STRUCTURE GEOTECHNICAL REPORT

MATTIS AVENUE OVER F.A.I. 74
(STATION 19+01.76)

Existing SN: 010-0270

Proposed SN: 010-1270

F.A.U. 7158
Section 10 (5-1-RS-1, 14-1,6) R
Champaign County

Contract No.: 70B38
P-95-030-11
PTB: 161-28

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Attachments: Boring Location Map
Preliminary TSL
Subsurface Boring Logs
Boring Profile Sheet
Pile Tables
Est. Factored Loadings

1.0 Introduction

Bacon Farmer Workman (BFW) Engineering & Testing, Inc., completed a geotechnical investigation for the replacement of an existing bridge location (SN 010-0270) (Station 19+01.76) carrying N. Mattis Avenue over I-74 in Section 10R, Township 20 North, Range 8 East of the 3rd PM in the city of Champaign, Champaign County, Illinois. This structure is slated to be replaced by proposed structure SN 010-1270. Phased construction is planned during construction.

The purpose of the investigation was to explore the subsurface conditions, to determined engineering properties of the subsurface soil, and develop design and construction recommendations for the project.

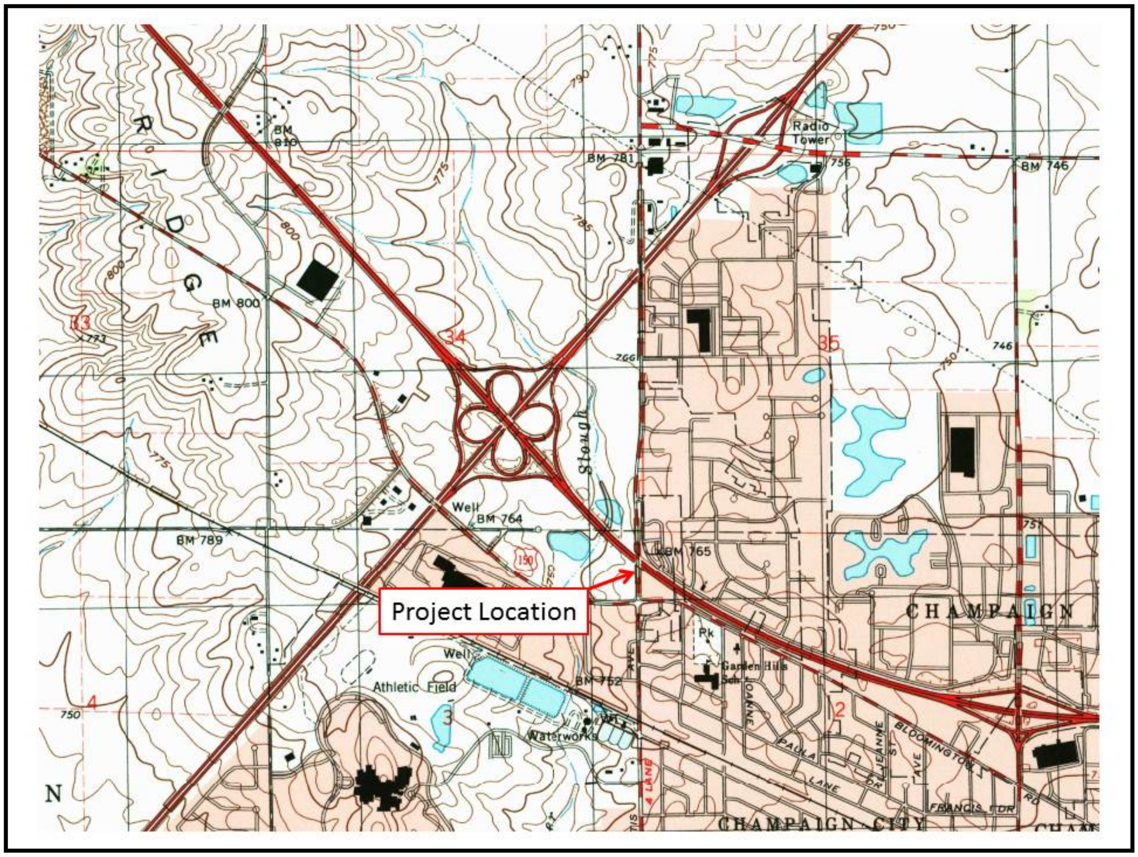


Exhibit 1: Project Location Map

2.0 Existing and Proposed Structure Information

Existing Structure (SN 010-0270)

Based on information from the Bridge Condition Report, the original structure was constructed in 1992 as a two-span 48" web steel plate girder structure composite in the positive moment regions. The superstructure is supported on open stub abutments on concrete piles and multi-column reinforced concrete piers on spread footings. Total length of the existing bridge is 249'-10 ¾" back to back of abutments, with a total width of 71'-7" out to out. The structure has a 40°51'29" skew to the left.

Proposed Structure (SN 010-1270)

The proposed structure will be 320'-1¾" back to back of abutments, double span structure with 70" web plate girders supporting a composite concrete deck. Total width from back to back of concrete barriers is 84 feet. The southern abutment will consist of a pile supported stub abutment with 2:1 concrete end slope. The proposed northern abutment will be moved back to allow space for an I-74 off ramp and will consist of a cut wall system. The use of an anchored soldier pile wall or soil nail wall system will be used to retain the end slope with a vertical pile supported stub abutment lying beyond. The center pier is proposed to include a pile supported multiple round column pier.

The Type, Size and Location (TS&L) plan for the N. Mattis Avenue over F.A.I. 74 has been included in the Appendix.

3.0 Existing Site Conditions

N. Mattis Avenue extends north – south and crosses over I-74. The existing embankment slopes and the north and south end slopes appear to be approximately 2H:1V..

Exhibit 2: Existing N. Mattis Avenue over I-74

3.1 Regional Geology

According to the Illinois State Geological Survey, "Bedrock Geology of Illinois" map, the site and surrounding area is situated in the Illinois Basin and is underlain by the Pennsylvanian-aged Tradewater Formation. The Illinois Basin is a Paleozoic depositional and structural basin centered in and underlying most of the state of Illinois. An Illinois Basin study reveals that the Tradewater Formation is composed of 70 to 80 percent shale and siltstone, 20 to 30 percent sandstone, and generally less than 5 percent coal and limestone. The Tradewater Formation is overlain by the Wedron Group, which is composed of mostly glacial till (an unsorted mixture of clay, silt, sand, and gravel) in broad ridges (last glaciation), and forms end moraines. The Wedron Group is finally capped by the Peoria and Roxana Silts, which are composed of windblown silt (loess) generally thicker than 20 feet blankets upland surfaces in these areas.

4.0 Subsurface Exploration and Generalized Subsurface Conditions

This section describes the subsurface exploration program and laboratory testing program completed as part of this Structure Geotechnical Report (SGR). The locations and subsurface data were provided by McCleary Engineering and were completed based on field conditions and accessibility. Therefore, no site observations have been made by BFW relative to existing conditions of the structure, roadway or of subsurface sample conditions. The locations of the soil borings are shown on the Boring Location Map located in the Appendix. The subsurface exploration program was performed in accordance with applicable IDOT geotechnical manuals and procedures.

4.1 Subsurface Exploration

The site subsurface exploration was conducted on January 20, 2015 and included advancing a total of two (2) standard penetration test (SPT) borings within the vicinity of the proposed abutments. One boring initially proposed near the bridge pier location was not advanced per IDOT. However, historic soil data (1990) from the existing structure center pier location (SB-1) is provided for additional information. The locations of the current soil borings are shown on the **Boring Location Map** provided in the Appendix.

Table 1 – Summary of Subsurface Exploration N. Mattis Ave.

Boring ID	Location	Station	Offset	Depth (feet)	Surface Elevation (feet)
B-1	South Abutment	16+37	26.5 Right	90	776.87
B-3	North Abutment	20+78	26.0 Right	75	776.90
SB-1 (1990)	Center Pier	19+21	33.0 Left	50.5	754.8

The soil borings were drilled using a track mounted drill rig. All of the borings were drilled using 3¼ - inch I.D. hollow stem augers. Soil sampling was performed according to AASHTO T 206, "Penetration Test and Split Barrel Sampling of Soils." Soil samples were obtained at 2.5 foot intervals to a minimum depth of 20 feet below existing grade and 5 foot intervals thereafter. McCleary Engineering field representative inspected, visually classified and logged the soil samples during the subsurface exploration activities, and performed unconfined compressive strength tests on cohesive soil samples using a calibrated Rimac compression tester and a calibrated hand penetrometer in accordance with IDOT procedures and requirements. Representative soil samples were collected from each sample interval, and were placed in jars and returned to the laboratory for further testing and evaluation.

4.2 Laboratory Testing

All samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the subsurface soils encountered in the area of the proposed bridge.

The following laboratory tests were performed on representative soil samples:

- Moisture content ASTM D2216 / AASHTO T-265
- Grain Size Analysis ASTM C136 / AASHTO T-88 / AASHTO T-90
- Unconfined compression ASTM D2166 / AASHTO T-208

The laboratory tests were performed in accordance with test procedures outlined in the IDOT Geotechnical Manual (1999) and per ASTM and AASHTO requirements. Based on the laboratory test results, the soils encountered were classified according to the AASHTO classification system. The results of the laboratory testing program are included in the Appendix and are shown along with the field test results in the Soil Boring Logs also located in the appendix.

4.3 Subsurface Conditions

This section provides a brief description of the soils encountered in the borings performed in the vicinity of the proposed improvements. Variations in the general subsurface soil profile were noted during the drilling activities. Detailed descriptions of the subsurface soils are provided in the Soil Boring Logs located in the Appendix and are shown graphically in the Subsurface Profiles. The soil boring logs provide specific soil conditions encountered at each soil boring location. The soil boring logs include soil descriptions, stratifications, penetration resistance, elevations, location of the samples and laboratory test data. Unless otherwise noted, soil descriptions indicated on boring logs are visual identifications. The stratifications shown on the boring logs represent the conditions only at the actual boring locations, and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

Subsurface information was obtained during a geotechnical investigation conducted over the entire proposed I-57 / I-74 interchange modifications. Borings B-1 and B-3 (N. Mattis Avenue over I-74) were advanced in support of Proposed Structure 010-1270 on January 20, 2015 along the existing N. Mattis Avenue alignment. Historic soil data (1990) from the existing structure center pier location (SB-1) is provided for additional information.

Bridge Abutments

Boring **B-1**, advanced near the proposed <u>south abutment</u>, was located at Station 16+37 (Elev. 776.87'). The borings were advanced in a relatively flat area, with approximately 12 inches of HMA and 12-inches of aggregate base. The soil profile underlying the surface cover in Boring **B-1** is described as a fill material composed of a medium to very stiff brown-gray silty clay which extends to approximately 34 feet deep (Elev. 742.87'). At approximately 17 feet deep (Elev. 759.87'), pieces of asphalt were found mixed with the fill soil. Below the 34 feet depth the material transitions to a stiff gray silty clay then to a stiff gray silty clay till. The silty clay till extended to a depth of approximately 58 feet (Elev. 718.87) where it rapidly transitioned into a medium dense sand and gravel layer. The sand and gravel layer extended to approximately 61 feet (Elev. 715.87) where it transitioned back into the hard gray silty clay till to silty loam till. The silty clay loam till extended to boring termination depth of 90 feet below ground surface (Elev. 686.87).

Soil boring **B-3**, advanced near the proposed <u>north abutment</u> was located at Station 20+78 (Elev. 776.90). In boring B-3, the surface coverage consisted of approximately 12 inches of HMA and 12-inches of aggregate base. Underlying the surface cover is a fill soil consisting of brown to gray hard to very stiff silty clay. This fill soil continues with depth to approximately 34.5 feet deep (Elev. 742.40'), where a gray silty clay till is encountered. This till continues to boring completion depth of 75 feet deep (Elev. 701.90').

Center Pier

No current boring data was available the proposed center pier; however, historic soil data (1990) from the existing structure near the center pier (soil boring SB-1) is provided. In the previous boring a black to brown firm silty clay was encountered from the surface (Elev. 757.0) to approximately Elev. 547. Below the upper silty clay soil a brown to gray mottled, stiff clayey till was encountered. The till continued to boring termination depths of 50.5 feet (Elev. 704.3)

4.4 Groundwater Conditions

Water levels were checked in each boring to determine the general groundwater conditions present at the site and were measured while drilling and after each boring was completed.

Groundwater was identified in each boring as follows:

Table 2 – Groundwater Elevations

Boring	Groundwater Elevation (At time of drilling)	Groundwater Elevation (24-hours)
B-1 (South Abut)	718.9	N/A
B-3 (North Abut)	Dry	N/A
SB-1 (Existing Center Pier)	752.0	N/A

No 24-hour groundwater readings were noted. No streambed elevations or surface water elevations were noted. Groundwater elevation for the original boring SB-1 may have been related to mud-rotary drilling which effects groundwater elevation at the time of drilling. No 24-hour groundwater data was available.

Water level readings were made in the boreholes at times and under conditions shown on the boring logs and stated in the text of this report. However, it should be noted that fluctuations in groundwater level may occur due to variations in rainfall, other climatic conditions, or other factors not evident at the time measurements were made and reported.

5.0 Geotechnical Evaluations

The section provides geotechnical analysis and recommendations for the design of the proposed bridge based on the results of the field exploration, laboratory testing, and geotechnical analysis.

The area of the northern abutment will involve the use of a cut wall system (i.e. soil nail or soldier pile and lagging)

5.2 Settlement

Southern Approach / Abutment

The existing side slopes are about 2H:1V at the north and south abutments of N. Mattis Avenue. The preliminary TS&L shows the side slopes of the southern approach and new end slope at the southern abutment location will remain at approximately 2H:1V.

The approach slabs near the southern abutment will be supported by new engineered fill placed over the existing approach. It is anticipated that approximately 4.0 feet (at the south abutment) of fill will be placed at the new southern embankment approach. To accommodate the proposed increase in approach and abutment heights, the abutment slopes will need to be regraded. The design grading shows that the proposed abutment slope will be a 2H:1V.

Based on preliminary settlement calculations, the increase in stress due to the increase in fill would produce only minor settlements in the range of less than 0.4-inch near the southern abutments and should not adversely affect the approach pavements. Therefore the anticipated settlement of the southern abutment due to the regarding activities is considered to be negligible.

Northern Approach / Abutment

The proposed northern abutment will be moved back from the existing location to allow space for an I-74 off ramp and will consist of a cut wall retaining system. The use of an anchored soldier pile wall or soil nail wall system will be used to retain the end slope with a vertical pile supported stub abutment lying beyond.

The approach slabs near the northern abutment will be supported by new engineered fill placed over the existing approach. It is anticipated that approximately 3.0 feet (at the north abutment) of fill will be placed at the relocated northern embankment approach. To accommodate the proposed increase in approach and abutment heights, the abutment slopes will need to be regraded. The design grading shows that the proposed abutment slope will be a 2H:1V.

Based on preliminary settlement calculations, the increase in stress due to the increase in fill would produce only minor settlements in the range of less than 0.4-inch near the northern abutments and should not adversely affect the approach pavements. Therefore the anticipated settlement of the northern abutment due to the regarding activities is considered to be negligible.

The proposed bridge will also have one pier near the center of the structure. Based on preliminary settlement calculations, the increase in stress due to the anticipated structural loadings at each pier locations using shallow foundations would produce settlements in the range of 2 to 3 inches. These settlements ranges would be considered unacceptable due to the settlement occurring after the pier is fully loaded. Therefore, the use of deep foundations will be required for the center pier location.

5.3 Slope Stability – Bridge Abutments

The proposed construction of N. Mattis Avenue over I-74 requires the northern abutment to be moved outward away from I-74. This new construction will result in changes to the northern abutment endslopes from an end slope of 2 horizontal to 1 vertical (2H:1V) to a cut wall retaining system (i.e. anchored soldier pile wall or soil nail wall). The northern abutment itself will be a pile supported stub abutment lying beyond the cut wall retaining system. The southern abutment is also proposed to be a pile supported stub abutment but with an end slope of 2H:1V. Slope stability of the bridge abutments was evaluated using a slope stability analysis software: *GSTABL7 with STEDwin.*

The proposed side slopes were analyzed based on the grading and the soils encountered during subsurface exploration. Three analyses were evaluated using the Bishop and Janbu analyses methods for the proposed slope geometry: end-of-construction (short term - undrained), long-term (drained) and a design seismic event. The analyses were performed using the soil parameters in Table 3 above. A critical factor of safety (FOS) was calculated for each condition. According to the current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability and 1.0 for the design seismic event.

In an effort to model the end-of-construction conditions, full cohesion was used with a friction angle of 0 degrees assumed. Nominal values for cohesion were used with full friction angle to model the long-term and seismic conditions to analyze the condition where pore water pressure has dissipated. The results of the analysis are shown on the following page in Table 3.

Based on the analysis performed, the proposed slopes meet the minimum required factor of safety of 1.5 (end-of-construction, long-term) and 1.0 (seismic).

Table 3 – Stability Analysis Results – Bridge Abutments

Boring Location	Slope	Calculated Critical FOS		
		End-of-Construction	Long Term	Seismic
B-1, West Abut	2H:1V	2.7	1.9	1.5

5.4 Seismic Parameters

The seismic hazard for the site was analyzed per the IDOT Geotechnical Manual, IDOT Bridge Design Manual, and AASHTO LRDF Bridge Design Specifications. The Seismic Soil Site Class was determined per the requirements of All Geotechnical Manual Users (AGMU) Memo 9.1, Design Guide for Seismic Site Class Determination, and the “Seismic Site class Determination” Excel spreadsheet provided by IDOT.

The proposed bridge has a total length less than 750 feet, with no single span longer than 200 feet, therefore, a global Site Class Definition was determined for this project Based on the seismic hazard maps the following coefficients should be used in design:

$\mathbf{S_s}$=0.146 g, $\mathbf{F_a}$=1.60; therefore Design Spectral Accelerations at 0.2 sec, ($\mathbf{S_{Ds}}$)=0.234g
$\mathbf{S_1}$=0.056 g, $\mathbf{F_v}$=2.40; therefore Design Spectral Accelerations at 1.0 sec, ($\mathbf{S_{D1}}$)=0.135g

According to Table 3.10.3.1-1 (Site Class Definitions) of the 2008 AASHTO LRFD Manual, the project site soil profile is most accurately described as the AASHTO Soil Site Class D. According to Table 3.10.6-1 (Seismic Zones) of the 2008 AASHTO LRFD Manual, the Seismic Performance Zone is most accurately described as (SPZ)=1 (F_vS_1#0.15)

Liquefaction analysis was conducted using Design Guide AGMU Memo 10.1 – Liquefaction Analysis. As noted in the previous paragraph the Seismic Performance Zone (SPZ) is SPZ – 1 and the Peak Ground Acceleration (PGA) modified by the zero-period site factor, F_{pga} is less than 0.15. Therefore, no liquefaction of soil layers are anticipated to occur.

Table 4 – Seismic Coefficients Summary Table

Seismic Performance Zone (SPZ)	1
Design Spectral Acceleration at 0.2 sec. ($\mathbf{S_{DS}}$)	0.234 g
Design Spectral Acceleration at 1.0 sec. ($\mathbf{S_{D1}}$)	0.135 g
Soil Site Class	D

5.5 Scour

The proposed bridge structure carrying N. Mattis Avenue crosses over Interstate I-74 and no waterways are in the vicinity of the proposed project; therefore scour will not be a concern for this project.

5.6 Mining Activity

Based on a review of the Illinois State Geological Survey's on-line collection of County Coal Maps and Directories, the proposed structure is not located over a mine or mined out area.

5.7 Liquefaction

Based on the AGMU Memo 10.1 – Liquefaction Analysis Seismic Performance Zones 3 and 4 required liquefaction analysis, as well as, SPZ 2 with a Peak Seismic Ground Surface Acceleration, As equal to or greater than 0.15. The subject site is in SPZ 1 with a less than 0.15. Therefore, liquefaction was not considered as a reduction for the pile design capacity or other foundation considerations included herein.

5.8 Approach Slabs

Based on information from the structural engineer, the approach slabs are 30 feet in length and are cast-in-place. In accordance with the IDOT Bridge Manual, BFW evaluated the foundation soils at the approach slabs for bearing capacity and excessive settlement. With proper compaction of the approach subgrades, the bearing capacity and settlement requirements of the IDOT Bridge manual will be satisfied.

6.0 Foundation Type Evaluation and Design Recommendations

6.1 Foundation Type Feasibility

Based on the preliminary TS&L, the proposed structure (SN 010-1270), Station 19+01.76 will consist of a two-span structure supported to the north and south by pile supported stub abutment. The north endslope will consist of a cut wall retaining system.

According to the IDOT Bridge manual, metal shell or HP-piles are permitted for stub abutment. Anticipated factored structural loadings were obtained from the structural engineer and are provided in Table 5

Table 5 – Structural Loadings

STRENGTH I Loads, Fy (kips):

	# of Lanes Loaded				STRENGTH I (max)
	1	2	3	4	
*MPF, m	1.20	1.00	0.85	0.65	
S. Abut.	2339.5	2514.4	2634.6	2645.5	2645
Pier 1	7154.1	7536.9	7800.0	7823.9	7824
N. Abut.	3104.8	3296.6	3428.5	3440.5	3440

*** Multiple Presence Factor (LRFD Table 3.6.1.1.2-1)**

The center pier is proposed as a multiple circular column, pile supported pier due to the anticipated structural loads. A spread footing was considered for support at the proposed pier location, since the existing pier is currently supported on shallow foundations. The structural engineer has provided a preliminary pier load of 7,824 kips. Based on preliminary settlement calculations, due to the increased individual pier load and subsurface conditions anticipated settlements would preclude the use of shallow foundations at the pier. A pile supported pier is recommended in this location. Driven metal shell piles or HP piles are feasible in this location.

6.2 Shallow Foundations

Based on the soils encountered, the significant factored structural loadings, shallow foundations are not a feasible option for use at either the proposed abutments or the individual pier locations due to potential settlement concerns and are not discussed in the report.

6.3 Driven Pile Supported Foundations

Piles considered for this site include HP-piles and metal shell piles. The Modified IDOT static method Excel spreadsheet was used to estimate the pile lengths at various axial geotechnical resistances for driven piles per AGMU Memo 10.2. Nominal required bearing was calculated from LRFD skin-friction and end-bearing calculations. A value of 1.04 is used for Bias Factor Ratio (I_G). A geotechnical resistance factor (Φ_G) of 0.55 was used in calculations for the Strength Limit State and a geotechnical resistance factor (Φ_G) of 1.0 was used for the Extreme Limit State.

The Nominal Required Bearing (NRB - R_N) represents the resistance the pile will experience during driving and also assists the contractor in selecting a proper hammer size. The Factored Resistance Available (RF) documents the net long-term axial factored pile capacity available at the top of the pile to support factored substructure loads. The Maximum Nominal Required Bearing (R_{Nmax}) is the maximum nominal required bearing that can be safely specified in the pile table due to pile driving stresses.

The pile cutoff elevations used for analysis were Elev. 767.64 and Elev. 770.53 for the North and South abutments, respectively. The pile cutoff elevation used for analysis for center pier location was 753.20. The pile cutoff elevations included a 1 feet embedment into the abutment for the stub abutment and 1 feet embedment into the pier cap as required by the Bridge Manual.

Tables 6 and 7 summarize the estimated pile lengths at various axial resistances for metal shell piles and HP-piles various sizes piles for the stub abutment at the North and South abutments. Based on the results of the subsurface investigation no geotechnical losses due to down drag or liquefaction were included in the axial pile capacity calculations for the individual pier foundations or abutment foundations. Pile capacities and lengths were calculated to the piles' maximum Nominal Required Bearing for shell pile and HP pile sections. It should be noted that none of the HP pile sections reached the maximum NRB as prescribed by IDOT for drivability as shown in Table 6 (Southern Abutment), with the soil data available. However, each of metal shell pile sizes met the maximum nominal required bearing for the south abutment

A cut-wall system is proposed at the north abutment immediately in front of the proposed pile supported stub abutment to accommodate the geometry of the bridge and the special requirements of the proposed I-74 off ramp. Cut-wall options include soldier pile and lagging and soil nailing. Due to the close proximity of the cut wall (i.e. Soil Nail Wall or Soldier Pile and Lagging) to the pile supported stub abutment, the upper portion of the piles will be in the active zone of the cut wall system. No pile down drag issues are anticipated however, the cut wall anchors will need to work independent of the driven piles. The use of pre drilled piles or pile sleeves are recommended in the active zone of the cut wall system approximately 16.92 feet in height. As a result, no unit friction values in the upper 16.92 feet were used for the calculated pile capacity in Table 7 for the northern abutment. It should be noted that none of the HP pile sections reached the maximum NRB as prescribed by IDOT for drivability as shown in Table 8 (Northern Abutment), in the soil conditions encountered. Only the 12" diameter metal shell piles with 0.179" or 0.25" walls and the 14" diameter with 0.25 walls met the maximum nominal required bearing for the north abutment given the soil data available. The metal shell pile 14" diameter with 0.312" walls did not meet the maximum NBR within the soil data available.

Table 8 summarizes the estimated pile lengths for various metal shell piles and HP-piles for the center pier location. Historic soil data from the existing structure was used for pile capacity calculations. It should be noted that none of the HP pile sections reached the maximum NRB as prescribed by IDOT for drivability as shown in Table 8 (Center Pier), with the soil data available. In addition the metal shell pile 14" diameter with 0.312" walls did not meet the maximum NBR within the soil data available. However, the remaining metal shell pile sizes did meet the maximum NBR for the center pier

The pile capacities are listed in the pile capacity table provided below. The complete IDOT Pile Design Tables for each substructure are included in the Appendix.

Pile shoes for HP piles should not be required due to the subsurface conditions and the absence of bedrock. However, due to some layers of gravels cobbles, piles shoes are recommended for metal shell piles in the locations of southern abutment.

The pile capacity tables provided in this report and appendix are estimates and test piles should be used for final pile length selections. Due to the relative consistency between the soil test borings, only one test pile should be required for abutments and one for the center pier. 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 is also the time in which the contractor's proposed equipment and methodologies identified in their Pile Installation Plan can be assessed.

Design Capacity Limitations

There are no downdrag, liquefaction, scour, or settlement issues at this structure that would result in the loss of capacity of the piling. Therefore, no design capacity limitations are necessary.

6.4 Lateral Load Resistance

Section 3.10.1.10 of the 2012 IDOT Bridge manual requires performing detailed structure interaction analysis if the factored lateral loading per pile exceeds 3 kips. Lateral loadings applied to pile foundations are typically resisted by battering selected piles, the soil/structure interaction, pile flexure, or a combination of these factors. Based on information provided by the structural engineer the lateral loads were anticipated to be less than 3 kips.

6.5 Cut Wall Retaining System Recommendations

The northern abutment will be move back from the existing location to accommodate the spatial requirements of the new off ramp. As a result, the most feasible and cost effective soil retention methods would include a cut wall retaining system. With the cut wall option, the abutment may be supported on metal shells as planned with the cut wall system in front of it or the abutment could be supported on soldier piles with the cap being tied back.

Feasible cut wall system designs include anchored soldier pile wall or soil nail wall. Based on the preliminary TS&L the proposed structure will completed with staged construction. Therefore, the timing of the installation of the cut wall system will be dependent on which cut wall system will be constructed. A soil nail wall could be constructed similar to existing methods used for lane widening below an existing bridge and therefore could be completed after Stage II of the northern abutment is completed. With the soldier pile and lagging option, pile installation (whether drilled or driven) will need to be partially completed during each stage due to overhead accessibility. With the soil nail system only a relatively small area of soil will need to be temporarily retained during the staged construction above an excavation line at the bottom of the proposed north abutment (Elev. 766.64). With the soldier pile and lagging additional soil areas of soil retention would be required. An additional consideration includes the width of soldier pile wall. The typical soldier pile wall with may not allow for enough room to batter the front row of abutment piles therefore the abutment would likely require being tied back as well to avoid lengthening the bridge. Based on the proposed TS&L, a soil nail cut wall system appears to be the most viable option. However, a feasibility and economic analysis should be performed before finalizing the design.

6.5.1 Soldier Pile and Lagging Wall

Based on the preliminary TS&L the final required retained height of the cut wall system would be approximately 17 feet. Given the height, the weight of the retained soil and the close proximity of the pile supported stub abutments the use of tiebacks will be required to limit wall deflections to acceptable amounts.

For tieback design, capacity developed in the potential failure zone defined as a failure envelope starting at the toe of the wall and rising at an angle or 45°-Φ/2 plus an additional 5 feet should be ignored in design. The maximum horizontal spacing between anchors is based on allowable individual anchor loads and flexural capacity of individual soldier beams. Typical horizontal spacing for soldier beams is 1.5 m to 3 m (4.92 to 9.84 feet). Given the height of the proposed cut wall, multiple levels of anchors will be required. Given the geometry and close proximity of the proposed stub abutment the use of deadman anchors is not feasible.

Based on soil data from boring, B-3, helical anchors and permanent ground anchors appear to be feasible types of anchor options. The location and alignment of wingwalls will need to be reviewed to ensure that the permanent ground anchors do not interfere with the proposed abutment and with each other.

The FHWA Circular #4 for ground anchor design should be referenced for design methodology. Soil properties in the lateral resistance recommendations section may be used for design of the wall.

6.5.2 Soil Nail Wall

Based on the preliminary TS&L, a soil nail cut wall system may provide a more economical solution for the project. With a soil nail cut wall system, the entire soil nail wall can be construction after completing Stage II of the bridge abutment and will not need to be staged.

By using the soil nail wall system, the temporary maximum retained height at the north abutment for stage construction is approximately 12.8 feet from the top of the sheet piling (Elev. 779.38) to the excavation line (Elev. 766.64) at the bottom of the north abutment. Given the lower height of soil to retain the use of temporary sheet piling may be used at the north abutment instead of a more costly temporary soil retention system.

Soil conditions (i.e. stiff cohesive soils) are present with a low water table which are conditions favorable for a soil nail design. Typical estimated Bond Strength (q_u) for fine grain soils (stiff silty clays) of between 6-9 pounds per square inch (psi) should be used for preliminary design. However, soil nail pullout tests should be required to field verify presumptive values. Additional soil properties are provided in the lateral resistance recommendations section may be used for design of the wall. Proper drainage should always be provided behind the cut wall systems

The FHWA Soil Nail Walls Reference Manual (Publication: FHWA-NHI-14-007) should be referenced for design methodology.

Pile Capacity Tables (Tables 6, 7 & 8)

Table 6 – Southern Abutment

Piling Driven at Southern Abutment (B-1 data)						
Nominal Required Bearing (Kips)	**Factored Resistance Available (Kips)**	**Estimated Pile Length (Ft)**		**Nominal Required Bearing (Kips)**	**Factored Resistance Available (Kips)**	**Estimated Pile Length (Ft)**
Metal Shell 12”Φ w/0.179” walls				**HP 12 x 53**		
124	68	30		Did Not Reach Max NRB (within boring depth)		
142	78	35		**HP 12 x 74**		
165	91	40		Did Not Reach Max NRB (within boring depth)		
191	105	45		**HP 14 x 73**		
218	120	50		Did Not Reach Max NRB (within boring depth)		
254 †	140 †	51 †		**HP 14 x 73**		
Metal Shell 12”Φ w/0.25” walls				Did Not Reach Max NRB (within boring depth)		
124	68	30		**HP 14 x 89**		
142	78	35		Did Not Reach Max NRB (within boring depth)		
165	91	40		**HP 14 x 102**		
191	105	45		Did Not Reach Max NRB (within boring depth)		
218	120	50		**HP 14 x 117**		
307	169	60		Did Not Reach Max NRB (within boring depth)		
324	178	64				
353 †	194 †	65 †				
Metal Shell 14”Φ w/0.25” walls						
90	49	30				
101	56	35				
119	65	40				
137	76	45				
156	86	50				
363	200	62				
382	210	64				
413 †	227 †	65 †		**† = Maximum Nominal Required Bearing of Pile**		
Metal Shell 14”Φ w/0.312” walls						
146	80	30				
167	92	35				
195	107	40				
226	124	45				
257	141	50				
337	186	58				
382	210	64				
513 †	282 †	65 †				

Capacity Tables (Tables 6, 7 & 8)

Table 7 – Northern Abutment

Piling Driven at Northern Abutment (B-3 data)						
Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft)		Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft)
Metal Shell 12"Φ w/0.179" walls				**HP 12 x 53**		
163	90	44		Did Not Reach Max NRB (within boring depth)		
180	99	46		**HP 12 x 74**		
197	108	49		Did Not Reach Max NRB (within boring depth)		
213	117	54		**HP 14 x 73**		
244	134	56		Did Not Reach Max NRB (within boring depth)		
254 †	140 †	58 †		**HP 14 x 73**		
Metal Shell 12"Φ w/0.25" walls				Did Not Reach Max NRB (within boring depth)		
257	142	59		**HP 14 x 89**		
272	150	61		Did Not Reach Max NRB (within boring depth)		
295	162	64		**HP 14 x 102**		
313	172	66		Did Not Reach Max NRB (within boring depth)		
324	178	69		**HP 14 x 117**		
339	186	71		Did Not Reach Max NRB (within boring depth)		
346	190	74				
353 †	194 †	75 †				
Metal Shell 14"Φ w/0.25" walls						
304	167	59				
321	176	61				
349	192	64				
371	204	66				
382	210	69				
339	219	71				
406	223	74				
413 †	227 †	76 †		**† = Maximum Nominal Required Bearing of Pile**		
Metal Shell 14"Φ w/0.312" walls						
Did Not Reach Max NRB (within boring depth)						

Pile Capacity Tables (Tables 6, 7 & 8)

Table 8 – Center Pier

Piling Driven at Center Pier (Previous Structure Soil Data SB-1)					
Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft)	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft)
Metal Shell 12"Φ w/0.179" walls			**HP 12 x 53**		
169	93	23	Did Not Reach Max NRB (within boring depth)		
183	101	26	**HP 12 x 74**		
203	112	28	Did Not Reach Max NRB (within boring depth)		
221	121	31	**HP 14 x 73**		
233	128	33	Did Not Reach Max NRB (within boring depth)		
248	136	36	**HP 14 x 89**		
254 †	140 †	38	Did Not Reach Max NRB (within boring depth)		
Metal Shell 12"Φ w/0.25" walls			**HP 14 x 102**		
203	112	28	Did Not Reach Max NRB (within boring depth)		
221	121	31	**HP 14 x 114**		
233	128	33	Did Not Reach Max NRB (within boring depth)		
248	136	36			
299	164	37			
324	178	40			
336	185	42			
353 †	194 †	45			
Metal Shell 14"Φ w/0.25" walls					
242	133	28			
262	144	31			
275	151	33			
293	161	36			
360	198	37			
390	215	40			
401	221	42			
413 †	227 †	45			
Metal Shell 14"Φ w/0.312" walls					
Did Not Reach Max NRB (within boring depth)					

† = Maximum Nominal Required Bearing of Pile

6.6 Lateral Resistance Recommendations

Only the following table is a summary of lateral soil parameters to be used for design of the earth retention soldier pile or soil nail wall.

Unit weights, friction angles and shear strength parameters were estimated using standard penetration test (SPT) using published correlations for N values results. **Table 9** - presents generalized soil parameters to be used based for designs on the laboratory and in-situ testing data:

Table 9 – Summary of Soil Parameters

Approx. Depth / Elevation (feet)	Soil Description	Unit Weight γ (pcf)	Lateral Modulus of Subgrade Reaction (pci)	Strain	Undrained		Drained	
					Cohesion c (psf)	Friction Angle Φ (degrees)	Cohesion c (psf)	Friction Angle Φ (degrees)
742' to surface	Existing Silty Clay Fill	120	500	0.006	1,500	0	100	28
736 – 742'	Silty Clay	120	1000	0.005	1,000	0	125	28

Allowances should be made for any surcharge loads adjacent to the retaining structure. Proper drainage should be provided behind the walls. For the long-term active case (permanent case), cohesion in the clay layers should be ignored and the effective stress condition (drained friction angle) should be used. For the long-term passive case, the undrained cohesion should be used at undisturbed depths below the frost line (greater than 4 feet below the ground line).

6.7 Wing Wall Foundation Recommendations

Based on information provided by the structural engineer and the preliminary TS&L the wing walls for the northern and southern stub abutments will be pile supported using pile capacity tables provided for each abutment. Adjustments to the cut wall retaining anchors will need to be considered to avoid interference with wing walls or abutments.

7.0 Construction Considerations

All work performed for the proposed project should conform to the requirements in the IDOT Standard Specifications for Road and Bridge Construction (2012) and the Supplemental Specifications and Recurring Special Provisions (2015). Any deviation from the requirements in the manuals above should be approved by the design engineer.

7.1 Site Excavation

The contractor will be responsible to provide a safe excavation during the construction activities of the project. All excavation should be conducted in accordance with applicable federal, state, and local safety regulation, including, but not limited to the Occupational Safety and Health Administration (OSHA) excavation safety standards. Excavation stability and soil pressures on temporary shoring are dependent on soil conditions, depths of excavation, installation procedures, and the magnitude of any surcharge loads on the ground surface adjacent to the excavation. Excavation near existing structures and underground utilities should be performed with extreme care to avoid undermining existing structures. Excavation should not extend below the level of adjacent existing foundations or utilities unless underpinning or other support is installed. It is the responsibility of the contractor for field determinations of applicable conditions and providing adequate shoring for all excavation activities.

7.2 Groundwater Management

Based on the depth of groundwater observed in the borings, significant groundwater management is not anticipated for bridge construction. The contactor should control groundwater and surface water infiltration to provide construction in dry condition. Temporary ditches, sumps, granular drainage blankets, stone ditch protection, or hand-laid riprap with geotextile underlayment could be used to divert groundwater if significant seepage is encountered during construction. If water seepage occurs during footing or where wet conditions are encountered such that the water cannot be removed with conventional sumping, we recommend placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation.

The CA-7 stone should be placed to 12 inches about the water table, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable. The remaining portion of the excavation beneath the footing should be backfilled using approved structural fill.

7.3 Temporary Sheeting and Soil Retention

The preliminary TS&L plans indicate that the construction of the proposed bridge will require complete removal of the existing structure and abutments. Based on information provided by the structural engineer, the construction for the proposed structure will be phased maintaining one lane of traffic. In addition, due to the close proximity I-74 the use of temporary sheeting will be required for the construction of the center pier.

Temporary Sheeting and Soil Retention

On the northern abutment with the use of a soil nail wall system, the temporary maximum retained height at the north abutment for stage construction is approximately 12.8 feet from the top of the sheet piling (Elev. 779.38) to the excavation line (Elev. 766.64) at the bottom of the north abutment. For the southern abutment the retained height for staged construction is approximately 12. 38.

In evaluating the use of temporary cantilever sheet piling, a maximum of 13 feet was used for calculations. Embedment depths of approximately 9.8 feet for both the northern and southern abutments were determined from the design charts. Based on the subsurface soils encountered and on preliminary calculations for the depth of embedment as per IDOT Bridge Manual using the "Design Guide and Charts for Temporary Cantilever Sheet Piling" simple cantilever sheeting piles are feasible to be used for both the east and west abutments.

For the center pier location, the existing center pier footing will need to be removed and replaced with compacted backfill. The proposed center pier will bear an elevation of the approximately 752.20. A retained height of approximately 4 feet will be required. Based on the design charts simple cantilever sheeting piles are also feasible at the center pier location.

8.0 Limitations

This report has been prepared for the exclusive use of the Illinois Department of Transportation and its structural consultant. The recommendations provided in the repot are specific to the project described herein, and are based on the information obtained from the soil boring locations within the project limits. The analysis have been performed and the recommendations have been provided in this report are based on subsurface conditions determined at the location of the borings. The report may not reflect all variations that may occur between boring locations or at some other time, the nature and extend of which may not become evident until during the time of construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations provided herein in light of the new conditions

Appendix A

Soil Boring Location Map

Boring Number	Location	Station	Offset	Elevation	Latitude	Longitude
B-1 (Mattis Ave I-74)	South Abut Boring Mattis Ave/I-74	16+37	26.5 RT	776.87	40.140361	-88.277162
B-3 (Mattis Ave I-74)	North Abut Mattis Ave over I-74	20+78	26 RT	776.9	40.14138	-88.277205

FILE NAME = $FILEL$ $MODELNAME$	USER NAME = $USER$	DESIGNED -	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	MATTIS AVENUE (I-57/I-74 INTERCHANGE)
		DRAWN -	REVISED -		
	PLOT SCALE = $SCALE$	CHECKED -	REVISED -		
	PLOT DATE = $DATE$	DATE -	REVISED -		SCALE: SHEET OF SHEETS STA. TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
57/74	10(5-1-RS-1, 14-1, 6) R	CHAMPAIGN		

CONTRACT NO. 70897

ILLINOIS FED. AID PROJECT

Appendix B

Preliminary TS&L

Bench Mark: Chiseled "□" on the north side of the south leg of the interstate sign foundation located on the south side of F.A.I. 74, Sta. 1093+41, 93' RT. Elev. 757.45.

Existing Structure: S.N. 010-0270 built 1992 as F.A.U. 7158 (Mattis Ave.), Section (10-5-1 HB)BR at Station 19+01.76. Structure is a two-span 48" web steel plate girder bridge supported by open stub abutments on concrete piles and multi-column reinforced concrete piers on spread footings. 249'-10¾" back-to-back abutments. 71'-7" out-to-out deck. Structure to be removed and replaced using stage construction.

No Salvage.

HIGHWAY CLASSIFICATION

F.A.U. 7158 (Mattis Ave.)	F.A.I. 74
Functional Class: Minor Arterial	Functional Class: Interstate
ADT: 16,000 (2013); 18,700 (2040)	ADT: 38,900 (2013); 59,900 (2040)
ADTT: 800 (2013); 935 (2040)	ADTT: 7,350 (2013); 13,720 (2040)
DHV: 1,760 (2040)	DHV: 4,930 (2040)
Design Speed: 45 m.p.h.	Design Speed: 75 m.p.h.
Posted Speed: 40 m.p.h.	Posted Speed: 70 m.p.h.
2 -Way Traffic	2 -Way Traffic
Directional Distribution: 50:50	Directional Distribution: 50:50

DESIGN STRESSES

FIELD UNITS

f'c = 3,500 psi
f'c = 4,000 psi (Superstructure concrete)
fy = 60,000 psi (Reinforcement)
fy = 50,000 psi (M270 Grade 50)

LOADING HL-93

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

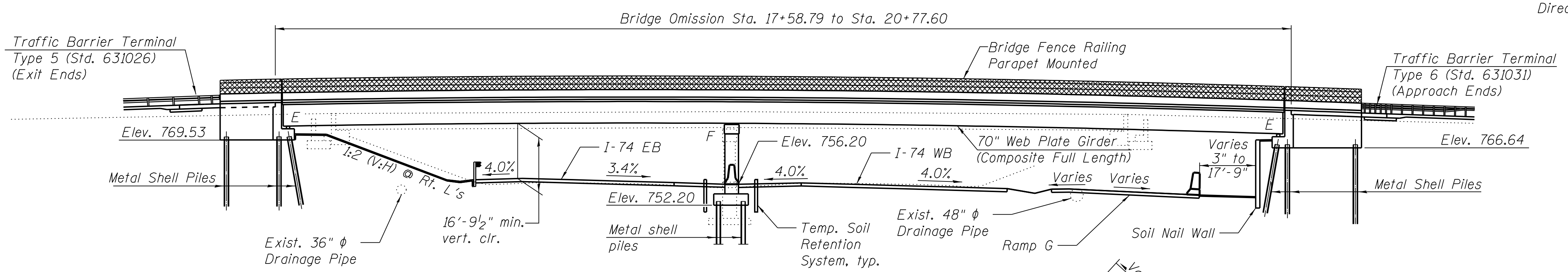
SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.135 g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.234 g
Soil Site Class = D

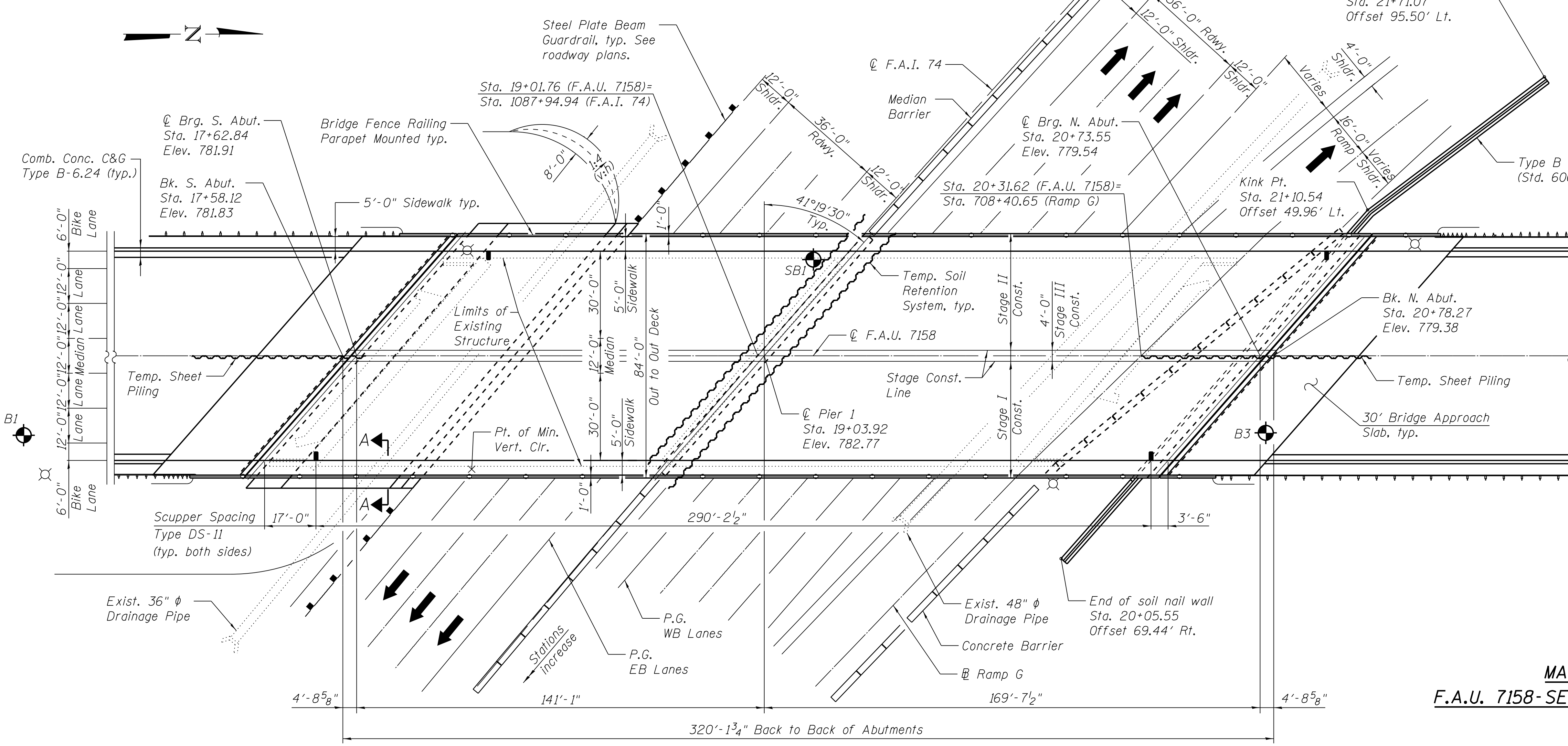
DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, 7th Edition with 2015 Interims.

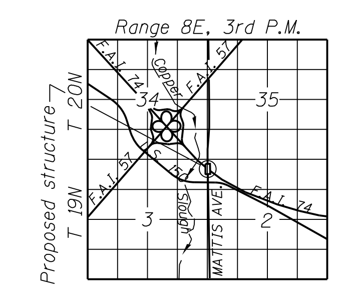
¤ Existing Light Pole to be removed.



ELEVATION



PLAN



LOCATION SKETCH

GENERAL PLAN
MATTIS AVE. OVER F.A.I. 74
F.A.U. 7158-SECTION (10-34)BR, BR-1 & (10-5-1)BR-1
CHAMPAIGN COUNTY
STATION 19+01.76
STRUCTURE NO. 010-1270

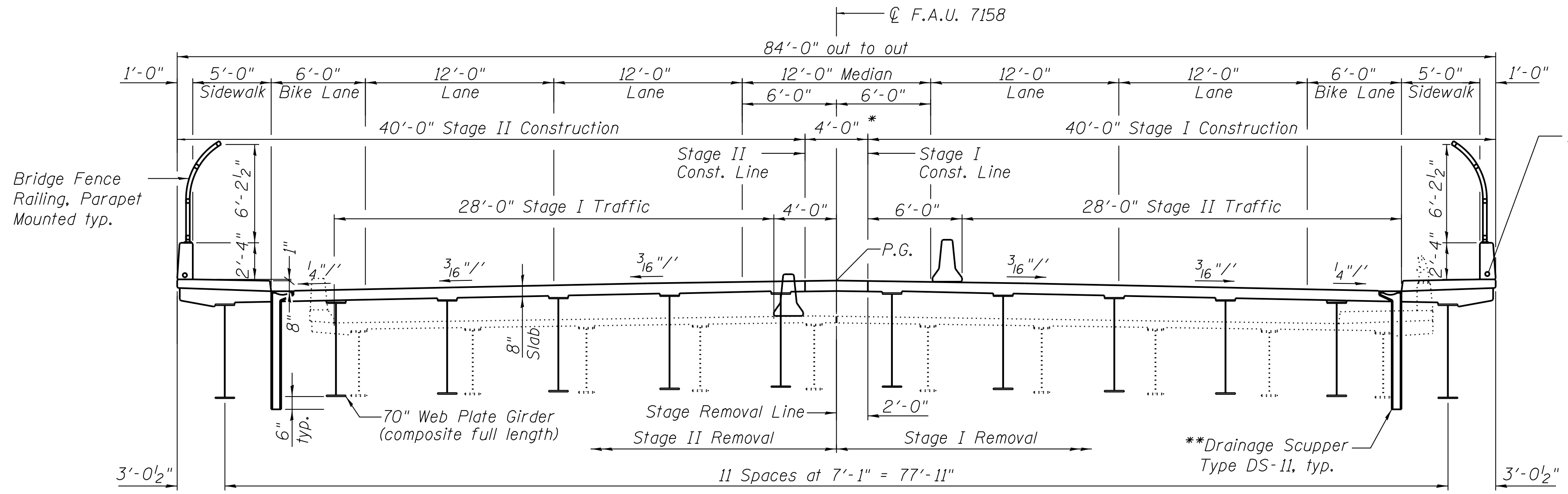
*(10-34)BR, BR-1 & (10-5-1)BR-1

FILE NAME = 0101270-70B38-TSL-001.dgn	USER NAME =	DESIGNED - BWP	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
BACON | FARMER | WORKMAN ENGINEERING & TESTING, INC. 403 NORTH COURT STREET MARION, ILLINOIS 62959 PHONE - 618.997.9190		CHECKED - RSB	REVISED -	
	PLOT SCALE =	DRAWN - BJV	REVISED -	
	PLOT DATE = 6/16/2016	CHECKED - BWP	REVISED -	SHEET NO. 1 OF 3 SHEETS

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
7158	*	CHAMPAIGN	3	1

CONTRACT NO. 70B38

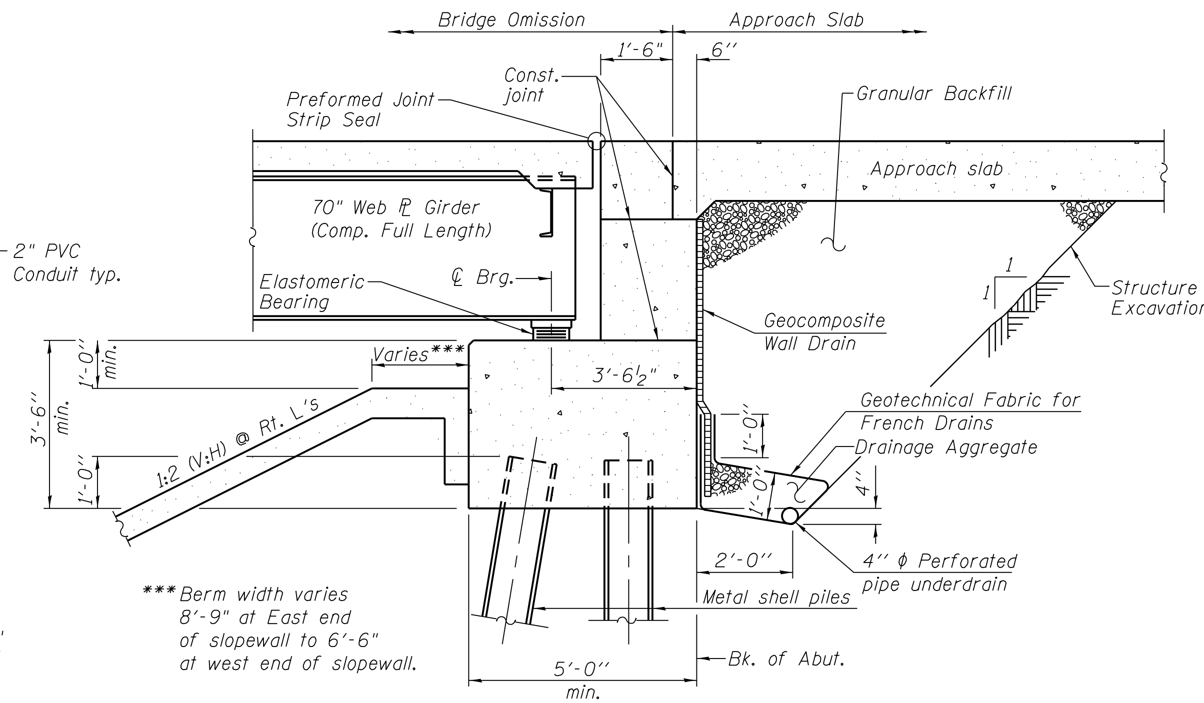
ILLINOIS FED. AID PROJECT



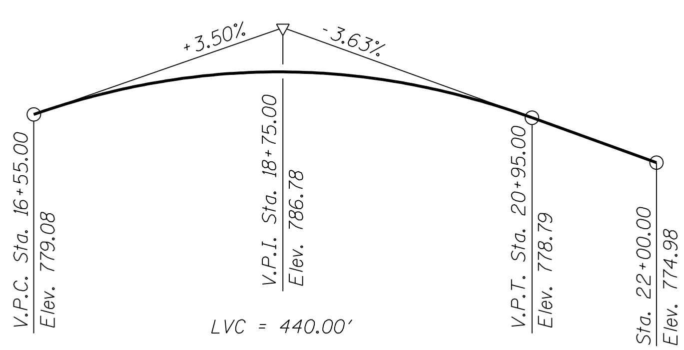
CROSS SECTION
(Looking North)

* Stage III Construction

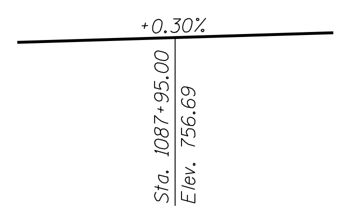
** Drainage Scuppers at north end of bridge shall be attached to a closed drainage system.



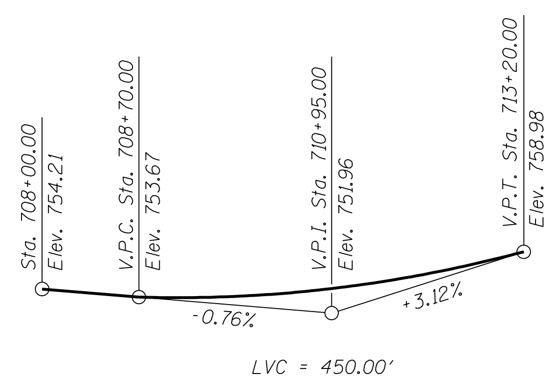
SECTION THRU SOUTH ABUTMENT
(Horiz. dim. @ Rt. L's)



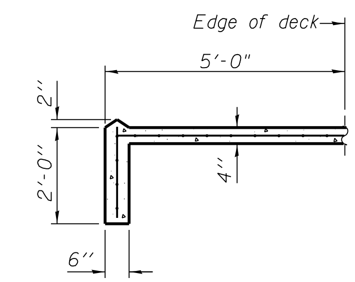
PROFILE GRADE F.A.U. 7158 (MATTIS AVE.)
(along ℄ roadway)



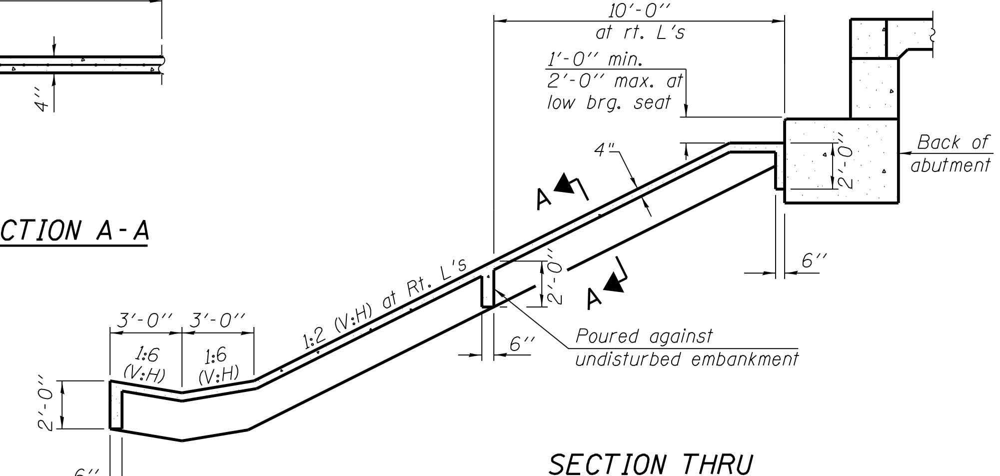
PROFILE GRADE F.A.I. 74
(along PG EB & WB I-74)



PROFILE GRADE RAMP G
(along ℙ Roadway)



SECTION A-A



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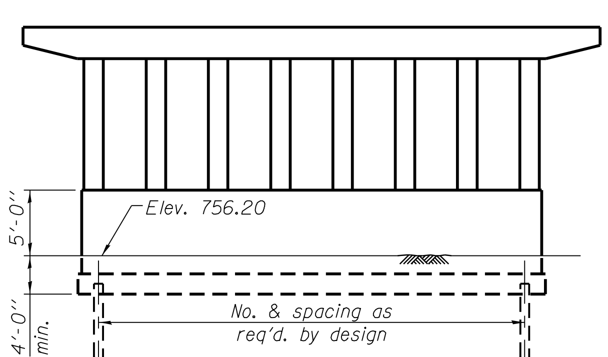


PIER SKETCH

EXIST. CURVE F.A.I. 74-1

PI STA. = 1088+67.30
Δ = 18° 37' 57" (LT)
D = 0° 48' 50"
R = 7,040.65'
T = 1,155.00'
L = 2,289.60'
E = 94.11'
e = 3.4%
T.R. = N/A
S.E. RUN = 215'
P.C. STA. = 1077+12.30
P.C.C. STA. = 1100+01.90

PROP. CURVE RAMP G-1

PI STA. = 709+83.61
Δ = 16° 53' 10" (RT)
D = 4° 35' 01"
R = 1,250.00'
T = 185.54'
L = 368.40'
E = 13.70'
e = 7.6%
T.R. = N/A
S.E. RUN = 260'
P.C. STA. = 707+98.07
P.T. STA. = 711+66.47

ATTAIN S.E. (EXIT TERMINAL):
STA. 707+44.91 (+4.0% MATCH M.L.)
STA. 708+68.07 (+7.6% S.E. @ D-D)

PROP. MEDIAN TRANSITION
(W.B. LANES)

R = 5,950.00' (INSIDE E.O.P.)
e = 4.0%
T.R. = 125'
S.E. RUN = 250'
P.C. STA. = 1079+51.02
P.C.C. STA. = 1092+77.27

STAGING & DETAILS
MATTIS AVE. OVER F.A.I. 74
F.A.U. 7158-SECTION (10-34)BR, BR-1 & (10-5-1)BR-1
CHAMPAIGN COUNTY
STATION 19+01.76
STRUCTURE NO. 010-1270

*(10-34)BR, BR-1 & (10-5-1)BR-1

FILE NAME = 0101270-70B38-TSL-002.dgn	USER NAME =	DESIGNED - BWP	REVISED -
BACON | FARMER | WORKMAN ENGINEERING & TESTING, INC.		CHECKED - RSB	REVISED -
	PLOT SCALE =	DRAWN - BJV	REVISED -
	PLOT DATE = 6/16/2016	CHECKED - BWP	REVISED -

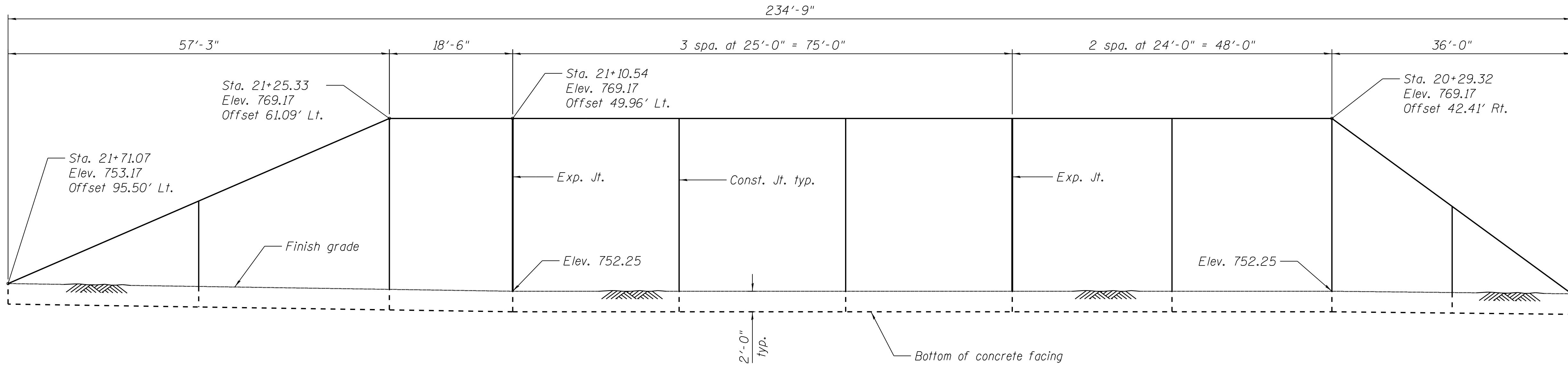
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 2 OF 3 SHEETS

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
7158	*	CHAMPAIGN	3	2

CONTRACT NO. 70B38

ILLINOIS FED. AID PROJECT



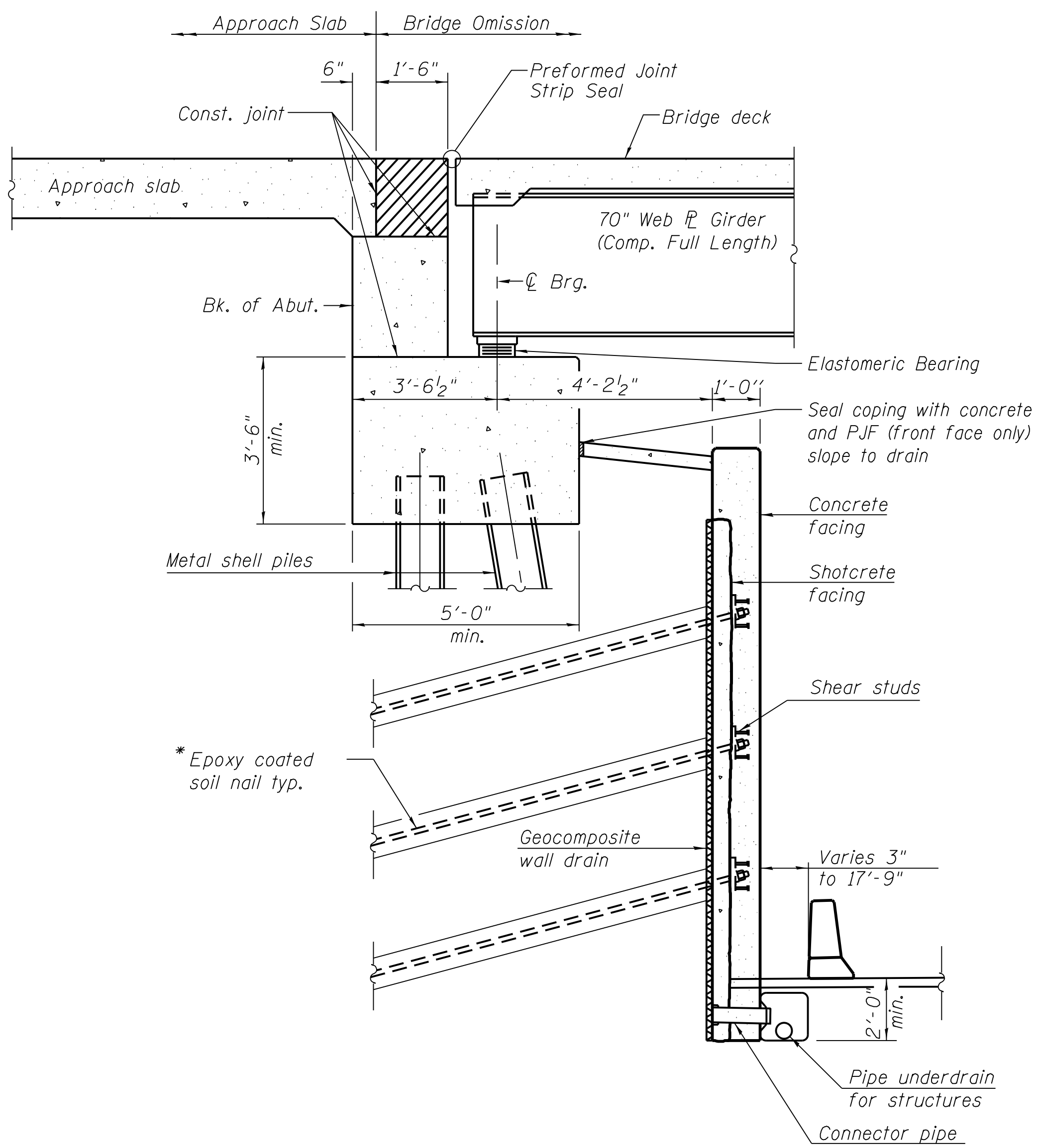
NORTH ABUTMENT SOIL NAIL WALL

(Unfolded Elevation)

Notes:

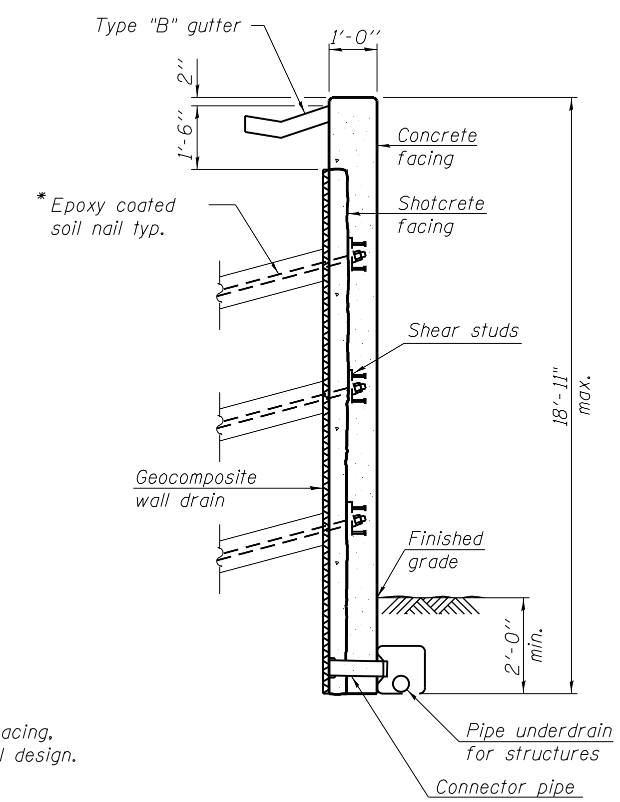
Wall offsets are measured to the front face of the concrete facing.

Soil nail wall to be constructed after completion of Stage II construction.



SECTION THRU NORTH ABUTMENT

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



SECTION THRU SOIL NAIL WALL

* Soil nail size, length, and spacing, to be determined during final design.

SOIL NAIL WALL
MATTIS AVE. OVER F.A.I. 74
F.A.U. 7158-SECTION (10-34)BR, BR-1 & (10-5-1)BR-1
CHAMPAIGN COUNTY
STATION 19+01.76
STRUCTURE NO. 010-1270

*(10-34)BR, BR-1 & (10-5-1)BR-1

FILE NAME = 0101270-70B38-TSL-003.dgn	USER NAME =	DESIGNED - BWP	REVISED -
BFW BACON | FARMER | WORKMAN ENGINEERING & TESTING, INC. 403 NORTH COURT STREET MARION, ILLINOIS 62959 PHONE: 618.997.3150		CHECKED - RSB	REVISED -
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	PLOT DATE = 6/16/2016	CHECKED - BWP	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 3 OF 3 SHEETS

F.A.U. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
7158	*	CHAMPAIGN	3	3
		CONTRACT NO. 70B38		
	ILLINOIS	FED. AID PROJECT		

Appendix C

Subsurface Boring Logs

Illinois Department of Transportation
Division of Highways
Kaskaskia Engineering Group

SOIL BORING LOG

Date 1/20/15

ROUTE I-57/74 **DESCRIPTION** South Abut Boring Mattis Ave/I-74 **LOGGED BY** TLM

SECTION 10(5-1-RS-1, 14-1,6)R **LOCATION** , **SEC.** 34, **TWP.** 20N, **RNG.** 8E, 3 **PM**

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

STRUCT. NO.
Station

BORING NO. B-1 (Mattis Ave I-74)
Station 16+37
Offset 26.5ft Right
Ground Surface Elev. 776.87 ft

Surface Water Elev. n/a ft
Stream Bed Elev. ft

Groundwater Elev.:
▽ **First Encounter** 718.9 ft
▼ **Upon Completion** ft
▼ **After** Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
12" HMA	775.87				
12" Aggregate Base	774.87				
FILL: Silt Clay, brown, stiff, trace gravel			4 / 7 / 7	2.06 B	12.7
		-5	4 / 4 / 8	1.5 P	12.3
			4 / 7 / 5	3.92 B	14.0
		-10	3 / 3 / 3	2.5 P	14.2
			4 / 4 / 7	1.07 B	16.8
		-15	4 / 8 / 13	2.06 B	14.3
	759.87		5 / 24 / 27	2.5 P	10.8
FILL: Silty Clay, brown, hard, pieces of ashpalt	757.87				
FILL: Silty Clay Loam, brown, medium		-20	3 / 3 / 6	1.24 B	15.3
FILL: Silty Clay Loam, brown, medium *(continued)*		-25	3 / 3 / 5	0.16 B	14.1
		-30	3 / 5 / 7	0.41 B	13.8
	742.87				
SILTY CLAY: Gray, stiff		-35	3 / 4 / 6	1.24 B	12.6
	738.37				
SILTY CLAY TILL: Gray, stiff		-40	4 / 4 / 7	1.07 B	12.7

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name P:\GINT\PROJECTS\I 57 74 CHAMPAIGN COUNTY.GPJ Data Template D6TEMPLT.GDT Date Printed 3/2/15
Latitude Longitude Datum Job Number MCE-14044

Illinois Department of Transportation
Division of Highways
Kaskaskia Engineering Group

SOIL BORING LOG

Date 1/20/15

ROUTE I-57/74 **DESCRIPTION** South Abut Boring Mattis Ave/I-74 **LOGGED BY** TLM

SECTION 10(5-1-RS-1, 14-1,6)R **LOCATION** , **SEC.** 34, **TWP.** 20N, **RNG.** 8E, 3 **PM**

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

STRUCT. NO. ____
Station ____

BORING NO. B-1 (Mattis Ave I-74)
Station 16+37
Offset 26.5ft Right
Ground Surface Elev. 776.87 ft

Surface Water Elev. n/a ft
Stream Bed Elev. ____ ft

Groundwater Elev.:
First Encounter 718.9 ft
Upon Completion ____ ft
After ____ **Hrs.** ____ ft

Description	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
SILTY CLAY TILL: Gray, stiff *(continued)*				
		4		
		7	1.40	10.9
	-45	10	B	
		3		
		5	1.65	11.2
	-50	7	B	
		4		
2" Sand seam at 54 ft.		8	1.75	12.9
	-55	8	P	
718.87				
SAND and GRAVEL: Medium dense, coarse		9		
		9		18.4
	-60	9		

Description	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
SAND and GRAVEL: Medium dense, coarse *(continued)* 715.87				
SILTY CLAY TILL: Gray, hard				
		13		
		10	4.0	10.7
	-65	13	P	
		8		
		11	2.47	12.3
	-70	18	B	
703.37				
SILTY LOAM TILL: Gray, medium dense		7		
(very fine silty sand)		12		15.4
	-75	16		
		4		
		10		10.8
	-80	15		

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Kaskaskia Engineering Group

SOIL BORING LOG

Date 1/20/15

ROUTE I-57/74 **DESCRIPTION** South Abut Boring Mattis Ave/I-74 **LOGGED BY** TLM

SECTION 10(5-1-RS-1, 14-1,6)R **LOCATION** , **SEC.** 34, **TWP.** 20N, **RNG.** 8E, 3 **PM**

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

STRUCT. NO.
Station

BORING NO. B-1 (Mattis Ave I-74)
Station 16+37
Offset 26.5ft Right
Ground Surface Elev. 776.87 ft

Surface Water Elev. n/a ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter 718.9 ft
Upon Completion ft
After Hrs. ft

Description	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
695.87				
SILTY CLAY LOAM TILL: Gray				
		5		
		12	2.56	10.6
	-85	17	B	
		7		
		11	2.23	12.8
686.87	-90	18	B	
End of Boring				
	-95			
	-100			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name P:\GINT\PROJECTS\I 57 74 CHAMPAIGN COUNTY.GPJ Data Template D6TEMPLT.GDT Date Printed 3/2/15
Latitude Longitude Datum Job Number MCE-14044

Illinois Department of Transportation
Division of Highways
Kaskaskia Engineering Group

SOIL BORING LOG

Date 1/20/15

ROUTE I-57/74 **DESCRIPTION** North Abut Mattis Ave over I-74 **LOGGED BY** MLL

SECTION 10(5-1-RS-1, 14-1,6)R **LOCATION** , **SEC.** 34, **TWP.** 20N, **RNG.** 8E, 3 **PM**

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

STRUCT. NO.
Station

BORING NO. B-3 (Mattis Ave I-74)
Station 20+78
Offset 26.0ft Right
Ground Surface Elev. 776.90 ft

Surface Water Elev. n/a ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After Hrs. ft

Description	Elev.	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
12" HMA	775.90				
12" Aggregate Base	774.90				
FILL: Silty Clay, brown, hard			7		
			9	4.12	14.3
	773.40		9	B	
FILL: Silty Clay, brown, very stiff			5		
			6	2.39	16.3
		-5	7	B	
No Recovery			5		
			5		
	768.90		5		
FILL: Silty Clay, gray, very stiff			4		
			5	1.65	12.6
		-10	7	B	
			4		
			4	1.65	17.8
	763.90		6	B	
FILL: Silty Clay, brown, very stiff			2		
			3	1.48	27.5
	761.40	-15	3	B	
FILL: Silty Clay, gray, very stiff			2		
			6	1.65	16.9
	758.90		13	B	
FILL: Silty Clay, brown, some gravel			5		
			5	1.6	13.1
		-20	5	P	

Description	Elev.	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
FILL: Silty Clay, brown, some gravel *(continued)*			3		
			3	1.40	26.3
		-25	5	B	
			4		
			5		9.3
		-30	6		
			3		
	742.40		7	2.06	11.2
SILTY CLAY: Gray		-35	8	B	
			7		
			10	2.6	13.1
	736.90	-40	13	P	

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Kaskaskia Engineering Group

SOIL BORING LOG

Date 1/20/15

ROUTE I-57/74 **DESCRIPTION** North Abut Mattis Ave over I-74 **LOGGED BY** MLL

SECTION 10(5-1-RS-1, 14-1,6)R **LOCATION** , **SEC.** 34, **TWP.** 20N, **RNG.** 8E, 3 **PM**

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

STRUCT. NO.
Station

BORING NO. B-3 (Mattis Ave I-74)
Station 20+78
Offset 26.0ft Right
Ground Surface Elev. 776.90 ft

Surface Water Elev. n/a ft
Stream Bed Elev. ft

Groundwater Elev.:
First Encounter Dry ft
Upon Completion Dry ft
After Hrs. ft

Description	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
SILTY CLAY TILL: Gray				
		5		
		7	2.56	10.7
	-45	10	B	
		3		
		7	2.31	11.3
	-50	7	B	
		4		
		7	2.06	10.1
	-55	12	B	
		9		
		13	3.0	10.1
	-60	17	P	

Description	DEPTH (ft)	BLOWS	UCS Qu (tsf)	MOIST (%)
SILTY CLAY TILL: Gray *(continued)*				
		4		
		6	2.06	13.0
	-65	8	B	
		4		
		8	1.24	12.5
	-70	10	B	
		4		
		8	0.82	12.8
701.90	-75	11	B	
End of Boring				
	-80			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated)
Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name P:\GINT\PROJECTS\I 57 74 CHAMPAIGN COUNTY.GPJ Data Template D6TEMPLT.GDT Date Printed 3/2/15
Latitude Longitude Datum Job Number MCE-14044

ROUTE NO.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
FAI-74	*	CHAMPAIGN	70	51
FED. ROAD DIST. NO.		ILLINOIS	PROJECT	

* (10-5-1HB) BR

ILLINOIS DEPARTMENT OF TRANSPORTATION
BRIDGE FOUNDATION BORING LOG

Project ____ Bridge S.N. 010-0101 Date 10/30/90
Route FAI-74 I-74 over Mattis Avenue Bored By Winschief
Sec. (10-5-1,14-14-1)R STA. 18+94.65 Checked By TGB
County Champaign Boring No. 1 Station 19+21 Offset 33' LT

Surface Water El. ____ Groundwater El. at Completion Dry After ____ Hours ____

Ground Surface 754.8

BROWN SAND LOAM	748.3
BROWN CLAY LOAM TILL	745.8
GRAY CLAY LOAM TILL	704.3
LIMIT OF BORING	

Depth (EL.)	N	Qu TSF	W%
5	4		19
	10	2.9 B	15
10	12	3.1 B	12
	11	3.1 B	11
15	12	3.5 B	9.0
	12	3.5 B	11
20	10	2.5 B	12
	11	2.7 B	12
25	8	2.1 B	12
	10	2.7 B	12
30	10	2.1 B	11
35	17	7.0	12
40	17	5.4 B	12
45	12	2.7 B	13
50	10	2.5 B	13
55			

Type failure: B-Bulge Failure, S-Shear Failure, E-Estimated Value, P-Penetrometer

ILLINOIS DEPARTMENT OF TRANSPORTATION
BRIDGE FOUNDATION BORING LOG

Project ____ Bridge S.N. 010-0101 Date 10/31/90
Route FAI-74 I-74 over Mattis Avenue Bored By Winschief
Sec. (10-5-1,14-14-1)R STA. 18+94.65 Checked By TGB
County Champaign Boring No. 2 Station 17+67 Offset 19' LT

Surface Water El. ____ Groundwater El. at Completion PLUGGED After ____ Hours ____

Ground Surface 776.3

MIXED BROWN & GRAY CLAY LOAM EMBANKMENT	759.8
MIXED BLACK & BROWN SILTY CLAY EMBANKMENT	754.8
BROWN-GRAY MOTTLED SILTY CLAY LOAM / BROWN GRAY MOTTLED SILTY CLAY LOAM	749.8
BROWN SAND LOAM-SAND (FREE WATER)	747.3
BROWN CLAY LOAM TILL	744.8
GRAY CLAY LOAM TILL	725.8
LIMIT OF BORING	

Depth (EL.)	N	Qu TSF	W%
5	6	1.2 B	17
	6	3.1 B	24
10	5	1.9 B	25
	8	3.1 B	14
15	10	3.9 B	16
	10	3.3 B	21
20	9	2.0 E	20
	5	1.2	18
25	7	1.6	20
	8		
30	10	1.9 B	14
	14	4.7 B	11
35	11	5.4 B	11
40	12	3.9 B	11
45	10	3.3 B	
50	14	3.9 B	
55			

Type failure: B-Bulge Failure, S-Shear Failure, E-Estimated Value, P-Penetrometer

BRIDGE FOUNDATION BORING LOG

Project ____ Bridge S.N. 010-0101 Date 10/31/90
Route FAI-74 I-74 over Mattis Avenue Bored By Winschief
(10-5-1,14-14-1)R STA. 18+94.65 Checked By TGB
County Champaign Boring No. 3 Station 20+56 Offset 16' LT

Surface Water El. ____ Groundwater El. at Completion PLUGGED After ____ Hours ____

Ground Surface 776.0

MIXED BROWN GRAY CLAY LOAM EMBANKMENT	753.5
BROWN GRAY MOTTLED SILTY CLAY	750.0
BROWN SAND LOAM - SAND FREE WATER	747.5
BROWN-GRAY MOTTLED CLAY LOAM TILL	743.0
GRAY CLAY LOAM TILL	726.0
LIMIT OF BORING	

Depth (EL.)	N	Qu TSF	W%
5	6	1.0 B	24
10	7	1.6 B	20
	7	2.7 B	18
15	5	1.0 B	22
	7	1.0 B	23
20	7	2.1 B	19
	11	2.0 E	23
25	6	1.4 B	25
	6		
30	7	2.1 B	15
	12	2.9 B	12
35	14	6.2 B	11
40	12	5.0 B	11
45	11	5.0 B	11
50	15	4.9 B	11
55			

Type failure: B-Bulge Failure, S-Shear Failure, E-Estimated Value, P-Penetrometer

NOTE: STATIONS AND OFFSETS SHOWN ARE TAKEN FROM EXISTING CENTERLINE.

SOIL BORINGS

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS

F.A.I.-74 SEC (10-5-1HB) BR
SN 010-0270
CHAMPAIGN COUNTY

HOMER L. CHASTAIN & ASSOCIATES
CONSULTING ENGINEERS

Drawn by m/t Date 3-91
Project No. 3400-14

MATTIS AVENUE

Appendix D

Soil Boring Profile Sheet

Illinois Department of Transportation

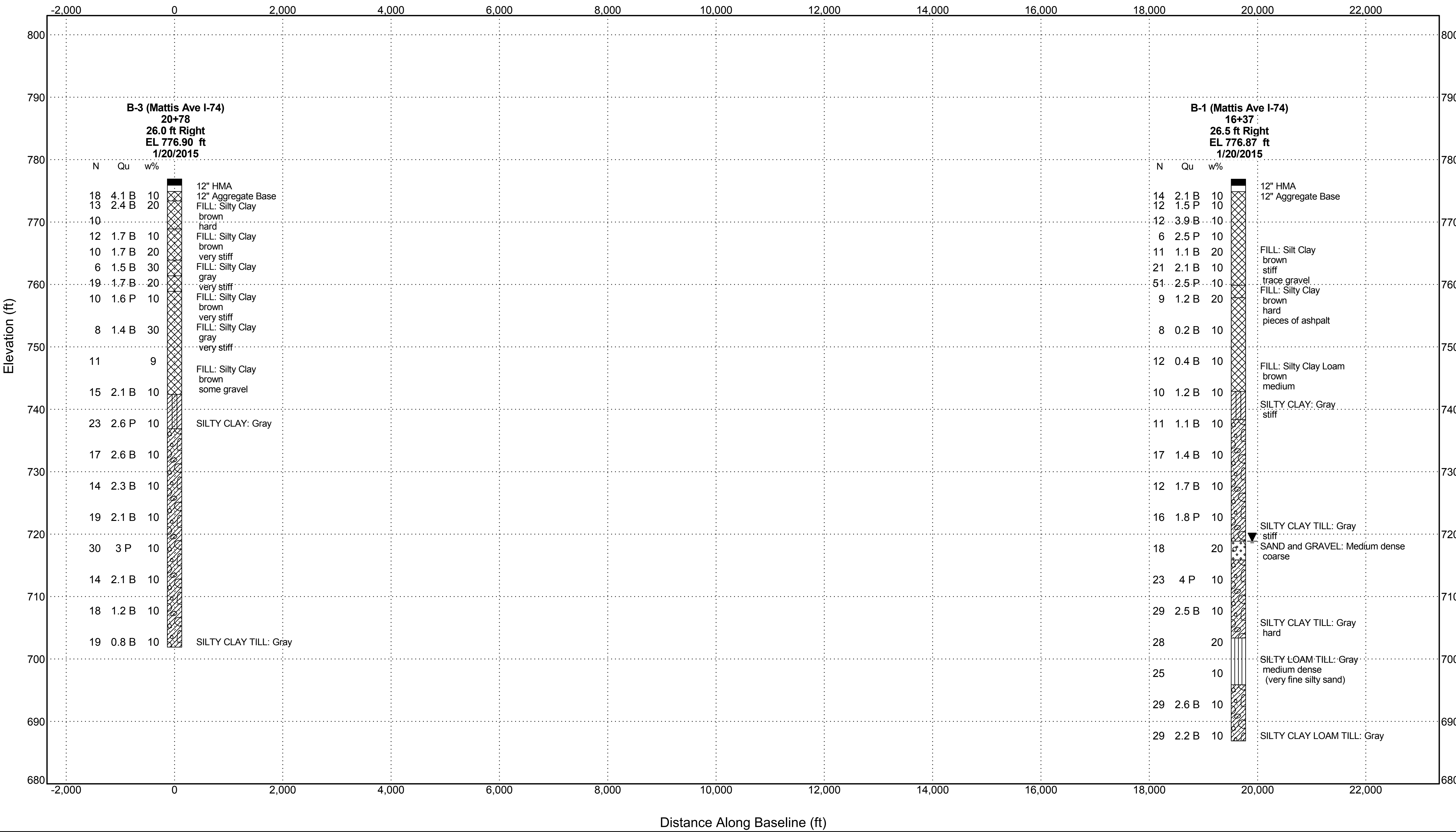
Division of Highways
BFW Engineering & Testing Inc.

ROUTE I-57/74
SECTION 10(5-1-RS-1, 14-1,6)R
COUNTY Champaign
PROJECT LOCATION

SUBSURFACE PROFILE SN 010-0270

LEGEND
EL = Elevation (ft)
D = Depth Below Existing Ground Surface (ft)
N = SPT N-Value (AASHTO T206)
Qu = Unconfined compressive Strength (tsf)
Failure Mode (B= Bulge, S= shear, P= penetrometer)
w% = Moisture Content Percentage

WATER TABLE LEGEND
▼ = First Encountered
▽ = Upon Completion
= After __ hours



ROADWAY PROFILE - BETA I 57 74 CHAMPAIGN COUNTY.GPJ IL_DOT_D4_9-15-10.GDT 3/23/15

Appendix E

Pile Capacity Tables (North Abutment, South Abutment, Center Pier)

Pile Design Table for South Abutment utilizing Boring #B-1

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	57	32	8
	76	42	10
	81	45	13
	92	50	15
	93	51	18
	94	52	20
	98	54	23
	102	56	25
	113	62	28
	124	68	30
	132	73	33
	142	78	35
	154	85	38
	165	91	40
	178	98	43
	191	105	45
	205	112	48
	218	120	50
Metal Shell 12"Φ w/.25" walls			
	57	32	8
	76	42	10
	81	45	13
	92	50	15
	93	51	18
	94	52	20
	98	54	23
	102	56	25
	113	62	28
	124	68	30
	132	73	33
	142	78	35
	154	85	38
	165	91	40
	178	98	43
	191	105	45
	205	112	48
	218	120	50
	284	156	58
	307	169	60
	308	169	62
	324	178	64
Metal Shell 14"Φ w/.25" walls			
	48	26	5
	70	39	8
	92	51	10
	97	53	13
	108	60	18
	110	61	20
	115	63	23

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)

Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)

120	66	25			
134	74	28	S		
146	80	30			
156	86	33			
167	92	35			
182	100	38			
195	107	40			
211	116	43			
226	124	45			
242	133	48			
257	141	50			
337	186	58			
363	200	62			
382	210	64			
Metal Shell 14"Φ w/.312" walls					
48	26	5			
70	39	8			
92	51	10			
97	53	13			
108	60	18			
110	61	20			
115	63	23			
120	66	25			
134	74	28			
146	80	30			
156	86	33			
167	92	35			
182	100	38			
195	107	40	S		
211	116	43			
226	124	45			
242	133	48			
257	141	50			
337	186	58			
363	200	62			
382	210	64			

Pile Design Table for North Abutment utilizing Boring #B-3

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	77	42	29
	88	49	31
	101	55	34
	112	62	36
	129	71	39
	144	79	41
	163	90	44
	180	99	46
	197	108	49
	213	117	51
	228	125	54
	244	134	56
Metal Shell 12"Φ w/.25" walls			
	77	42	29
	88	49	31
	101	55	34
	112	62	36
	129	71	39
	144	79	41
	163	90	44
	180	99	46
	197	108	49
	213	117	51
	228	125	54
	244	134	56
	257	142	59
	272	150	61
	295	162	64
	313	172	66
	324	178	69
	339	186	71
	346	190	74
Metal Shell 14"Φ w/.25" walls			
	80	44	26
	92	51	29
	106	58	31
	120	66	34
	134	74	36
	154	85	39
	171	94	41
	194	107	44
	214	118	46
	234	128	49
	253	139	51
	270	148	54
	288	159	56
	304	167	59
	321	176	61
	349	192	64

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)

371	204	66
382	210	69
399	219	71
406	223	74

Pile Design Table for Center Pier utilizing Boring #SB-1

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)
Metal Shell 12"Φ w/.179" walls			
	25	14	3
	45	25	6
	64	35	8
	87	48	11
	108	59	13
	121	66	16
	139	76	18
	156	86	21
	169	93	23
	183	101	26
	203	112	28
	221	121	31
	233	128	33
	248	136	36
Metal Shell 12"Φ w/.25" walls			
	25	14	3
	45	25	6
	64	35	8
	87	48	11
	108	59	13
	121	66	16
	139	76	18
	156	86	21
	169	93	23
	183	101	26
	203	112	28
	221	121	31
	233	128	33
	248	136	36
	299	164	37
	324	178	40
	336	185	42
Metal Shell 14"Φ w/.25" walls			
	34	19	3
	58	32	6
	80	44	8
	107	59	11
	132	73	13
	145	80	16
	166	92	18
	187	103	21
	200	110	23
	217	120	26
	242	133	28
	262	144	31
	275	151	33
	293	161	36
	360	198	37
	390	215	40

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)

	Nominal Required Bearing (Kips)	Factored Resistance Available (Kips)	Estimated Pile Length (Ft.)

I	401	221	42

S

S