	-
	677.5 to 672.5	A-1-a	G	4	26	19	125 psf	62.6 psf	φ = 38°	125 pci	-	-
	672.5 to 667.5	A-1-a	G	4	54	38	135 psf	72.6 psf	φ = 41°	175 pci	-	-
	667.5 to 657.0	A-4a	C	2	92	92	130 psf	67.6 psf	Su = 8,000 psf	2,665 pci	0.0033	-
	657.0 to 647.4	Limestone	R	9	-	-	165 psf	102.6 psf	Qu = 10,000 psi	0.00005	1,000,000 psi	73
B-012-E-68 (Forward Abutment)	704.4 to 695.4	A-1-a	G	4	18	26	125 psf	125 psf	φ = 39°	250 pci	-	-
	695.4 to 684.4	A-1-b	G	4	7	7	120 psf	120 psf	φ = 33°	95 pci	-	-
	684.4 to 674.4	A-1-a	G	4	37	34	130 psf	67.6 psf	φ = 41°	175 pci	-	-
	674.4 to 664.4	A-2-4	G	4	100	85	135 psf	72.6 psf	φ = 41°	175 pci	-	-
	664.4 to 659.4	A-4a	G	4	26	21	125 psf	62.6 psf	φ = 34°	70 pci	-	-
	659.4 to 654.4	A-4a	C	2	100	100	130 psf	67.6 psf	Su = 8,000 psf	2,665 pci	0.0033	-
	654.4 to 646.4	A-2-4	G	4	37	27	130 psf	67.6 psf	φ = 38°	125 pci	-	-
	646.4 to 644.4	Limestone	R	9	-	-	165 psf	102.6 psf	Qu = 10,000 psi	0.00005	1,000,000 psi	85
B-014-7-20 (Forward Abutment)	715.5 to 709.5	A-6a	C	3	22	22	120 psf	120 psf	Su = 2,750 psf	915 pci	0.0053	-
	709.5 to 704.0	A-6a	C	3	50	50	130 psf	130 psf	Su = 6,250 psf	2,085 pci	0.0039	-
	704.0 to 690.5	A-7-6	C	3	40	40	130 psf	130 psf	Su = 5,000 psf	1,665 pci	0.0043	-
	690.5 to 683.5	A-1-b	G	4	100	82	135 psf	72.6 psf	φ = 42°	195 pci	-	-
	683.5 to 673.5	A-1-a	G	4	40	31	130 psf	67.6 psf	φ = 40°	155 pci	-	-
	673.5 to 667.5	A-4a	C	2	23	23	125 psf	62.6 psf	Su = 2,875 psf	960 pci	0.0052	-
	667.5 to 658.9	A-1-a	G	4	45	31	130 psf	67.6 psf	φ = 40°	155 pci	-	-

APPENDIX XII

GB1 ANALYSIS OUTPUTS

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

FRA-70-13.01
105430

Subsurface exploration for improvements along I-70 EB from Souder Avenue to the FRA-70-1321R bridge structure in Franklin County, Ohio.

Resource International, Inc.

Prepared By: Leila Sadeghi, Ph.D., Brian Trenner, P.E.
Date prepared: Wednesday, May 13, 2020

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Columbus, Ohio 43231
Phone: 614.823.4949
leilas@resourceinternational.com

NO. OF BORINGS: 3

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-014-1-19	BL I-70 EB	130+97	21	Lt	CME 55	91	736.5	735.1	1.4 C
2	B-019-5-19	BL I-70 EB	135+82	16	Lt	CME 55	91	744.5	743.0	1.5 C
3	B-019-8-19	BL I-70 EB	145+09	10	Lt	CME 55	91	736.1	734.7	1.4 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.5	3.0	0.1	1.6	15			19	14	5	18	5	23	8	6	A-1-b	0	1900					
	014-1	SS-2	3.0	4.5	1.6	3.1	30		3.5	21	17	4	26	10	36	13	12	A-4a	0						
	19	SS-3	4.5	6.0	3.1	4.6	35		3.5							13	10	A-4a	8						
		SS-4	6.0	7.5	4.6	6.1	39	15	4.5							11	14	A-6a	10						
2	B	SS-1	1.5	3.0	0.0	1.5	21		3.5	19	16	3	24	12	36	16	11	A-4a	0	1500		Mc			
	019-5	SS-2	3.5	5.0	2.0	3.5	29		3.75							11	10	A-4a	8						
	19	2S-3A	6.0	8.0	4.5	6.5	21		3							13	10	A-4a	8						
		SS-4	8.5	10.0	7.0	8.5	15	21	3	26	15	11	32	20	52	14	14	A-6a							
3	B	SS-1B	1.5	3.0	0.1	1.6	27		3.5	36	21	15	33	18	51	13	16	A-6a	5	640					
	019-8	SS-2	3.0	4.5	1.6	3.1	23		3.5	33	23	10	26	18	44	20	18	A-4a	2						
	19	SS-3	4.5	6.0	3.1	4.6	29		3							21	10	A-4a	8						
		SS-4	6.0	7.3	4.6	5.9	50	23	4.25							14	10	A-4a	8						

PID: 105430

County-Route-Section: FRA-70-13.01
No. of Borings: 3

Geotechnical Consultant: Resource International, Inc.
Prepared By: Leila Sadeghi, Ph.D., Brian Trenner, P.E.
Date prepared: 5/13/2020

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	NA

Excavate and Replace Stabilization Options	
Global Geotextile Override(N60L):	12''
Average(HP):	0''
Global Geogrid Override(N60L):	0''
Average(HP):	0''

Design CBR	8

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	0%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	0%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	91%	HP > 2	91%
M+	9%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

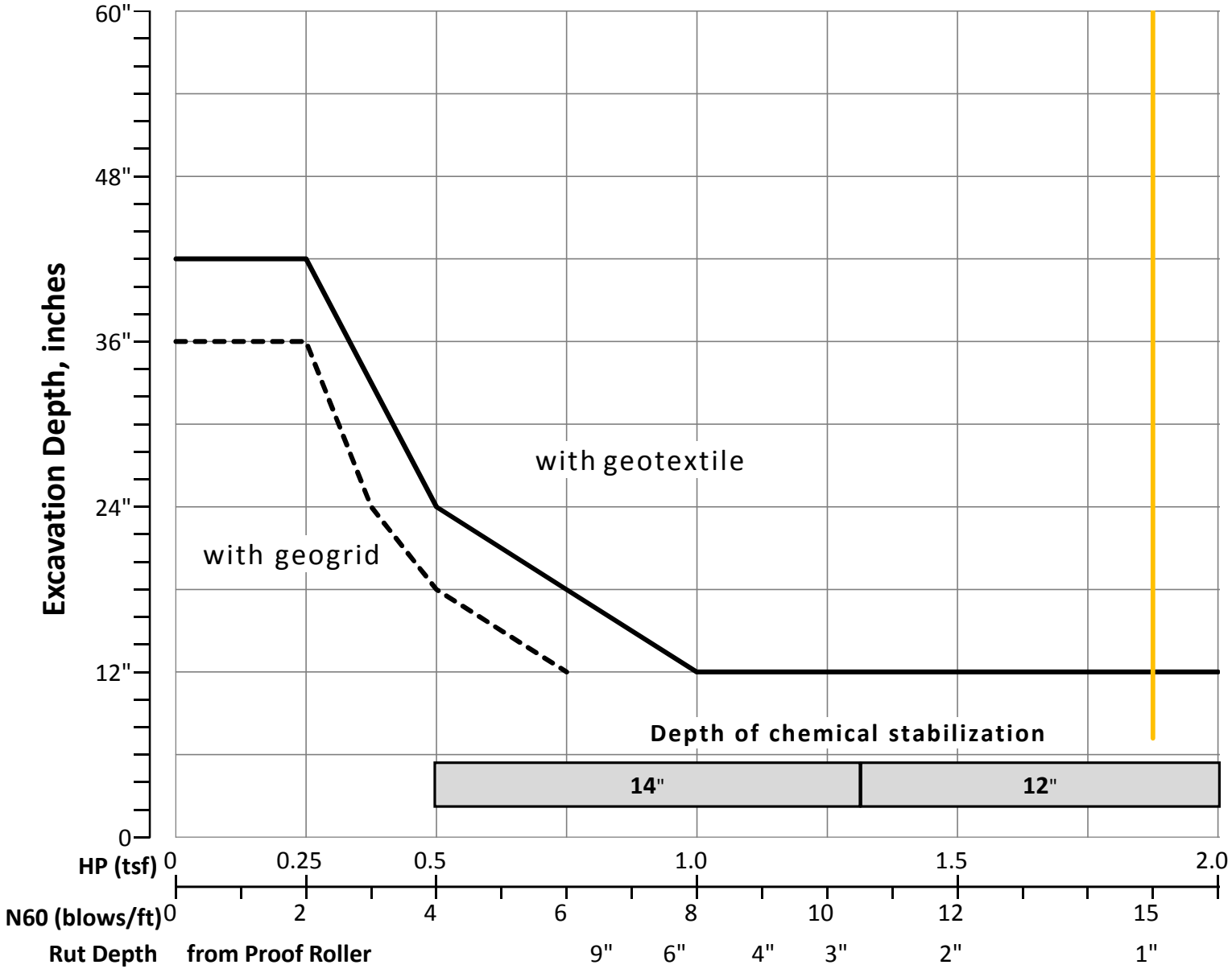
% Proposed Subgrade Surface	
Unstable & Unsuitable	17%
Unstable	17%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	28	20	3.55	26	18	8	27	14	40	14	12	5
Maximum	50	23	4.50	36	23	15	33	20	52	21	18	10
Minimum	15	15	3.00	19	14	3	18	5	23	8	6	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	1	0	0	0	0	0	0	8	0	0	3	0	0	0	0	0	12
Percent	0%	0%	8%	0%	0%	0%	0%	0%	0%	67%	0%	0%	25%	0%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	75%									25%								100%
Surface Class Count	0	0	1	0	0	0	0	0	0	4	0	0	1	0	0	0	0	0	6
Surface Class Percent	0%	0%	17%	0%	0%	0%	0%	0%	0%	67%	0%	0%	17%	0%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.55		☐ HP
19.67	15.00	☑ N60L

Average HP
Average N_{60L}

The subgrade analysis workbook consists of five worksheets. Each worksheet functions independently. In all of the worksheets the fields are color coded as follows:

- Every yellow highlighted field indicates a field to be entered by the user.
- Every salmon field is to indicate a problem/issue.
- Every gray or green field is a heading/informational field.

IMPORTANT: The sequence of filling out the data needs to be followed as outlined below:

1. Cover Sheet: this worksheet is designed for the purpose of entering the project information. Enter all the following fields:

County-Route-Section	This includes the county, route, section number assigned to the project.
PID	the Project Identification Number
Project Description	See Cover Sheet for list of example details
Geotechnical Consultant	The Geotechnical Consultant performing the analysis.
Prepared By	The preparer of the subgrade analysis
Date prepared	The date the analysis is performed.
Contact Information	Name, address, telephone #, and email address
No. of Borings	Enter the total number of borings within the alignment that is being

2. Boring Logs Entry Worksheet: this worksheet has a programming code that will run in the background every time the sheet is activated and will make the sheet unresponsive for less than a minute. The code is designed to read the total number of borings from the cover sheet and generate the needed number of fields.
    a. All yellow highlighted fields are user's entry.
    b. ODOT has developed a text table export from gINT *(GB 1 Borings Log Entry Tab)* that will allow for copy and paste of all highlighted fields with the exception of proposed subgrade elevation. The designer must provide a proposed subgrade elevation in order for the spreadsheet to function properly.
    c. The Cut/Fill field is a calculated field that, based on the difference between the boring elevation and the proposed subgrade elevation, will highlight the cell either gray and adds the letter "C" to the end in a cut situation or highlights the cell in light purple and adds the letter "F" to the end in a fill situation.
    d. Every duplicate boring ID will be highlighted in salmon background and red text.
    e. **IMPORTANT**: <u>After</u> entering all the borings' information, the user must click "Add Subgrade Analysis Entry Fields" button. This will generate all the required fields in the "Subgrade Analysis" Worksheet.

3. Subgrade Analysis Worksheet:
    a. The boring number and boring ID is read from the "Boring Logs Entry Worksheet" excluding every boring that has six feet or more of fill.
    b. All yellow highlighted fields are to be entered by the user and salmon highlighted fields indicates a problem or issue.

c. Every sample that has a Sulfate Content greater than or equal to 3000 will be highlighted in light salmon background. Every sample that has a Sulfate Content greater than or equal to 8000 will be highlighted in darker salmon background. Note the revised sulfate criteria in GB1 issued July 20, 2018.

d. Unsuitable/Unstable:

i. Unsuitable samples that are within 3 feet of the top of subgrade will be highlighted with salmon background and the class will be showing in this field.

ii. Unstable Samples that are within 3 feet of top of subgrade will be highlighted with salmon background and text to indicate the problem as follows:

Criterion	Stabilization Need Check	Text displayed in the field
A-1-a, A-1-b, A-3, or A-3a Soil Class	No Stabilization is needed	
HP ≥ 1.875	No Stabilization is needed	
$N_{60} \geq 15$	No Stabilization is needed	
$1.875 \geq HP \geq 1.5$ and $M_c \geq$ Opt. M_c+3	Unstable Subgrade	HP & Mc
$15 \geq N_{60} \geq 12$ and $M_c \geq$ Opt. M_c+3	Unstable Subgrade	N_{60} & Mc
HP ≤ 1.5	Unstable Subgrade	HP
$N_{60} \leq 12$	Unstable Subgrade	N_{60}

iii. The field is formulated to check for HP first and check for N_{60} second.

e. Excavate and Replace (Item 204) is going to be calculated based on the subgrade depth for each sample indicating an unsuitable or unstable problem.

f. Recommendation:

i. Geotextile Option is calculated and rounded to a multiple of 3 inches based on the subgrade depth for every sample indicating an unsuitable or unstable problem.

ii. GEOGRID Option is only offered in case of unstable subgrade problem and if the geotextile option indicates the need to excavate greater than 12 inches.

PLEASE NOTE: The Problem, Excavate & Replace, and Recommendation Fields are the responsibility of the Designer. These fields are being enhanced to attempt to capture the ODOT philosophy regarding the GB1 stabilization chart, but are considered still under development. If there are discrepancies between the spreadsheet output and the GB1 chart - the chart governs in conjunction with engineering judgement. Please contact Steve Taliaferro at stephen.taliaferro@dot.ohio.gov if you have any questions.

PLEASE NOTE: It is the Designer's responsibility to identify the most representative data when samples have been separated into multiple specimen (say 1.5 to 2.3 feet and 2.3 to 3.0 feet). The spreadsheet is not capable at this time of addressing this issue within a direct data export from gINT.

4. Results Summary:

All fields in this sheet are password protected and are either calculated or read from the other worksheets.

5. Graph Worksheet:

This worksheet is designed to read the average N_{60L} and the average HP from the Cover Sheet and plot a blue line for Average HP and orange line for Average N_{60L} on GB1 Figure B – Subgrade Stabilization. The Override Table can be used to enter HP and/or N_{60L} values that are different than the calculated averages. The Override values will change the global undercut recommendation in the Results Summary.