# STRUCTURE GEOTECHNICAL REPORT

## IL 145 over Bear Creek Ditch

**Existing S.N. 076-0019**

**F.A.P RTE. 132**
**SECTION 103A-BY (103B-3)**
**POPE COUNTY, ILLINOIS**
**JOB NO. D-99-059-19**
**PTB 193 Item 032**
**KEG NO. 19-1143.04**


10/12/2022
Exp. 11/30/2022

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**April 19, 2022**
**REVISED October 12, 2022**

Kaskaskia
Engineering Group, LLC

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# EXHIBITS

## 1.0 PROJECT DESCRIPTION AND SCOPE

### 1.1 Introduction

The geotechnical study summarized in this report was performed by Kaskaskia Engineering Group, LLC (KEG) for a proposed bridge replacement carrying IL-145 over Bear Creek Ditch in Pope County, Illinois. The purpose of this report is to document subsurface geotechnical conditions, provide analyses of anticipated site conditions as they pertain to the project described herein, and to present design and construction recommendations for the proposed structure.

### 1.2 Project Description

The project consists of the removal and replacement of a single-span bridge (SN 076-0019) carrying IL-145 over Bear Creek Ditch in Pope County, Illinois. The general location of the proposed structure is shown on a Location Map, Exhibit A. The project is located approximately 4.8 miles south of the intersection of IL-145 and IL-146. The site lies within the Shawnee Hills Section of the Interior Low Plateaus Province.

### 1.3 Proposed Structure Information

The proposed structure (SN 076-~~0019~~ 0034) will consist of a three-span bridge, which will be built on a 38°30'-degree skew over the Bear Creek Ditch. The bridge will provide two 12 ft. wide driving lanes and two 8 ft. wide shoulders. The total width of the bridge will be 40 ft. out-to-out. The bridge will consist of two 22 ft.-4 in. spans and one 29 ft. span and will measure 77 ft.-6 in. back-to-back of abutments. A Type, Size, and Location Plan (TS&L) is included in Exhibit B.

Further substructure details will be based on the findings of this SGR.

## 2.0 FIELD EXPLORATION

### 2.1 Subsurface Exploration and Testing

The site exploration plan was developed and completed by IDOT. Two standard penetration test (SPT) borings designated 1-S and 2-S were drilled on November 01, 2021, and November 14, 2021. Detailed information regarding the nature and thickness of the soils encountered and the results of the field sampling and laboratory testing are shown on the Boring Logs, Exhibit C. The soil profile for the above-mentioned borings can be found in Subsurface Profile, Exhibit D.

### 2.2 Subsurface Conditions

The profiles at the two (2) boring locations exhibited layers of clays, silty clays, sands, sandstone, and limestone. Boring 1-S was drilled to a depth of 109.5 ft. below a Ground Surface Elevation (GSE) of 356.90 ft. and included rock coring from 99.5 to 109.5 ft. Boring 2-S was drilled to a depth of 88.25 ft. below a GSE of 356.80 ft.

Topsoil was not encountered beneath the pavement in the borings. The pavement consisted of 5 to 7 inches of asphalt over 7 to 9 inches of concrete.

Clay – Clay was encountered in Boring 1-S from 1.2 to 64.0 and 79.0 to 89.0 ft. below the Ground Surface Elevation (GSE) of approximately 356.9 ft. Clay was exhibited in 2-S from 4.5 to 35.0 and

36.0 to 80.0 ft. below the GSE of approximately 356.8 ft. The N-values ranged from 0 to 12 blows per foot (bpf) and the unconfined compressive strength (Qu) ranged from 0.3 to 3.3 tons per square foot (tsf). The moisture content ranged from 17 to 34 percent.

Clay Loam – Clay loam was encountered in Boring 1-S from 64.0 to 79.0 ft. below GSE. The N-values ranged from 1 to 6 bpf and the UCS (Qu) ranged from 0.5 to 1.2 tsf. The moisture content ranged from 22 to 24 percent.

Silty Clay/Silty Clay Loam – A silty clay to silty clay loam was encountered in Boring 2-S from 1.2 to 4.5 and 35 to 36 ft. below GSE. The N-values ranged from 0 to 5 bpf and the UCS (Qu) ranged from 0.2 to 1.0 tsf. The moisture content ranged from 23 to 27 percent.

Sand – Sand was encountered in Boring 1-S from approximately 89.0 to 99.5 ft. below GSE and in Boring 2-S from 80.0 to 87.9 ft. below GSE. The N-values ranged from 5 to 23 bpf and the UCS and moisture content was unable to be determined since it is non-cohesive and was poorly recovered.

Sandstone – Sandstone was encountered in Boring 1-S from 99.5 to 107.8 ft. below GSE and in Boring 2-S from 87.9 to 88.2 ft. below GSE. Compressive strength tests run on the core samples showed that the strength ranged from 818.3 to 929.6 tsf.

Limestone – Limestone was encountered in Boring 1-S from 107.8 to 109.5 ft. below GSE. A compressive strength test was run on the core sample, and it was determined to have strength ranging from 859.2 to 936.3 tsf.

### 2.3 Groundwater

Groundwater was encountered at the time of drilling in Boring 1-S at an elevation of 309.9 ft. (47.0 ft. below GSE) and in Boring 2-S at an elevation of 320.8 ft. (36 ft. below GSE). It should be further noted that the groundwater level is subject to seasonal and climatic variations, including the level of adjacent affluents.

## 3.0 GEOTECHNICAL EVALUATIONS

### 3.1 Settlement

Since no significant grading or changes to the existing embankments are expected at the proposed structure, it is estimated that existing embankments will experience no settlement. Therefore, no settlement calculations were performed for the proposed structure.

### 3.2 Slope Stability

A limit equilibrium pseudo static stability analysis using SLOPE/W was performed using the proposed roadway and bridge geometry on the TS&L and soil characteristics from Borings 1-S and 2-S. Two conditions were modeled for each scenario: end-of-construction and long-term stability. The pseudo static stability analysis adds an inertial force of the earthquake, described by a seismic coefficient into a conventional slope stability analysis. The seismic coefficient was determined using the Peak Horizontal Ground acceleration (PGA) and the height of the slope (See SLOPE/W Slope Stability Analysis - Exhibit E).

A critical factor of safety (FOS) was calculated for each condition. According to current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability and 1.1 for the pseudo static stability analysis. The slope stability analyses indicated that the required minimum FOS for all conditions were met.

To model the end-of-construction condition, full cohesion, and a friction angle of 0 degrees were assumed. Nominal values for cohesion were used with full friction angle to model the long-term condition to analyze the theoretical condition where pore water pressure has dissipated. Nominal values were between 50 and 150 psf for the cohesive soils, with friction angles between 26 and 34 degrees.

The Bishop Circular Method, which generates circular-shaped failure surfaces, was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis is shown in Table 3.2. SLOPE/W program output from this analysis can be found in SLOPE/W Slope Stability Analysis, Exhibit E.

**Table 3.2 – Slope Stability Critical FOS IL 145 over Bear Creek**

| Location (1V:2H Slope) | Critical FOS | | |
|---|---|---|---|
| | End of Construction | Long Term | Seismic |
| North Abutment (2-S) | 4.6 | 1.7 | 2.1 |
| South Abutment (1-S) | 4.4 | 2.1 | 2.1 |

## 3.3 Seismic Considerations

The determination of Seismic Site Class was based on the method described by IDOT AGMU Memo 09.1 - Seismic Site Class Definition and the IDOT provided spreadsheet titled: '*Seismic Site Class Determination*.' Using these resources, the controlling global site class for this project is Soil Site Class D.

Additional seismic parameters were calculated for use in design of the structure. Published information and mapping from the USGS, including software directly applicable to the AASHTO Guide Specifications for LRFD Seismic Bridge Design, was used to develop the parameters for the bridge location. The values, based on Soil Site Class D, are summarized below.

**Table 3.3 - Summary of Seismic Parameters**

| Parameter | Value |
|---|---|
| Soil Site Class | D |
| Spectral Response Acceleration, 0.2 Sec, $S_{DS}$ | 1.056 g (Site Class D) |
| Spectral Response Acceleration, 1.0 Sec, $S_{D1}$ | 0.455g (Site Class D) |
| Seismic Performance Zone | 3 |

As indicated in the table above, the Seismic Performance Zone is 3, based on $S_{D1}$ and Table 3.15.2 in the IDOT Bridge Manual, the Soil Site Class D, and Figure 2.3.10-2 in the IDOT Bridge Manual.

### 3.4 Scour

The design scour elevations for the proposed structure are shown in Table 3.4. Stone riprap class A-4, typ., will be placed on the surface of the proposed abutment end slopes to reduce the potential for future scour.

**Table 3.4 – Design Scour Elevations**

| Event/Limit State | Design Scour Elevations (ft.) | | | | Item 113 |
|---|---|---|---|---|---|
| | South Abutment | Pier 1 | Pier 2 | North Abutment | |
| $Q_{100}$ | 351.96 | 331.30 | 331.30 | 351.99 | 5 |
| $Q_{200}$ | 351.96 | 329.30 | 329.30 | 351.99 | |
| Design | 351.96 | 331.30 | 331.30 | 351.99 | |
| Check | 351.96 | 329.30 | 331.30 | 351.99 | |

### 3.5 Liquefaction

A liquefaction analysis was performed using the liquefaction analysis worksheet provided by IDOT BBS Central Geotechnical Unit and procedures outlined in AGMU 10.1 - Liquefaction Analysis.

The PGA and Mw to be used were obtained from the deaggregation data of the seismic hazard for the site, by accessing the USGS website: https://earthquake.usgs.gov/hazards/interactive/ for both NMSZ (far source-site) and CEUS (near source-site) models. The deaggregation data indicated a near source-site contributing at least 9.52% to the hazard for this site; hence, a PGA maximum from the NMSZ Model was necessary. The Maximum Horizontal Ground Surface Acceleration value was set to the NMSZ PGA (0.50g) calculated in the IDOT Liquefaction Analysis Spreadsheet.

Both Borings (1-S and 2-S) were analyzed. The results from the analysis for the soil profile encountered in the borings showed no potential for liquefaction. Therefore, no reduction for liquefaction was considered for the pile design capacity or other foundation considerations. A summary of the liquefaction analysis including each specific run is included in Exhibit F, Liquefaction Analysis.

## 4.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

### 4.1 Driven Piles

The foundations supporting the proposed bridge must provide sufficient support to resist dead and live loads. The IDOT Static Method uses the LRFD Pile Design Guide Procedure to estimate the pile lengths (Pile Length/Pile Type, Exhibit G).

The factored reactions and the preliminary design loads, as provided by CM&T, Inc. are provided in Table 4.1.1.

**Table 4.1.1 - Preliminary Design Loads**

| Substructure Unit | Factored Reactions (kips) |
|---|---|
| Abutments | 572.8 |
| Piers | 1070.8 |

The estimated pile lengths for applicable pile types are shown in Tables 4.1.2 through 4.1.6 below. The Nominal Required Bearing ($R_N$) represents the resistance the pile will experience during driving and will assist the contractor in selecting a proper hammer size. The Factored Resistance Available ($R_F$) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loadings.

**Table 4.1.2 - Estimated Pile Lengths for HP 10x42 Steel H-Piles**

| Substructure Unit | $R_n$ Nominal Required Bearing (kips) | $R_F$ Factored Resistance Available (LRFD) (kips) | Estimated Pile Length (ft.) | Assumed Pile Cut-off Elevation (ft.) |
|---|---|---|---|---|
| South Abutment (1-S) | 335 | 184 | 95 | 353.82 |
| Pier 1 (1-S) | 335 | 167 | 93 | 350.00 |
| Pier 2 (2-S) | 335 | 165 | 81 | 350.00 |
| North Abutment (2-S) | 335 | 184 | 84 | 353.80 |

**Table 4.1.3 - Estimated Pile Lengths for HP 12x53 Steel H-Piles**

| Substructure Unit | $R_n$ Nominal Required Bearing (kips) | $R_F$ Factored Resistance Available (LRFD) (kips) | Estimated Pile Length (ft.) | Assumed Pile Cut-off Elevation (ft.) |
|---|---|---|---|---|
| South Abutment (1-S) | 418 | 230 | 97 | 353.82 |
| Pier 1 (1-S) | 418 | 208 | 94 | 350.00 |
| Pier 2 (2-S) | 418 | 207 | 82 | 350.00 |
| North Abutment (2-S) | 418 | 230 | 85 | 353.80 |

**Table 4.1.4 - Estimated Pile Lengths for HP 12x63 Steel H-Piles**

| Substructure Unit | $R_n$ Nominal Required Bearing (kips) | $R_F$ Factored Resistance Available (LRFD) (kips) | Estimated Pile Length (ft.) | Assumed Pile Cut-off Elevation (ft.) |
|---|---|---|---|---|
| South Abutment (1-S) | 497 | 273 | 97 | 353.82 |
| Pier 1 (1-S) | 497 | 252 | 94 | 350.00 |
| Pier 2 (2-S) | 497 | 250 | 82 | 350.00 |
| North Abutment (2-S) | 497 | 273 | 85 | 353.80 |

**Table 4.1.5 - Estimated Pile Lengths for HP 14x73 Steel H-Piles**

| Substructure Unit | $R_n$ Nominal Required Bearing (kips) | $R_F$ Factored Resistance Available (LRFD) (kips) | Estimated Pile Length (ft.) | Assumed Pile Cut-off Elevation (ft.) |
|---|---|---|---|---|
| South Abutment (1-S) | 578 | 318 | 97 | 353.82 |
| Pier 1 (1-S) | 578 | 293 | 94 | 350.00 |
| Pier 2 (2-S) | 578 | 290 | 82 | 350.00 |
| North Abutment (2-S) | 578 | 318 | 85 | 353.80 |

**Table 4.1.6 - Estimated Pile Lengths for HP 14x89 Steel H-Piles**

| Substructure Unit | $R_n$ Nominal Required Bearing (kips) | $R_F$ Factored Resistance Available (LRFD) (kips) | Estimated Pile Length (ft.) | Assumed Pile Cut-off Elevation (ft.) |
|---|---|---|---|---|
| South Abutment (1-S) | 705 | 386 | 88 | 353.82 |
| Pier 1 (1-S) | 705 | 362 | 94 | 350.00 |
| Pier 2 (2-S) | 705 | 361 | 83 | 350.00 |
| North Abutment (2-S) | 705 | 387 | 86 | 353.80 |

As shown in the Tables above and in Pile Length/Pile Type, Exhibit G, downdrag and liquefaction has not been included at the substructure locations.

KEG recommends one test pile be performed at a west abutment location, at a minimum. A test pile is performed prior to production driving so that actual, on-site field data can be gathered to determine pile driving requirements for the project. This is also the manner in which the contractor's proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

Some H-piles are expected to be driven into sandstone and pre-coring should not be required to reach estimated embedment depths. KEG recommends using pile shoes to facilitate driving and protect piles from damage.

## 4.2 Lateral Pile Response

Generally, the geotechnical engineer provides soil parameters to the structural engineer so that an L-Pile program or other approved software can be used for the lateral or displacement analysis of the foundations. Tables 4.2.1 and 4.2.2 are included for the structural engineer's use in determining lateral pile response.

**Table 4.2.1 - Soil Parameters for Lateral Pile Load Analysis**

| Boring | Depth at Bottom of Layer (Feet) | γ (pcf) | Short Term | | Long Term | | N Value (Est. Range) | Assumed % Fines < #200 | K (pci) | ε50 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Φ (deg) | c (psf) | Φ (deg) | c (psf) | | | | |
| 1-S | 292.9 | 120 | 0 | 1395 | 29 | 100 | 1 to 10 | 85% | 500 | 0.007 |
| | 277.9 | 120 | 0 | 833 | 28 | 50 | 1 to 6 | 65% | 100 | 0.01 |
| | 267.9 | 120 | 0 | 1700 | 30 | 100 | 6 | 85% | 500 | 0.007 |
| | 257.4 | 115 | 34 | -- | 34 | -- | 23 to 100 | 3% | 60 | -- |
| 2-S | 352.3 | 120 | -- | 200 | 28 | 50 | 0 | 65% | 30 | 0.02 |
| | 321.8 | 120 | -- | 2008 | 29 | 100 | 2 to 12 | 85% | 1000 | 0.005 |
| | 320.8 | 120 | -- | 1000 | 29 | 100 | 5 | 65% | 100 | 0.01 |
| | 276.8 | 120 | -- | 1386 | 29 | 100 | 2 to 12 | 85% | 500 | 0.007 |
| | 268.9 | 115 | 34 | -- | 34 | -- | 5 | 3% | 20 | -- |

**Table 4.2.2 - Rock Parameters for Lateral Pile Load Analysis**

| Rock Type | Weak Rock | | | Strong Rock | |
|---|---|---|---|---|---|
| | y (pcf) | RQD | Qu (tsf) | y (pcf) | Qu (tsf) |
| Limestone | -- | -- | -- | 150 | 897.75 |
| Sandstone | -- | -- | -- | 125 | 873.95 |

## 5.0 CONSTRUCTION CONSIDERATIONS

### 5.1 Construction Activities

Construction activities should be performed in accordance with the current IDOT Standard Specifications for Road and Bridge Construction and any pertinent Special Provisions or Policies.

Should any design considerations assumed by KEG change, KEG should be contacted to determine if the recommendations stated in this report still apply.

### 5.2 Temporary Sheeting and Soil Retention

Temporary Shoring may be required at various stages of this project, due to the proposed staged-construction layout shown in the TS&L.

Therefore, a Temporary Soil Retention System is required to support the structure during construction. An Illinois-licensed Structural Engineer is required to design and seal the design of the Temporary Soil Retention System, if deemed necessary.

### 5.3 Cofferdams and Seal Coats

Cofferdams will be required at the proposed pier locations. The estimated water surface elevation is greater than 6 ft. above the bottom elevation of the substructure. Therefore, a Type 2 cofferdam will be required. All cofferdams are required to be dewatered. The foundation soils below the pier encasements are anticipated to be cohesive and sealcoats should not be required.

The contractor is required to retain an Illinois licensed structural engineer to design the cofferdams. Per the Bridge Manual, the plans and computations shall be submitted to the Bureau of Bridges and Structures for review and final approval prior to beginning any work on the structure.

### 5.4 Site and Soil Conditions

Provisions of the Standard Specifications should adequately address site and soil conditions.

## 6.0 COMPUTATIONS

Computations and analyses for specific circumstances, if any, are included as exhibits. Please refer to each section of the report for reference to the exhibit containing any such calculations or analysis used.

## 7.0 GEOTECHNICAL DATA

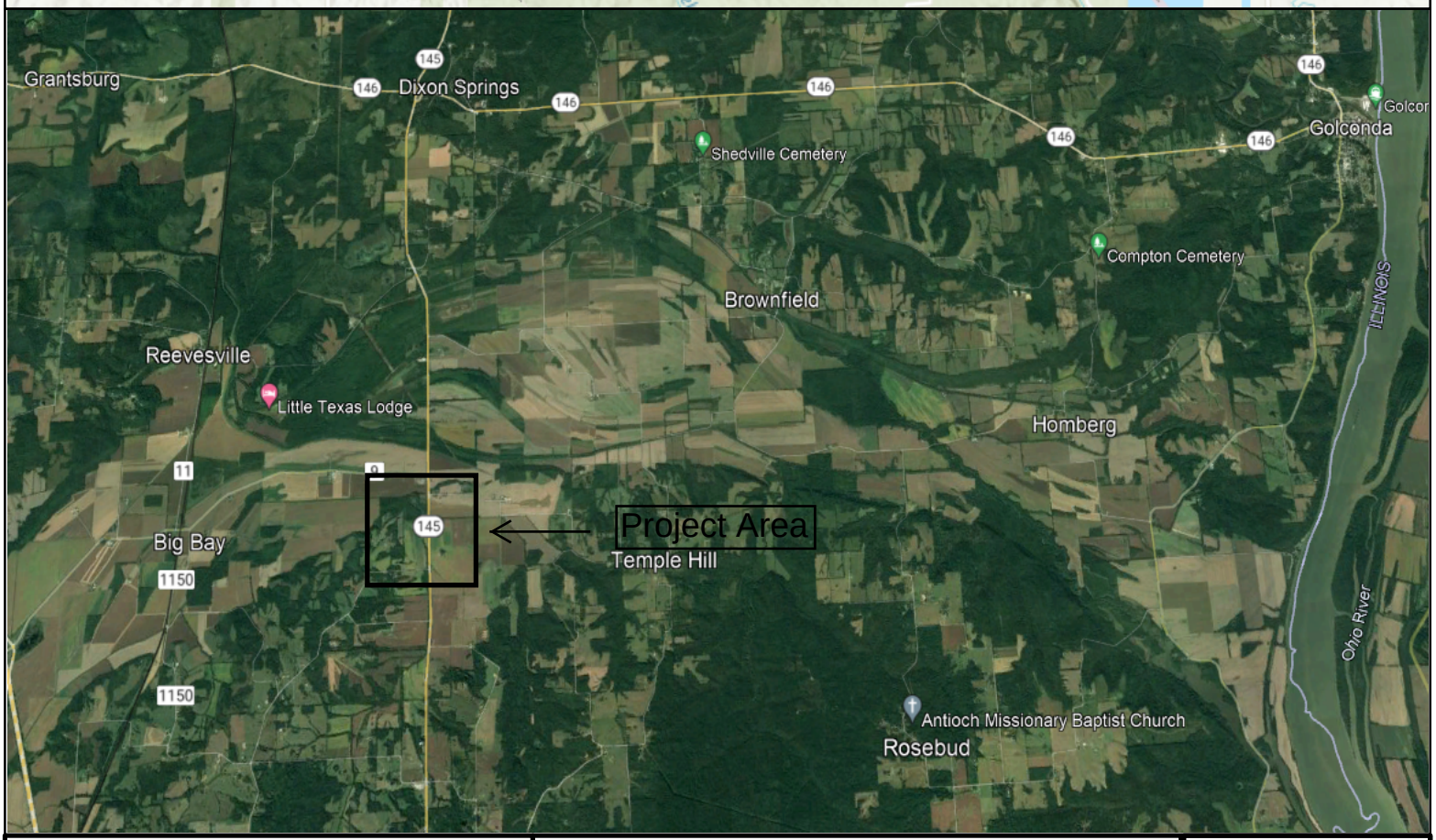
Soil boring logs can be found in Exhibit C. The Subsurface Profiles can be found in Exhibit D**.** Pile Design Tables can be found in Exhibit G.

## 8.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of CM&T and the Illinois Department of Transportation (IDOT) District 9. They are specific only to the project described and are based on the subsurface information obtained by IDOT at two boring locations within the structure areas, KEG's understanding of the project as described herein, and geotechnical engineering practice consistent with the standard of care. No other warranty is expressed or implied. KEG should be contacted if conditions encountered during construction are not consistent with those described.

# EXHIBIT A

# LOCATION MAP


Kaskaskia Engineering Group, LLC

**LOCATION MAP**

**IL 145 Over Bear Creek**
**Pope County, Illinois**

**Exhibit No.**

**A**

KEG JOB #19-1143.04

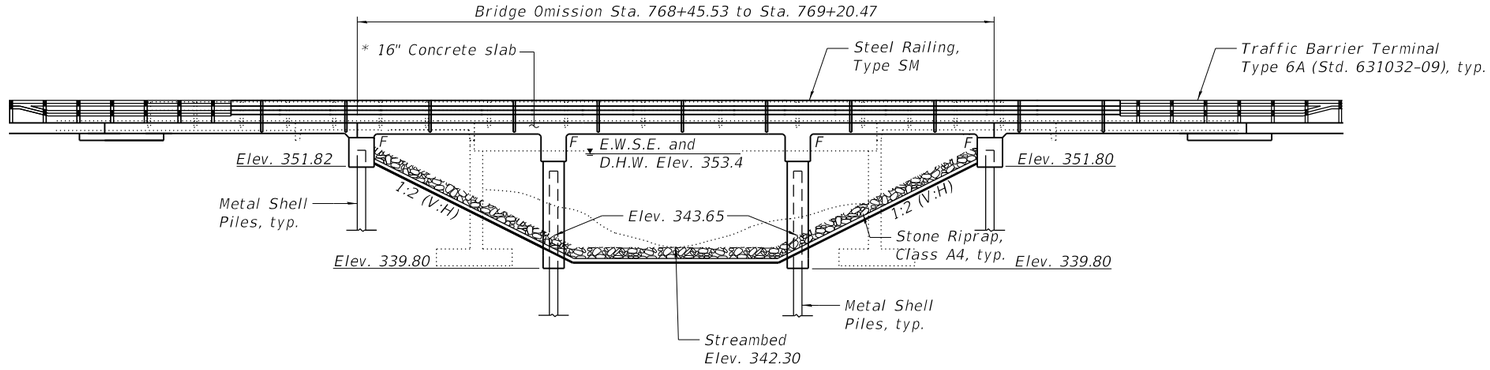
# EXHIBIT B

# TYPE, SIZE, AND LOCATION PLAN (TS&L)

Benchmark: Chisled "□" on top of wingwall of NE corner of Structure 076-0019 along IL Rt. 145, BM 808, Elevation = 354.765'

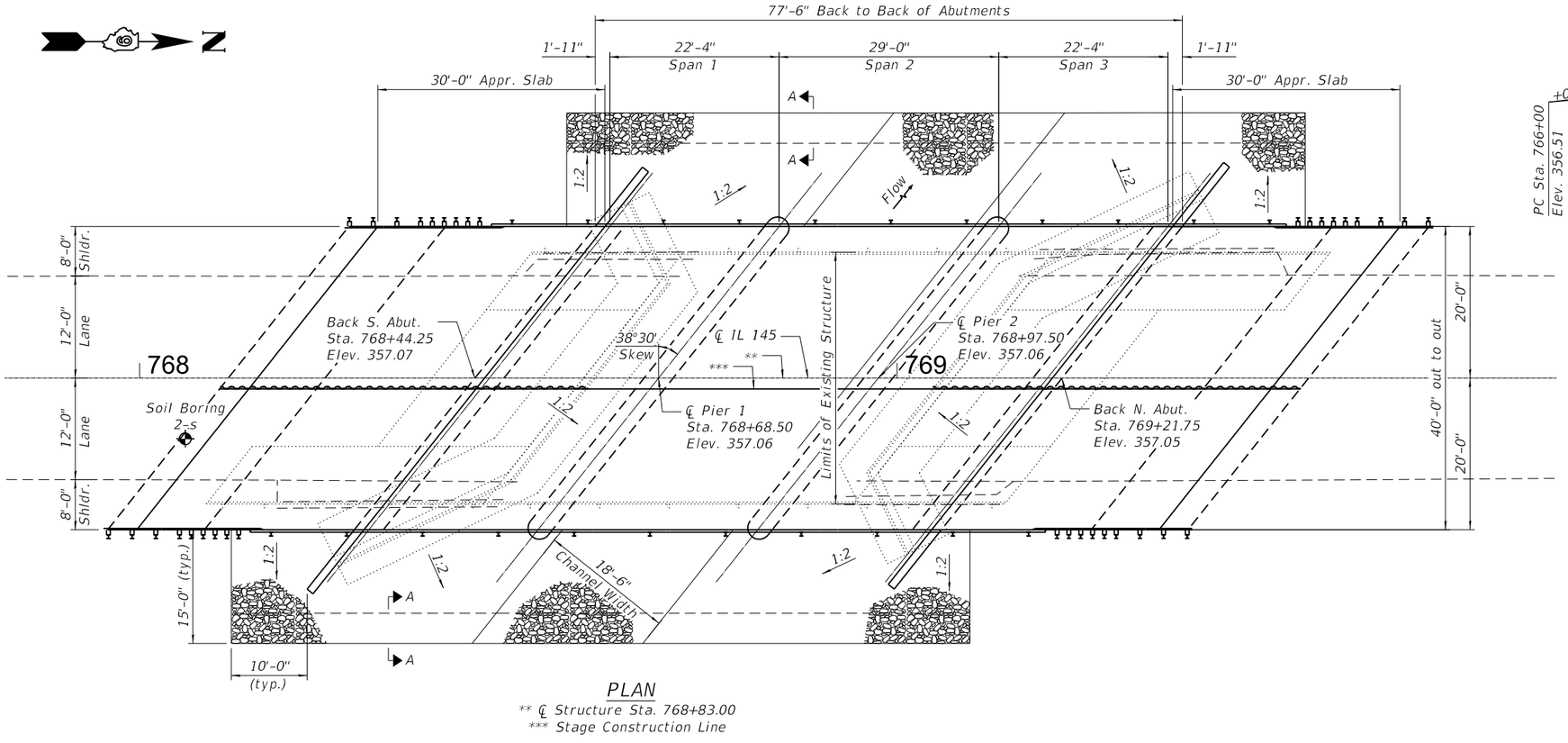
Existing Structure: SN 076-0019 was originally built in 1934 under Section 103-A. The structure is a single span bridge with closed abutments on untreated timber piles with an overall length of 48'-10" from back to back of abutments. The superstructure consists of a 7" thick slab supported on haunched reinforced concrete t-beams and P.P.C. deck beams. The width of the structure is 33'-2½" out-to-out of the deck. The structure is to be removed and replaced utilizing stage construction.

No Salvage.




ELEVATION

* Subject to refinement during final design




PLAN

** ℄ Structure Sta. 768+83.00

*** Stage Construction Line

## HIGHWAY CLASSIFICATION

F.A.P. 132 – IL Rt. 145
Functional Class: Minor Arterial
ADT: 2,000 (2019); 1974 (2032)
ADTT: 280 (2019); 277 (2032)
DHV: 180 (2032)
Speed: 55 mph (posted); 60 mph (design)
Two-Way traffic

## LOADING HL-93

Allow 50 #/sq. ft. for future wearing surface

## DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications 9th Edition

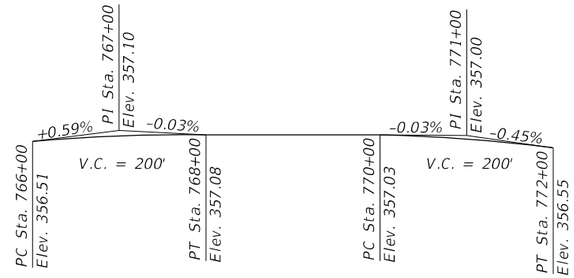
## DESIGN STRESSES

### FIELD UNITS

f'c = 5,000 psi (superstructure)
f'c = 3,500 psi (substructure)
fy = 60,000 psi (reinforcement)

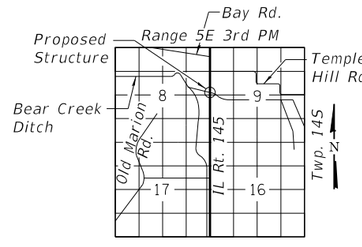
## SEISMIC DATA

Seismic Performance Zone (SPZ) = 3
Design Spectral Acceleration at 1.0 sec. (SD1) = 0.455g
Design Spectral Acceleration at 0.2 sec. (SDS) = 1.056g
Soil Site Class = D




PROFILE GRADE

Along ℄ IL 145




LOCATION SKETCH

# GENERAL PLAN
# IL 145 OVER BEAR CREEK DITCH
# F.A.P. RTE. 132 - 103A-BY
# POPE COUNTY
# STATION 768+83.00
# STRUCTURE NO. 076-0019

MODEL: Default
FILE NAME: L:\IDOT\1950610\WO_4\Drawl\Structures\001 - TSL IL 145 Over Bear Creek Ditch.dgn

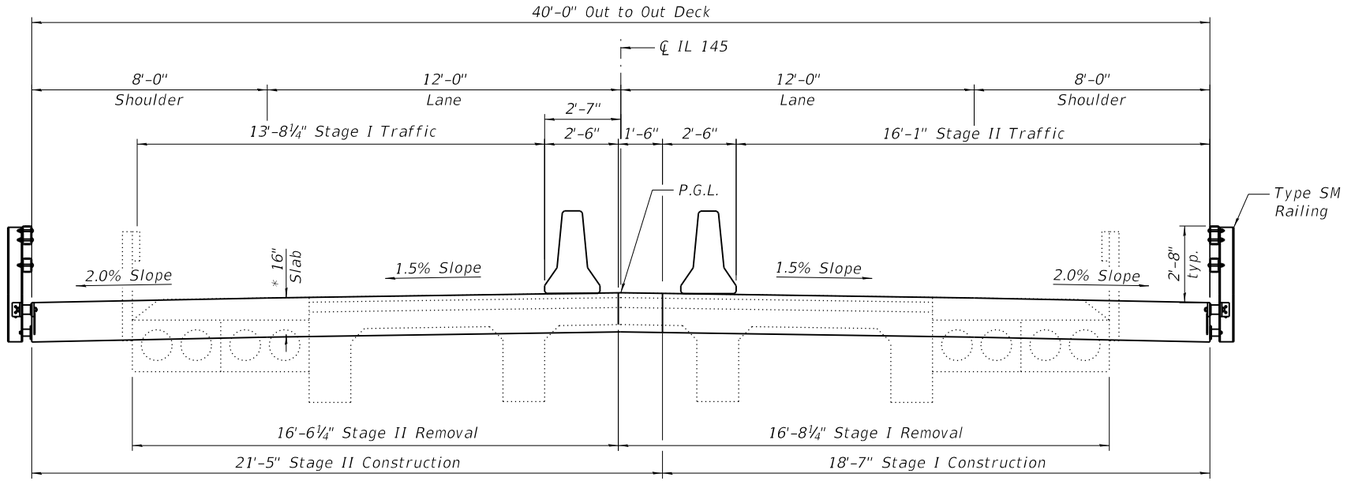
CMT
License No. 184-000613


| | | | |
|---|---|---|---|
| USER NAME = Derek Cochran | DESIGNED - DAC | REVISED - | |
| | CHECKED - ATI | REVISED - | |
| PLOT SCALE = N/A | DRAWN - DAC | REVISED - | |
| PLOT DATE = 5/10/2022 (10:16:04 AM) | CHECKED - ATI | REVISED - | |

**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

**GENERAL PLAN AND ELEVATION**
**S.N. 076-0019**
SHEET 1 OF 2 SHEETS

| F.A.P. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
|---|---|---|---|---|
| 132 | | POPE | | |
| | | CONTRACT NO. | | |
| | | ILLINOIS | FED. AID PROJECT | |




## CROSS SECTION

*(Looking North)*

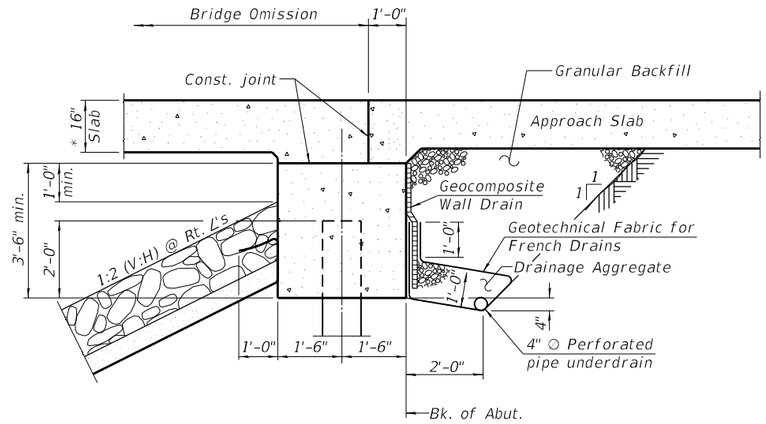
** Subject to refinement during final design*

## WATERWAY INFORMATION

| Drainage Area = 4.5 Sq. Mi. | | Existing Overtopping Elevation = 355.20 @ Sta. 762+90<br>Proposed Overtopping Elevation = 355.20 @ Sta. 762+90 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Flood | Freq. Yr. | Q C.F.S. | Opening Sq. Ft. | | Nat. H.W.E. | Head - Ft. | | Headwater El. | |
| | | | Exist. | Prop. | | Exist. | Prop. | Exist. | Prop. |
| | 10 | 832 | 254 | 263 | 352.4 | 0.5 | 0.4 | 352.9 | 352.8 |
| Design | 50 | 1288 | 284 | 310 | 353.4 | 0.3 | 0.2 | 353.7 | 353.6 |
| Base | 100 | 1488 | 284 | 320 | 353.6 | 0.4 | 0.3 | 354.0 | 353.9 |
| Scour Design Check | 200 | 1711 | 284 | 345 | 354.1 | 0.7 | 0.4 | 354.8 | 354.5 |
| Max. Calc. | 500 | 2016 | 284 | 354 | 354.3 | 0.7 | 0.3 | 355.0 | 354.6 |

## DESIGN SCOUR ELEVATION TABLE

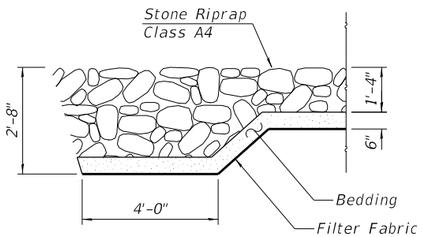
| Event / Limit State | Design Scour Elevations (ft.) | | | | Item 113 |
|---|---|---|---|---|---|
| | S. Abut. | Pier 1 | Pier 2 | N. Abut. | |
| Q200 | 351.82 | 329.30 | 329.30 | 351.80 | |
| Design | 351.82 | 331.30 | 331.30 | 351.80 | 5 |
| Check | 351.82 | 331.30 | 331.30 | 351.80 | |



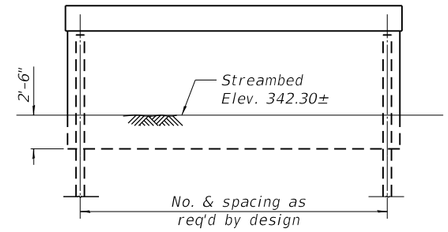

## SECTION THRU INTEGRAL ABUTMENT

*(Horiz. dim. @ Rt. ℄'s)*

** Subject to refinement during the final design*




## SECTION A-A




## PIER SKETCH

## GENERAL PLAN
## IL 145 OVER BEAR CREEK DITCH
## F.A.P. RTE. 132 - 103A-BY
## POPE COUNTY
## STATION 768+83.00
## STRUCTURE NO. 076-0019

MODEL: Default
FILE NAME: L:\DOT\1906810WO_4\Drawn\Structures\002 - TSL IL 145 Over Bear Creek Ditch.dgn

CMT
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| | | | |
|---|---|---|---|
| USER NAME = Derek Cochran | DESIGNED - DAC | REVISED - | |
| | CHECKED - ATI | REVISED - | |
| PLOT SCALE = N/A | DRAWN - DAC | REVISED - | |
| PLOT DATE = 5/10/2022 (10:14:46 AM) | CHECKED - ATI | REVISED - | |

**STATE OF ILLINOIS**
**DEPARTMENT OF TRANSPORTATION**

**STRUCTURE DETAILS**
**S.N. 076-0019**
SHEET 2 OF 2 SHEETS

| F.A.P. RTE. | SECTION | COUNTY | TOTAL SHEETS | SHEET NO. |
|---|---|---|---|---|
| 132 | | POPE | | |
| | | CONTRACT NO. | | |
| | | ILLINOIS FED. AID PROJECT | | |

# EXHBIT C

# BORING LOGS

**Illinois Department of Transportation**
Division of Highways

# SOIL BORING LOG



Date 11/1/19

**ROUTE** IL 145 **DESCRIPTION** Structure over Bear Creek Ditch **LOGGED BY** L. Estel

**SECTION** _____ **LOCATION** 0.6 Miles N of Massac Co. Line (S. Abut.)

**COUNTY** Pope **DRILLING METHOD** HSA **HAMMER TYPE** Auto

**STRUCT. NO.** 076-0019
**Station** 768+83

**BORING NO.** 1-S
**Station** 768+32
**Offset** 6.0 ft LT
**Ground Surface Elev.** 356.90 ft

**Surface Water Elev.** 345.20 ft
**Stream Bed Elev.** 342.80 ft

**Groundwater Elev.:**
**First Encounter** 309.9 ft ▼
**Upon Completion** _____ ft
**After** _____ **Hrs.** _____ ft

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | | | | PAVEMENT-Asphalt (7") over Concrete (7") |
| 355.7 | | | | |
| | | | | CLAY-Gray, Stiff, Moist |
| | 1 | | | |
| | 3<br>3 | 1.0<br>B | 25 | |
| -5 | 1 | | | |
| | 2<br>3 | 1.0<br>B | 24 | |
| 349.9 | | | | |
| | WH | | | CLAY-Gray, Medium-Stiff, Moist |
| | 1<br>2 | 0.8<br>B | 34 | |
| -10 | 1 | | | |
| | 2<br>2 | 0.7<br>B | 25 | |
| 344.9 | | | | |
| | 1 | | | CLAY-Brownish-Gray w/ Brown Specks, Very Stiff, Moist |
| | 3<br>4 | 2.3<br>B | 22 | |
| -15 | 1 | | | |
| | 3<br>4 | 2.0<br>B | 22 | |
| 339.9 | | | | |
| | WH | | | CLAY-Brown w/ Gray Specks, Stiff, Moist |
| | 2<br>3 | 1.2<br>B | 24 | |
| 337.4 | | | | |
| -20 | 2 | | | |
| | 5<br>5 | 2.7<br>B | 27 | CLAY-Brown w/ Gray Specks, Very Stiff, Moist *(continued)* |
| | 1 | | | |
| | 3<br>4 | 2.9<br>B | 27 | |
| 332.4 | | | | |
| -25 | 1 | | | CLAY-Gray, Stiff, Moist |
| | 2<br>4 | 1.5<br>B | 26 | |
| | 1 | | | Becomes Brownish-Gray |
| | 2<br>3 | 1.9<br>B | 27 | |
| 327.4 | | | | |
| -30 | 1 | | | CLAY-Brownish-Gray, Very Stiff, Moist |
| | 3<br>3 | 2.1<br>B | 28 | |
| 324.9 | | | | |
| | 1 | | | CLAY-Brownish-Gray, Stiff, Moist, w/ SILTY LOAM Seam, wet |
| | 2<br>3 | 1.7<br>B | 24 | |
| 322.4 | | | | |
| -35 | 1 | | | CLAY-Brownish-Gray, Medium-Stiff, Moist |
| | 2<br>3 | 1.0<br>B | 26 | |
| | 1 | | | |
| | 3<br>3 | 0.8<br>B | 25 | |
| 317.4 | | | | |
| -40 | WH | | | CLAY-Brownish-Gray, Soft, Moist |

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)**

**Illinois Department of Transportation**
Division of Highways

# SOIL BORING LOG

**Date** 11/1/19

**ROUTE** IL 145 **DESCRIPTION** Structure over Bear Creek Ditch **LOGGED BY** L. Estel

**SECTION** _____ **LOCATION** 0.6 Miles N of Massac Co. Line (S. Abut.)

**COUNTY** Pope **DRILLING METHOD** HSA **HAMMER TYPE** Auto

**STRUCT. NO.** 076-0019
**Station** 768+83

**BORING NO.** 1-S
**Station** 768+32
**Offset** 6.0 ft LT
**Ground Surface Elev.** 356.90 ft

**Surface Water Elev.** 345.20 ft
**Stream Bed Elev.** 342.80 ft

**Groundwater Elev.:**
**First Encounter** 309.9 ft ▼
**Upon Completion** _____ ft
**After** _____ **Hrs.** _____ ft

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | WH | 0.4 | 31 | CLAY-Brownish-Gray, Soft, Moist *(continued)* |
| | 1 | B | | |
| 312.9 | | | | |
| | WH | | | CLAY-Brownish-Gray, Medium Stiff, Moist |
| -45 | 1 | 0.8 | 25 | |
| | 1 | B | | |
| ▼ | | | | |
| 307.9 | | | | |
| | 1 | | | CLAY-Brownish-Gray, Stiff, Moist |
| -50 | 3 | 1.6 | 26 | |
| | 4 | B | | |
| 302.9 | | | | |
| | WH | | | CLAY-Brownish-Gray, Soft, Moist |
| -55 | WH | 0.3 | 33 | |
| | 1 | B | | |
| 297.9 | | | | |
| | 1 | | | CLAY-Brownish-Gray, Stiff, Moist |
| -60 | 3 | 1.2 | 22 | |

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | 5 | B | | CLAY-Brownish-Gray, Stiff, Moist *(continued)* |
| 292.9 | | | | |
| | 1 | | | CLAY LOAM-Brownish-Gray, Stiff, Moist |
| -65 | 2 | 1.2 | 24 | |
| | 4 | B | | |
| 287.9 | | | | |
| | WH | | | CLAY LOAM-Gray, Medium-Stiff, Wet |
| -70 | WH | 0.8 | 22 | |
| | 1 | B | | |
| | WH | | | |
| -75 | WH | 0.5 | - | |
| | 1 | P | | |
| 277.9 | | | | |
| | 2 | | | CLAY-Gray, Stiff, Moist |
| -80 | 3 | 1.7 | 22 | |

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)**

**Illinois Department of Transportation**
Division of Highways

# SOIL BORING LOG

**Date** 11/1/19

**ROUTE** IL 145 **DESCRIPTION** Structure over Bear Creek Ditch **LOGGED BY** L. Estel

**SECTION** _____ **LOCATION** 0.6 Miles N of Massac Co. Line (S. Abut.)

**COUNTY** Pope **DRILLING METHOD** HSA **HAMMER TYPE** Auto

**STRUCT. NO.** 076-0019
**Station** 768+83

**BORING NO.** 1-S
**Station** 768+32
**Offset** 6.0 ft LT
**Ground Surface Elev.** 356.90 ft

**Surface Water Elev.** 345.20 ft
**Stream Bed Elev.** 342.80 ft

**Groundwater Elev.:**
**First Encounter** 309.9 ft ▼
**Upon Completion** _____ ft
**After** _____ **Hrs.** _____ ft

| | DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) |
|---|---|---|---|---|
| CLAY-Gray, Stiff, Moist *(continued)* | | 3 | B | |
| | -85 | | | |
| | 267.9 | | | |
| NO RECOVERY. Possibly SAND | | 8 | | |
| (Medium-Dense) | -90 | 8<br>15 | - | - |
| | -95 | | | |
| | 257.9 | | | |
| NO RECOVERY-Possibly SAND | 257.4 | 8/6" | | |
| (Medium-Dense) | -100 | 100/0" | | |

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)**

Illinois Department of Transportation
Division of Highways

# ROCK CORE LOG

Date 11/1/19

**ROUTE** IL 145 **DESCRIPTION** Structure over Bear Creek Ditch **LOGGED BY** L. Estel

**SECTION** _____ **LOCATION** 0.6 Miles N of Massac Co. Line (S. Abut.)

**COUNTY** Pope **CORING METHOD** Conventional Rotary Wash

**STRUCT. NO.** 076-0019
**Station** 768+83

**BORING NO.** 1-S
**Station** 768+32
**Offset** 6.0 ft LT
**Ground Surface Elev.** 356.90 ft

**CORING BARREL TYPE & SIZE** NV3 5FT NWJ
**Core Diameter** 2 in
**Top of Rock Elev.** 99.50 ft
**Begin Core Elev.** 257.40 ft

| | | DEPTH (ft) | CORE (#) | RECOVERY (%) | R.Q.D. (%) | CORE TIME (min/ft) | STRENGTH (tsf) |
|---|---|---|---|---|---|---|---|
| SANDSTONE-Greenish-Blue, Hard, Fine-Grained, Dry | 257.40 | -100 | 1 | 80 | 7 | 2 | 929.6 |
| | 251.70 | -105 | 2 | 100 | 55 | 3 | 818.3 |
| SANDSTONE-Light Gray, Hard, Fine-Grained, Dry | 249.10 | | | | | | |
| LIMESTONE-White to Light Gray, Hard, Fine-Grained, Dry | 247.40 | | | | | | 936.3 / 859.2 |
| End of Boring | | -110 / -115 | | | | | |

**Color pictures of the cores** _____
**Cores will be stored for examination until** _____
**The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)**

# Illinois Department of Transportation
# District Nine Materials
# Unconfined Compressive Strength

## IL 145
## Structure 076-0019 (Boring 1-S)
## Pope County


| Boring # | Specimen# | Depth | Unconfined Compression |
|---|---|---|---|
| 1-S | 1 | 108’ 6” | 11,934 psi |
| 1-S | 2 | 107’ 6” | 13,004 psi |
| 1-S | 3 | 104’ 11” | 11,365 psi |
| 1-S | 4 | 102’ 6” | 12,911 psi |

Foundation Core Instructions
Use 1.78" for the diameter
3.8" is the length

$$\frac{\pi d^2}{4} = 2.487$$

Pounds divided by 2.487 = psi

**Illinois Department of Transportation**
Division of Highways

# SOIL BORING LOG

**Date** 11/14/19

**ROUTE** IL 145 **DESCRIPTION** Structure over Bear Creek Ditch **LOGGED BY** L. Estel

**SECTION** _____ **LOCATION** 0.6 Miles N of Massac Co. Line (N. Abut.)

**COUNTY** Pope **DRILLING METHOD** HSA **HAMMER TYPE** Auto

**STRUCT. NO.** 076-0019
**Station** 768+83

**BORING NO.** 2-S
**Station** 769+34
**Offset** 8.0 ft RT
**Ground Surface Elev.** 356.80 ft

**Surface Water Elev.** 345.20 ft
**Stream Bed Elev.** 342.80 ft

**Groundwater Elev.:**
**First Encounter** 320.8 ft ▼
**Upon Completion** _____ ft
**After** _____ **Hrs.** _____ ft

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | | | | 355.6 |
| | | | | PAVEMENT-Asphalt (5.25") and Concrete (9") |
| | WH | | | SILTY CLAY-Brown, Soft, Moist |
| | WH | 0.2 B | 27 | |
| | WH | | | |
| | | | | 352.3 |
| -5 | 1 | | | CLAY-Brown, Very Stiff, Moist |
| | 3 | 2.7 B | 21 | |
| | 5 | | | |
| | 1 | | | |
| | 2 | 2.1 B | 22 | |
| | 3 | | | |
| | | | | 347.3 |
| -10 | WH | | | CLAY-Gray with Brown Specks, Very Stiff, Moist |
| | 1 | 1.3 B | 23 | |
| | 3 | | | |
| | | | | 344.8 |
| | 1 | | | CLAY-Gray and Mottled Brown, Very Stiff, Moist |
| | 3 | 3.1 B | 21 | |
| | 5 | | | |
| | | | | Becomes Gray and Mottled Black |
| -15 | 1 | | | |
| | 3 | 2.1 B | 23 | |
| | 4 | | | |
| | 1 | | | |
| | 5 | 3.3 B | 23 | |
| | 7 | | | |
| | | | | 337.3 |
| -20 | 1 | | | |

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | 3 | 1.5 B | 26 | CLAY-Gray and Mottled Black, Stiff, Moist *(continued)* |
| | 5 | | | |
| | | | | 334.8 |
| | 2 | | | CLAY-Brown, Very Stiff, Moist |
| | 5 | 2.9 B | 25 | |
| | 7 | | | |
| | | | | 332.3 |
| -25 | 1 | | | CLAY-Brownish-Gray, Medium-Stiff, Moist |
| | 2 | 0.8 B | 32 | |
| | 3 | | | |
| | | | | 329.8 |
| | WH | | | CLAY-Brownish-Gray, Stiff, Moist |
| | WH | 1.8 B | 25 | |
| | 2 | | | |
| -30 | 1 | | | |
| | 2 | 1.5 B | 24 | |
| | 3 | | | |
| | 1 | | | |
| | 2 | 1.0 B | 23 | |
| | 2 | | | |
| | | | | 321.8 |
| -35 | 1 | | | SILTY LOAM-Gray, Medium-Stiff, Wet |
| | 2 | 1.0 B | 23 | |
| | 3 | | | 320.8 ▼ |
| | | | | SAND-4%, SILT-77%, CLAY-19% LL=24% PL=7% |
| | WH | | | |
| | WH | 0.6 B | 27 | CLAY-Brownish-Gray, Medium-Stiff, Moist |
| | 2 | | | |
| | | | | 317.3 |
| -40 | 1 | | | CLAY-Brownish-Gray, Stiff, Moist |

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)**

**Illinois Department of Transportation**
Division of Highways

# SOIL BORING LOG

**Date** 11/14/19

**ROUTE** IL 145 **DESCRIPTION** Structure over Bear Creek Ditch **LOGGED BY** L. Estel

**SECTION** _____ **LOCATION** 0.6 Miles N of Massac Co. Line (N. Abut.)

**COUNTY** Pope **DRILLING METHOD** HSA **HAMMER TYPE** Auto

**STRUCT. NO.** 076-0019
**Station** 768+83

**BORING NO.** 2-S
**Station** 769+34
**Offset** 8.0 ft RT
**Ground Surface Elev.** 356.80 ft

**Surface Water Elev.** 345.20 ft
**Stream Bed Elev.** 342.80 ft

**Groundwater Elev.:**
**First Encounter** 320.8 ft ▼
**Upon Completion** _____ ft
**After** _____ **Hrs.** _____ ft

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | 2<br>3 | 1.2<br>B | 24 | CLAY-Brownish-Gray, Stiff, Moist *(continued)* |
| 312.8 | | | | |
| | 1 | | | CLAY-Brownish-Gray, Medium-Stiff, Moist |
| -45 | 3<br>3 | 0.8<br>B | 24 | |
| 307.8 | | | | |
| | 1 | | | CLAY-Brownish-Gray, Stiff, Moist |
| -50 | 3<br>4 | 1.5<br>B | 25 | |
| | 1 | | | |
| -55 | 3<br>5 | 1.7<br>B | 27 | |
| 297.8 | | | | |
| | 1 | | | CLAY-Brownish-Gray, Very Stiff, Moist |
| -60 | 4 | 2.9 | 18 | |

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | Description |
|---|---|---|---|---|
| | 5 | B | | CLAY-Brownish-Gray, Very Stiff, Moist *(continued)* |
| 292.8 | | | | |
| | 1 | | | CLAY-Gray, Stiff, Moist |
| -65 | 1<br>2 | 1.0<br>B | 25 | |
| 287.8 | | | | |
| | WH | | | CLAY-Dark Gray, Medium-Stiff, Moist |
| -70 | WH<br>WH | 0.8<br>B | 28 | |
| 282.8 | | | | |
| | WH | | | CLAY-Dark Gray, Stiff, Moist |
| -75 | 1<br>3 | 1.8<br>B | 21 | |
| 277.8 | | | | |
| | 1 | | | CLAY-Gray, Medium-Stiff, Very Moist |
| 276.8 -80 | 2 | 0.7 | 17 | |

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)**

**Illinois Department of Transportation**
Division of Highways

# SOIL BORING LOG

**Date** 11/14/19

**ROUTE** IL 145 **DESCRIPTION** Structure over Bear Creek Ditch **LOGGED BY** L. Estel

**SECTION** _____ **LOCATION** 0.6 Miles N of Massac Co. Line (N. Abut.)

**COUNTY** Pope **DRILLING METHOD** HSA **HAMMER TYPE** Auto

**STRUCT. NO.** 076-0019
**Station** 768+83

**BORING NO.** 2-S
**Station** 769+34
**Offset** 8.0 ft RT
**Ground Surface Elev.** 356.80 ft

**Surface Water Elev.** 345.20 ft
**Stream Bed Elev.** 342.80 ft

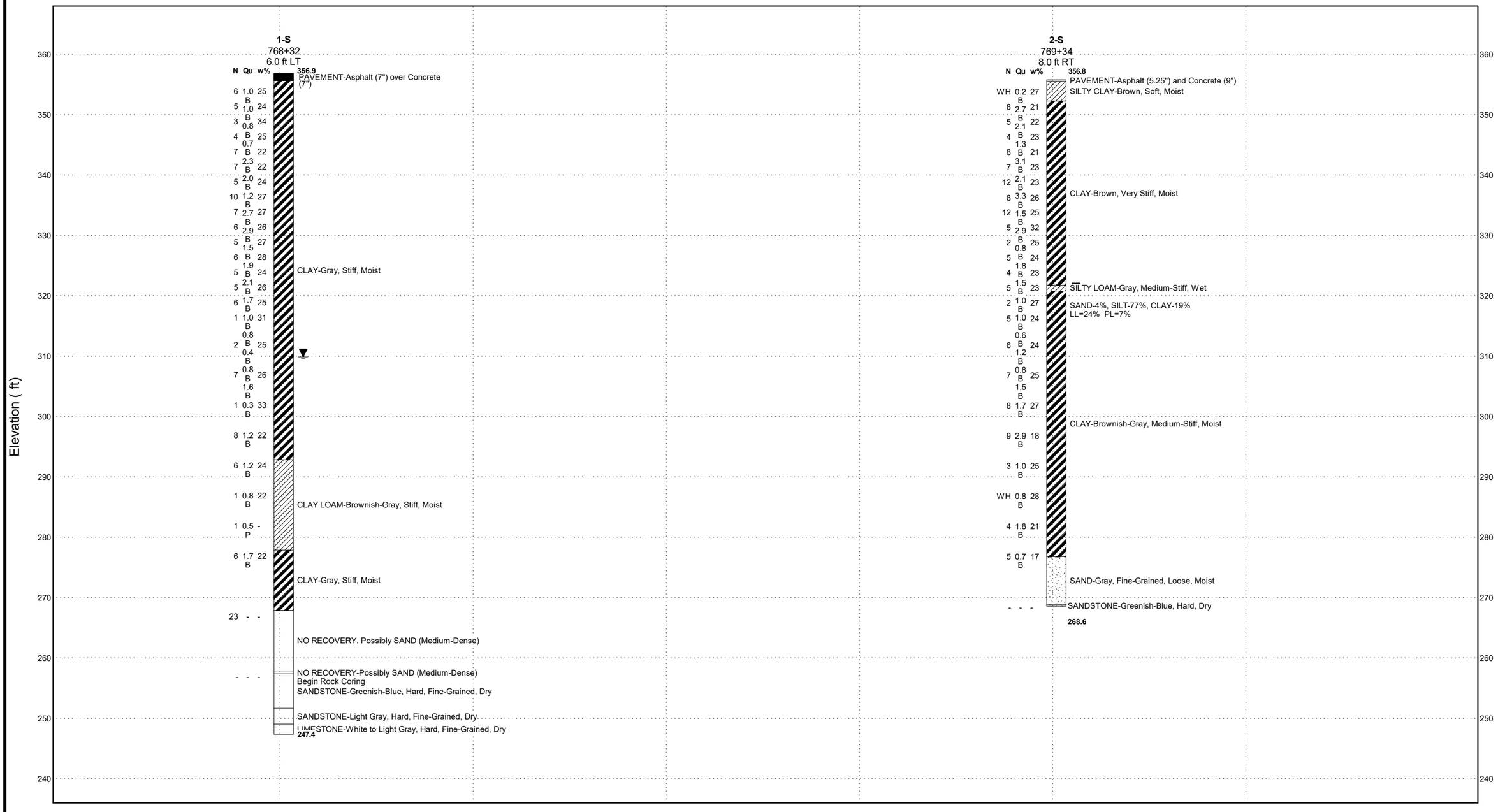
**Groundwater Elev.:**
**First Encounter** 320.8 ft ▼
**Upon Completion** _____ ft
**After** _____ **Hrs.** _____ ft

| DEPTH (ft) | BLOWS (/6") | UCS Qu (tsf) | MOIST (%) | |
|---|---|---|---|---|
| | 3 | B | | SAND-Gray, Fine-Grained, Loose, Moist |
| -85 | | | | |
| 268.9 | | | | |
| 268.6 | 100/3" | - | - | SANDSTONE-Greenish-Blue, HArd, Dry |
| | - | | | |
| | - | | | End of Boring |
| -90 | | | | |
| -95 | | | | |
| -100 | | | | |

**The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)**
**The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)**

# EXHIBIT D

# SUBSURFACE PROFILE




**Illinois Department of Transportation**
**Division of Highways**

**NOT TO HORIZONTAL SCALE**

## SUBSURFACE DATA PROFILE

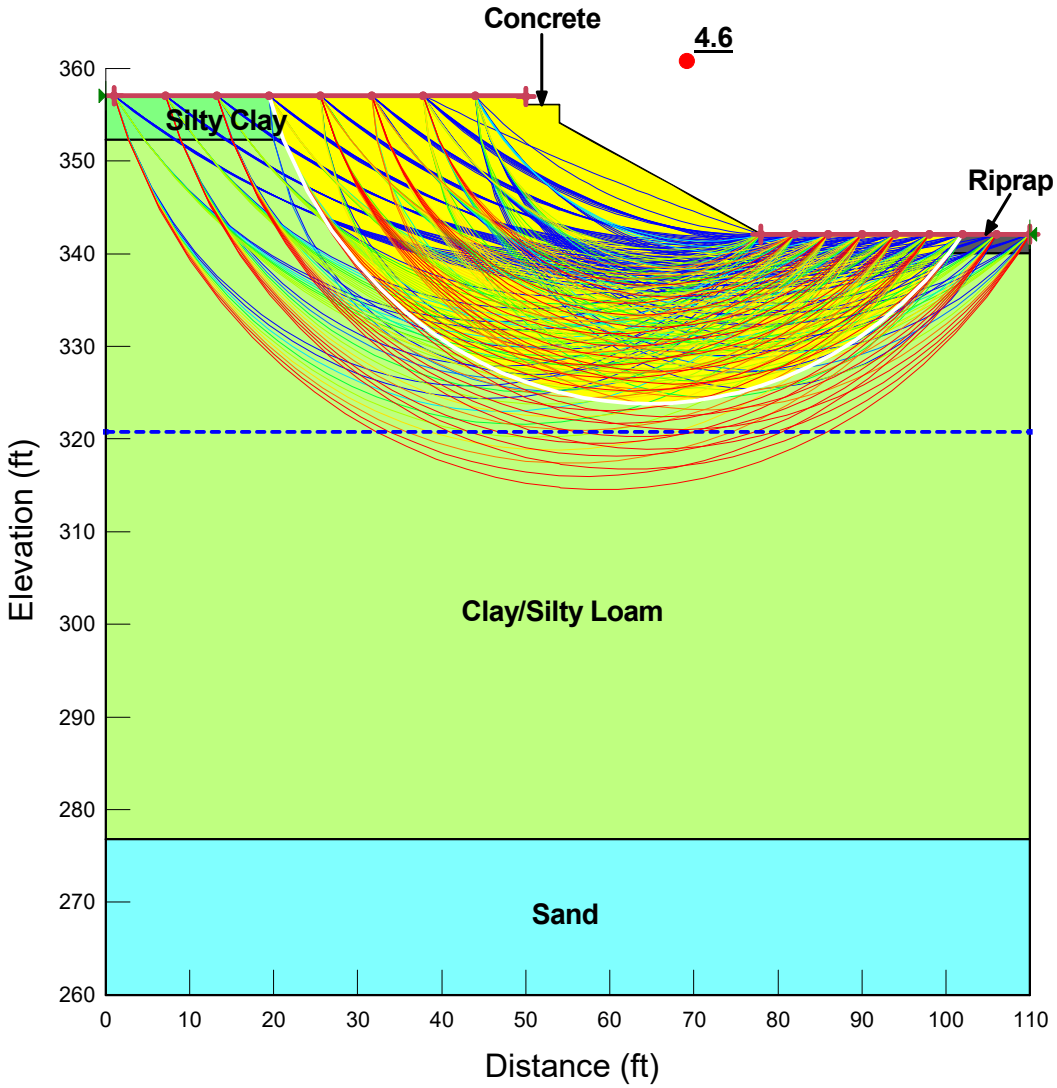
Route: IL 145 over Bear Creek
County: Pope

PRINTERMOD2 11X17 19-1143.04 STRUCTURE OVER BEAR CREEK.GPJ IL_DOT.GDT 4/14/22

# EXHIBIT E

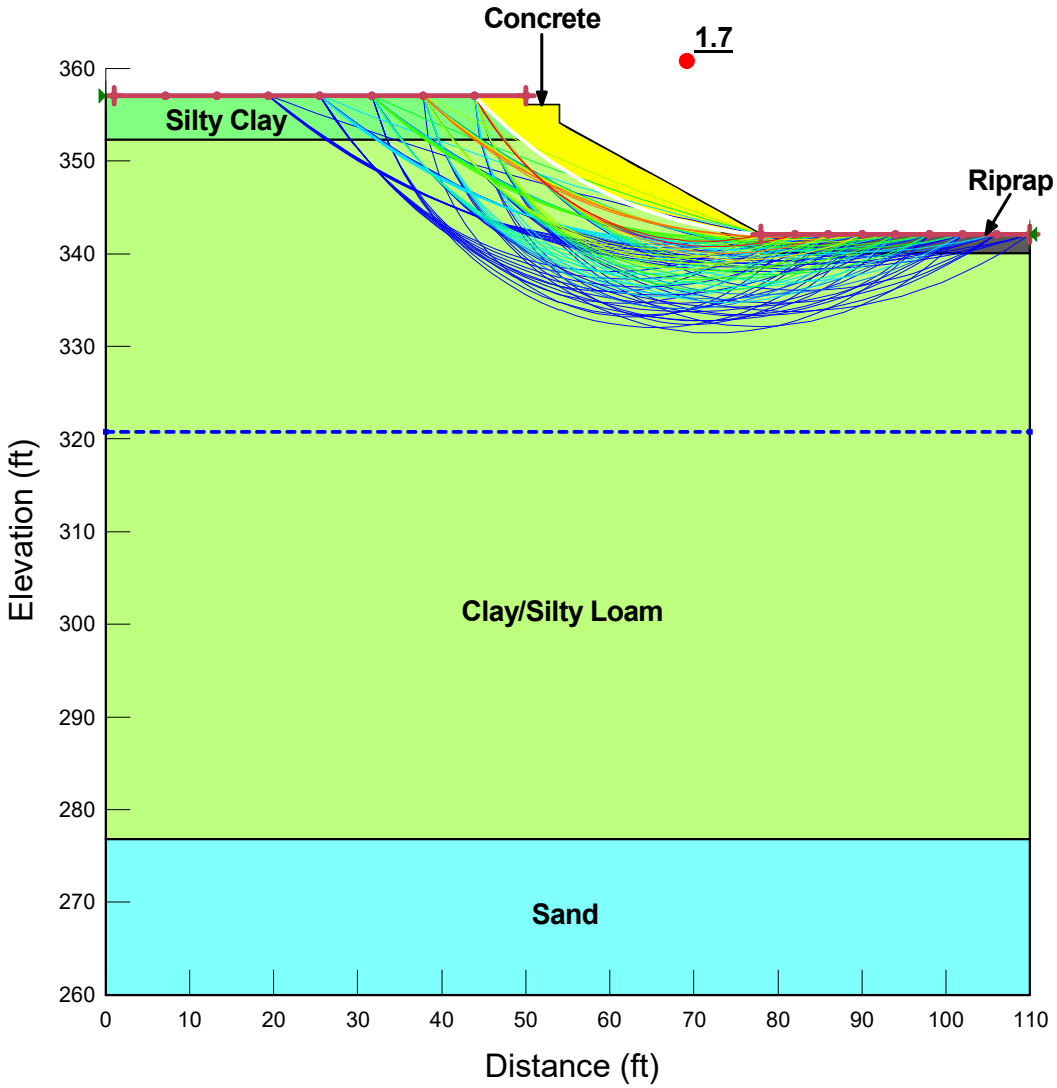
# SLOPE W SLOPE STABILITY ANALYSIS

# IL 145 over Bear Creek Ditch
# North Abutment (Boring 2-S)
# End-of-Construction (Undrained Analysis)



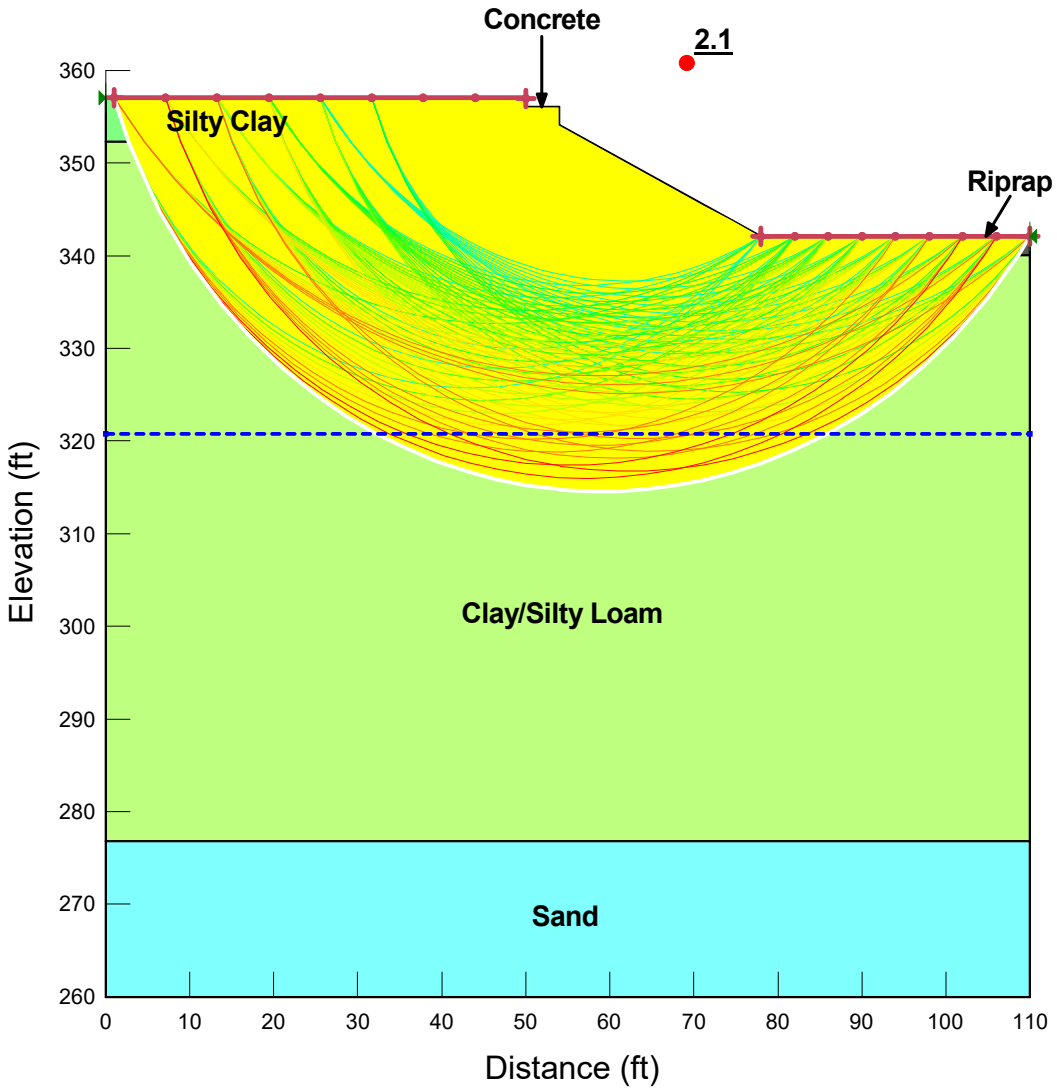

| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) |
|---|---|---|---|---|---|
| | Clay/Silty Loam | Mohr-Coulomb | 120 | 1,500 | 0 |
| | Concrete | Mohr-Coulomb | 150 | 5,000 | 45 |
| | Riprap | Mohr-Coulomb | 135 | 0 | 42 |
| | Sand | Mohr-Coulomb | 115 | 0 | 34 |
| | Silty Clay | Mohr-Coulomb | 120 | 200 | 0 |

# IL 145 over Bear Creek Ditch
# North Abutment (Boring 2-S)
# Long Term (Drained Analysis)



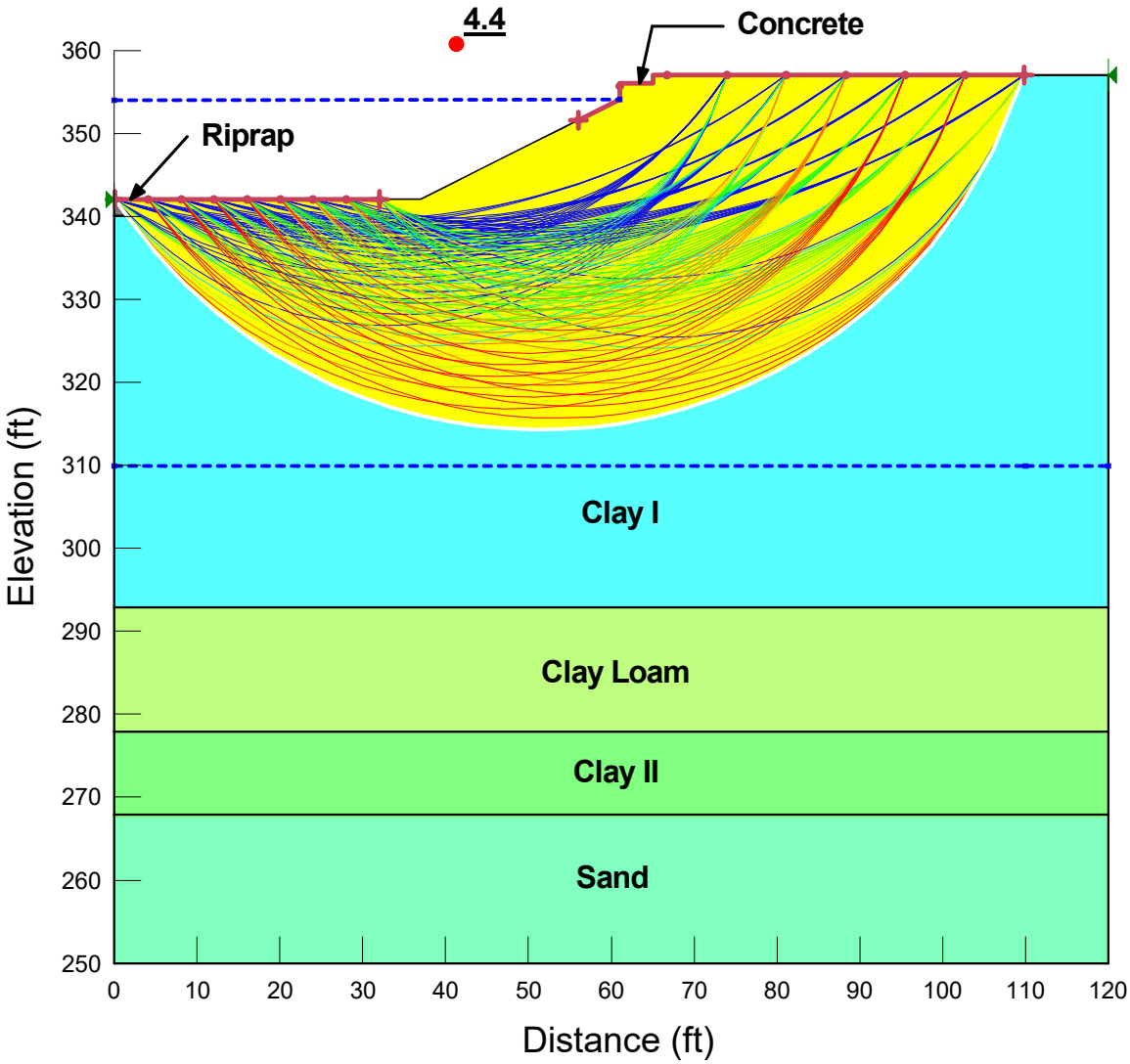

| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) |
|---|---|---|---|---|---|
| | Clay/Silty Loam | Mohr-Coulomb | 120 | 100 | 29 |
| | Concrete | Mohr-Coulomb | 150 | 5,000 | 45 |
| | Riprap | Mohr-Coulomb | 135 | 0 | 42 |
| | Sand | Mohr-Coulomb | 115 | 0 | 34 |
| | Silty Clay | Mohr-Coulomb | 120 | 50 | 28 |

# IL 145 over Bear Creek Ditch
# North Abutment (Boring 2-S)
# Seismic Analysis



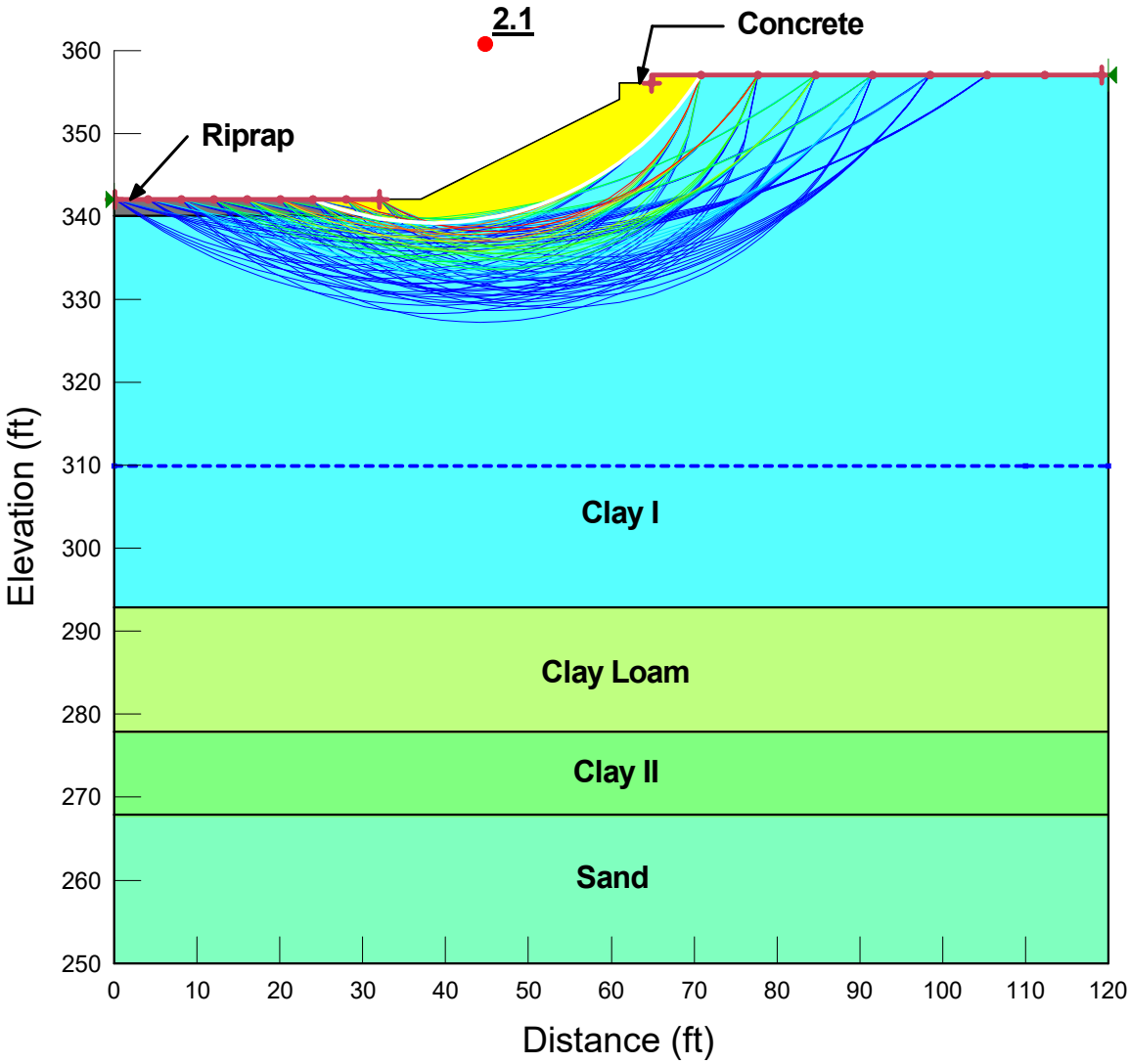

| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) |
|---|---|---|---|---|---|
| | Clay/Silty Loam | Mohr-Coulomb | 120 | 1,500 | 0 |
| | Concrete | Mohr-Coulomb | 150 | 5,000 | 45 |
| | Riprap | Mohr-Coulomb | 135 | 0 | 42 |
| | Sand | Mohr-Coulomb | 115 | 0 | 34 |
| | Silty Clay | Mohr-Coulomb | 120 | 200 | 0 |

# IL 145 over Bear Creek Ditch
# South Abutment (Boring 1-S)
# End-of-Construction (Undrained Analysis)



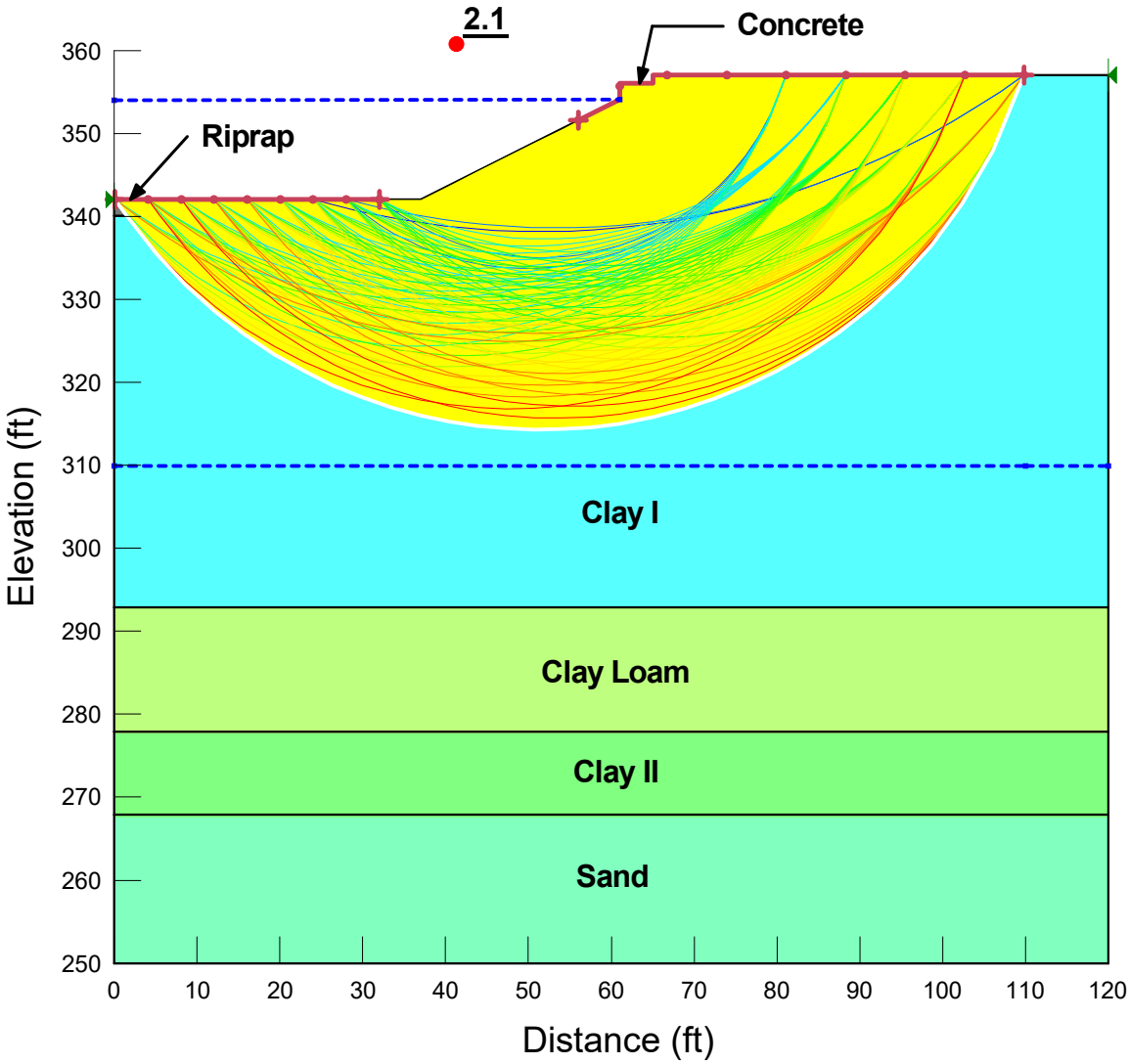

| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) |
|---|---|---|---|---|---|
| | Clay I | Mohr-Coulomb | 120 | 1,395 | 0 |
| | Clay II | Mohr-Coulomb | 120 | 1,700 | 0 |
| | Clay Loam | Mohr-Coulomb | 120 | 833 | 0 |
| | Concrete | Mohr-Coulomb | 150 | 5,000 | 45 |
| | Rip Rap | Mohr-Coulomb | 135 | 0 | 45 |
| | Sand | Mohr-Coulomb | 115 | 0 | 34 |

# IL 145 over Bear Creek Ditch
# South Abutment (Boring 1-S)
# Long Term (Drained Analysis)




| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) |
|---|---|---|---|---|---|
| | Clay I | Mohr-Coulomb | 120 | 100 | 29 |
| | Clay II | Mohr-Coulomb | 120 | 100 | 30 |
| | Clay Loam | Mohr-Coulomb | 120 | 50 | 28 |
| | Concrete | Mohr-Coulomb | 150 | 5,000 | 45 |
| | Rip Rap | Mohr-Coulomb | 135 | 0 | 42 |
| | Sand | Mohr-Coulomb | 115 | 0 | 34 |

# IL 145 over Bear Creek Ditch
# South Abutment (Boring 1-S)
# Seismic Analysis




| Color | Name | Slope Stability Material Model | Unit Weight (pcf) | Effective Cohesion (psf) | Effective Friction Angle (°) |
|---|---|---|---|---|---|
| | Clay I | Mohr-Coulomb | 120 | 1,395 | 0 |
| | Clay II | Mohr-Coulomb | 120 | 1,700 | 0 |
| | Clay Loam | Mohr-Coulomb | 120 | 833 | 0 |
| | Concrete | Mohr-Coulomb | 150 | 5,000 | 45 |
| | Rip Rap | Mohr-Coulomb | 135 | 0 | 45 |
| | Sand | Mohr-Coulomb | 115 | 0 | 34 |

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Project Title: IL 145 over Bean Cr Sheet: 1 of 1
Project Number: 19-1143.04
Calculated By: TG Date: 9/26/22
Checked By: MDM Date: 10/11/22
Comments:

Seismic Stability Analysis (Limit Equilibrium Pseudo-statics stability Method)

Height of Slope = 17ft

From Figure 6.3 and $\beta = 1.1 \rightarrow \quad \alpha = 0.88$

$K_{max} = F_{pga} * PGA$

$= 1 * 0.514$

$= 0.514$

$K_{AV} = \alpha K_{max}$

$= 0.88 \cdot 0.514$

$= 0.452$

$K_S = 0.5 K_{AV}$

$= 0.5(0.452)$

$= 0.226$

If the result FOS is at least 1.1, the slope meets seismic stability Requirements, using horizontal seismic load factor as $K_S$.

* Refer to Slope Stability Analysis

# EXHIBIT F

# LIQUEFACTION ANALYSIS

Illinois Department of Transportation

# LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 1-S
ELEVATION OF BORING GROUND SURFACE ========== 356.90 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 47.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 49.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.500
EARTHQUAKE MOMENT MAGNITUDE ========== 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 2.00 FT. (Fill Height)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

**EQ MAGNITUDE SCALING FACTOR**
(MSF) = **0.996**

**AVG. SHEAR WAVE VELOCITY (top 40')**
$\bar{V}_{s,40'}$ = **414** FT./SEC.

**PGA CALCULATOR**
Earthquake Moment Magnitude = 7.53
Source-To-Site Distance, R (km) = 32.51
Ground Motion Prediction Equations = NMSZ
*PGA* = **0.500**

| | BORING DATA | | | | | | | CONDITIONS DURING DRILLING | | | | | CONDITIONS DURING EARTHQUAKE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV. OF SAMPLE (FT.) | BORING SAMPLE DEPTH (FT.) | SPT N VALUE (BLOWS) | UNCONF. COMPR. STR., $Q_u$ (TSF.) | % FINES < #200 (%) | PLAST. INDEX PI | LIQUID LIMIT LL | MOIST. CONTENT $w_c$ (%) | EFFECTIVE UNIT WT. (KCF.) | EFFECTIVE VERT. STRESS (KSF.) | CORR. SPT N VALUE $(N_1)_{60}$ | EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$ | CRR RESIST. MAG 7.5 $CRR_{7.5}$ | EFFECTIVE UNIT WT. (KCF.) | EFFECTIVE VERT. STRESS (KSF.) | TOTAL VERT. STRESS (KSF.) | OVER-BURDEN CORR. FACT. (Ks) | CORR. RESIST. $CRR_{7.5}$ CRR | SOIL MASS PART. FACTOR $(r_d)$ | EQ INDUCED CSR | FACTOR OF SAFETY * CRR/CSR |
| 353.4 | 3.5 | 6 | 1 | 85 | | | 25 | 0.122 | 0.427 | 9.454 | 16.345 | 0.174 | 0.122 | 0.667 | 0.667 | 1.368 | **0.237** | 0.931 | **0.303** | **N.L. (1)** |
| 350.9 | 6 | 5 | 1 | 85 | | | 24 | 0.122 | 0.732 | 7.145 | 13.574 | 0.146 | 0.122 | 0.972 | 0.972 | 1.219 | **0.177** | 0.892 | **0.290** | **N.L. (1)** |
| 348.4 | 8.5 | 3 | 0.8 | 85 | | | 34 | 0.119 | 1.030 | 4.092 | 9.911 | 0.112 | 0.119 | 1.270 | 1.270 | 1.126 | **0.126** | 0.850 | **0.276** | **N.L. (1)** |
| 345.9 | 11 | 4 | 0.7 | 85 | | | 25 | 0.117 | 1.322 | 5.390 | 11.468 | 0.126 | 0.117 | 1.562 | 1.562 | 1.076 | **0.135** | 0.805 | **0.262** | **N.L. (1)** |
| 343.4 | 13.5 | 7 | 2.3 | 85 | | | 22 | 0.132 | 1.652 | 9.106 | 15.927 | 0.170 | 0.132 | 1.892 | 1.892 | 1.031 | **0.174** | 0.759 | **0.247** | **N.L. (1)** |
| 340.9 | 16 | 7 | 2 | 85 | | | 22 | 0.130 | 1.977 | 8.734 | 15.481 | 0.165 | 0.130 | 2.217 | 2.217 | 0.988 | **0.162** | 0.713 | **0.232** | **N.L. (1)** |
| 338.4 | 18.5 | 5 | 1.2 | 85 | | | 24 | 0.124 | 2.287 | 5.975 | 12.170 | 0.133 | 0.124 | 2.527 | 2.527 | 0.958 | **0.127** | 0.669 | **0.217** | **N.L. (1)** |
| 335.9 | 21 | 10 | 2.7 | 85 | | | 27 | 0.134 | 2.622 | 11.359 | 18.630 | 0.199 | 0.134 | 2.862 | 2.862 | 0.918 | **0.182** | 0.627 | **0.204** | **N.L. (1)** |
| 333.4 | 23.5 | 7 | 2.9 | 85 | | | 27 | 0.134 | 2.957 | 7.553 | 14.064 | 0.151 | 0.134 | 3.197 | 3.197 | 0.900 | **0.135** | 0.590 | **0.192** | **N.L. (1)** |
| 330.9 | 26 | 6 | 1.5 | 85 | | | 26 | 0.126 | 3.272 | 6.174 | 12.409 | 0.135 | 0.126 | 3.512 | 3.512 | 0.883 | **0.119** | 0.557 | **0.181** | **N.L. (1)** |
| 328.4 | 28.5 | 5 | 1.9 | 85 | | | 27 | 0.129 | 3.595 | 4.905 | 10.886 | 0.121 | 0.129 | 3.835 | 3.835 | 0.869 | **0.105** | 0.529 | **0.172** | **N.L. (1)** |
| 325.9 | 31 | 6 | 2.1 | 85 | | | 28 | 0.130 | 3.920 | 5.616 | 11.739 | 0.129 | 0.130 | 4.160 | 4.160 | 0.849 | **0.109** | 0.505 | **0.164** | **N.L. (1)** |
| 323.4 | 33.5 | 5 | 1.7 | 85 | | | 24 | 0.128 | 4.240 | 4.477 | 10.372 | 0.116 | 0.128 | 4.480 | 4.480 | 0.840 | **0.097** | 0.485 | **0.158** | **N.L. (1)** |
| 320.9 | 36 | 5 | 1 | 85 | | | 26 | 0.122 | 4.545 | 4.299 | 10.158 | 0.115 | 0.122 | 4.785 | 4.785 | 0.828 | **0.094** | 0.469 | **0.152** | **N.L. (1)** |
| 318.4 | 38.5 | 6 | 0.8 | 85 | | | 25 | 0.119 | 4.842 | 4.966 | 10.959 | 0.122 | 0.119 | 5.082 | 5.082 | 0.812 | **0.099** | 0.456 | **0.148** | **N.L. (1)** |
| 315.9 | 41 | 1 | 0.4 | 85 | | | 31 | 0.111 | 5.120 | 0.800 | 5.960 | 0.079 | 0.111 | 5.360 | 5.360 | 0.826 | **0.065** | 0.446 | **0.145** | **N.L. (1)** |
| 311.4 | 45.5 | 2 | 0.8 | 85 | | | 25 | 0.119 | 5.655 | 1.503 | 6.804 | 0.086 | 0.119 | 5.895 | 5.895 | 0.805 | **0.069** | 0.432 | **0.141** | **N.L. (1)** |
| 306.4 | 50.5 | 7 | 1.6 | 85 | 17 | 24 | 26 | 0.065 | 5.980 | 5.084 | 11.101 | 0.123 | 0.065 | 6.220 | 6.438 | 0.774 | **0.095** | 0.423 | **0.142** | **N.L. (2)** |
| 301.4 | 55.5 | 1 | 0.3 | 85 | 17 | 24 | 33 | 0.046 | 6.210 | 0.710 | 5.851 | 0.079 | 0.046 | 6.450 | 6.980 | 0.796 | **0.062** | 0.417 | **0.147** | **N.L. (2)** |
| 296.4 | 60.5 | 8 | 1.2 | 85 | 17 | 24 | 22 | 0.061 | 6.515 | 5.495 | 11.594 | 0.127 | 0.061 | 6.755 | 7.597 | 0.756 | **0.096** | 0.414 | **0.151** | **N.L. (2)** |
| 291.4 | 65.5 | 6 | 1.2 | 65 | 17 | 24 | 24 | 0.061 | 6.820 | 3.989 | 9.787 | 0.111 | 0.061 | 7.060 | 8.214 | 0.758 | **0.084** | 0.405 | **0.153** | **N.L. (2)** |

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR $w_c$/LL $\leq$ 0.85
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

Illinois Department of Transportation

# LIQUEFACTION ANALYSIS

REFERENCE BORING NUMBER ========== 2-S
ELEVATION OF BORING GROUND SURFACE ========== 356.80 FT.
DEPTH TO GROUNDWATER - DURING DRILLING ========== 36.00 FT. (Below Boring Ground Surface)
DEPTH TO GROUNDWATER - DURING EARTHQUAKE ========== 38.00 FT. (Below Finished Grade Cut or Fill Surface)
PEAK HORIZ. GROUND SURFACE ACCELERATION COEFFICIENT (As) ===== 0.500
EARTHQUAKE MOMENT MAGNITUDE ========== 7.5
FINISHED GRADE FILL OR CUT FROM BORING SURFACE ========== 2.00 FT. (Fill Height)
HAMMER EFFICIENCY========== 73 %
BOREHOLE DIAMETER========== 2.5 to 4.5 IN.
SAMPLING METHOD========== Sampler w/out Liners

**EQ MAGNITUDE SCALING FACTOR**
(MSF) = **0.996**

**AVG. SHEAR WAVE VELOCITY (top 40')**
$\bar{V}_{s,40'}$ = **#DIV/0!** FT./SEC.

**PGA CALCULATOR**
Earthquake Moment Magnitude = 7.53
Source-To-Site Distance, R (km) = 32.51
Ground Motion Prediction Equations = NMSZ
*PGA* = **0.500**

| | BORING DATA | | | | | | | CONDITIONS DURING DRILLING | | | | | CONDITIONS DURING EARTHQUAKE | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ELEV. OF SAMPLE (FT.) | BORING SAMPLE DEPTH (FT.) | SPT N VALUE (BLOWS) | UNCONF. COMPR. STR., $Q_u$ (TSF.) | % FINES < #200 (%) | PLAST. INDEX PI | LIQUID LIMIT LL | MOIST. CONTENT $w_c$ (%) | EFFECTIVE UNIT WT. (KCF.) | EFFECTIVE VERT. STRESS (KSF.) | CORR. SPT N VALUE $(N_1)_{60}$ | EQUIV. CLN. SAND SPT N VALUE $(N_1)_{60cs}$ | CRR RESIST. MAG 7.5 $CRR_{7.5}$ | EFFECTIVE UNIT WT. (KCF.) | EFFECTIVE VERT. STRESS (KSF.) | TOTAL VERT. STRESS (KSF.) | OVER-BURDEN CORR. FACT. (Ks) | CORR. RESIST. $CRR_{7.5}$ CRR | SOIL MASS PART. FACTOR $(r_d)$ | EQ INDUCED CSR | FACTOR OF SAFETY * CRR/CSR |
| 353.3 | 3.5 | 0 | 0.2 | 85 | | | 27 | 0.104 | 0.364 | 0.000 | 5.000 | 0.072 | 0.104 | 0.604 | 0.604 | 1.286 | **0.092** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 350.8 | 6 | 8 | 2.7 | 85 | | | 21 | 0.134 | 0.699 | 11.707 | 19.048 | 0.204 | 0.134 | 0.939 | 0.939 | 1.264 | **0.257** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 348.3 | 8.5 | 5 | 2.1 | 85 | | | 22 | 0.130 | 1.024 | 6.831 | 13.198 | 0.142 | 0.130 | 1.264 | 1.264 | 1.139 | **0.162** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 345.8 | 11 | 4 | 1.3 | 85 | | | 23 | 0.125 | 1.337 | 5.370 | 11.444 | 0.126 | 0.125 | 1.577 | 1.577 | 1.074 | **0.135** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 343.3 | 13.5 | 8 | 3.1 | 85 | | | 21 | 0.135 | 1.674 | 10.352 | 17.423 | 0.185 | 0.135 | 1.914 | 1.914 | 1.029 | **0.190** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 340.8 | 16 | 7 | 2.1 | 85 | | | 23 | 0.130 | 1.999 | 8.692 | 15.430 | 0.164 | 0.130 | 2.239 | 2.239 | 0.986 | **0.161** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 338.3 | 18.5 | 12 | 3.3 | 85 | | | 23 | 0.136 | 2.339 | 14.376 | 22.251 | 0.246 | 0.136 | 2.579 | 2.579 | 0.941 | **0.230** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 335.8 | 21 | 8 | 1.5 | 85 | | | 26 | 0.126 | 2.654 | 9.031 | 15.837 | 0.169 | 0.126 | 2.894 | 2.894 | 0.920 | **0.155** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 333.3 | 23.5 | 12 | 2.9 | 85 | | | 25 | 0.134 | 2.989 | 12.887 | 20.465 | 0.221 | 0.134 | 3.229 | 3.229 | 0.883 | **0.195** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 330.8 | 26 | 5 | 0.8 | 85 | | | 32 | 0.119 | 3.287 | 5.132 | 11.159 | 0.123 | 0.119 | 3.527 | 3.527 | 0.886 | **0.109** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 328.3 | 28.5 | 2 | 1.8 | 85 | | | 25 | 0.128 | 3.607 | 1.958 | 7.350 | 0.091 | 0.128 | 3.847 | 3.847 | 0.880 | **0.079** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 325.8 | 31 | 5 | 1.5 | 85 | | | 24 | 0.126 | 3.922 | 4.679 | 10.614 | 0.119 | 0.126 | 4.162 | 4.162 | 0.853 | **0.101** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 323.3 | 33.5 | 4 | 1 | 85 | | | 23 | 0.122 | 4.227 | 3.588 | 9.306 | 0.107 | 0.122 | 4.467 | 4.467 | 0.844 | **0.090** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 320.8 | 36 | 5 | 1 | 85 | | | 23 | 0.122 | 4.532 | 4.307 | 10.168 | 0.115 | 0.122 | 4.772 | 4.772 | 0.828 | **0.095** | #DIV/0! | **#DIV/0!** | **N.L. (1)** |
| 318.3 | 38.5 | 2 | 0.6 | 85 | 17 | 24 | 27 | 0.053 | 4.664 | 1.696 | 7.036 | 0.088 | 0.053 | 4.904 | 5.060 | 0.836 | **0.073** | #DIV/0! | **#DIV/0!** | **N.L. (2)** |
| 315.8 | 41 | 5 | 1.2 | 85 | 17 | 24 | 24 | 0.061 | 4.817 | 4.165 | 9.998 | 0.113 | 0.061 | 5.057 | 5.369 | 0.818 | **0.092** | #DIV/0! | **#DIV/0!** | **N.L. (2)** |
| 311.3 | 45.5 | 6 | 0.8 | 85 | 17 | 24 | 24 | 0.057 | 5.073 | 4.854 | 10.825 | 0.120 | 0.057 | 5.313 | 5.906 | 0.805 | **0.097** | #DIV/0! | **#DIV/0!** | **N.L. (2)** |
| 306.3 | 50.5 | 7 | 1.5 | 85 | 17 | 24 | 25 | 0.064 | 5.393 | 5.460 | 11.552 | 0.127 | 0.064 | 5.633 | 6.538 | 0.790 | **0.100** | #DIV/0! | **#DIV/0!** | **N.L. (2)** |
| 301.3 | 55.5 | 8 | 1.7 | 85 | 17 | 24 | 27 | 0.065 | 5.718 | 6.014 | 12.217 | 0.133 | 0.065 | 5.958 | 7.175 | 0.776 | **0.103** | #DIV/0! | **#DIV/0!** | **N.L. (2)** |
| 296.3 | 60.5 | 9 | 2.9 | 85 | 17 | 24 | 18 | 0.072 | 6.078 | 6.495 | 12.794 | 0.139 | 0.072 | 6.318 | 7.847 | 0.762 | **0.105** | #DIV/0! | **#DIV/0!** | **N.L. (2)** |
| 291.3 | 65.5 | 3 | 1 | 85 | 17 | 24 | 25 | 0.059 | 6.373 | 2.095 | 7.513 | 0.092 | 0.059 | 6.613 | 8.454 | 0.782 | **0.072** | #DIV/0! | **#DIV/0!** | **N.L. (2)** |

* FACTOR OF SAFETY DESCRIPTIONS

N.L. (1) = NOT LIQUEFIABLE, ABOVE EQ GROUND WATER ELEVATION
N.L. (2) = NOT LIQUEFIABLE, PI $\geq$ 12 OR $w_c/LL \leq 0.85$
N.L. (3) = NOT LIQUEFIABLE, $(N_1)_{60} > 25$
(C) = CONTRACTIVE SOIL TYPES
(D) = DILATIVE SOIL TYPES

# EXHIBIT G

# PILE LENGTH/PILE TYPE

Illinois Department of Transportation

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== North Abutment
REFERENCE BORING ========== 2-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 353.80 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 351.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 351.99 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 573 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 77.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 59.13 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 22.17 KIPS

***MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses***

| Maximum Nominal Req'd Bearing of Pile | Maximum Nominal Req.d Bearing of Boring | Maximum Factored Resistance Available in Boring | Maximum Pile Driveable Length in Boring |
|---|---|---|---|
| **418** KIPS | **418** KIPS | **230** KIPS | **85** FT. |

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

| BOT. OF LAYER ELEV. (FT.) | LAYER THICK. (FT.) | UNCONF. COMPR. STRENGTH (TSF.) | S.P.T. N VALUE (BLOWS) | GRANULAR OR ROCK LAYER DESCRIPTION | NOMINAL PLUGGED SIDE RESIST. (KIPS) | NOMINAL PLUGGED END BRG. RESIST. (KIPS) | NOMINAL PLUGGED TOTAL RESIST. (KIPS) | NOMINAL UNPLUG'D SIDE RESIST. (KIPS) | NOMINAL UNPLUG'D END BRG. RESIST. (KIPS) | NOMINAL UNPLUG'D TOTAL RESIST. (KIPS) | NOMINAL REQ'D BEARING (KIPS) | FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS) | FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS) | FACTORED RESISTANCE AVAILABLE (KIPS) | ESTIMATED PILE LENGTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 350.52 | 1.28 | 2.70 | | | 7.2 | | 36.1 | 10.5 | | ***13.7*** | 14 | 0 | 0 | 8 | 3 |
| 347.02 | 3.50 | 2.10 | | | 16.7 | 28.9 | 41.8 | 24.4 | 3.2 | ***36.9*** | 37 | 0 | 0 | 20 | 7 |
| 344.52 | 2.50 | 1.30 | | | 8.6 | 17.9 | 75.2 | 12.6 | 2.0 | ***52.2*** | 52 | 0 | 0 | 29 | 9 |
| 343.02 | 1.50 | 3.10 | 8 | | 9.3 | 42.7 | 70.8 | 13.6 | 4.7 | ***64.3*** | 64 | 0 | 0 | 35 | 11 |
| 340.52 | 2.50 | 2.10 | | | 11.9 | 28.9 | 99.2 | 17.4 | 3.2 | ***83.5*** | 84 | 0 | 0 | 46 | 13 |
| 337.02 | 3.50 | 3.30 | 12 | | 22.8 | 45.5 | ***97.2*** | 33.3 | 5.0 | 114.1 | 97 | 0 | 0 | 53 | 17 |
| 334.52 | 2.50 | 1.50 | | | 9.5 | 20.7 | ***126.0*** | 13.9 | 2.3 | 130.2 | 126 | 0 | 0 | 69 | 19 |
| 332.02 | 2.50 | 2.90 | | | 14.8 | 40.0 | ***111.9*** | 21.7 | 4.4 | 148.7 | 112 | 0 | 0 | 62 | 22 |
| 329.52 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***131.5*** | 8.6 | 1.2 | 158.7 | 132 | 0 | 0 | 72 | 24 |
| 328.02 | 1.50 | 1.80 | | | 6.5 | 24.8 | ***133.8*** | 9.5 | 2.7 | 167.7 | 134 | 0 | 0 | 74 | 26 |
| 325.52 | 2.50 | 1.50 | | | 9.5 | 20.7 | ***136.5*** | 13.9 | 2.3 | 180.9 | 136 | 0 | 0 | 75 | 28 |
| 323.52 | 2.00 | 1.00 | | | 5.6 | 13.8 | ***142.1*** | 8.2 | 1.5 | 189.2 | 142 | 0 | 0 | 78 | 30 |
| 321.52 | 2.00 | 1.00 | | | 5.6 | 13.8 | ***147.8*** | 8.2 | 1.5 | 197.4 | 148 | 0 | 0 | 81 | 32 |
| 320.52 | 1.00 | 1.00 | | | 2.8 | 13.8 | ***145.1*** | 4.1 | 1.5 | 200.9 | 145 | 0 | 0 | 80 | 33 |
| 317.02 | 3.50 | 0.60 | | | 6.4 | 8.3 | ***159.7*** | 9.3 | 0.9 | 211.2 | 160 | 0 | 0 | 88 | 37 |
| 315.02 | 2.00 | 1.20 | | | 6.5 | 16.5 | ***166.2*** | 9.5 | 1.8 | 220.7 | 166 | 0 | 0 | 91 | 39 |
| 312.52 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***168.8*** | 11.9 | 1.8 | 231.9 | 169 | 0 | 0 | 93 | 41 |
| 310.02 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***174.7*** | 8.6 | 1.2 | 240.5 | 175 | 0 | 0 | 96 | 44 |
| 307.52 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***190.2*** | 8.6 | 1.2 | 250.1 | 190 | 0 | 0 | 105 | 46 |
| 305.02 | 2.50 | 1.50 | | | 9.5 | 20.7 | ***199.7*** | 13.9 | 2.3 | 264.1 | 200 | 0 | 0 | 110 | 49 |
| 302.52 | 2.50 | 1.50 | | | 9.5 | 20.7 | ***212.0*** | 13.9 | 2.3 | 278.3 | 212 | 0 | 0 | 117 | 51 |
| 300.02 | 2.50 | 1.70 | | | 10.4 | 23.4 | ***222.4*** | 15.2 | 2.6 | 293.5 | 222 | 0 | 0 | 122 | 54 |
| 297.52 | 2.50 | 1.70 | | | 10.4 | 23.4 | ***249.3*** | 15.2 | 2.6 | 310.5 | 249 | 0 | 0 | 137 | 56 |
| 295.02 | 2.50 | 2.90 | | | 14.8 | 40.0 | ***264.1*** | 21.7 | 4.4 | 332.1 | 264 | 0 | 0 | 145 | 59 |
| 292.52 | 2.50 | 2.90 | | | 14.8 | 40.0 | ***252.8*** | 21.7 | 4.4 | 350.9 | 253 | 0 | 0 | 139 | 61 |
| 290.02 | 2.50 | 1.00 | | | 7.0 | 13.8 | ***259.8*** | 10.3 | 1.5 | 361.2 | 260 | 0 | 0 | 143 | 64 |
| 287.52 | 2.50 | 1.00 | | | 7.0 | 13.8 | ***264.1*** | 10.3 | 1.5 | 371.2 | 264 | 0 | 0 | 145 | 66 |
| 285.02 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***270.0*** | 8.6 | 1.2 | 379.8 | 270 | 0 | 0 | 148 | 69 |
| 282.52 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***289.6*** | 8.6 | 1.2 | 389.9 | 290 | 0 | 0 | 159 | 71 |
| 280.02 | 2.50 | 1.80 | | | 10.8 | 24.8 | ***300.4*** | 15.8 | 2.7 | 405.6 | 300 | 0 | 0 | 165 | 74 |
| 277.52 | 2.50 | 1.80 | | | 10.8 | 24.8 | ***296.0*** | 15.8 | 2.7 | 419.8 | 296 | 0 | 0 | 163 | 76 |
| 276.52 | 1.00 | 0.70 | | | 2.1 | 9.6 | ***300.7*** | 3.1 | 1.1 | 423.1 | 301 | 0 | 0 | 165 | 77 |
| 272.52 | 4.00 | | 5 | Fine Sand | 1.4 | 12.2 | ***302.0*** | 2.0 | 1.3 | 425.1 | 302 | 0 | 0 | 166 | 81 |
| 268.52 | 4.00 | | 5 | Fine Sand | 1.4 | 12.2 | 490.2 | 2.0 | 1.3 | ***447.5*** | ~~448~~ | ~~0~~ | ~~0~~ | ~~246~~ | ~~85~~ |
| 267.52 | 1.00 | | | Sandstone | 82.4 | 199.1 | 572.6 | 120.4 | 21.8 | ***567.9*** | ~~568~~ | ~~0~~ | ~~0~~ | ~~312~~ | ~~86.3~~ |
| 266.52 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***654.9*** | 120.4 | 21.8 | 688.3 | ~~655~~ | ~~0~~ | ~~0~~ | ~~360~~ | ~~87.3~~ |
| 265.52 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***737.3*** | 120.4 | 21.8 | 808.8 | ~~737~~ | ~~0~~ | ~~0~~ | ~~406~~ | ~~88.3~~ |
| 264.52 | 1.00 | | | Sandstone | | 199.1 | | | 21.8 | | | | | | |

Illinois Department of Transportation

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 1
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 350.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 339.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 331.30 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1071 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 77.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 110.53 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 41.45 KIPS

***MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses***

| Maximum Nominal Req'd Bearing of Pile | Maximum Nominal Req.d Bearing of Boring | Maximum Factored Resistance Available in Boring | Maximum Pile Driveable Length in Boring |
|---|---|---|---|
| **418** KIPS | **418** KIPS | **209** KIPS | **94** FT. |

PILE TYPE AND SIZE ========== Steel HP 12 X 53

Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

| BOT. OF LAYER ELEV. (FT.) | LAYER THICK. (FT.) | UNCONF. COMPR. STRENGTH (TSF.) | S.P.T. N VALUE (BLOWS) | GRANULAR OR ROCK LAYER DESCRIPTION | NOMINAL PLUGGED SIDE RESIST. (KIPS) | NOMINAL PLUGGED END BRG. RESIST. (KIPS) | NOMINAL PLUGGED TOTAL RESIST. (KIPS) | NOMINAL UNPLUG'D SIDE RESIST. (KIPS) | NOMINAL UNPLUG'D END BRG. RESIST. (KIPS) | NOMINAL UNPLUG'D TOTAL RESIST. (KIPS) | NOMINAL REQ'D BEARING (KIPS) | FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS) | FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS) | FACTORED RESISTANCE AVAILABLE (KIPS) | ESTIMATED PILE LENGTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 337.24 | 2.56 | 1.50 | | | 9.8 | | 47.0 | 14.3 | | ***18.4*** | 18 | 5 | 0 | 5 | 13 |
| 335.74 | 1.50 | 2.70 | | | 8.4 | 37.2 | 58.2 | 12.4 | 4.1 | ***31.0*** | 31 | 10 | 0 | 7 | 14 |
| 332.24 | 3.50 | 2.90 | | | 20.7 | 40.0 | 59.6 | 30.3 | 4.4 | ***59.2*** | 59 | 21 | 0 | 11 | 18 |
| 330.74 | 1.50 | 1.50 | | | 5.7 | 20.7 | 70.9 | 8.4 | 2.3 | ***68.2*** | 68 | 21 | 0 | 16 | 19 |
| 327.24 | 3.50 | 1.90 | | | 15.6 | 26.2 | ***89.3*** | 22.9 | 2.9 | 91.4 | 89 | 21 | 0 | 28 | 23 |
| 324.74 | 2.50 | 2.10 | | | 11.9 | 28.9 | ***95.6*** | 17.4 | 3.2 | 108.2 | 96 | 21 | 0 | 31 | 25 |
| 322.24 | 2.50 | 1.70 | | | 10.4 | 23.4 | ***96.4*** | 15.2 | 2.6 | 122.3 | 96 | 21 | 0 | 32 | 28 |
| 320.74 | 1.50 | 1.00 | | | 4.2 | 13.8 | ***97.9*** | 6.2 | 1.5 | 128.2 | 98 | 21 | 0 | 32 | 29 |
| 317.24 | 3.50 | 0.80 | | | 8.2 | 11.0 | ***100.5*** | 12.0 | 1.2 | 139.6 | 101 | 21 | 0 | 34 | 33 |
| 315.24 | 2.00 | 0.40 | | | 2.5 | 5.5 | ***103.1*** | 3.7 | 0.6 | 143.2 | 103 | 21 | 0 | 35 | 35 |
| 312.74 | 2.50 | 0.40 | | | 3.1 | 5.5 | ***111.7*** | 4.6 | 0.6 | 148.4 | 112 | 21 | 0 | 40 | 37 |
| 310.24 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***117.6*** | 8.6 | 1.2 | 157.0 | 118 | 21 | 0 | 43 | 40 |
| 307.74 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***134.5*** | 8.6 | 1.2 | 166.8 | 134 | 21 | 0 | 53 | 42 |
| 305.24 | 2.50 | 1.60 | | | 10.0 | 22.0 | ***144.4*** | 14.6 | 2.4 | 181.4 | 144 | 21 | 0 | 58 | 45 |
| 302.74 | 2.50 | 1.60 | | | 10.0 | 22.0 | ***136.5*** | 14.6 | 2.4 | 194.0 | 136 | 21 | 0 | 54 | 47 |
| 300.24 | 2.50 | 0.30 | | | 2.4 | 4.1 | ***138.9*** | 3.5 | 0.5 | 197.5 | 139 | 21 | 0 | 55 | 50 |
| 297.74 | 2.50 | 0.30 | | | 2.4 | 4.1 | ***153.7*** | 3.5 | 0.5 | 202.3 | 154 | 21 | 0 | 63 | 52 |
| 295.24 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***161.8*** | 11.9 | 1.8 | 214.2 | 162 | 21 | 0 | 68 | 55 |
| 292.74 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***169.9*** | 11.9 | 1.8 | 226.1 | 170 | 21 | 0 | 72 | 57 |
| 290.24 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***178.1*** | 11.9 | 1.8 | 238.0 | 178 | 21 | 0 | 77 | 60 |
| 287.74 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***180.7*** | 11.9 | 1.8 | 249.3 | 181 | 21 | 0 | 78 | 62 |
| 285.24 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***186.5*** | 8.6 | 1.2 | 257.8 | 187 | 21 | 0 | 81 | 65 |
| 282.74 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***188.3*** | 8.6 | 1.2 | 265.9 | 188 | 21 | 0 | 82 | 67 |
| 280.24 | 2.50 | 0.50 | | | 3.9 | 6.9 | ***192.1*** | 5.7 | 0.8 | 271.6 | 192 | 21 | 0 | 84 | 70 |
| 277.74 | 2.50 | 0.50 | | | 3.9 | 6.9 | ***212.5*** | 5.7 | 0.8 | 279.1 | 213 | 21 | 0 | 95 | 72 |
| 272.74 | 5.00 | 1.70 | | | 20.8 | 23.4 | ***233.3*** | 30.4 | 2.6 | 309.4 | 233 | 21 | 0 | 107 | 77 |
| 267.74 | 5.00 | 1.70 | | | 20.8 | 23.4 | ***287.0*** | 30.4 | 2.6 | 343.4 | 287 | 21 | 0 | 136 | 82 |
| 262.74 | 5.00 | | 23 | Medium Sand | 8.3 | 56.3 | ***295.3*** | 12.2 | 6.2 | 355.5 | 295 | 21 | 0 | 141 | 87 |
| 257.24 | 5.50 | | 23 | Medium Sand | 9.1 | 56.3 | 447.1 | 13.4 | 6.2 | ***384.5*** | 385 | 21 | 0 | 190 | 93 |
| 256.24 | 1.00 | | | Sandstone | 82.4 | 199.1 | 529.5 | 120.4 | 21.8 | ***504.9*** | ~~505~~ | ~~21~~ | ~~0~~ | ~~256~~ | ~~93.8~~ |
| 255.24 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***611.9*** | 120.4 | 21.8 | 625.4 | ~~612~~ | ~~21~~ | ~~0~~ | ~~315~~ | ~~94.8~~ |
| 254.24 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***694.2*** | 120.4 | 21.8 | 745.8 | ~~694~~ | ~~21~~ | ~~0~~ | ~~360~~ | ~~95.8~~ |
| 253.24 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***776.6*** | 120.4 | 21.8 | 866.2 | ~~777~~ | ~~21~~ | ~~0~~ | ~~406~~ | ~~96.8~~ |
| 252.24 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***858.9*** | 120.4 | 21.8 | 986.6 | ~~859~~ | ~~21~~ | ~~0~~ | ~~451~~ | ~~97.8~~ |
| 251.24 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***941.3*** | 120.4 | 21.8 | 1107.0 | ~~941~~ | ~~21~~ | ~~0~~ | ~~496~~ | ~~98.8~~ |
| 250.24 | 1.00 | | | Sandstone | | 199.1 | | | 21.8 | | | | | | |

Illinois Department of Transportation

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== Pier 2
REFERENCE BORING ========== 2-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 350.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 339.80 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 331.30 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 1071 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 77.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 110.53 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 41.45 KIPS

***MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses***

| Maximum Nominal Req'd Bearing of Pile | Maximum Nominal Req.d Bearing of Boring | Maximum Factored Resistance Available in Boring | Maximum Pile Driveable Length in Boring |
|---|---|---|---|
| **418** KIPS | **418** KIPS | **207** KIPS | **82** FT. |

PILE TYPE AND SIZE ========== Steel HP 12 X 53
Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area======== 0.108 SQFT.

| BOT. OF LAYER ELEV. (FT.) | LAYER THICK. (FT.) | UNCONF. COMPR. STRENGTH (TSF.) | S.P.T. N VALUE (BLOWS) | GRANULAR OR ROCK LAYER DESCRIPTION | NOMINAL PLUGGED SIDE RESIST. (KIPS) | NOMINAL PLUGGED END BRG. RESIST. (KIPS) | NOMINAL PLUGGED TOTAL RESIST. (KIPS) | NOMINAL UNPLUG'D SIDE RESIST. (KIPS) | NOMINAL UNPLUG'D END BRG. RESIST. (KIPS) | NOMINAL UNPLUG'D TOTAL RESIST. (KIPS) | NOMINAL REQ'D BEARING (KIPS) | FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS) | FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS) | FACTORED RESISTANCE AVAILABLE (KIPS) | ESTIMATED PILE LENGTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 337.14 | 2.66 | 3.30 | 12 | | 17.3 | | 38.0 | 25.3 | | ***27.6*** | 28 | 10 | 0 | 6 | 13 |
| 334.64 | 2.50 | 1.50 | | | 9.5 | 20.7 | 66.8 | 13.9 | 2.3 | ***43.6*** | 44 | 15 | 0 | 9 | 15 |
| 332.14 | 2.50 | 2.90 | | | 14.8 | 40.0 | ***52.7*** | 21.7 | 4.4 | 62.1 | 53 | 23 | 0 | 6 | 18 |
| 329.64 | 2.50 | 0.80 | | | 5.9 | 11.0 | 72.3 | 8.6 | 1.2 | ***72.2*** | 72 | 23 | 0 | 17 | 20 |
| 327.14 | 2.50 | 1.80 | | | 10.8 | 24.8 | ***79.0*** | 15.8 | 2.7 | 87.5 | 79 | 23 | 0 | 21 | 23 |
| 325.64 | 1.50 | 1.50 | | | 5.7 | 20.7 | ***77.8*** | 8.4 | 2.3 | 95.1 | 78 | 23 | 0 | 20 | 24 |
| 323.14 | 2.50 | 1.00 | | | 7.0 | 13.8 | ***84.8*** | 10.3 | 1.5 | 105.4 | 85 | 23 | 0 | 24 | 27 |
| 321.14 | 2.00 | 1.00 | | | 5.6 | 13.8 | ***90.5*** | 8.2 | 1.5 | 113.6 | 90 | 23 | 0 | 27 | 29 |
| 319.14 | 2.00 | 1.00 | | | 5.6 | 13.8 | ***90.6*** | 8.2 | 1.5 | 121.3 | 91 | 23 | 0 | 27 | 31 |
| 318.14 | 1.00 | 0.60 | | | 1.8 | 8.3 | ***100.7*** | 2.7 | 0.9 | 124.9 | 101 | 23 | 0 | 32 | 32 |
| 314.64 | 3.50 | 1.20 | | | 11.4 | 16.5 | ***112.1*** | 16.6 | 1.8 | 141.5 | 112 | 23 | 0 | 39 | 35 |
| 312.64 | 2.00 | 1.20 | | | 6.5 | 16.5 | ***113.1*** | 9.5 | 1.8 | 150.4 | 113 | 23 | 0 | 39 | 37 |
| 310.14 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***118.9*** | 8.6 | 1.2 | 159.0 | 119 | 23 | 0 | 42 | 40 |
| 307.64 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***134.4*** | 8.6 | 1.2 | 168.6 | 134 | 23 | 0 | 51 | 42 |
| 305.14 | 2.50 | 1.50 | | | 9.5 | 20.7 | ***144.0*** | 13.9 | 2.3 | 182.5 | 144 | 23 | 0 | 56 | 45 |
| 302.64 | 2.50 | 1.50 | | | 9.5 | 20.7 | ***156.2*** | 13.9 | 2.3 | 196.8 | 156 | 23 | 0 | 63 | 47 |
| 300.14 | 2.50 | 1.70 | | | 10.4 | 23.4 | ***166.6*** | 15.2 | 2.6 | 212.0 | 167 | 23 | 0 | 69 | 50 |
| 297.64 | 2.50 | 1.70 | | | 10.4 | 23.4 | ***193.6*** | 15.2 | 2.6 | 228.9 | 194 | 23 | 0 | 84 | 52 |
| 295.14 | 2.50 | 2.90 | | | 14.8 | 40.0 | ***208.4*** | 21.7 | 4.4 | 250.6 | 208 | 23 | 0 | 92 | 55 |
| 292.64 | 2.50 | 2.90 | | | 14.8 | 40.0 | ***197.0*** | 21.7 | 4.4 | 269.4 | 197 | 23 | 0 | 85 | 57 |
| 290.14 | 2.50 | 1.00 | | | 7.0 | 13.8 | ***204.0*** | 10.3 | 1.5 | 279.7 | 204 | 23 | 0 | 89 | 60 |
| 287.64 | 2.50 | 1.00 | | | 7.0 | 13.8 | ***208.3*** | 10.3 | 1.5 | 289.7 | 208 | 23 | 0 | 92 | 62 |
| 285.14 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***214.2*** | 8.6 | 1.2 | 298.3 | 214 | 23 | 0 | 95 | 65 |
| 282.64 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***233.8*** | 8.6 | 1.2 | 308.3 | 234 | 23 | 0 | 106 | 67 |
| 280.14 | 2.50 | 1.80 | | | 10.8 | 24.8 | ***244.6*** | 15.8 | 2.7 | 324.1 | 245 | 23 | 0 | 112 | 70 |
| 277.64 | 2.50 | 1.80 | | | 10.8 | 24.8 | ***240.2*** | 15.8 | 2.7 | 338.2 | 240 | 23 | 0 | 109 | 72 |
| 276.64 | 1.00 | 0.70 | | | 2.1 | 9.6 | ***244.9*** | 3.1 | 1.1 | 341.5 | 245 | 23 | 0 | 112 | 73 |
| 272.64 | 4.00 | | 5 | Fine Sand | 1.4 | 12.2 | ***246.3*** | 2.0 | 1.3 | 343.5 | 246 | 23 | 0 | 113 | 77 |
| 268.64 | 4.00 | | 5 | Fine Sand | 1.4 | 12.2 | 434.4 | 2.0 | 1.3 | ***366.0*** | 366 | 23 | 0 | 178 | 81 |
| 267.64 | 1.00 | | | Sandstone | 82.4 | 199.1 | 516.8 | 120.4 | 21.8 | ***486.4*** | ~~486~~ | ~~23~~ | ~~0~~ | ~~245~~ | ~~82.4~~ |
| 266.64 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***599.2*** | 120.4 | 21.8 | 606.8 | ~~599~~ | ~~23~~ | ~~0~~ | ~~307~~ | ~~83.4~~ |
| 265.64 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***681.5*** | 120.4 | 21.8 | 727.2 | ~~682~~ | ~~23~~ | ~~0~~ | ~~352~~ | ~~84.4~~ |
| 264.64 | 1.00 | | | Sandstone | | 199.1 | | | 21.8 | | | | | | |

Illinois Department of Transportation

# IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE========== South Abutment
REFERENCE BORING ========== 1-S
LRFD or ASD or SEISMIC ========== LRFD
PILE CUTOFF ELEV. ========== 353.82 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 351.82 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ===== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ========== 351.96 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ========== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ========== 573 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========= 77.50 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ====== 1

Approx. Factored Loading Applied per pile at 8 ft. Cts ========== 59.13 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ========== 22.17 KIPS

***MAX. REQUIRED BEARING & RESISTANCE for Selected Pile, Soil Profile, & Losses***

| Maximum Nominal Req'd Bearing of Pile | Maximum Nominal Req.d Bearing of Boring | Maximum Factored Resistance Available in Boring | Maximum Pile Driveable Length in Boring |
|---|---|---|---|
| **418** KIPS | **418** KIPS | **230** KIPS | **97** FT. |

PILE TYPE AND SIZE ========== Steel HP 12 X 53

Plugged Pile Perimeter========== 3.967 FT. Unplugged Pile Perimeter========== 5.800 FT.
Plugged Pile End Bearing Area========== 0.983 SQFT. Unplugged Pile End Bearing Area========= 0.108 SQFT.

| BOT. OF LAYER ELEV. (FT.) | LAYER THICK. (FT.) | UNCONF. COMPR. STRENGTH (TSF.) | S.P.T. N VALUE (BLOWS) | GRANULAR OR ROCK LAYER DESCRIPTION | NOMINAL PLUGGED SIDE RESIST. (KIPS) | NOMINAL PLUGGED END BRG. RESIST. (KIPS) | NOMINAL PLUGGED TOTAL RESIST. (KIPS) | NOMINAL UNPLUG'D SIDE RESIST. (KIPS) | NOMINAL UNPLUG'D END BRG. RESIST. (KIPS) | NOMINAL UNPLUG'D TOTAL RESIST. (KIPS) | NOMINAL REQ'D BEARING (KIPS) | FACTORED GEOTECH. LOSS FROM SCOUR or DD (KIPS) | FACTORED GEOTECH. LOSS LOAD FROM DD (KIPS) | FACTORED RESISTANCE AVAILABLE (KIPS) | ESTIMATED PILE LENGTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 349.64 | 2.18 | 1.00 | | | 6.1 | | 17.2 | 9.0 | | ***10.2*** | 10 | 0 | 0 | 6 | 4 |
| 348.14 | 1.50 | 0.80 | | | 3.5 | 11.0 | 19.3 | 5.1 | 1.2 | ***15.2*** | 15 | 0 | 0 | 8 | 6 |
| 344.64 | 3.50 | 0.70 | | | 7.3 | 9.6 | 48.7 | 10.7 | 1.1 | ***28.3*** | 28 | 0 | 0 | 16 | 9 |
| 343.14 | 1.50 | 2.30 | | | 7.6 | 31.7 | 52.1 | 11.1 | 3.5 | ***38.9*** | 39 | 0 | 0 | 21 | 11 |
| 339.64 | 3.50 | 2.00 | | | 16.2 | 27.6 | ***57.2*** | 23.6 | 3.0 | 61.3 | 57 | 0 | 0 | 31 | 14 |
| 337.14 | 2.50 | 1.20 | | | 8.1 | 16.5 | 86.0 | 11.9 | 1.8 | ***75.5*** | 75 | 0 | 0 | 42 | 17 |
| 335.64 | 1.50 | 2.70 | | | 8.4 | 37.2 | 97.2 | 12.4 | 4.1 | ***88.1*** | 88 | 0 | 0 | 48 | 18 |
| 332.14 | 3.50 | 2.90 | | | 20.7 | 40.0 | ***98.7*** | 30.3 | 4.4 | 116.3 | 99 | 0 | 0 | 54 | 22 |
| 330.64 | 1.50 | 1.50 | | | 5.7 | 20.7 | ***109.9*** | 8.4 | 2.3 | 125.3 | 110 | 0 | 0 | 60 | 23 |
| 327.14 | 3.50 | 1.90 | | | 15.6 | 26.2 | ***128.3*** | 22.9 | 2.9 | 148.5 | 128 | 0 | 0 | 71 | 27 |
| 324.64 | 2.50 | 2.10 | | | 11.9 | 28.9 | ***134.7*** | 17.4 | 3.2 | 165.3 | 135 | 0 | 0 | 74 | 29 |
| 322.14 | 2.50 | 1.70 | | | 10.4 | 23.4 | ***135.4*** | 15.2 | 2.6 | 179.4 | 135 | 0 | 0 | 74 | 32 |
| 320.64 | 1.50 | 1.00 | | | 4.2 | 13.8 | ***136.9*** | 6.2 | 1.5 | 185.3 | 137 | 0 | 0 | 75 | 33 |
| 317.14 | 3.50 | 0.80 | | | 8.2 | 11.0 | ***139.6*** | 12.0 | 1.2 | 196.7 | 140 | 0 | 0 | 77 | 37 |
| 315.14 | 2.00 | 0.40 | | | 2.5 | 5.5 | ***142.1*** | 3.7 | 0.6 | 200.4 | 142 | 0 | 0 | 78 | 39 |
| 312.64 | 2.50 | 0.40 | | | 3.1 | 5.5 | ***150.8*** | 4.6 | 0.6 | 205.6 | 151 | 0 | 0 | 83 | 41 |
| 310.14 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***156.6*** | 8.6 | 1.2 | 214.1 | 157 | 0 | 0 | 86 | 44 |
| 307.64 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***173.5*** | 8.6 | 1.2 | 223.9 | 174 | 0 | 0 | 95 | 46 |
| 305.14 | 2.50 | 1.60 | | | 10.0 | 22.0 | ***183.5*** | 14.6 | 2.4 | 238.5 | 183 | 0 | 0 | 101 | 49 |
| 302.64 | 2.50 | 1.60 | | | 10.0 | 22.0 | ***175.5*** | 14.6 | 2.4 | 251.1 | 176 | 0 | 0 | 97 | 51 |
| 300.14 | 2.50 | 0.30 | | | 2.4 | 4.1 | ***177.9*** | 3.5 | 0.5 | 254.6 | 178 | 0 | 0 | 98 | 54 |
| 297.64 | 2.50 | 0.30 | | | 2.4 | 4.1 | ***192.7*** | 3.5 | 0.5 | 259.5 | 193 | 0 | 0 | 106 | 56 |
| 295.14 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***200.9*** | 11.9 | 1.8 | 271.3 | 201 | 0 | 0 | 110 | 59 |
| 292.64 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***209.0*** | 11.9 | 1.8 | 283.2 | 209 | 0 | 0 | 115 | 61 |
| 290.14 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***217.1*** | 11.9 | 1.8 | 295.1 | 217 | 0 | 0 | 119 | 64 |
| 287.64 | 2.50 | 1.20 | | | 8.1 | 16.5 | ***219.7*** | 11.9 | 1.8 | 306.4 | 220 | 0 | 0 | 121 | 66 |
| 285.14 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***225.6*** | 8.6 | 1.2 | 315.0 | 226 | 0 | 0 | 124 | 69 |
| 282.64 | 2.50 | 0.80 | | | 5.9 | 11.0 | ***227.3*** | 8.6 | 1.2 | 323.1 | 227 | 0 | 0 | 125 | 71 |
| 280.14 | 2.50 | 0.50 | | | 3.9 | 6.9 | ***231.2*** | 5.7 | 0.8 | 328.7 | 231 | 0 | 0 | 127 | 74 |
| 277.64 | 2.50 | 0.50 | | | 3.9 | 6.9 | ***251.6*** | 5.7 | 0.8 | 336.2 | 252 | 0 | 0 | 138 | 76 |
| 272.64 | 5.00 | 1.70 | | | 20.8 | 23.4 | ***272.4*** | 30.4 | 2.6 | 366.5 | 272 | 0 | 0 | 150 | 81 |
| 267.64 | 5.00 | 1.70 | | | 20.8 | 23.4 | ***326.0*** | 30.4 | 2.6 | 400.5 | 326 | 0 | 0 | 179 | 86 |
| 262.64 | 5.00 | | 23 | Medium Sand | 8.3 | 56.3 | ***334.4*** | 12.2 | 6.2 | 412.7 | 334 | 0 | 0 | 184 | 91 |
| 257.14 | 5.50 | | 23 | Medium Sand | 9.1 | 56.3 | 486.2 | 13.4 | 6.2 | ***441.6*** | ~~442~~ | ~~0~~ | ~~0~~ | ~~243~~ | ~~97~~ |
| 256.14 | 1.00 | | | Sandstone | 82.4 | 199.1 | 568.6 | 120.4 | 21.8 | ***562.1*** | ~~562~~ | ~~0~~ | ~~0~~ | ~~309~~ | ~~97.7~~ |
| 255.14 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***650.9*** | 120.4 | 21.8 | 682.5 | ~~651~~ | ~~0~~ | ~~0~~ | ~~358~~ | ~~98.7~~ |
| 254.14 | 1.00 | | | Sandstone | 82.4 | 199.1 | ***733.3*** | 120.4 | 21.8 | 802.9 | ~~733~~ | ~~0~~ | ~~0~~ | ~~403~~ | ~~99.7~~ |
| 253.14 | 1.00 | | | Sandstone | | 199.1 | | | 21.8 | | | | | | |