STRUCTURE GEOTECHNICAL REPORT

Carman Road over Dugout Creek

S.N. 036-0074 (Proposed)

F.A.P. ROUTE 522
SECTION (14-2Q)I
HENDERSON COUNTY, ILLINOIS
JOB NO. P-94-28-10
PTB 156/031
KEG NO. 10-1063.02

Authored By:
Matthew D. Masterson, P.E.
Charles R. Graham
Kaskaskia Engineering Group, LLC
208 East Main Street, Suite 100
Belleville, Illinois 62220
mmasterson@kaskaskiaeng.com
618-233-5877

LICENSED PROFESSIONAL ENGINEER
MATTHEW DENNIS MASTERSON
062-061885
STATE OF ILLINOIS

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Prepared for:
Veenstra & Kimm, Inc.
907 South 4th Street
Springfield, IL 62703

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Kaskaskia
Engineering Group, LLC

EXECUTIVE SUMMARY

F.A.P. Route 522 (Carman Road) over Dugout Creek
Section (14-2Q)I
Henderson County, Illinois
JOB NO. P-94-28-10
PTB 156/031
KEG No. 10-1063.02
Structure No. 036-0074 (Proposed)

The project consists of construction of a three-span structure (S.N. 036-3003 existing) carrying Carman Road over Dugout Creek. The purpose of this report is to present design and construction recommendations for the proposed structure.

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EXHIBITS

1.0 PROJECT DESCRIPTION AND PROPOSED STRUCTURE INFORMATION

1.1 Introduction

The geotechnical study summarized in this report was performed for the proposed three-span structure for Carman Road over Dugout Creek in Henderson County, Illinois. The purpose of this report is to present design and construction recommendations for the proposed structure.

1.2 Project Description

The project consists of construction of a three-span structure, S.N. 036-0074 (Proposed) carrying Carman Road over Dugout Creek. The general location of the structure is shown on a Location Map, Exhibit A. The site lies within the limits of the Third Principal Meridian (T. 8 N R. 6W Section 15) within the Galesburg Plain of the Till Plains section of the Central Lowland Province.

1.3 Proposed Bridge Information

The proposed structure (S.N. 036-0074) located at Carman Road over Dugout Creek will consist of a three-span structure built on a 30°skew. The structure will have a combined overall out-to-out width of 40'-5". The structure will be located at Station 495+00.00 (Carman Road). Integral abutments and piers are proposed for the substructures.

The structure will measure 112'-9.25", from back-to-back of abutments. The three-span structure will support two 12' lanes, with shoulder widths of 4', and a 5-foot sidewalk. Further substructure details will be based on the findings of this SGR.

2.0 SITE INVESTIGATION, SUBSURFACE EXPLORATION, AND GENERALIZED SUBSURFACE CONDITIONS

The site investigation was performed by Terracon Consultants, Inc.

Three standard penetration test (SPT) borings, designated SB-1 through SB-3, were drilled on March 17, 2020. The stations and offsets of the borings are listed in Table 2.0. The boring locations are shown on the Type, Size, and Location Plan (TS&L) shown in Exhibit B, as provided by Veenstra & Kimm, Inc. 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. A soil profile for borings SB-1 through SB-3 can be found under Subsurface Profile, Exhibit D.

Table 2.0 - Boring Stations and Offsets

Designation	Stationing	Offset from Proposed Centerline	Surface Elevation (ft.)
SB-1	496+02	17 ft. LT	553.00
SB-2	495+33	35 ft. RT	548.00
SB-3	493+97	29 ft. RT	552.00

2.1 Subsurface Conditions

Boring SB-1 was drilled at Station 496+02 from El. 553.0. The boring encountered an approximate 8-foot layer of silty clay loam fill with an average N-value of 6 blows per foot (bpf) with an average moisture content of 22 percent. Below the fill material, the boring encountered an approximate 4.5’ layer of clay loam. The average N-value of the clay loam material was 5 bpf with an average unconfined compressive strength (Q_u) of 0.6 tons per square foot (tsf). The average moisture content of the clay loam material was 19 percent. Below the clay loam, the boring advanced through a 40.5’ layer of loose to medium-dense sand with an average N-value of 9 bpf and an average moisture content of 16 percent. Below the loose sand, a medium-dense poorly graded sand was encountered with an average N-value of 18 bpf and an average moisture content of 18 percent. The boring was terminated in the medium-dense sand after advancing 100 feet below the ground surface to El. 453.0.

Boring SB-2 was drilled at Station 495+33 from El. 548.0. The boring encountered an approximate 6-foot layer of silty clay loam fill with an average N-value of 2 bpf, a Q_u value of 0.16 tsf, and an average moisture content of 33 percent. Below the fill material, the boring encountered an approximate 7-foot layer of clay loam. The average N-value of the clay loam material was 6 bpf with an average Q_u of 0.7 tsf. The average moisture content of the clay loam material was 22 percent. Below the clay loam, the boring advanced through a 25-foot layer of loose to medium-dense sand with traces of gravel. The average N-value of the sand was 7 bpf with an average moisture content of 21 percent. Below the loose sand, a medium-dense poorly graded sand was encountered with an average N-value of 18 bpf and an average moisture content of 18 percent. The boring was terminated in the medium-dense sand after advancing 80 feet below the ground surface to El.468.0.

Boring SB-3 was drilled at Station 493+97 from El. 552.0. The boring encountered an approximate 6-foot layer of sandy clay loam fill with an average N-value of 13, a Q_u value of 0.7 tsf, and an average moisture content of 14 percent. Below the fill material, the boring encountered an approximate 11.5-foot layer of clay loam material. The average N-value of the clay loam material was 4 bpf with an average Q_u of 0.29 tsf. The average moisture content of the clay loam material was 21 percent. Below the clay loam, the borings advanced through approximately 35 feet of a loose sand. The average N-value of the sand was 7 bpf with an average moisture content of 20 percent. Below the loose sand, a medium-dense poorly graded sand was encountered with an average N-value of 19 bpf and an average moisture content of 18 percent. The boring was terminated in the medium-dense sand after advancing 80 feet below the ground surface to El. 472.0

2.2 Bedrock

Bedrock was not encountered in any of the borings. The borings were advanced to depths ranging from 80 to 100 feet below ground surface. The three borings terminated in medium-dense sands.

2.3 Groundwater

Groundwater was encountered in Borings SB-1 and SB-2 at El. 529.0, and at El. 528.5 in SB-3. The surface elevation of Dugout Creek was not recorded during drilling operations.

3.0 GEOTECHNICAL EVALUATIONS

3.1 Settlement

Since grading and changes to the existing approach embankments are anticipated to have minimal impact on the existing alignment and the predominately granular nature of the underlying site materials, it is estimated that settlement magnitudes of less than 0.5 inches will be experienced. Therefore, no settlement calculations were performed for the proposed structure and down-drag was not included in the pile capacity calculations.

3.2 Slope Stability

The proposed construction of the new Carman Road over Dugout Creek structure will result in new end-slopes at the abutment locations sloping into Dugout Creek. The abutment end-slopes will be protected with riprap.

The proposed abutments are integral abutments with end-slopes at 1 Vertical to 2 Horizontal (1V:2H). Slope stability of the end-slopes was analyzed using SLOPE/W; the soil properties at the site, including those in Borings SB-1 and SB-3; and end-slope geometrics. Kaskaskia Engineering Group, LLC (KEG) modeled the slopes at both the north and south abutment locations. Two conditions were modeled for each: end-of-construction (E-O-C) and long-term (L-T). 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.

In order to model the E-O-C condition, undrained soil strength parameters were used with a friction angle of 0° assumed for cohesive soils. Drained soil strength parameters with assumed friction angles ranging from 26° to 34° were used to model the L-T cases where excess pore water pressure from construction has dissipated. For clay and silty clay materials, a nominal cohesion of 50 to 100 psf was included in the drained strength parameters.

The Modified Bishop Method, which generates circular-arc failure surfaces, was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis are 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

Location	Slope	Calculated Critical FOS	
		End-of- Construction	Long-Term
North Abutment End-Slope	1V:2H	1.5	1.5
South Abutment End-Slope	1V:2H	1.6	1.5

The results of the analysis, as provided in Table 3.2, indicate an acceptable FOS will exist at both the north and south abutment end-slopes for the structure under short-term and long-term conditions.

3.3 Seismic Considerations

The determination of Seismic Site Class was based on the method described by Illinois Department of Transportation (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 and evaluation of liquefaction potential. Published information and mapping, including software directly applicable to the American Association of State Highway and Transportation Officials (AASHTO) Guide Specifications for LRFD Seismic Bridge Design, was used to develop the parameters for the project site 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}	0.144 g (Site Class E)
Spectral Response Acceleration, 1.0 Sec, S_{D1}	0.101 g (Site Class E)
Seismic Performance Zone	1

As indicated in the table above, the Seismic Performance Zone is 1, 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. Because these structures are considered critical, the appropriate Response Modification Factors as indicated in the AASHTO Bridge Design Specifications, Table 3.10.7.1-1 shall be applied.

3.4 Scour

The design scour elevations for the proposed structure are shown in Table 3.4. Class A4 stone riprap will be placed to protect abutment endslopes extending past the pier encasements at the natural creek channel banks, to reduce the potential for future scour. The scour depths at the pier locations have not been reduced based on the non-cohesive sands observed in the borings above and extending below both Pier 1 and Pier 2 scour elevations.

Table 3.4 - Design Scour Elevations

Event/Limit State	Design Scour Elevations (ft.)				Item 113
	North Abutment	Pier 1	Pier 2	South Abutment	
Q_{100}	541.0	521.5	521.5	541.4	8
Q_{200}	541.0	520.5	520.5	541.4	
Design	541.0	521.5	521.5	541.4	
Check	541.0	520.5	520.5	541.4	

3.5 Liquefaction

Per the Geotechnical Manual, due to the location of this structure and the seismic conditions resulting in an SPZ 1, a liquefaction analysis is not required for the proposed structure.

4.0 FOUNDATION EVALUATIONS AND DESIGN RECOMMENDATIONS

4.1 General Feasibility

Due to the unknown depth and composition of bedrock, anticipated foundation loads, and the amount of granular materials indicated on the boring logs, driven metal-shell piles appear applicable for support of the bridge substructures. The Modified IDOT Static Method of Estimating Pile Length spreadsheet, as provided by IDOT BBS Foundations and Geotechnical Unit, was used to estimate the capacities of the driven piles.

The preliminary design loads, as provided by Veenstra & Kimm, are provided in Table 4.1.

Table 4.1 - Preliminary Design Loads

Substructure Unit	Factored Reactions (kips)
North and South Abutments	827.6
Piers	1276.7

4.2 Pile Supported Foundations

The foundations supporting the proposed bridge must provide sufficient support to resist dead, live, and wind loads, including seismic loadings. Based on the encountered subsurface conditions, the Modified IDOT Static Method of Estimating Pile Length provided by IDOT BBS Foundations and Geotechnical Unit, and the information available to date, KEG recommends using Metal-Shell piles. The Modified IDOT Static Method uses the LRFD Pile Design Guide Procedure to estimate the pile lengths (Pile Length/Pile Type, Exhibit F).

The estimated pile lengths for the pile types considered are shown in Table 4.2.1 through 4.2.5 below and under Exhibit F, Pile Length/Pile Type. 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.

As shown in the tables and under Pile Length/Pile Type, Exhibit F; downdrag, and liquefaction have not been considered at the pile locations. Scour has been taken into consideration for the factored resistance available at the substructure locations.

Table 4.2.1 - Estimated Pile Lengths for 12” Φ w/ 0.25” Wall Metal-Shell Piles

Substructure	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment SB-1	285	157	65	543.4
	358	197	70	543.4
	392	208	75	543.4
Pier 1 & 2 SB-2	266	143	59	542.0
	321	173	64	542.0
	358*	194	69	542.0
North Abutment SB-3	282	155	56	543.0
	316	174	61	543.0
	349*	192	66	543.0

*maximum nominal required bearing of pile is not reached in depth of boring

Table 4.2.2 - Estimated Pile Lengths for 14” Φ w/ 0.25” Wall Metal-Shell Piles

Substructure	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment SB-1	317	174	60	543.4
	350	192	65	543.4
	459	250	71	543.4
Pier 1 & 2 SB-2	332	179	59	542.0
	399	216	64	542.0
	442*	239	69	542.0
North Abutment SB-3	350	192	56	543.0
	388	214	61	543.0
	427*	235	66	543.0

*maximum nominal required bearing of pile is not reached in depth of boring

Table 4.2.3 - Estimated Pile Lengths for 14” Φ w/ 0.312” Wall Metal-Shell Piles

Substructure	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment SB-1	480	264	80	543.4
	488	264	85	543.4
	510*	281	89	543.4
Pier 1 & 2 SB-2	332	179	59	542.0
	399	216	64	542.0
	442*	239	69	542.0
North Abutment SB-3	350	192	56	543.0
	388	214	61	543.0
	427*	235	66	543.0

*maximum nominal required bearing of pile is not reached in depth of boring

Table 4.2.4 - Estimated Pile Lengths for 16” Φ w/ 0.312” Wall Metal-Shell Piles

Substructure	R_n Nominal Required Bearing (kips)	R_F Allowable Resistance Available (LRFD Criteria) (kips)	Estimated Pile Length (ft.)	Assumed Pile Cut-off Elevation (ft.)
South Abutment SB-1	569	313	80	543.4
	574	316	85	543.4
	600*	330	89	543.4
Pier 1 & 2 SB-2	403	217	59	542.0
	485	262	64	542.0
	532*	288	69	542.0
North Abutment SB-3	423	232	56	543.0
	467	257	61	543.0
	511*	281	66	543.0

*maximum nominal required bearing of pile is not reached in depth of boring

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

4.3 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. Table 4.3 is included for the structural engineer’s use in evaluating lateral pile response. The values were estimated based on the descriptions as listed on the boring logs. No specific hydrometer analyses were performed on the site soils.

Table 4.3 - Soil Parameters for Lateral Pile Load Analysis

Boring	Elev. at Bottom of Layer	γ (pcf)	Short Term		Long Term		N	% fines < #200	K (pci)	ε50
			Φ (deg.)	c (psf)	Φ (deg.)	c (psf)				
South Abutment (SB-1)	545.0	120	0	750	27	50	6	85	100	0.010
	540.5	125	0	600	26	50	8	65	100	0.010
	529.0	115	32	0	32	0	9	25	25	--
	500.0	115	32	0	32	0	9	25	20	--
	466.0	110	34	0	34	0	18	10	60	--
	453.0	110	34	0	34	0	19	10	60	--
Pier 1 & 2 (SB-2)	542.0	120	0	160	27	50	2	85	30	0.020
	535.0	125	0	720	26	50	6	65	100	0.010
	529.0	115	32	0	32	0	10	25	25	--
	510.0	115	32	0	32	0	8	25	20	--
	468.0	110	34	0	34	0	18	10	60	--
North Abutment (SB-3)	545.5	120	0	780	27	50	13	40	100	0.010
	534.0	125	0	290	26	50	4	65	30	0.020
	528.5	115	32	0	32	0	8	25	25	--
	499.0	115	32	0	32	0	7	25	20	--
	472.0	110	34	0	34	0	19	10	60	--

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.

5.2 Temporary Sheeting and Soil Retention

Temporary sheeting may be required at various stages of this project, due to the potential for staged construction. The IDOT Temporary Sheet Piling Design Guide and Charts and Spreadsheet were used to review various retained heights ranging from 5 to 15 feet below existing grades. Based on these resources, Cantilevered Sheet Piling Systems are feasible for retained heights of 15 feet or less in the area of the north and south abutments.

Table 5.2, below, summarizes the retained heights versus required embedment depth and applicable section modulus. The design spreadsheets are included in Exhibit G, for additional information.

Table 5.2 – Temporary Sheet Pile Design Parameters

Location	Reference Boring	Retained Height (Feet)	Embedment Depth (Feet)	Section Modulus (IN.^{3}/Foot)
South Abutment	SB-1	5	3.75	1.12
	SB-1	10	11.25	8.05
	SB-1	15	25.32	50.49
North Abutment	SB-3	5	3.75	1.12
	SB-3	10	19.89	17.92
	SB-3	15	28.51	55.70

Temporary Soil Retention Systems may be required versus Cantilevered Sheet Piling, depending upon the surcharge loading and retained heights required to be supported during construction. An Illinois-licensed Structural Engineer is required to seal the design of Temporary Soil Retention Systems, if deemed necessary.

5.3 Site and Soil Conditions

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

5.4 Foundation Construction

Conventional pile driving equipment and methodologies should be assumed.

A Joint Utility Locating Information for Excavators (JULIE) locate shall be conducted to determine if any underground utilities are present in the area of the proposed structure prior to construction. If utilities become a problem during construction, the appropriate owner shall be contacted immediately.

5.5 Cofferdams

Cofferdams may be required at the proposed pier locations. The water surface elevation is not recorded on the provided boring logs; however, based off of the streambed elevation; Type 2 cofferdams are recommended for construction of both piers. All cofferdams are required to be de-watered. Granular materials are present at the proposed pier foundation locations and the use of a seal coat is recommended. A seal coat will reduce the potential for water from seeping beneath the cofferdams. As per 2012 IDOT Bridge Manual, if a seal coat is specified, General Note 26 shall be added to the plans.

6.0 COMPUTATIONS

Computations and analyses for special 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

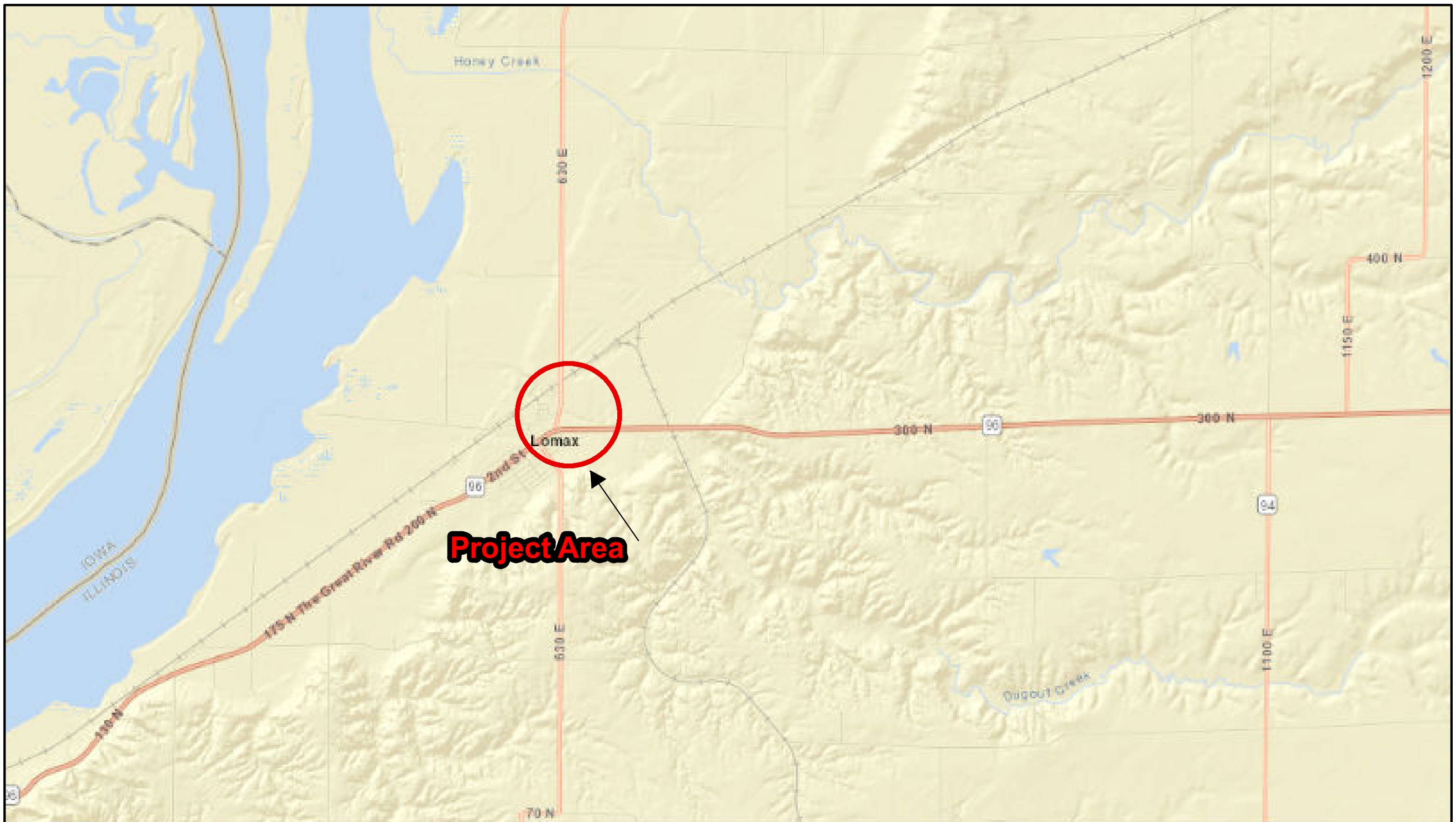
Soil borings can be found in Exhibit C. The Subsurface Profile can be found in Exhibit D.

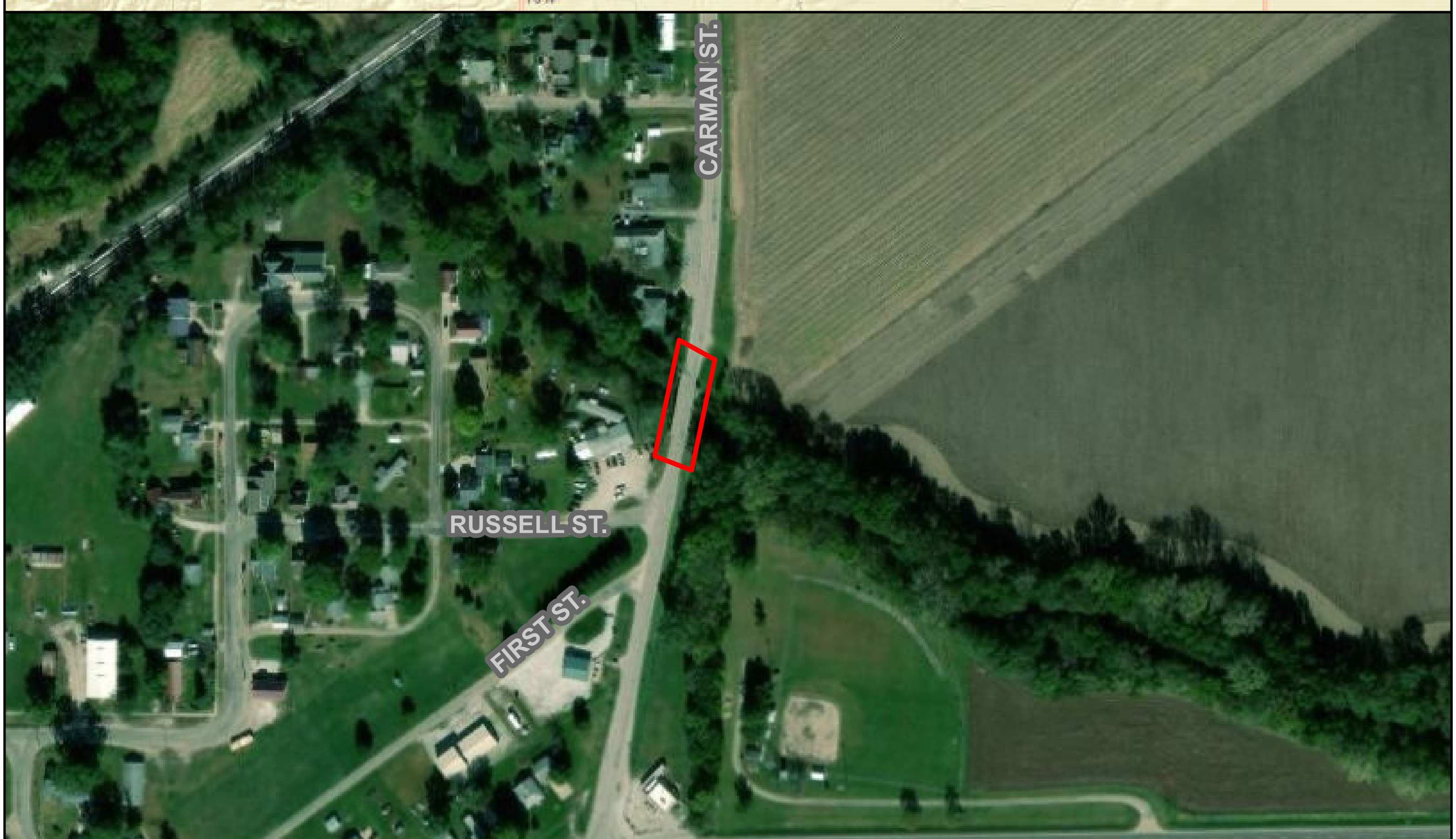
8.0 LIMITATIONS

The recommendations provided herein are for the exclusive use of Veenstra & Kimm and IDOT. They are specific only to the project described and are based on the subsurface information obtained by Terracon at three boring locations within the bridge area in 2020; 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

USGS TOPOGRAPHIC LOCATION MAP





Kaskaskia Engineering Group, LLC

LOCATION MAP

Carman Road (FAP 522) over Dugout Creek
Section (14-2Q)I
Henderson County, Illinois

Exhibit No.

A

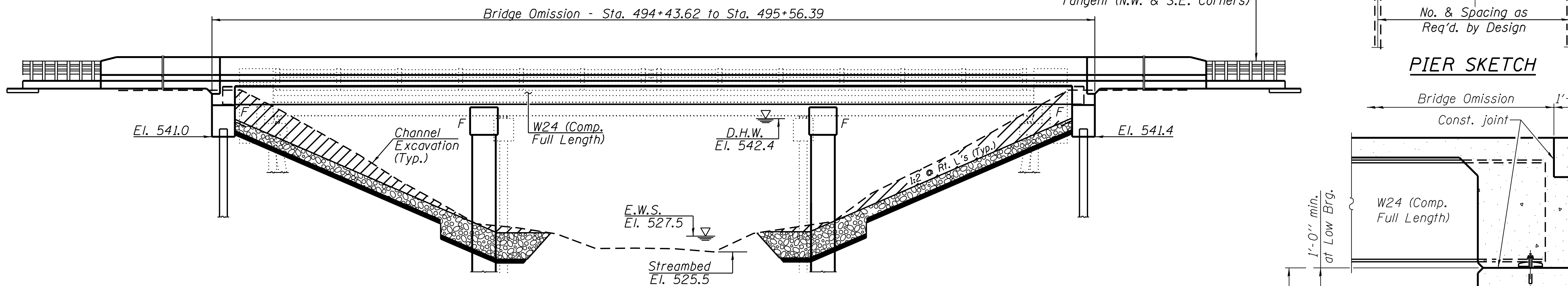
KEG JOB #10-1063.02

EXHIBIT B

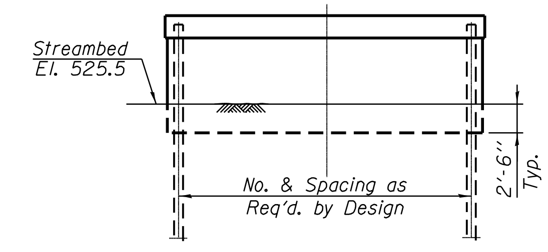
TYPE, SIZE, AND LOCATION PLAN (TS&L)

Existing Structure: Structure Number 036-3003, built in 1954 as F.A.S. Route 418, Section 14-2Q at Station 495+00. The existing structure is a three span bridge having a back to back abutment length of 105'-0" and a face to face of curb width of 24'-0" and an out to out deck width of 29'-8". The superstructure consists of a reinforced concrete deck supported by continuous steel I beams with welded cover plates over the piers. The substructure consists of reinforced concrete pile bent abutments and concrete pile bent piers. The bridge is skewed 30° left forward.

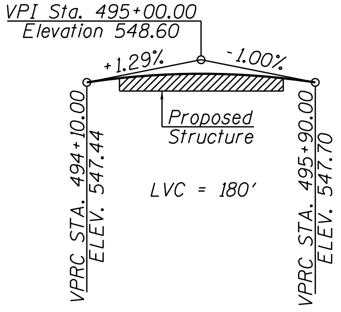
Bench Mark: High point on top of R.O.W. marker. Sta. 495+27.8, 37' Rt. El. 543.32



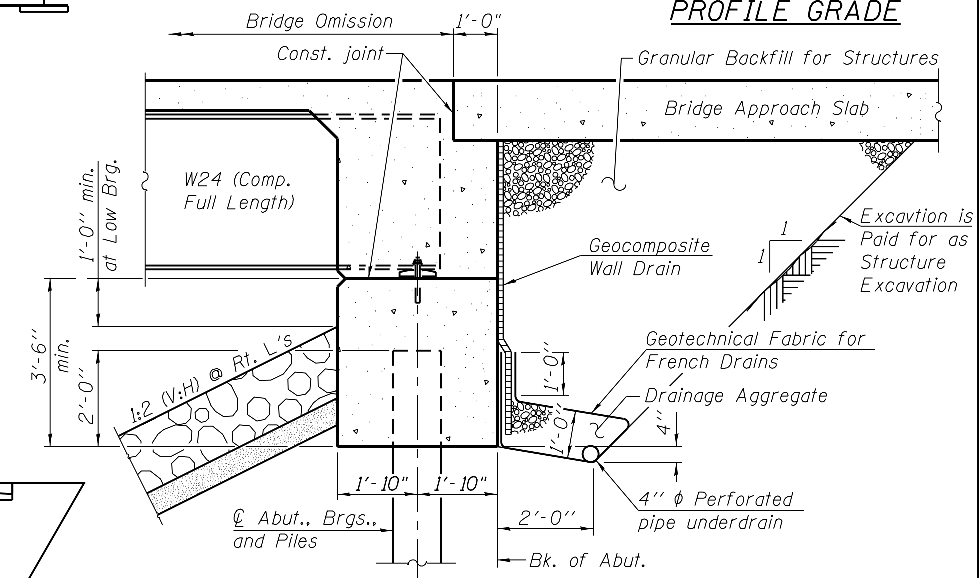
ELEVATION



PIER SKETCH

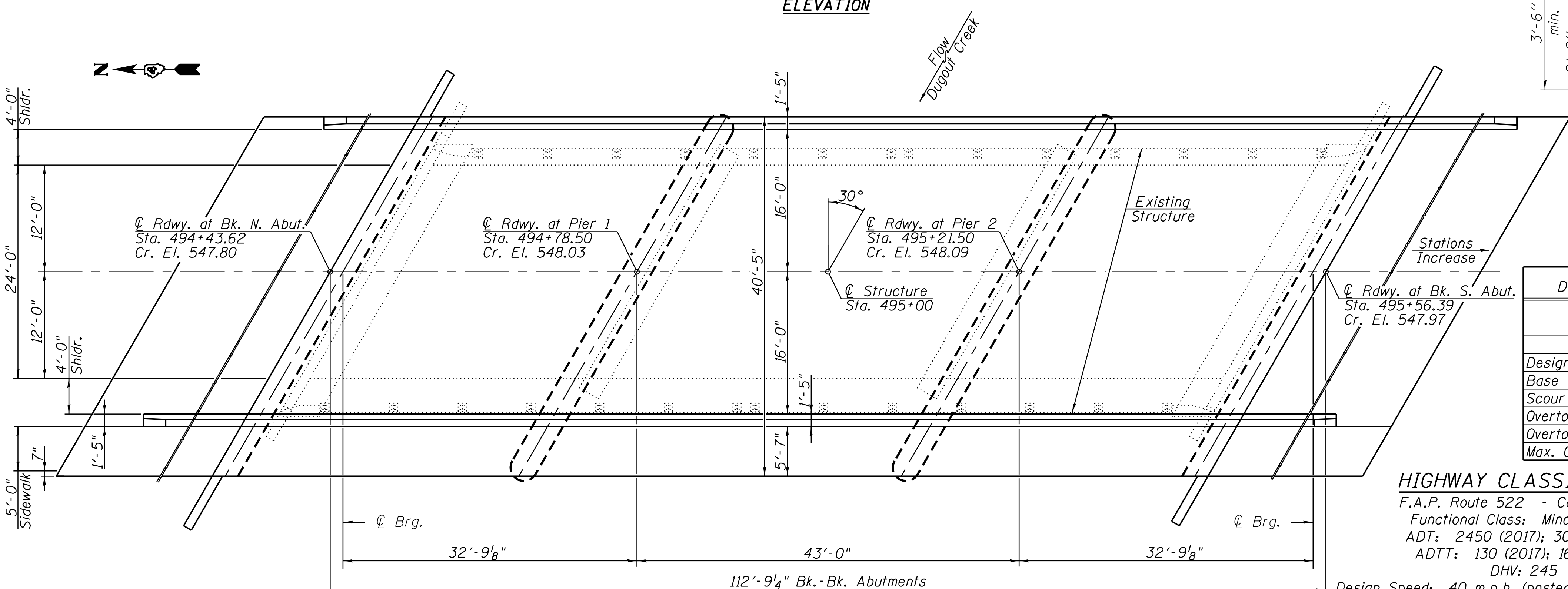


PROFILE GRADE

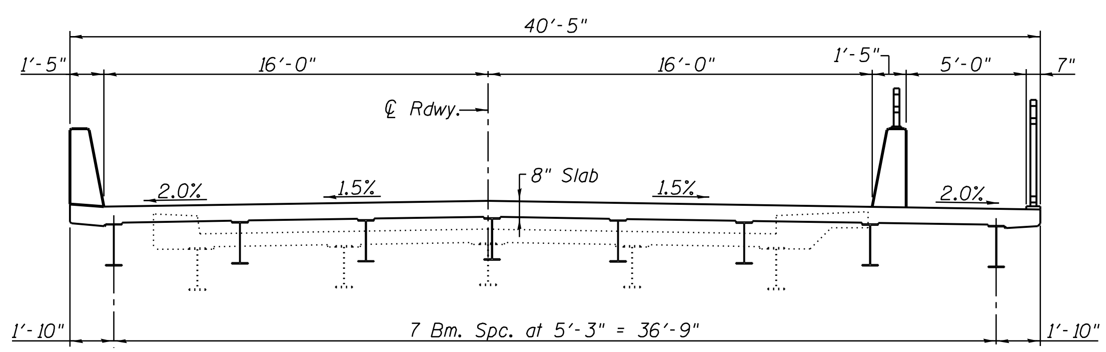


SECTION THRU INTEGRAL ABUTMENT

(Horiz. dim. @ Rt. L's)

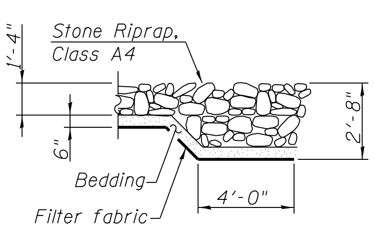


PLAN

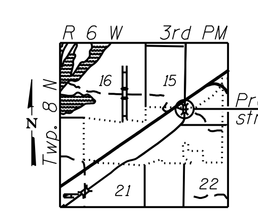


PROPOSED BRIDGE CROSS SECTION

(Looking South)



SECTION A-A



LOCATION SKETCH

WATERWAY INFORMATION

Drainage Area = 19 mi^2

Exist. Low Grade Elev. 545.4 @ Sta. 491+00
Prop. Low Grade Elev. 545.4 @ Sta. 491+00

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	2670	573	670	539.6	0.3	0.1	539.9	539.7
Design	50	4150	763	891	542.4	0.3	0.1	542.7	542.5
Base	100	4830	839	978	543.4	0.3	0.1	543.7	543.5
Scour Design Check	200	5480	897	1048	544.2	0.3	0.1	544.5	544.3
Overtop Existing	400	6200	897	----	544.9	0.5	----	545.4	----
Overtop Proposed	460	6350	----	1065	545.1	----	0.3	----	545.4
Max. Calc.									

10 year velocity through existing bridge = 4.7 fps
10 year velocity through prop. bridge = 4.0 fps

DESIGN SCOUR ELEVATION TABLE

Event/Limit State	Design Scour Elevations (ft.) N. Abut.	Pier 1	Pier 2	S. Abut.	Item 113
Q100	541.0	521.5	521.5	541.4	8
Q200	541.0	520.5	520.5	541.4	
Design	541.0	521.5	521.5	541.4	
Check	541.0	520.5	520.5	541.4	

HIGHWAY CLASSIFICATION

F.A.P. Route 522 - Carman Road
Functional Class: Minor Arterial
ADT: 2450 (2017); 3022 (2037)
ADTT: 130 (2017); 160 (2037)
DHV: 245
Design Speed: 40 m.p.h. (posted); 40 m.p.h. (design)
Two way traffic Directional Dist. 50:50

LOADING HL 93

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

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, 8th Edition.

DESIGN STRESSES

FIELD UNITS

f'_c = 3,500 psi
f'_c = 4,000 psi (Superstructure Concrete)
f_y = 60,000 psi (reinforcement)
f_y = 50,000 psi (M270 Grade 50)

GENERAL PLAN & ELEVATION
CARMAN ROAD OVER DUGOUT CREEK
F.A.P. ROUTE 522 - SEC. (14-2Q)I
HENDERSON COUNTY
STA. 495+00.00
STRUCTURE NO. ______

Veenstra & Kimm, Inc. Springfield, IL. Phone: (217)544-8033	USER NAME = ___	DESIGNED - ___	REVISED - ___
		CHECKED - ___	REVISED - ___
	PLOT SCALE = ___	DRAWN - ___	REVISED - ___
	PLOT DATE = ___	CHECKED - ___	REVISED - ___

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN & ELEVATION

SHEET NO. 1 OF 3 SHEETS

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
	(14-2Q)I	HENDERSON		

CONTRACT NO. ____

ILLINOIS FED. AID PROJECT

EXHIBIT C

BORING LOGS

Illinois Department of Transportation
Division of Highways
Terracon

SOIL BORING LOG

Date 3/17/20

ROUTE FAP 522 (Carman Road) **DESCRIPTION** Structure boring for bridge replacement **LOGGED BY** GS (Terracon)

SECTION (14-2Q)I **LOCATION** Carman Road over Dugout Creek, **SEC.** 15, **TWP.** 68N, **RNG.** 6W, 4th **PM**, **Latitude** 40°40'54"N, **Longitude** 91° 04'13"W

COUNTY Henderson **DRILLING METHOD** HSA to 24' then Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 036-3003 (EX) 036-0074 (PR)
Station 495+00

BORING NO. SB-1
Station 496+02
Offset 17.0 ft LT
Ground Surface Elev. 553.00 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 529.0 ft ▼
Upon Completion ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
FILL - SILTY CLAY LOAM: dark brown, moist, with traces of sand and gravel (USCS - Silty Clay with Sand, CL-ML)			2		
			3		21
			2		
- grayish brown at 6.5 feet			3		
		-5	3		18
			4		
			1		
			2		28
	545.00		3		
CLAY LOAM: grayish brown, moist, soft to medium stiff, with traces of sand and gravel (USCS - Lean Clay with Sand, CL)			1		
		-10	2	0.4	17
			2		
			2		
	540.50		5	0.8	20
SAND: brown, moist, loose to medium dense, with traces of gravel (USCS - Silty Sand, SM)			6		7
			3		
		-15	4		8
			3		
			5		
			4		4
			4		
			3		
		-20	6		5

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, moist, loose to medium dense, with traces of gravel (USCS - Silty Sand, SM) *(continued)*			4		
			4		
			4		5
			5		
- wet at 24 feet		▼	3		
		-25	3		19
			4		
			6		
			6		21
			7		
			5		
			6		25
		-30	6		
			3		
			3		28
		-35	4		
			3		
			4		23
	513.00	-40	3		

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
Terracon

SOIL BORING LOG

Date 3/17/20

ROUTE FAP 522 (Carman Road) **DESCRIPTION** Structure boring for bridge replacement **LOGGED BY** GS (Terracon)

SECTION (14-2Q)I **LOCATION** Carman Road over Dugout Creek, **SEC.** 15, **TWP.** 68N, **RNG.** 6W, 4th **PM**, **Latitude** 40°40'54"N, **Longitude** 91° 04'13"W

COUNTY Henderson **DRILLING METHOD** HSA to 24' then Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 036-3003 (EX) 036-0074 (PR)
Station 495+00

BORING NO. SB-1
Station 496+02
Offset 17.0 ft LT
Ground Surface Elev. 553.00 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 529.0 ft ▼
Upon Completion ft
After Hrs. ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, wet, loose, with traces of gravel (USCS - Silty Sand, SM)		3		
		3		23
	-45	4		
		4		
		4		24
	-50	4		
500.00				
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand, SP)		4		
		6		18
	-55	7		
		5		
		8		20
	-60	8		

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand, SP) *(continued)*		7		
		9		18
	-65	9		
		7		
		8		
	-70	8		
		7		
		8		16
	-75	10		
		8		
		9		20
	-80	9		

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
Terracon

SOIL BORING LOG

Date 3/17/20

ROUTE FAP 522 (Carman Road) **DESCRIPTION** Structure boring for bridge replacement **LOGGED BY** GS (Terracon)

SECTION (14-2Q)I **LOCATION** Carman Road over Dugout Creek, **SEC.** 15, **TWP.** 68N, **RNG.** 6W, 4th **PM**, **Latitude** 40°40'54"N, **Longitude** 91° 04'13"W

COUNTY Henderson **DRILLING METHOD** HSA to 24' then Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 036-3003 (EX) 036-0074 (PR)
Station 495+00

BORING NO. SB-1
Station 496+02
Offset 17.0 ft LT
Ground Surface Elev. 553.00 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 529.0 ft ▼
Upon Completion ____ ft
After ____ **Hrs.** ____ ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand, SP) *(continued)*					
			7		
			13		21
		-85	14		
	466.00				
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand with Gravel, SP)					
			11		
			11		13
		-90	11		
			10		
			11		19
		-95	8		
			11		
			9		13
End of Boring	453.00	-100	6		

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-105			
-110			
-115			
-120			

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
Terracon

SOIL BORING LOG

Date 3/17/20

ROUTE FAP 522 (Carman Road) **DESCRIPTION** Structure boring for bridge replacement **LOGGED BY** GS (Terracon)

SECTION (14-2Q)I **LOCATION** Carman Road over Dugout Creek, **SEC.** 15, **TWP.** 68N, **RNG.** 6W, 4th **PM**, **Latitude** 40°40'55"N, **Longitude** 91° 04'13"W

COUNTY Henderson **DRILLING METHOD** HSA to 19' then Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 036-3003 (EX) 036-0074 (PR)
Station 495+00

BORING NO. SB-2
Station 495+33
Offset 35.0 ft RT
Ground Surface Elev. 548.00 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 529.0 ft ▼
Upon Completion ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
FILL - SILTY CLAY LOAM: grayish brown, moist, soft, with traces of sand and gravel (USCS - Silty Clay, CL-ML)			1 1 1		25
- dark brown at 4 feet	542.00	-5	1 1 1	0.16	41
CLAY LOAM: dark brown, moist, soft to medium stiff, with traces of sand and gravel (USCS - Lean Clay with Sand, CL)			1 2 3	0.44	24
		-10	1 2 3	0.82	21
	535.00		2 3 5	0.91	21
SAND: brown, moist, loose, with traces of gravel (USCS - Silty Sand, SM)		-15	5 5 5		6
			4 5 5		9
- wet at 19 feet ▼	528.00	-20	1 2		19

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, wet, medium dense to loose, with traces of gravel (USCS - Silty Sand, SM)			4		
			5 6 5		24
		-25	3 4 4		22
			4 5 5		24
		-30	4 4 3		22
		-35	3 3 3		
	510.00				
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand, SP)		-40	7 6 5		19

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)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Terracon

SOIL BORING LOG

Date 3/17/20

ROUTE FAP 522 (Carman Road) **DESCRIPTION** Structure boring for bridge replacement **LOGGED BY** GS (Terracon)

SECTION (14-2Q)I **LOCATION** Carman Road over Dugout Creek, **SEC.** 15, **TWP.** 68N, **RNG.** 6W, 4th **PM**, **Latitude** 40°40'55"N, **Longitude** 91° 04'13"W

COUNTY Henderson **DRILLING METHOD** HSA to 19' then Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 036-3003 (EX) 036-0074 (PR)
Station 495+00

BORING NO. SB-2
Station 495+33
Offset 35.0 ft RT
Ground Surface Elev. 548.00 ft

Surface Water Elev. ______ ft
Stream Bed Elev. ______ ft

Groundwater Elev.:
First Encounter 529.0 ft ▼
Upon Completion ______ ft
After ___ **Hrs.** ______ ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand, SP) *(continued)*				
	-45	6 7 7		14
	-50	6 7 8		17
	-55	4 7 9		21
	-60	5 8 9		21

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand, SP) *(continued)*				
	-65	7 10 9		19
	-70	11 13 9		16
	-75	7 11 15		19
End of boring 468.00	-80	10 13 12		20

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
Terracon

SOIL BORING LOG

Date 3/17/20

ROUTE FAP 522 (Carman Road) **DESCRIPTION** Structure boring for bridge replacement **LOGGED BY** GS (Terracon)

SECTION (14-2Q)I **LOCATION** Carman Road over Dugout Creek, **SEC.** 15, **TWP.** 68N, **RNG.** 6W, 4th **PM**, **Latitude** 40°40'56"N, **Longitude** 91° 04'13"W

COUNTY Henderson **DRILLING METHOD** HSA to 24' then Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 036-3003 (EX) 036-0074 (PR)
Station 495+00

BORING NO. SB-3
Station 493+97
Offset 29.0 ft RT
Ground Surface Elev. 552.00 ft

Surface Water Elev. ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 528.5 ft ▼
Upon Completion ft
After Hrs. ft

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
FILL - SANDY CLAY LOAM: grayish brown, moist, with traces of sand and gravel (USCS - Sandy Lean Clay, CL)			3 4 2		17
- dark brown at 4 feet		-5	4 10 11	0.78	14 11
	545.50				
CLAY LOAM: dark brown, moist, soft, with traces of sand and gravel (USCS - Lean Clay with Sand, CL)			1 1 1	0.26	28
		-10	1 1 1	0.25	25
			2 3 2	0.46	15
		-15	4 4 3	0.32	15
	534.00		2 2 2	0.16	20
SAND: brown, moist, loose, with traces of gravel (USCS - Silty Sand, SM)		-20	2 3		20

Description	Elev. (ft)	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, moist, loose, with traces of gravel (USCS - Silty Sand, SM) *(continued)*			4		9
			4 5 4		8
▼ - wet at 24 feet		-25	1 1 2		19
			5 4 4		28
		-30	4 4 4		27
		-35	4 4 4		21
	512.00	-40	3 4 4		26

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
Terracon

SOIL BORING LOG

Date 3/17/20

ROUTE FAP 522 (Carman Road) **DESCRIPTION** Structure boring for bridge replacement **LOGGED BY** GS (Terracon)

SECTION (14-2Q)I **LOCATION** Carman Road over Dugout Creek, **SEC.** 15, **TWP.** 68N, **RNG.** 6W, 4th **PM**, **Latitude** 40°40'56"N, **Longitude** 91° 04'13"W

COUNTY Henderson **DRILLING METHOD** HSA to 24' then Mud Rotary **HAMMER TYPE** Automatic

STRUCT. NO. 036-3003 (EX) 036-0074 (PR)
Station 495+00

BORING NO. SB-3
Station 493+97
Offset 29.0 ft RT
Ground Surface Elev. 552.00 ft

Surface Water Elev. ____ ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 528.5 ft ▼
Upon Completion ____ ft
After ____ **Hrs.** ____ ft

Description	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SAND: brown, wet, loose, with traces of gravel (USCS - Silty Sand, SM)		3		
	-45	3 4		26
		4		
	-50	4 5		16
499.00				
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand, SP)		6		
	-55	10 12		16
		6		
	-60	8 9		23
SAND: brown, wet, medium dense, with traces of gravel (USCS - Poorly Graded Sand, SP) *(continued)*		4		
	-65	6 8		19
		7		
	-70	10 11		14
		10		
	-75	11 10		22
		8		
End of Boring 472.00	-80	10 11		16

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

NOT TO HORIZONTAL SCALE

Kaskaskia Engineering Group, LLC

SUBSURFACE PROFILE: Carman Road over Dugout Creek

Route: F.A.P. 522

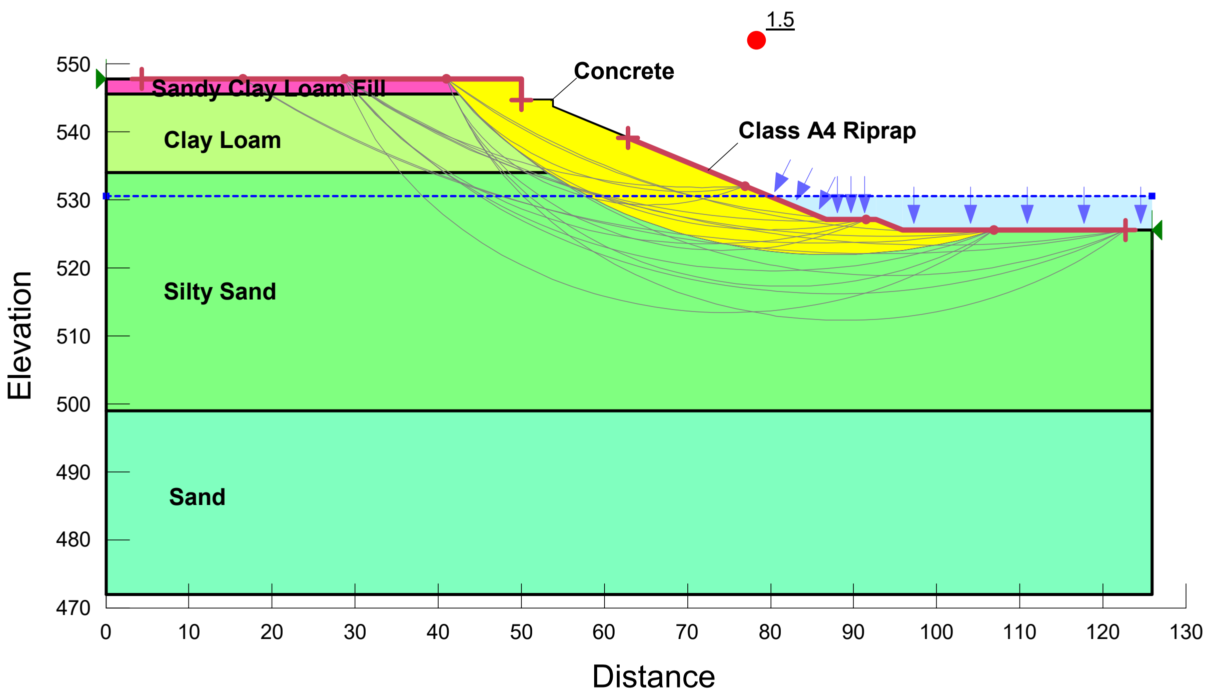
Section: (14-2Q)I

County: Henderson

EXHIBIT E

SLOPE/W SLOPE STABILITY ANALYSIS

Carman Road over Dugout Creek
North Abutment End Slope - Boring SB-3
End-of-construction (Undrained Analysis)



Name: Sandy Clay Loam Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 780 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay Loam
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 400 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

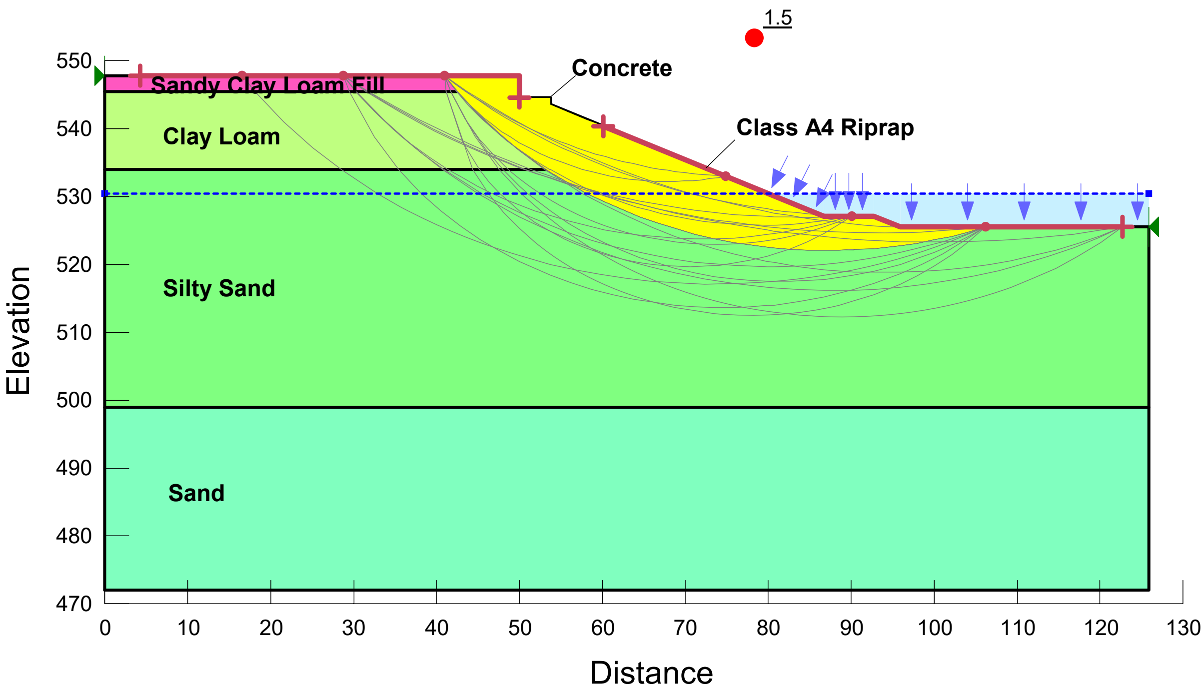
Name: Silty Sand
Model: Mohr-Coulomb
Unit Weight: 112 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Name: Class A4 Riprap
Model: Mohr-Coulomb
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °
Phi-B: 0 °
Piezometric Line: 1

Carman Road over Dugout Creek
North Abutment End Slope - Boring SB-3
Long Term Analysis (Drained Analysis)



Name: Sandy Clay Loam Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 150 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay Loam
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 28 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Sand
Model: Mohr-Coulomb
Unit Weight: 112 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Piezometric Line: 1

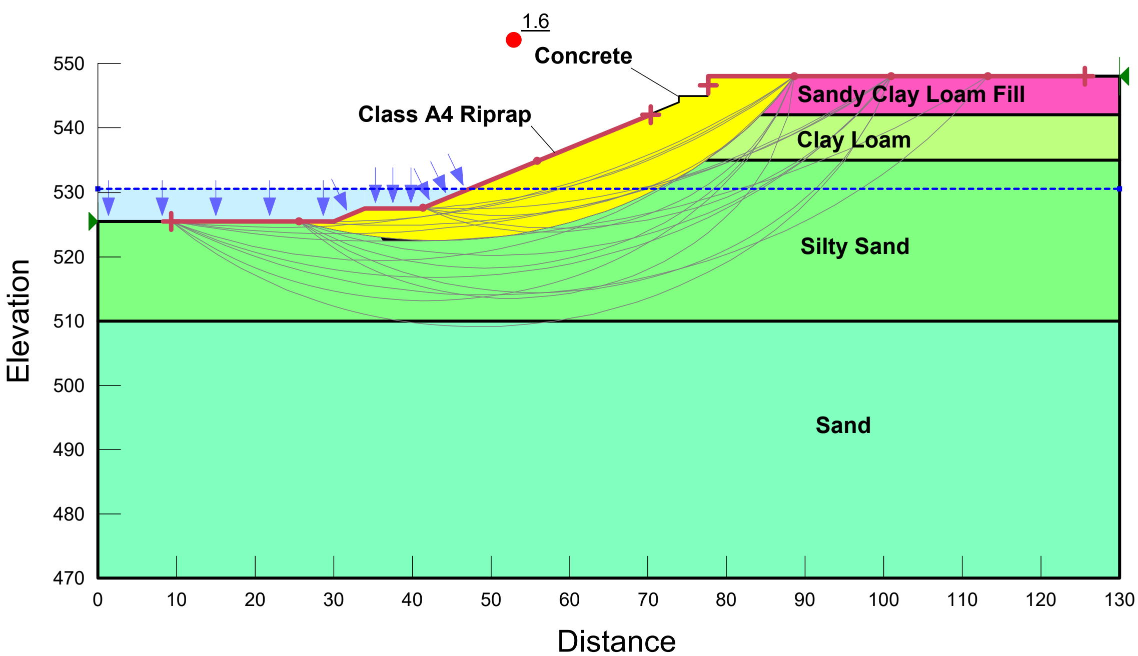
Name: Sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Name: Class A4 Riprap
Model: Mohr-Coulomb
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sandy Clay Loam Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 160 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

Carman Road over Dugout Creek
South Abutment End Slope - Boring SB-2
End-of-construction (Undrained Analysis)



Name: Clay Loam
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 720 psf
Phi': 0 °
Phi-B: 0 °
Piezometric Line: 1

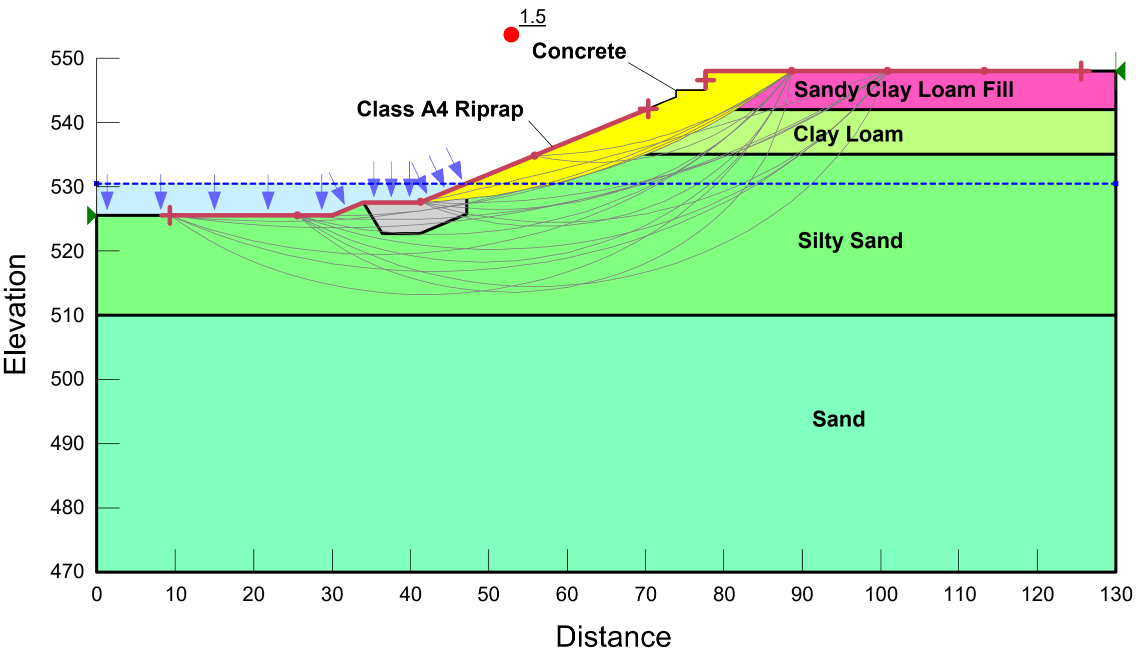
Name: Silty Sand
Model: Mohr-Coulomb
Unit Weight: 112 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Name: Class A4 Riprap
Model: Mohr-Coulomb
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °
Phi-B: 0 °
Piezometric Line: 1

Carman Road over Dugout Creek
South Abutment End Slope - Boring SB-2
Long Term Analysis (Drained Analysis)



Name: Sandy Clay Loam Fill
Model: Mohr-Coulomb
Unit Weight: 120 pcf
Cohesion': 50 psf
Phi': 26 °
Phi-B: 0 °
Piezometric Line: 1

Name: Clay Loam
Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion': 100 psf
Phi': 28 °
Phi-B: 0 °
Piezometric Line: 1

Name: Silty Sand
Model: Mohr-Coulomb
Unit Weight: 112 pcf
Cohesion': 0 psf
Phi': 32 °
Phi-B: 0 °
Piezometric Line: 1

Name: Sand
Model: Mohr-Coulomb
Unit Weight: 110 pcf
Cohesion': 0 psf
Phi': 34 °
Phi-B: 0 °
Piezometric Line: 1

Name: Concrete
Model: Mohr-Coulomb
Unit Weight: 150 pcf
Cohesion': 25,000 psf
Phi': 45 °
Phi-B: 0 °
Piezometric Line: 1

Name: Class A4 Riprap
Model: Mohr-Coulomb
Unit Weight: 145 pcf
Cohesion': 0 psf
Phi': 42 °
Phi-B: 0 °
Piezometric Line: 1

EXHIBIT F

PILE LENGTH/PILE TYPE

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

Illinois Department of Transportation

SUBSTRUCTURE====================================	North Abutment	
REFERENCE BORING ================================	SB-3	
LRFD or ASD or SEISMIC ==============================	LRFD	
PILE CUTOFF ELEV. ====================================	543.00	ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING =	539.00	ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ======	Scour	
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD ===============	541.00	ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) ===============		ft
TOTAL FACTORED SUBSTRUCTURE LOAD ==============	828	kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)==========	40.40	ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE =======	2	
Approx. Factored Loading Applied per pile at 8 ft. Cts ============	81.94	KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============	30.73	KIPS
PILE TYPE AND SIZE =============	Metal Shell 14"Φ w/.25" walls	
Pile Perimeter==============================	3.665	FT.
Pile End Bearing Area==========================	1.069	SQFT.

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
459 KIPS	**215** KIPS	**118** KIPS	*** Below Boring

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
536.50	2.50	7.00	0.32		29.8		***76.7***				77	0	0	42	7
534.00	2.50	4.00	0.16		27.2	46.9	***87.3***				87	0	0	48	9
531.50	2.50		7	Very Fine Silty Sand	5.0	30.3	***107.5***				107	0	0	59	12
529.00	2.50		9	Very Fine Silty Sand	6.5	45.4	***83.7***				84	0	0	46	14
526.50	2.50		3	Very Fine Silty Sand	2.2	15.1	***111.1***				111	0	0	61	17
524.00	2.50		8	Very Fine Silty Sand	5.8	40.4	***116.9***				117	0	0	64	19
521.50	2.50		8	Very Fine Silty Sand	5.8	40.4	***122.6***				123	0	0	67	22
516.50	5.00		8	Very Fine Silty Sand	11.5	40.4	***134.2***				134	0	0	74	27
511.50	5.00		8	Very Fine Silty Sand	11.5	40.4	***140.6***				141	0	0	77	32
506.50	5.00		7	Very Fine Silty Sand	10.1	35.3	***160.8***				161	0	0	88	37
499.00	7.50		9	Very Fine Silty Sand	19.5	45.4	***282.9***				283	0	0	156	44
497.00	2.00		22	Clean Coarse Sand	16.2	148.0	***265.5***				266	0	0	146	46
492.00	5.00		17	Clean Coarse Sand	31.4	114.4	***276.7***				277	0	0	152	51
487.00	5.00		14	Clean Coarse Sand	25.8	94.2	***349.7***				350	0	0	192	56
482.00	5.00		21	Clean Coarse Sand	38.8	141.3	***388.4***				388	0	0	214	61
477.00	5.00		21	Clean Coarse Sand	38.8	141.3	***427.2***				427	0	0	235	66
472.00	5.00		21	Clean Coarse Sand		141.3									

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE===================================== Piers
REFERENCE BORING ================================ SB-2
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 542.00 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 523.00 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =============== 520.50 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD ============== 1277 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 40.40 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 1
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 252.81 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 94.80 KIPS

PILE TYPE AND SIZE ============= Metal Shell 12"Φ w/.25" walls
Pile Perimeter============================== 3.142 FT.
Pile End Bearing Area=========================== 0.785 SQFT.

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
392 KIPS	**358** KIPS	**194** KIPS	*** Below Boring

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
520.50	2.50		10	Very Fine Silty Sand	6.2		***23.5***				23	3	0	10	22
518.00	2.50		7	Very Fine Silty Sand	4.3	17.3	***32.8***				33	3	0	15	24
510.00	8.00		6	Very Fine Silty Sand	11.9	22.2	***76.8***				77	3	0	39	32
508.00	2.00		11	Clean Coarse Sand	7.0	54.4	***98.6***				99	3	0	51	34
503.00	5.00		14	Clean Coarse Sand	22.1	69.2	***125.6***				126	3	0	66	39
498.00	5.00		15	Clean Coarse Sand	23.7	74.2	***154.3***				154	3	0	81	44
493.00	5.00		16	Clean Coarse Sand	25.3	79.1	***184.6***				185	3	0	98	49
488.00	5.00		17	Clean Coarse Sand	26.9	84.0	***221.4***				221	3	0	118	54
483.00	5.00		19	Clean Coarse Sand	30.1	93.9	***266.3***				266	3	0	143	59
478.00	5.00		22	Clean Coarse Sand	34.8	108.8	***320.8***				321	3	0	173	64
473.00	5.00		26	Clean Coarse Sand	42.2	128.5	***358.1***				358	3	0	194	69
468.00	5.00		25	Clean Coarse Sand		123.6									

Illinois Department of Transportation

IDOT STATIC METHOD OF ESTIMATING PILE LENGTH

SUBSTRUCTURE==================================== South Abutment
REFERENCE BORING ================================ SB-1
LRFD or ASD or SEISMIC ============================== LRFD
PILE CUTOFF ELEV. ================================== 543.40 ft
GROUND SURFACE ELEV. AGAINST PILE DURING DRIVING = 539.40 ft
GEOTECHNICAL LOSS TYPE (None, Scour, Liquef., DD) ====== Scour
BOTTOM ELEV. OF SCOUR, LIQUEF., or DD =============== 541.00 ft
TOP ELEV. OF LIQUEF. (so layers above apply DD) =============== ft

TOTAL FACTORED SUBSTRUCTURE LOAD =============== 828 kips
TOTAL LENGTH OF SUBSTRUCTURE (along skew)========== 40.40 ft
NUMBER OF ROWS OF PILES PER SUBSTRUCTURE ======= 2
Approx. Factored Loading Applied per pile at 8 ft. Cts ============ 81.94 KIPS
Approx. Factored Loading Applied per pile at 3 ft. Cts ============ 30.73 KIPS

PILE TYPE AND SIZE ============= Metal Shell 12"Φ w/.25" walls
Pile Perimeter============================== 3.142 FT.
Pile End Bearing Area=========================== 0.785 SQFT.

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
392 KIPS	**378** KIPS	**208** KIPS	**75** FT.

BOT. OF LAYER ELEV. (FT.)	LAYER THICK. (FT.)	UNCONF. COMPR. STRENGTH (TSF.)	S.P.T. N VALUE (BLOWS)	GRANULAR OR ROCK LAYER DESCRIPTION	NOMINAL SIDE RESIST. (KIPS)	NOMINAL END BRG. RESIST. (KIPS)	NOMINAL 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.)
537.40	2.00		7	Very Fine Silty Sand	3.5		***21.3***				21	0	0	12	6
534.90	2.50		8	Very Fine Silty Sand	4.9	17.8	***40.0***				40	0	0	22	9
533.00	1.90		10	Very Fine Silty Sand	4.7	31.6	***46.5***				46	0	0	26	10
530.50	2.50		9	Very Fine Silty Sand	5.6	33.4	***44.6***				45	0	0	25	13
528.00	2.50		7	Very Fine Silty Sand	4.3	26.0	***71.2***				71	0	0	39	15
525.50	2.50		13	Very Fine Silty Sand	8.0	48.2	***75.5***				76	0	0	42	18
523.00	2.50		12	Very Fine Silty Sand	7.4	44.5	***64.4***				64	0	0	35	20
518.00	5.00		7	Very Fine Silty Sand	8.7	26.0	***73.0***				73	0	0	40	25
513.00	5.00		7	Very Fine Silty Sand	8.7	26.0	***81.7***				82	0	0	45	30
508.00	5.00		7	Very Fine Silty Sand	8.7	26.0	***94.1***				94	0	0	52	35
500.00	8.00		8	Very Fine Silty Sand	15.8	29.7	***144.5***				144	0	0	79	43
498.00	2.00		13	Clean Coarse Sand	8.2	64.3	***167.6***				168	0	0	92	45
493.00	5.00		16	Clean Coarse Sand	25.3	79.1	***202.8***				203	0	0	112	50
488.00	5.00		18	Clean Coarse Sand	28.5	89.0	***221.3***				221	0	0	122	55
483.00	5.00		16	Clean Coarse Sand	25.3	79.1	***256.5***				257	0	0	141	60
478.00	5.00		18	Clean Coarse Sand	28.5	89.0	***285.0***				285	0	0	157	65
473.00	5.00		18	Clean Coarse Sand	28.5	89.0	***358.0***				358	0	0	197	70
468.00	5.00		27	Clean Coarse Sand	44.4	133.5	***377.7***				378	0	0	208	75
463.00	5.00		22	Clean Coarse Sand	34.8	108.8	***397.6***				~~398~~	~~0~~	~~0~~	~~219~~	~~80~~
458.00	5.00		19	Clean Coarse Sand	30.1	93.9	***407.9***				~~408~~	~~0~~	~~0~~	~~224~~	~~85~~
453.00	5.00		15	Clean Coarse Sand		74.2									

EXHIBIT G

TEMPORARY SHEET PILE DESIGN

SPREADSHEETS

Illinois Department of Transportation

TEMPORARY SHEET PILE DESIGN CHARTS

STRUCTURE ========================== Carman Road over Dugout Creek
SUBSTRUCTURE & REFERENCE BORING ==== South Abutment SB-1

SOIL PROPERTIES BELOW EXCAVATION LINE

RETAINED HEIGHT (FT)	LAYER THICKNESS (FT)	SPT N - VALUE (BPF)	UNCONFINED COMPR. STRENGTH Qu (TSF)
5	8	6	0.75
	4.5	8	0.6
	2.5	7	
	2.5	8	
	2.5	10	
	2.5	9	
	2.5	7	
	2.5	13	
	2.5	12	
	5	7	

COHESIVE CHARTS CONTROL USING AN EMBEDMENT DEPTH OF: **3.75** ***FT***

AND REQUIRES A SECTION MODULUS OF: **1.12** ***IN.^{3}/FT***

DEPTH BELOW EXCAV. (FT)	SPLIT LAYER THICK-NESS (FT)	SPLIT N AT DEPTH (BPF)	SPLIT Qu AT DEPTH (TSF)	AVG. N ABOVE DEPTH (BPF)	AVG. N IN UPPER 50% (BPF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. N IN UPPER 33% (BPF)	REQ'D CHART SECT. MOD. W/ AMP. (IN.^{3}/FT)	RATIO LOWER/ UPPER 1/3 N	AVG. Qu ABOVE DEPTH (TSF)	AVG. Qu IN UPPER 50% (TSF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. Qu IN UPPER 33% (TSF)	REQ'D CHART SECT.MOD. W/ AMP. (IN.^{3}/FT)	RATIO OF LOWER/ UPPER 1/3 Qu
2.00	2	7.5	0.75	7.50						0.75					
4.00	2	7.5	0.75	7.50						0.75					
6.00	2	7.5	0.75	7.50	7.50	~~9.94~~	7.50		1.00	0.75	0.75	3.75	0.75	1.12	1.00
8.00	2	7.5	0.75	7.50	7.50	~~9.94~~	7.50		1.00	0.75	0.75		0.75		1.00
8.56	0.5625	6	0.6	7.40	7.50	~~9.94~~	7.50		1.00	0.74	0.75		0.75		1.00
9.13	0.5625	6	0.6	7.32	7.50	~~9.98~~	7.50		1.00	0.73	0.75		0.75		1.00
9.69	0.5625	6	0.6	7.24	7.50	~~10.02~~	7.50		1.00	0.72	0.75		0.75		1.00
10.25	0.5625	6	0.6	7.17	7.50	10.05	7.50	3.15	1.00	0.72	0.75		0.75		1.00

Illinois Department of Transportation

TEMPORARY SHEET PILE DESIGN CHARTS

STRUCTURE ========================== Carman Road over Dugout Creek
SUBSTRUCTURE & REFERENCE BORING ==== South Abutment SB-1

SOIL PROPERTIES BELOW EXCAVATION LINE

RETAINED HEIGHT (FT)	LAYER THICK-NESS (FT)	SPT N - VALUE (BPF)	UNCONFINED COMPR. STRENGTH Qu (TSF)
10	8	6	0.75
	4.5	8	0.6
	2.5	7	
	2.5	8	
	2.5	10	
	2.5	9	
	2.5	7	
	2.5	13	
	2.5	12	
	5	7	

COHESIVE CHARTS CONTROL USING AN EMBEDMENT DEPTH OF: 11.25 ***FT***

AND REQUIRES A SECTION MODULUS OF: 8.05 ***$IN.^3/FT$***

DEPTH BELOW EXCAV. (FT)	SPLIT LAYER THICK-NESS (FT)	SPLIT N AT DEPTH (BPF)	SPLIT Qu AT DEPTH (TSF)	AVG. N ABOVE DEPTH (BPF)	AVG. N IN UPPER 50% (BPF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. N IN UPPER 33% (BPF)	REQ'D CHART SECT. MOD. W/ AMP. ($IN.^3/FT$)	RATIO LOWER/ UPPER 1/3 N	AVG. Qu ABOVE DEPTH (TSF)	AVG. Qu IN UPPER 50% (TSF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. Qu IN UPPER 33% (TSF)	REQ'D CHART SECT.MOD. W/ AMP. ($IN.^3/FT$)	RATIO OF LOWER/ UPPER 1/3 Qu
2.00	2	7.5	0.75	7.50						0.75					
4.00	2	7.5	0.75	7.50						0.75					
6.00	2	7.5	0.75	7.50	7.50	~~17.37~~	7.50		1.00	0.75	0.75	~~10.64~~	0.75		1.00
8.00	2	7.5	0.75	7.50	7.50	~~17.37~~	7.50		1.00	0.75	0.75	~~10.64~~	0.75		1.00
8.56	0.5625	6	0.6	7.40	7.50	~~17.37~~	7.50		1.00	0.74	0.75	~~10.64~~	0.75		1.00
9.13	0.5625	6	0.6	7.32	7.50	~~17.44~~	7.50		1.00	0.73	0.75	~~10.79~~	0.75		1.00
9.69	0.5625	6	0.6	7.24	7.50	~~17.51~~	7.50		1.00	0.72	0.75	~~10.93~~	0.75		1.00
10.25	0.5625	6	0.6	7.17	7.50	~~17.56~~	7.50		1.00	0.72	0.75	~~11.05~~	0.75		1.00
10.81	0.5625	6	0.6	7.11	7.50	~~17.61~~	7.50		1.00	0.71	0.75	~~11.16~~	0.75		1.00
11.38	0.5625	6	0.6	7.05	7.50	~~17.65~~	7.50		1.00	0.71	0.75	11.25	0.75	8.05	1.00
11.94	0.5625	6	0.6	7.01	7.50	~~17.69~~	7.50		1.00	0.70	0.75		0.75		1.00
12.50	0.5625	6	0.6	6.96	7.50	~~17.73~~	7.50		1.00	0.70	0.75		0.75		1.00
12.81	0.3125	7	0	6.96	7.50	~~17.77~~	7.50		1.00	0.68	0.75		0.75		1.00
13.13	0.3125	7	0	6.96	7.50	~~17.76~~	7.50		1.00	0.66	0.75		0.75		1.00
13.44	0.3125	7	0	6.96	7.50	~~17.76~~	7.50		1.00	0.65	0.75		0.75		1.00
13.75	0.3125	7	0	6.96	7.50	~~17.76~~	7.50		1.00	0.63	0.75		0.75		1.00
14.06	0.3125	7	0	6.96	7.50	~~17.76~~	7.50		1.00	0.62	0.75		0.75		1.00
14.38	0.3125	7	0	6.97	7.50	~~17.76~~	7.50		1.00	0.61	0.75		0.75		1.00
14.69	0.3125	7	0	6.97	7.50	~~17.76~~	7.50		1.00	0.59	0.75		0.75		1.00
15.00	0.3125	7	0	6.97	7.50	~~17.76~~	7.50		1.00	0.58	0.75		0.75		1.00
15.31	0.3125	8	0	6.99	7.50	~~17.76~~	7.50		1.00	0.57	0.75		0.75		1.00
15.63	0.3125	8	0	7.01	7.50	~~17.74~~	7.50		1.00	0.56	0.75		0.75		1.00
15.94	0.3125	8	0	7.03	7.50	~~17.73~~	7.50		1.00	0.55	0.75		0.75		1.00
16.25	0.3125	8	0	7.05	7.48	~~17.71~~	7.50		1.00	0.54	0.75		0.75		1.00
16.56	0.3125	8	0	7.06	7.45	~~17.70~~	7.50		1.00	0.53	0.74		0.75		1.00
16.88	0.3125	8	0	7.08	7.42	~~17.68~~	7.50		1.00	0.52	0.74		0.75		1.00
17.19	0.3125	8	0	7.10	7.40	~~17.67~~	7.50		1.00	0.51	0.74		0.75		1.00
17.50	0.3125	8	0	7.11	7.37	~~17.66~~	7.50		1.00	0.50	0.74		0.75		1.00
17.81	0.3125	10	0	7.16	7.35	17.65	7.50	17.29	1.00	0.49	0.73		0.75		1.00

Illinois Department of Transportation

TEMPORARY SHEET PILE DESIGN CHARTS

STRUCTURE ========================== Carman Road over Dugout Creek
SUBSTRUCTURE & REFERENCE BORING ==== South Abutment SB-1

SOIL PROPERTIES BELOW EXCAVATION LINE

RETAINED HEIGHT (FT)	LAYER THICKNESS (FT)	SPT N-VALUE (BPF)	UNCONFINED COMPR. STRENGTH Qu (TSF)
15	8	6	0.75
	4.5	8	0.6
	2.5	7	
	2.5	8	
	2.5	10	
	2.5	9	
	2.5	7	
	2.5	13	
	2.5	12	
	5	7	

GRANULAR CHARTS CONTROL USING AN EMBEDMENT DEPTH OF: 25.32 ***FT***

AND REQUIRES A SECTION MODULUS OF: 50.49 ***$IN.^3/FT$***

DEPTH BELOW EXCAV. (FT)	SPLIT LAYER THICK-NESS (FT)	SPLIT N AT DEPTH (BPF)	SPLIT Qu AT DEPTH (TSF)	AVG. N ABOVE DEPTH (BPF)	AVG. N IN UPPER 50% (BPF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. N IN UPPER 33% (BPF)	REQ'D CHART SECT. MOD. W/ AMP. ($IN.^3/FT$)	RATIO LOWER/ UPPER 1/3 N	AVG. Qu ABOVE DEPTH (TSF)	AVG. Qu IN UPPER 50% (TSF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. Qu IN UPPER 33% (TSF)	REQ'D CHART SECT.MOD. W/ AMP. ($IN.^3/FT$)	RATIO OF LOWER/ UPPER 1/3 Qu
2.00	2	7.5	0.75	7.50						0.75					
4.00	2	7.5	0.75	7.50						0.75					
6.00	2	7.5	0.75	7.50	7.50	~~24.77~~	7.50		1.00	0.75	0.75	########	0.75		1.00
8.00	2	7.5	0.75	7.50	7.50	~~24.77~~	7.50		1.00	0.75	0.75	########	0.75		1.00
8.56	0.5625	6	0.6	7.40	7.50	~~24.77~~	7.50		1.00	0.74	0.75	########	0.75		1.00
9.13	0.5625	6	0.6	7.32	7.50	~~24.87~~	7.50		1.00	0.73	0.75	########	0.75		1.00
9.69	0.5625	6	0.6	7.24	7.50	~~24.96~~	7.50		1.00	0.72	0.75	########	0.75		1.00
10.25	0.5625	6	0.6	7.17	7.50	~~25.03~~	7.50		1.00	0.72	0.75	########	0.75		1.00
10.81	0.5625	6	0.6	7.11	7.50	~~25.10~~	7.50		1.00	0.71	0.75	########	0.75		1.00
11.38	0.5625	6	0.6	7.05	7.50	~~25.16~~	7.50		1.00	0.71	0.75	########	0.75		1.00
11.94	0.5625	6	0.6	7.01	7.50	~~25.22~~	7.50		1.00	0.70	0.75	########	0.75		1.00
12.50	0.5625	6	0.6	6.96	7.50	~~25.27~~	7.50		1.00	0.70	0.75	########	0.75		1.00
12.81	0.3125	7	0	6.96	7.50	~~25.32~~	7.50		1.00	0.68	0.75		0.75		1.00
13.13	0.3125	7	0	6.96	7.50	~~25.32~~	7.50		1.00	0.66	0.75		0.75		1.00
13.44	0.3125	7	0	6.96	7.50	~~25.32~~	7.50		1.00	0.65	0.75		0.75		1.00
13.75	0.3125	7	0	6.96	7.50	~~25.32~~	7.50		1.00	0.63	0.75		0.75		1.00
14.06	0.3125	7	0	6.96	7.50	~~25.32~~	7.50		1.00	0.62	0.75		0.75		1.00
14.38	0.3125	7	0	6.97	7.50	~~25.32~~	7.50		1.00	0.61	0.75		0.75		1.00
14.69	0.3125	7	0	6.97	7.50	~~25.32~~	7.50		1.00	0.59	0.75		0.75		1.00
15.00	0.3125	7	0	6.97	7.50	~~25.32~~	7.50		1.00	0.58	0.75		0.75		1.00
15.31	0.3125	8	0	6.99	7.50	~~25.32~~	7.50		1.00	0.57	0.75		0.75		1.00
15.63	0.3125	8	0	7.01	7.50	~~25.29~~	7.50		1.00	0.56	0.75		0.75		1.00
15.94	0.3125	8	0	7.03	7.50	~~25.27~~	7.50		1.00	0.55	0.75		0.75		1.00
16.25	0.3125	8	0	7.05	7.48	~~25.25~~	7.50		1.00	0.54	0.75		0.75		1.00
16.56	0.3125	8	0	7.06	7.45	~~25.23~~	7.50		1.00	0.53	0.74		0.75		1.00
16.88	0.3125	8	0	7.08	7.42	~~25.21~~	7.50		1.00	0.52	0.74		0.75		1.00
17.19	0.3125	8	0	7.10	7.40	~~25.19~~	7.50		1.00	0.51	0.74		0.75		1.00
17.50	0.3125	8	0	7.11	7.37	~~25.18~~	7.50		1.00	0.50	0.74		0.75		1.00
17.81	0.3125	10	0	7.16	7.35	~~25.16~~	7.50		1.00	0.49	0.73		0.75		1.00
18.13	0.3125	10	0	7.21	7.32	~~25.11~~	7.50		1.00	0.48	0.73		0.75		1.00
18.44	0.3125	10	0	7.26	7.30	~~25.06~~	7.50		1.00	0.47	0.73		0.75		1.00
18.75	0.3125	10	0	7.31	7.28	~~25.01~~	7.50		1.00	0.46	0.73		0.75		1.00
19.06	0.3125	10	0	7.35	7.26	~~24.99~~	7.50		1.00	0.46	0.73		0.75		1.00
19.38	0.3125	10	0	7.39	7.24	~~25.01~~	7.50		1.00	0.45	0.72		0.75		1.00
19.69	0.3125	10	0	7.43	7.22	~~25.03~~	7.50		1.00	0.44	0.72		0.75		1.00
20.00	0.3125	10	0	7.48	7.20	~~25.05~~	7.50		1.00	0.44	0.72		0.75		1.00
20.31	0.3125	9	0	7.50	7.18	~~25.07~~	7.50		1.00	0.43	0.72		0.75		1.00
20.63	0.3125	9	0	7.52	7.16	~~25.09~~	7.50		1.00	0.42	0.72		0.75		1.00
20.94	0.3125	9	0	7.54	7.15	~~25.11~~	7.50		1.00	0.42	0.71		0.75		1.00
21.25	0.3125	9	0	7.56	7.13	~~25.13~~	7.50		1.00	0.41	0.71		0.75		1.00
21.56	0.3125	9	0	7.59	7.11	~~25.14~~	7.50		1.00	0.40	0.71		0.75		1.00
21.88	0.3125	9	0	7.61	7.10	~~25.16~~	7.50		1.00	0.40	0.71		0.75		1.00
22.19	0.3125	9	0	7.63	7.08	~~25.18~~	7.50		1.00	0.39	0.71		0.75		1.00
22.50	0.3125	9	0	7.64	7.07	~~25.19~~	7.50		1.00	0.39	0.71		0.75		1.00
22.81	0.3125	7	0	7.64	7.05	~~25.21~~	7.50		1.00	0.38	0.71		0.75		1.00
23.13	0.3125	7	0	7.63	7.04	~~25.22~~	7.50		1.00	0.38	0.70		0.75		1.00
23.44	0.3125	7	0	7.62	7.02	~~25.24~~	7.50		1.00	0.37	0.70		0.75		1.00
23.75	0.3125	7	0	7.61	7.01	~~25.25~~	7.50		1.00	0.37	0.70		0.75		1.00
24.06	0.3125	7	0	7.60	7.00	~~25.27~~	7.50		1.00	0.36	0.70		0.75		1.00
24.38	0.3125	7	0	7.59	6.98	~~25.28~~	7.48		0.99	0.36	0.70		0.75		0.99
24.69	0.3125	7	0	7.59	6.97	~~25.29~~	7.46		0.99	0.35	0.70		0.75		0.99
25.00	0.3125	7	0	7.58	6.96	~~25.31~~	7.44		0.98	0.35	0.70		0.74		0.98
25.31	0.3125	13	0	7.65	6.96	~~25.32~~	7.42		0.98	0.34	0.69		0.74		0.98
25.63	0.3125	13	0	7.71	6.96	25.32	7.40	50.49	0.97	0.34	0.68		0.74		0.97

Illinois Department of Transportation

TEMPORARY SHEET PILE DESIGN CHARTS

STRUCTURE ========================== Carman Road over Dugpout Creek
SUBSTRUCTURE & REFERENCE BORING ==== North Abutment SB-3

SOIL PROPERTIES BELOW EXCAVATION LINE

RETAINED HEIGHT (FT)	LAYER THICKNESS (FT)	SPT N-VALUE (BPF)	UNCONFINED COMPR. STRENGTH Qu (TSF)
5	3	6	0.75
	2.5	22	0.78
	11.5	4	0.29
	2.5	7	
	2.5	9	
	2.5	3	
	2.5	8	
	2.5	8	
	5	8	
	5	8	

COHESIVE CHARTS CONTROL USING AN EMBEDMENT DEPTH OF: 3.75 ***FT***

AND REQUIRES A SECTION MODULUS OF: 1.12 ***IN.^{3}/FT***

DEPTH BELOW EXCAV. (FT)	SPLIT LAYER THICKNESS (FT)	SPLIT N AT DEPTH (BPF)	SPLIT Qu AT DEPTH (TSF)	AVG. N ABOVE DEPTH (BPF)	AVG. N IN UPPER 50% (BPF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. N IN UPPER 33% (BPF)	REQ'D CHART SECT. MOD. W/ AMP. (IN.^{3}/FT)	RATIO LOWER/ UPPER 1/3 N	AVG. Qu ABOVE DEPTH (TSF)	AVG. Qu IN UPPER 50% (TSF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. Qu IN UPPER 33% (TSF)	REQ'D CHART SECT.MOD. W/ AMP. (IN.^{3}/FT)	RATIO OF LOWER/ UPPER 1/3 Qu
0.75	0.75	7.5	0.75	7.50						0.75					
1.50	0.75	7.5	0.75	7.50						0.75					
2.25	0.75	7.5	0.75	7.50	7.50	~~9.94~~	7.50		1.00	0.75	0.75	~~3.75~~	0.75		1.00
3.00	0.75	7.5	0.75	7.50	7.50	~~9.94~~	7.50		1.00	0.75	0.75	~~3.75~~	0.75		1.00
3.31	0.3125	7.8	0.78	7.53	7.50	~~9.94~~	7.50		1.00	0.75	0.75	~~3.75~~	0.75		1.00
3.63	0.3125	7.8	0.78	7.55	7.50	~~9.94~~	7.50		1.00	0.76	0.75	~~3.75~~	0.75		1.00
3.94	0.3125	7.8	0.78	7.57	7.50	~~9.94~~	7.50		1.00	0.76	0.75	3.75	0.75	1.12	1.00
4.25	0.3125	7.8	0.78	7.59	7.50	~~9.94~~	7.50		1.00	0.76	0.75		0.75		1.00
4.56	0.3125	7.8	0.78	7.60	7.50	~~9.94~~	7.50		1.00	0.76	0.75		0.75		1.00
4.88	0.3125	7.8	0.78	7.62	7.50	~~9.94~~	7.50		1.00	0.76	0.75		0.75		1.00
5.19	0.3125	7.8	0.78	7.63	7.50	~~9.94~~	7.50		1.00	0.76	0.75		0.75		1.00
5.50	0.3125	7.8	0.78	7.64	7.50	~~9.94~~	7.50		1.00	0.76	0.75		0.75		1.00
6.94	1.4375	2.9	0.29	6.65	7.54	~~9.94~~	7.50		1.00	0.67	0.75		0.75		1.00
8.38	1.4375	2.9	0.29	6.01	7.59	~~10.32~~	7.50		1.00	0.60	0.76		0.75		1.00
9.81	1.4375	2.9	0.29	5.55	7.62	~~10.64~~	7.52		1.01	0.56	0.76		0.75		1.01
11.25	1.4375	2.9	0.29	5.22	7.53	10.93	7.56	3.15	1.02	0.52	0.75		0.76		1.02

TEMPORARY SHEET PILE DESIGN CHARTS

Illinois Department of Transportation

STRUCTURE ========================== Carman Road over Dugpout Creek
SUBSTRUCTURE & REFERENCE BORING ==== North Abutment SB-3

SOIL PROPERTIES BELOW EXCAVATION LINE

RETAINED HEIGHT (FT)	LAYER THICKNESS (FT)	SPT N - VALUE (BPF)	UNCONFINED COMPR. STRENGTH Qu (TSF)
10	3	6	0.75
	2.5	22	0.78
	11.5	4	0.29
	2.5	7	
	2.5	9	
	2.5	3	
	2.5	8	
	2.5	8	
	5	8	
	5	8	

GRANULAR CHARTS CONTROL USING AN EMBEDMENT DEPTH OF: 19.89 ***FT***

AND REQUIRES A SECTION MODULUS OF: 17.92 ***IN.^{3}/FT***

DEPTH BELOW EXCAV. (FT)	SPLIT LAYER THICKNESS (FT)	SPLIT N AT DEPTH (BPF)	SPLIT Qu AT DEPTH (TSF)	AVG. N ABOVE DEPTH (BPF)	AVG. N IN UPPER 50% (BPF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. N IN UPPER 33% (BPF)	REQ'D CHART SECT. MOD. W/ AMP. (IN.^{3}/FT)	RATIO LOWER/ UPPER 1/3 N	AVG. Qu ABOVE DEPTH (TSF)	AVG. Qu IN UPPER 50% (TSF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. Qu IN UPPER 33% (TSF)	REQ'D CHART SECT.MOD. W/ AMP. (IN.^{3}/FT)	RATIO OF LOWER/ UPPER 1/3 Qu
0.75	0.75	7.5	0.75	7.50						0.75					
1.50	0.75	7.5	0.75	7.50						0.75					
2.25	0.75	7.5	0.75	7.50	7.50	~~17.37~~	7.50		1.00	0.75	0.75	~~10.64~~	0.75		1.00
3.00	0.75	7.5	0.75	7.50	7.50	~~17.37~~	7.50		1.00	0.75	0.75	~~10.64~~	0.75		1.00
3.31	0.3125	7.8	0.78	7.53	7.50	~~17.37~~	7.50		1.00	0.75	0.75	~~10.64~~	0.75		1.00
3.63	0.3125	7.8	0.78	7.55	7.50	~~17.37~~	7.50		1.00	0.76	0.75	~~10.64~~	0.75		1.00
3.94	0.3125	7.8	0.78	7.57	7.50	~~17.37~~	7.50		1.00	0.76	0.75	~~10.64~~	0.75		1.00
4.25	0.3125	7.8	0.78	7.59	7.50	~~17.37~~	7.50		1.00	0.76	0.75	~~10.64~~	0.75		1.00
4.56	0.3125	7.8	0.78	7.60	7.50	~~17.37~~	7.50		1.00	0.76	0.75	~~10.64~~	0.75		1.00
4.88	0.3125	7.8	0.78	7.62	7.50	~~17.37~~	7.50		1.00	0.76	0.75	~~10.64~~	0.75		1.00
5.19	0.3125	7.8	0.78	7.63	7.50	~~17.37~~	7.50		1.00	0.76	0.75	~~10.64~~	0.75		1.00
5.50	0.3125	7.8	0.78	7.64	7.50	~~17.37~~	7.50		1.00	0.76	0.75	~~10.64~~	0.75		1.00
6.94	1.4375	2.9	0.29	6.65	7.54	~~17.37~~	7.50		1.00	0.67	0.75	~~10.64~~	0.75		1.00
8.38	1.4375	2.9	0.29	6.01	7.59	~~18.03~~	7.50		1.00	0.60	0.76	~~13.03~~	0.75		1.00
9.81	1.4375	2.9	0.29	5.55	7.62	~~18.58~~	7.52		1.01	0.56	0.76	~~16.03~~	0.75		1.01
11.25	1.4375	2.9	0.29	5.22	7.53	~~19.07~~	7.56		1.02	0.52	0.75	~~########~~	0.76		1.02
12.69	1.4375	2.9	0.29	4.95	7.01	~~19.43~~	7.59		1.02	0.50	0.70	~~########~~	0.76		1.02
14.13	1.4375	2.9	0.29	4.74	6.59	~~19.72~~	7.61		1.03	0.47	0.66	~~########~~	0.76		1.03
15.56	1.4375	2.9	0.29	4.57	6.25	~~20.01~~	7.63		1.03	0.46	0.62	~~########~~	0.76		1.03
17.00	1.4375	2.9	0.29	4.43	5.96	~~20.24~~	7.50		1.00	0.44	0.60	~~########~~	0.75		1.00
17.31	0.3125	7	0	4.48	5.91	~~20.44~~	7.41		0.98	0.44	0.59		0.74		0.98
17.63	0.3125	7	0	4.52	5.86	~~20.38~~	7.33		0.96	0.43	0.59		0.73		0.96
17.94	0.3125	7	0	4.57	5.80	~~20.31~~	7.26		0.94	0.42	0.58		0.73		0.94
18.25	0.3125	7	0	4.61	5.75	~~20.25~~	7.18		0.91	0.41	0.58		0.72		0.91
18.56	0.3125	7	0	4.65	5.71	~~20.20~~	7.11		0.89	0.41	0.57		0.71		0.89
18.88	0.3125	7	0	4.69	5.66	~~20.14~~	7.04		0.87	0.40	0.57		0.70		0.87
19.19	0.3125	7	0	4.73	5.62	~~20.09~~	6.97		0.85	0.39	0.56		0.70		0.85
19.50	0.3125	7	0	4.76	5.57	~~20.04~~	6.91		0.84	0.39	0.56		0.69		0.84
19.81	0.3125	9	0	4.83	5.53	~~19.99~~	6.84		0.82	0.38	0.55		0.68		0.82
20.13	0.3125	9	0	4.89	5.49	19.89	6.78	17.92	0.80	0.37	0.55		0.68		0.80

TEMPORARY SHEET PILE DESIGN CHARTS

Illinois Department of Transportation

STRUCTURE ========================== Carman Road over Dugpout Creek
SUBSTRUCTURE & REFERENCE BORING ==== North Abutment SB-3

SOIL PROPERTIES BELOW EXCAVATION LINE

RETAINED HEIGHT (FT)	LAYER THICKNESS (FT)	SPT N - VALUE (BPF)	UNCONFINED COMPR. STRENGTH Qu (TSF)
15	3	6	0.75
	2.5	22	0.78
	11.5	4	0.29
	2.5	7	
	2.5	9	
	2.5	3	
	2.5	8	
	2.5	8	
	5	8	
	5	8	

GRANULAR CHARTS CONTROL USING AN EMBEDMENT DEPTH OF: 28.51 ***FT***

AND REQUIRES A SECTION MODULUS OF: 55.70 ***IN.^{3}/FT***

DEPTH BELOW EXCAV. (FT)	SPLIT LAYER THICK-NESS (FT)	SPLIT N AT DEPTH (BPF)	SPLIT Qu AT DEPTH (TSF)	AVG. N ABOVE DEPTH (BPF)	AVG. N IN UPPER 50% (BPF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. N IN UPPER 33% (BPF)	REQ'D CHART SECT. MOD. W/ AMP. (IN.^{3}/FT)	RATIO LOWER/ UPPER 1/3 N	AVG. Qu ABOVE DEPTH (TSF)	AVG. Qu IN UPPER 50% (TSF)	REQ'D CHART EMBED. DEPTH (FT)	AVG. Qu IN UPPER 33% (TSF)	REQ'D CHART SECT.MOD. W/ AMP. (IN.^{3}/FT)	RATIO OF LOWER/ UPPER 1/3 Qu
0.75	0.75	7.5	0.75	7.50						0.75					
1.50	0.75	7.5	0.75	7.50						0.75					
2.25	0.75	7.5	0.75	7.50	7.50	~~24.77~~	7.50		1.00	0.75	0.75	~~#########~~	0.75		1.00
3.00	0.75	7.5	0.75	7.50	7.50	~~24.77~~	7.50		1.00	0.75	0.75	~~#########~~	0.75		1.00
3.31	0.3125	7.8	0.78	7.53	7.50	~~24.77~~	7.50		1.00	0.75	0.75	~~#########~~	0.75		1.00
3.63	0.3125	7.8	0.78	7.55	7.50	~~24.77~~	7.50		1.00	0.76	0.75	~~#########~~	0.75		1.00
3.94	0.3125	7.8	0.78	7.57	7.50	~~24.77~~	7.50		1.00	0.76	0.75	~~#########~~	0.75		1.00
4.25	0.3125	7.8	0.78	7.59	7.50	~~24.77~~	7.50		1.00	0.76	0.75	~~#########~~	0.75		1.00
4.56	0.3125	7.8	0.78	7.60	7.50	~~24.77~~	7.50		1.00	0.76	0.75	~~#########~~	0.75		1.00
4.88	0.3125	7.8	0.78	7.62	7.50	~~24.77~~	7.50		1.00	0.76	0.75	~~#########~~	0.75		1.00
5.19	0.3125	7.8	0.78	7.63	7.50	~~24.77~~	7.50		1.00	0.76	0.75	~~#########~~	0.75		1.00
5.50	0.3125	7.8	0.78	7.64	7.50	~~24.77~~	7.50		1.00	0.76	0.75	~~#########~~	0.75		1.00
6.94	1.4375	2.9	0.29	6.65	7.54	~~24.77~~	7.50		1.00	0.67	0.75	~~#########~~	0.75		1.00
8.38	1.4375	2.9	0.29	6.01	7.59	~~25.70~~	7.50		1.00	0.60	0.76	~~#########~~	0.75		1.00
9.81	1.4375	2.9	0.29	5.55	7.62	~~26.48~~	7.52		1.01	0.56	0.76	~~#########~~	0.75		1.01
11.25	1.4375	2.9	0.29	5.22	7.53	~~27.17~~	7.56		1.02	0.52	0.75	~~#########~~	0.76		1.02
12.69	1.4375	2.9	0.29	4.95	7.01	~~27.68~~	7.59		1.02	0.50	0.70	~~#########~~	0.76		1.02
14.13	1.4375	2.9	0.29	4.74	6.59	~~28.10~~	7.61		1.03	0.47	0.66	~~#########~~	0.76		1.03
15.56	1.4375	2.9	0.29	4.57	6.25	~~28.51~~	7.63		1.03	0.46	0.62	~~#########~~	0.76		1.03
17.00	1.4375	2.9	0.29	4.43	5.96	~~28.84~~	7.50		1.00	0.44	0.60	~~#########~~	0.75		1.00
17.31	0.3125	7	0	4.48	5.91	~~29.12~~	7.41		0.98	0.44	0.59		0.74		0.98
17.63	0.3125	7	0	4.52	5.86	~~29.03~~	7.33		0.96	0.43	0.59		0.73		0.96
17.94	0.3125	7	0	4.57	5.80	~~28.94~~	7.26		0.94	0.42	0.58		0.73		0.94
18.25	0.3125	7	0	4.61	5.75	~~28.86~~	7.18		0.91	0.41	0.58		0.72		0.91
18.56	0.3125	7	0	4.65	5.71	~~28.78~~	7.11		0.89	0.41	0.57		0.71		0.89
18.88	0.3125	7	0	4.69	5.66	~~28.70~~	7.04		0.87	0.40	0.57		0.70		0.87
19.19	0.3125	7	0	4.73	5.62	~~28.62~~	6.97		0.85	0.39	0.56		0.70		0.85
19.50	0.3125	7	0	4.76	5.57	~~28.55~~	6.91		0.84	0.39	0.56		0.69		0.84
19.81	0.3125	9	0	4.83	5.53	~~28.48~~	6.84		0.82	0.38	0.55		0.68		0.82
20.13	0.3125	9	0	4.89	5.49	~~28.34~~	6.78		0.80	0.37	0.55		0.68		0.80
20.44	0.3125	9	0	4.96	5.45	~~28.22~~	6.72		0.78	0.37	0.54		0.67		0.78
20.75	0.3125	9	0	5.02	5.41	~~28.09~~	6.67		0.77	0.36	0.54		0.67		0.77
21.06	0.3125	9	0	5.08	5.37	~~27.98~~	6.61		0.75	0.36	0.54		0.66		0.75
21.38	0.3125	9	0	5.13	5.34	~~27.89~~	6.56		0.74	0.35	0.53		0.66		0.74
21.69	0.3125	9	0	5.19	5.30	~~27.81~~	6.50		0.72	0.35	0.53		0.65		0.72
22.00	0.3125	9	0	5.24	5.27	~~27.72~~	6.45		0.71	0.34	0.53		0.65		0.71
22.31	0.3125	3	0	5.21	5.24	~~27.64~~	6.40		0.69	0.34	0.52		0.64		0.69
22.63	0.3125	3	0	5.18	5.20	~~27.69~~	6.35		0.68	0.33	0.52		0.64		0.68
22.94	0.3125	3	0	5.15	5.17	~~27.73~~	6.31		0.67	0.33	0.52		0.63		0.67
23.25	0.3125	3	0	5.12	5.14	~~27.78~~	6.26		0.65	0.32	0.51		0.63		0.65
23.56	0.3125	3	0	5.09	5.11	~~27.82~~	6.22		0.64	0.32	0.51		0.62		0.64
23.88	0.3125	3	0	5.07	5.08	~~27.87~~	6.17		0.63	0.32	0.51		0.62		0.63
24.19	0.3125	3	0	5.04	5.05	~~27.91~~	6.13		0.62	0.31	0.51		0.61		0.62
24.50	0.3125	3	0	5.01	5.03	~~27.95~~	6.09		0.61	0.31	0.50		0.61		0.61
24.81	0.3125	8	0	5.05	5.00	~~27.99~~	6.05		0.60	0.30	0.50		0.60		0.60
25.13	0.3125	8	0	5.09	4.97	~~28.01~~	6.01		0.58	0.30	0.50		0.60		0.58
25.44	0.3125	8	0	5.12	4.95	~~28.06~~	5.97		0.57	0.30	0.49		0.60		0.57
25.75	0.3125	8	0	5.16	4.92	~~28.11~~	5.93		0.56	0.29	0.49		0.59		0.56
26.06	0.3125	8	0	5.19	4.90	~~28.16~~	5.90		0.55	0.29	0.49		0.59		0.55
26.38	0.3125	8	0	5.23	4.88	~~28.21~~	5.86		0.54	0.29	0.49		0.59		0.54
26.69	0.3125	8	0	5.26	4.85	~~28.25~~	5.83		0.53	0.28	0.49		0.58		0.53
27.00	0.3125	8	0	5.29	4.83	~~28.30~~	5.79		0.52	0.28	0.48		0.58		0.52
27.31	0.3125	8	0	5.32	4.81	~~28.34~~	5.76		0.52	0.28	0.48		0.58		0.52
27.63	0.3125	8	0	5.35	4.79	~~28.39~~	5.73		0.51	0.27	0.48		0.57		0.51
27.94	0.3125	8	0	5.38	4.76	~~28.43~~	5.70		0.50	0.27	0.48		0.57		0.50
28.25	0.3125	8	0	5.41	4.74	~~28.47~~	5.67		0.49	0.27	0.47		0.57		0.49
28.56	0.3125	8	0	5.44	4.72	28.51	5.64	55.70	0.48	0.26	0.47		0.56		0.48