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**STRUCTURE GEOTECHNICAL REPORT  
ILLINOIS 47 ANIMAL CROSSING  
STATION 598+22.00  
MCHENRY COUNTY, ILLINOIS**

**For  
Strand Associates, Inc.  
1170 South Houbolt Road  
Joliet, IL 60432**

**Submitted by  
Wang Engineering, Inc.  
1145 North Main Street  
Lombard, IL 60148**

**Original Report: August 24, 2018  
Revised Report: NA**

**Technical Report Documentation Page**

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<b>9. Prepared by</b> Wang Engineering, Inc. 1145 N Main Street Lombard, IL 60148	<b>Contributor(s)</b> Authors: Andri A.Kurnia, PE Nesam S. Balakumaran, PEng QA/QC: Corina T. Farez, PE, PG PM: Liviu Iordache, PG	<b>Contact</b> (630) 953-9928 ext. 1025 <a href="mailto:akurnia@wangeng.com">akurnia@wangeng.com</a>	
<b>10. Prepared for</b> Strand Associates, Inc. 1170 South Houbolt Rd Joliet, IL, 60431	<b>Contact(s)</b> Marc Grigas, PE	<b>Contact Information</b> (815)744-4200 <a href="mailto:Marc.Grigas@strand.com">Marc.Grigas@strand.com</a>	
<b>11. Abstract</b> <p>A new single box culvert is proposed for an animal crossing at the Illionis Route 47 Station 598+22. The proposed culvert will have an interior opening of 4-foot wide by 5-foot tall, and 164-foot long. New fill will be placed on top and around both culvert's ends. The culvert end will be retained by apron wingwalls.</p> <p>Beneath the topsoil, the general lithologic profile encountered during the investigation includes 2 to 7 feet of medium stiff to stiff silty clay loam fill over up to 8 feet of soft to medium stiff organic silty clay to silty clay followed by stiff to hard silty clay to silty clay loam. The groundwater elevations range from 874 to 900 feet.</p> <p>A layer of soft to medium stiff organic clay to silty clay was encountered beneath the proposed base of the culvert; we recommend removing soft to medium stiff soils and replacing with granular aggregate beneath the culvert. After the proposed removal, total long-term settlements are estimated to be 0.2 to 0.5 inches with a differential settlement of about 0.5 inches over 50 feet.</p> <p>We recommend the culvert barrel and wingwalls be designed for a maximum factored bearing resistance of 4,000 psf. Global stability analyses of the wingwalls show factors of safety meeting the minimum requirement of 1.5.</p> <p>We estimate a temporary steel sheet piling according to IDOT Design Guide 3.13.1 is feasible and sufficient to accommodate stage construction.</p>			
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**STRUCTURE GEOTECHNICAL REPORT  
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STATION 598+22.00  
MCHENRY COUNTY, ILLINOIS  
FOR  
STRAND ASSOCIATES, INC.**

## **1.0 INTRODUCTION**

This report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluations to support the design of and construction of the proposed culvert for animal crossing at the Illinois Route 47 (IL 47) Station 598+22 that is about 350 feet north of the intersection between Pleasant Valley Road and IL 47. The proposed structure is part of the widening and reconstruction of 1.65-mile long of IL 47 between Station 565+80 and Station 660+92 in McHenry County, Illinois. A *Site Location Map* is presented as Exhibit 1.

### **1.1 Proposed Structure**

Based on the information provided by Strand Associates, Inc. (Strand) and Christopher B. Burke Engineering, Ltd. (CBBEL) on February 14, 2018, and the *Preliminary General Plan and Elevation* (GPE) received in May, 2018, Wang Engineering, Inc. (Wang) understands the proposed animal crossing culvert will be a single box culvert with a 4-foot wide by 5-foot tall. The proposed culvert will be 164-foot long and will have an invert elevation of 900.5 feet for entire length of culvert. Apron with vertical wingwalls are proposed to support the widened roadway embankment at both ends. The roadway profile grade elevation will be slightly raised by 0.5 feet at the centerline of the road.

### **1.2 Existing Structure and Land Use**

There is no culvert at the proposed location. The animal crossing culvert is a new structure.

The purpose of this investigation was to characterize the site soil and groundwater conditions, perform geotechnical analyses, and provide recommendations for the design and construction of the proposed culvert and wingwalls.

## 2.0 GEOLOGICAL SETTING

The project area is located along IL 47 in Dorr Townships, in McHenry County, Illinois. On the USGS *Huntley 7.5 Minute Series Quadrangle map*, the project is located in SW ¼ of Section 33, Tier 44 N, Range 7 E of the Third Principal Meridian.

The following review of published geologic data, with emphasis on factors that might influence the design and construction of the proposed engineering works, is meant to place the project area within a geological framework and confirm the dependability and consistency of the subsurface investigation results. For the study of the regional geologic framework, Wang considered northeastern Illinois in general and McHenry County in particular. Exhibit 2 illustrates the *Site and Regional Geology*.

### 2.1 Physiography

The IL 47 at the culvert location runs through rural setting surrounded by agricultural used fields. The surface topography is generally flat with elevation of about 905 feet. At the proposed culvert location the elevation along IL 47 roadway is about 908 feet and at the drainage ditch bottom is about 900 feet.

### 2.2 Surficial Cover

The project area was shaped during the Wisconsin-age glaciation and about 200-foot thick overburden covers the bedrock. The glacial deposits were emplaced during pulsating advances and retreats of an icesheet lobe responsible for the formation of end moraines and associated low-relief till and lake plains (Hansel and Johnson 1996). The surficial cover within the project area consists of organic silt and clay of the Grayslake Peat found discontinuously throughout the project area. The Grayslake Peat overlies either the clay and silt of the Equality Formation, or the silty clayey diamicton of the Yorkville Member of the Lemont Formation. The clayey diamicton overlies the loamy diamicton of the Tiskilwa Formation or gravelly sand outwash of the Henry Formation. The outwash of the Henry Formation interfingers with the two diamictons.

The Grayslake Peat, less than 10-foot thick, consists of black to brown peat interbedded with gray organic reach sand and silty clay and white to light gray marl (Curry and Thomason 2012). The Equality Formation, less than 15-foot thick, consists of brown to gray bedded fine sand, silt, and clay lacustrine deposits (Curry and Thomason 2012). The Henry Formation consists of stratified sand and gravel outwash with thicknesses of about 5 to 10 feet, within the project limits (Curry and Thomason 2012). The Yorkville Member of the Lemont Formation, up to 15-foot thick, consists of

yellowish brown to gray silty clay to silty clay loam diamicton that contains lenses of gravel, sand, silt, and clay (Hansel and Johnson 1996, Curry and Thomason 2012). The Tiskilwa Formation, about 65-foot thick, consists of calcareous reddish brown to gray clay loam, loam to sandy loam diamicton that contains lenses of gravel, sand, silt, and clay (Wickham et al. 1988, Curry and Thomason 2012). The Tiskilwa Formation diamicton rests over the Illinoian-age drift, which in turn unconformably rests over the Silurian-age dolostone (Curry and Thomason 2012). The diamicton account for about 75% of the subsurface soil.

From a geotechnical viewpoint, the Yorkville Member characterized by low plasticity to moderate, high strength, and low to moderate moisture content and the Tiskilwa Formation characterized by low plasticity, medium to high strength, low moisture content, moderately to highly pebbly (Wickham et al. 1988, Bauer et al. 1991).

### **2.3 Bedrock**

In McHenry County, the surficial cover rests unconformably on top of Silurian-age and Ordovician-age bedrock. The top of the bedrock lies about 160 to 200 feet below the ground surface (bgs). Structurally, the site is located on the eastern flank of the Wisconsin Arch (Willman 1971). No active faults or underground mines are known in the area.

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area encountered native sediments consisting of organic reach silt and clay of the Grayslake Peat, gravel and sand outwash of the Henry Formation interbedded with silty clay diamicton of the Yorkville Member of the Lemont Formation and loamy diamicton of the Tiskilwa Formation. None of the borings were deep enough to encounter bedrock.

## **3.0 METHODS OF INVESTIGATION**

The following sections outline the subsurface and laboratory investigations performed by Wang.

### **3.1 Field Investigation**

No specific borings were performed for this culvert. However, two peat delineation borings, designated as PT6-03 and PT7-06 were drilled along this culvert. To supplement soil data, we considered soil borings performed for the culvert replacement at Station 598+48, about 25 feet north of this culvert. The subsurface investigation consisted of of three structure borings, designated as CUL-01 through CUL-03 and two Shelby tube borings, designated as CUL-02ST and CUL-03ST. In

addition, four peat delineation borings drilled along the culvert, designated as PT5-04, PT6-03, PT7-06, and PT8-07, were included on our analyses for the animal crossing culvert. The borings were drilled by Wang in October and December 2017 and were advanced to depths of 8 to 35 feet bgs. The as-drilled northings and eastings were acquired with a mapping-grade GPS unit; boring elevations were surveyed with a level. Stations and offsets were determined from drawings provided by Strand. Boring location data are presented in the *Boring Logs* (Appendix A). The as-drilled boring locations are shown in the *Boring Location Plan* (Exhibit 2).

An ATV- mounted drilling rig, equipped with hollow stem augers, was used to advance and maintain open boreholes. Soil sampling was performed according to AASHTO T 206, "*Penetration Test and Split Barrel Sampling of Soils.*" The soil was sampled at 2.5-foot intervals to 30 feet below ground surface (bgs) and at 5-foot intervals, thereafter. Peat delineation borings were sampled continuously. Soil samples collected from each sampling interval were placed in sealed jars and transported to the laboratory for further examination and laboratory testing. Shelby tube samples were obtained from Borings CUL-02ST and CUL-03ST where soft to medium stiff organic clay to silty clay was encountered.

Field boring logs, prepared and maintained by Wang geologists, include lithological descriptions, visual-manual soil classifications (IDH Textural), results of Rimac and pocket penetrometer unconfined compressive strength testing on cohesive soils, and results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration.

Groundwater observations were made during and at the end of drilling operations. Due to safety considerations, boreholes were backfilled immediately upon completion with soil cuttings and/or chips. The pavement surface was restored to its original condition.

### **3.2 Laboratory Testing**

The soil samples were tested in the laboratory for moisture content (AASHTO T265). Atterberg limits (AASHTO T89/T90) and particle size (AASHTO T88) analyses were performed on selected samples. A one-dimensional consolidation test (AASHTO T216) was performed on a shelly tube sample. Field visual descriptions of the soil samples were verified in the laboratory and index tested samples were classified according to the IDH Soil Classification System. Laboratory test results are shown in the *Boring Logs* (Appendix A) and in the *Laboratory Test Results* (Appendix B).



## 4.0 INVESTIGATION RESULTS

Detailed descriptions of the soil conditions encountered during the subsurface investigation are presented in the attached *Boring Logs* (Appendix A) and in the *Soil Profile* (Exhibit 4). Please note that strata contact lines represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in horizontal and vertical directions.

### 4.1 Lithological Profile

The borings encountered 3 to 32 inches of silty clay loam topsoil at the surface. In descending order, the general lithologic succession encountered beneath the surface includes: 1) man-made ground (fill); 2) soft to medium stiff organic silty clay to silty clay loam; and 3) stiff to hard silty clay to silty clay loam and clay loam to loam.

#### 1) *Man-made ground (fill)*

Beneath the topsoil, Borings CUL-02, PT6-03, and PT8-04 revealed 1 to 7 feet of fill material. The fill material is cohesive, consisting of medium stiff to stiff, dark brown to brown silty clay loam. The unconfined compressive strength ( $Q_u$ ) values of 0.9 and 1.5 tsf and the moisture content values of 16 to 19%. Below the fill, Boring CUL-02 encountered 6 inches of buried clay loam topsoil.

#### 2) *Soft to medium stiff organic silty clay to silty clay loam*

Beneath the fill and topsoil, at elevations of 898 to 900 feet, the borings encountered 3 to 8 feet of soft to medium stiff, brown to gray organic silty clay to silty clay loam. The unit has  $Q_u$  values of 0.41 to 1.00 tsf. The moisture content values range from 17 to 57%. Laboratory index testing on samples from this layer shows liquid limit ( $L_L$ ) values of 26 to 38% and plastic limit ( $P_L$ ) values of 13 to 19%. The consolidation properties of this soft to medium stiff silty clay layer were obtained. The resulting soil parameters are summarized in Table 1 and the laboratory test results are attached in Appendix B.

Table 1: Summary of Consolidation Testing

Boring ID	Test Depth (feet)	Test Elevation (feet)	$C_c$	$C_s$	$e_o$	OCR/ $P'_c$ (psf)	Moisture Content (%)
CUL-02ST	9 to 11	895	0.491	0.112	1.157	1.31/1835	44

$C_c$ : Compression index;  $C_s$ : Swelling index ;  $e_o$ : Initial void ratio; OCR: Over consolidation ratio; and  $P'_c$ : Preconsolidation pressure.

3) *Stiff to hard silty clay to silty clay loam and clay loam to loam*

At elevations of 899 to 903 feet, the borings encountered gray, stiff to hard silty clay to silty clay loam and clay loam to loam with wet to saturated sandy gravel to gravelly sand to loam interbeds. The unit has  $Q_u$  values of 1.2 to 4.6 tsf and moisture content values of 9 to 25%. The sandy gravel to gravelly sand to loam interbeds has N values of 12 to 27 blows per foot and moisture content values of 11 to 19%.

#### **4.2 Groundwater Conditions**

Groundwater was encountered while drilling at elevations of 885 to 891 (11 to 20 feet bgs). At the completion of drilling, the groundwater was observed at elevations of 874 to 900 feet (0 to 31 feet bgs).

### **5.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS**

Geotechnical evaluations and recommendations for the animal crossing culvert and wingwalls are included in the following sections. The proposed culvert will have an invert elevation of 900.5 feet. Apron wingwalls will be used to support the roadway embankment widening at both ends.

Wang has performed bearing capacity, settlement, and global stability analyses for the proposed culvert barrel and wingwalls.

#### **5.1 Ground Improvement**

Based on soil borings drilled along and nearby the proposed structure, the subsurface investigation indicates the soils at the culvert base may consist of soft to medium stiff organic silty clay, clay to silty clay, and silty clay loam. To mitigate settlement issues and to provide stable working platforms, Wang recommends removal and replacement of soft to medium stiff soil along the proposed culvert barrel and wingwalls. The recommended removal limit and depth are:

- West end of the culvert going east end to 50 feet right of centerline, for a depth of 1.5 feet below the proposed bottom of the culvert or to elevation 897 feet; and
- From 50 feet right of centerline to east end, for a depth of 7.5 feet below the proposed bottom of the culvert or to elevation 892 feet.

A sketch of the proposed removal is shown in Exhibit 5. The replacement material should extend a minimum of two feet beyond each side of the box (IDOT 2016). In addition, the following note should be shown in the plans.

*“ The limits and quantities of removal and replacement shown are based on the boring data may be modified by the District Geotechnical and Field Engineers for variable subsurface conditions encountered in the field”*

## **5.2 Bearing Capacity**

After the proposed removal and replacement, the walls could be designed based on a maximum factored bearing resistance of 4,000 psf, determined with a bearing resistance factor ( $\phi_b$ ) of 0.45 (AASHTO 2016). The wingwalls should be sized and designed based on the information and typical sections shown in IDOT *Culvert Manual*, Sections 4.3 and 4.4 ( IDOT 2017).

The culvert wingwalls could also be constructed as horizontal cantilever walls if they are less than 16 feet in length and the wingwall location can be adequately dewatered (IDOT 2017). Horizontal cantilever walls should be designed based on the structural guidelines provided in Section 4.2 of the IDOT (2017). These wingwalls should be founded at a minimum depth of 3.0 feet below the culvert invert elevations.

The wingwalls types suitable for precast concrete culvert include apron, driven sheetpile, and cast-in-place T-type wingwalls. For the cast-in-place culvert, the horizontal cantilever, L-type or T-type wingwalls are typically considered. The apron wingwalls should be designed and constructed based on IDOT Specifications and IDOT Base Sheet dated 2/17/2017 “ *SCB-GPE*.”

## **5.3 Settlement**

As discussed in Section 5.1, soft to medium stiff soil will be encountered below the base of proposed culvert. Without removal and replacement, we estimate up to 2.5 inches of settlement under the new culvert and fill loads. After the proposed removal and replacement, we estimate the foundation soils will experience total long-term settlements of about 0.2 to 0.5 inches, with differential settlement of 0.5 inches over 50 feet. We estimate the settlements are suitable for the construction of the proposed culvert and wingwalls.

## **5.4 Global Stability**

The global stability of the wingwalls was analyzed based on the generalized soil profile described in

Section 4.1. The maximum total fill height behind the wingwalls will be about 9 feet with a backfill slope of 1:3 (V:H). We have performed global stability analyses for the wingwalls at the southend section with the weaker soil conditions under both undrained (short-term) and drained (long-term) conditions. The analyses were performed with *Slide v6.0* and the results of the evaluations are provided in Appendix C. We estimate a factor of safety (FOS) of 3.9 for undrained soil condition and a FOS of 2.4 for a drained soil condition. The FOSs meet the minimum FOS requirement of 1.5 (IDOT 2015).

### **5.5 Cast-In-Place or Precast Culvert Considerations**

After the recommended removal of unsuitable material, the results of the analyses indicate that both the cast-in-place and precast culvert options are appropriate and feasible at the site. The differential settlement will be about 0.5 inches over 50 feet, which will not cause excessive separation of the precast sections.

### **5.6 Stage Construction Considerations**

Based on the information provided by Strand, Wang understands a temporary sheet piling system will be utilized to accommodate stage construction. The sheet piling should be designed based on IDOT *Design Guide* 3.13.1. Assuming an exposed height of about 11.5 feet (from elevation 908.5 to 897.0 feet) located at the stage construction line, our evaluations indicate the temporary steel sheet piling is feasible.

## **6.0 CONSTRUCTION CONSIDERATIONS**

### **6.1 Site Preparation**

Any vegetation, surface topsoil, and debris should be cleared and stripped where the animal crossing culvert and wingwalls will be placed. If unstable or unsuitable materials are exposed during excavation, they should be removed and replaced with compacted fill material as described in Section 6.3. The embankment fill behind the proposed wall will be placed against existing sloped embankment. These existing embankments should be deeply plowed or benched in accordance with IDOT Section 205.03 (IDOT 2016) prior to the placement of fill materials. We recommend that all embankment construction be performed in accordance with District One Embankment I Special Provision.

### **6.2 Excavation, Dewatering, and Utilities**

Excavations should be performed in accordance with local, state, and federal regulations. The

potential effect of ground movements upon nearby utilities should be considered during construction. Excavations for the placement of the culvert barrel should be steeped at no steeper than 1:2 (V:H). Any slopes that cannot be graded at 1:2 (V: H) should be properly shored with temporary sheeting or soil retention systems. Excavated material should not be stockpiled immediately adjacent to the top of slopes, nor should equipment be allowed to operate too closely to open excavations.

During the subsurface investigation, groundwater was not encountered in the borings drilled along the proposed barrel. However, groundwater was encountered at elevation ranging from 885 to 900 feet in the nearby soil borings. The proposed barrel and wingwalls will be established at 896.5 to 899.5 feet elevation, which is below the encountered groundwater. Therefore, the groundwater may be encountered and temporary steel piling or cofferdam will be required for dewatering of foundation excavation. Contractor should be prepared for dewatering measures. Any water that accumulates in open excavations by seepage or runoff should be immediately removed by sump-pump.

### **6.3 Filling and Backfilling**

Fill material used to attain the final design elevations should be IDOT Standard Specifications. Coarse aggregate of IDOT gradation CA-6 or pre-approved, compacted, cohesive or granular soil conforming to Section 204 would be acceptable as fill material (IDOT, 2016). The fill material should be free of organic matter and debris and should be placed in lifts and compacted according to IDOT Section 205, *Embankment* (IDOT, 2016).

Groundwater may exist beneath the culvert. As mentioned in IDOT (2017), in cases such as replacement below box culvert where dewatering and compaction may not be possible, the pay item “Rockfill” is commonly used. In this case, the following note should be added.

*“The Rockfill shall be capped with 6 in. of CA7 and satisfy the Standard Specifications unless otherwise indicated in the Special Provisions. The cost of the capping material shall be included in the pay item for Rockfill.”*

### **6.4 Earthwork Operations**

The required earthwork can be accomplished with conventional construction equipment. Moisture and traffic will cause deterioration of exposed subgrade soils. Precautions should be taken by the Contractor to prevent water erosion of the exposed subgrade. A compacted subgrade will minimize water runoff erosion.

Earth moving operations should be scheduled to not coincide with excessive cold or wet weather (early spring, late fall or winter). Any soil allowed to freeze or soften due to the standing water should be removed. Wet weather can cause problems with subgrade compaction.

It is recommended that an experienced geotechnical engineer be retained to inspect the exposed subgrade, monitor earthwork operations, and provide material inspection services during the construction phase of this project.

## **7.0 QUALIFICATIONS**

The analysis and recommendations submitted in this report are based upon the data obtained from the borings drilled at the locations shown on the boring logs and in Exhibit 3. This report does not reflect any variations that may occur between the borings or elsewhere on the site, variations whose nature and extent may not become evident until the course of construction. In the event that any changes in the design and/or location of the structure are planned, we should be timely informed so that our recommendations can be adjusted accordingly.

It has been a pleasure to assist Strand Associates, Inc. and the Illinois Department of Transportation on this project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

### **WANG ENGINEERING, INC.**

Andri A. Kurina, P. E.  
Senior Geotechnical Engineer

Corina T. Farez, P.E., P.G.  
QA/QC Reviewer

Nesam S. Balakumaran, P.Eng.  
Project Geotechnical Engineer

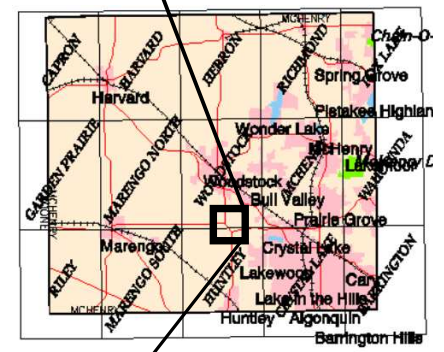
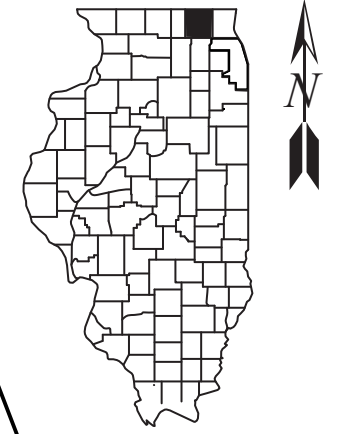
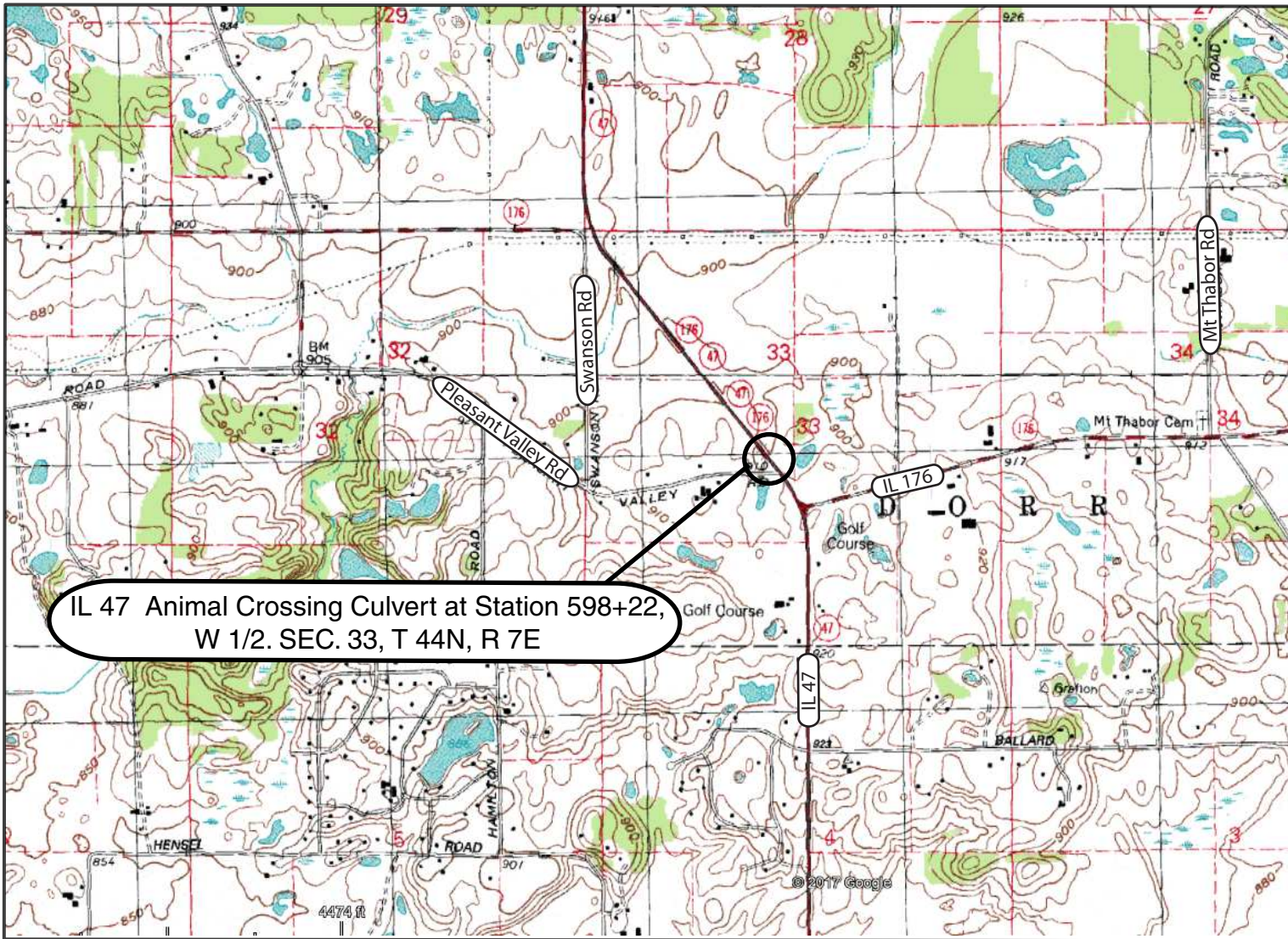
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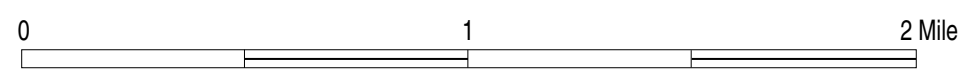
## **EXHIBITS**





McHenry County

Scale



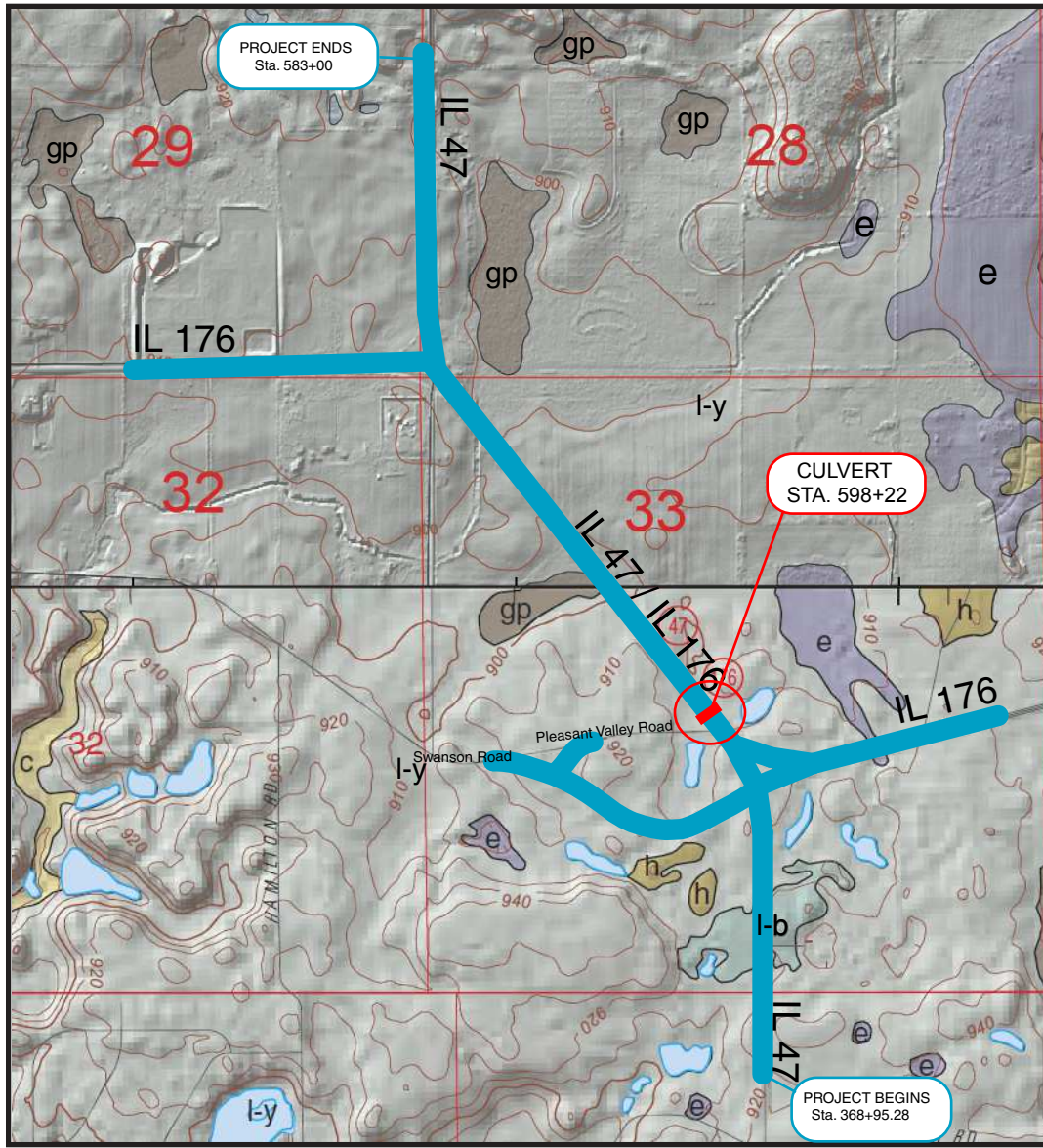
SITE LOCATION MAP: IL 47 ANIMAL CROSSING CULVERT AT STATION 598+22, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL	<b>EXHIBIT 1</b>	DRAWN BY: RKC CHECKED BY: A. Kurnia
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**Wang Engineering**  
 1145 N. Main Street  
 Lombard, IL 60148  
 www.wangeng.com

FOR STRAND ASSOCIATES, INC. 195-13-01





Modified after Flaherty, Thomason, and Malone (2013)

Modified after Curry and Thomason (2012)

### REGIONAL GEOLOGY



#### Wedron Group

- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

Modified after Hansel and Johnson (1996)

### LEGEND

#### HUDSON EPISODE

- gp** Grayslake Peat  
Decomposed wetland vegetation and sediment; peat and muck, interbedded sand, silty clay, and marl

#### WISCONSIN EPISODE

- e** Equality Formation  
Lake deposits in kettles and valleys; silt, clay, and fine sand; layered to massive
- h** Henry Formation  
Proglacial outwash plains downslope of glacial margins; sand and gravel, or sand; with lenses of silt and clay, or diamicton
- l-y** Lemont Formation, Yorkville Member  
Debris flow deposits and diamicton; silty clay, silty clay loam, and clay, includes layers of sand and gravel
- l-b** Lemont Formation, Batestown Member (Cross section only)  
Debris flow deposits and diamicton; sandy loam to loam with abundant cobbles; includes layers of sand and gravel or silt and sorted sediment
- t** Tiskilwa Formation (Cross section only)  
Till, debris flow deposits, and outwash; clay loam to loam; includes lenses of sand and gravel.

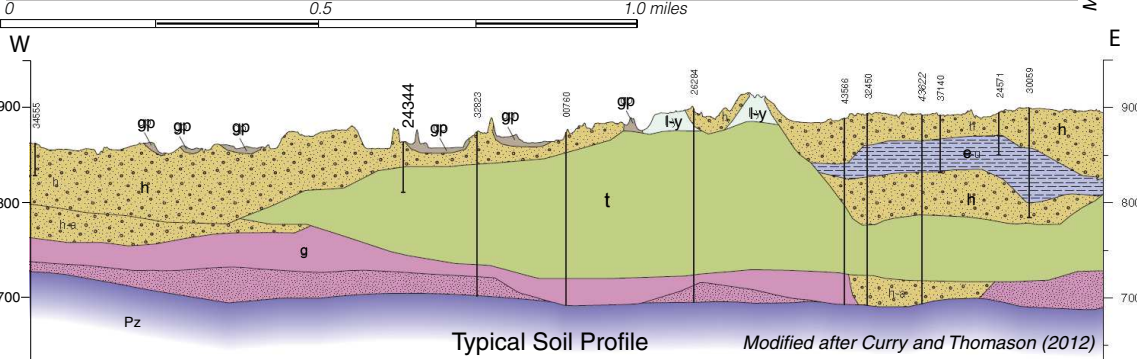
#### ILLINOIS EPISODE

- g** Glasford Formation (Cross section only)  
Till and debris flow deposits (diamicton) and outwash (sand and gravel); the diamicton is bouldery in places with reddish brown, sandy loam to loam matrix, with abundant lenses, and channel fills of sand and gravel.

#### PALEOZOIC BEDROCK

- Pz** Bedrock (Cross section only)  
Dolomite, shaly dolomite, and shale

Modified after Curry and Thomason (2012)



Typical Soil Profile Modified after Curry and Thomason (2012)

## SITE AND REGIONAL GEOLOGY: IL 47 ANIMAL CROSSING CULVERT AT STATION 598+22, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL

### EXHIBIT 2

DRAWN BY: C. Marin  
CHECKED BY: L. Iordache

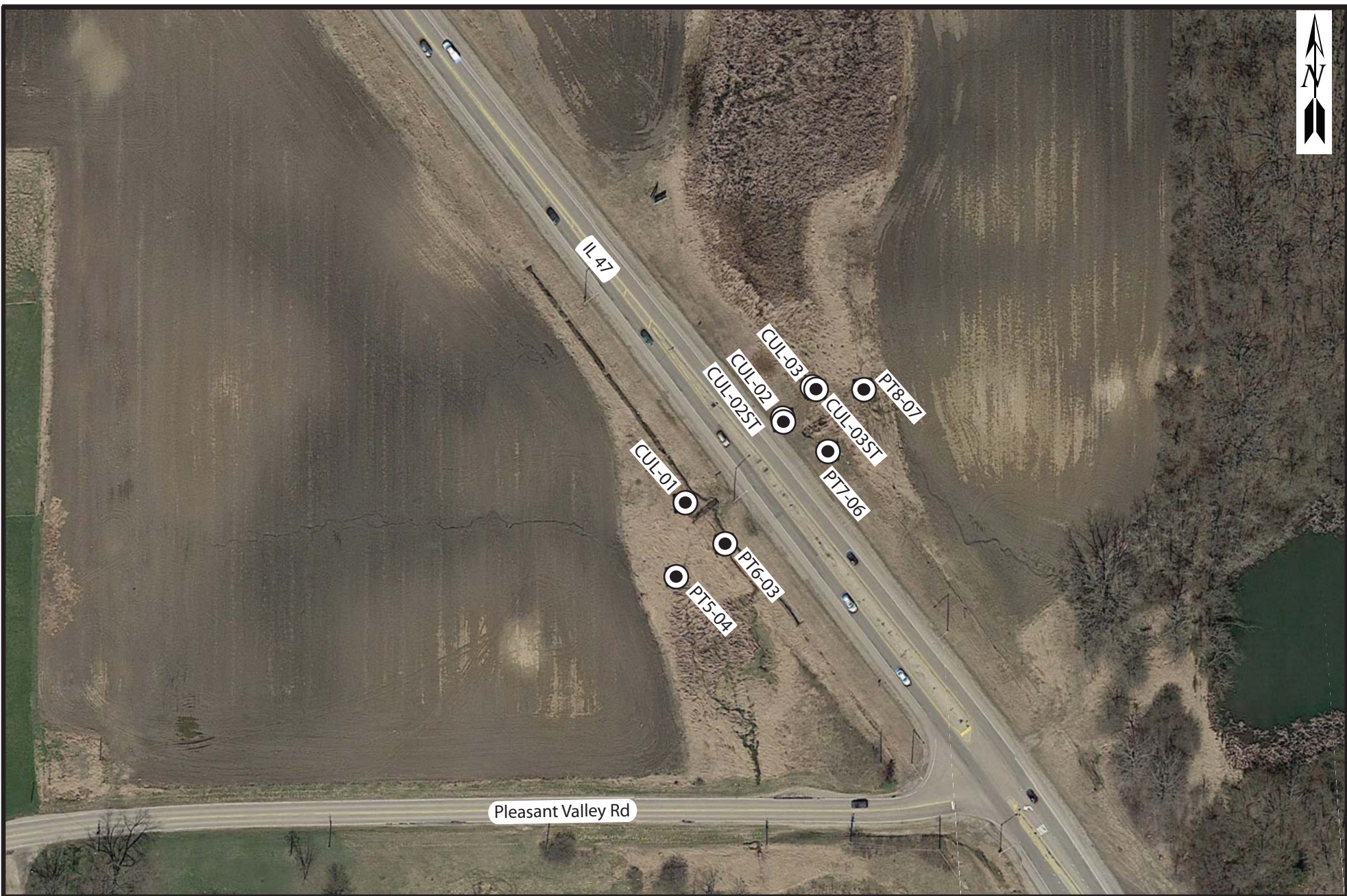


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195-13-01

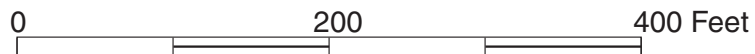




Legend

● Culvert Borings

Scale



BORING LOCATION PLAN: IL 47 ANIMAL CROSSING CULVERT AT STATION 598+22, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL

EXHIBIT 3-1

DRAWN BY: RKC  
CHECKED BY: NSB



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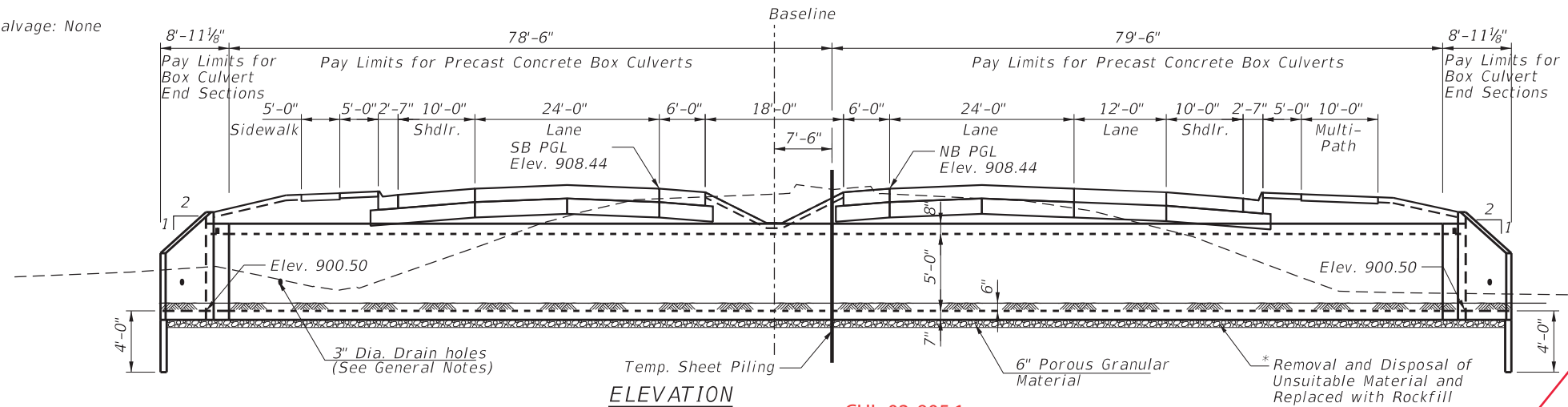
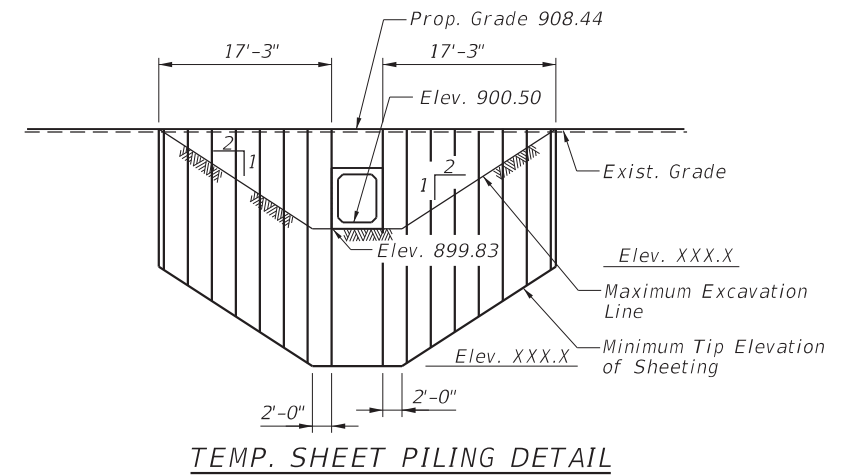
195-13-01



Benchmark: BM #6, Set cut square on light pole base along Illinois Rte. 47  
130± North of intersection of Pleasant Valley Road. Elev. 908.52

Traffic Control: Traffic to be maintained utilizing Stage Construction.

Salvage: None



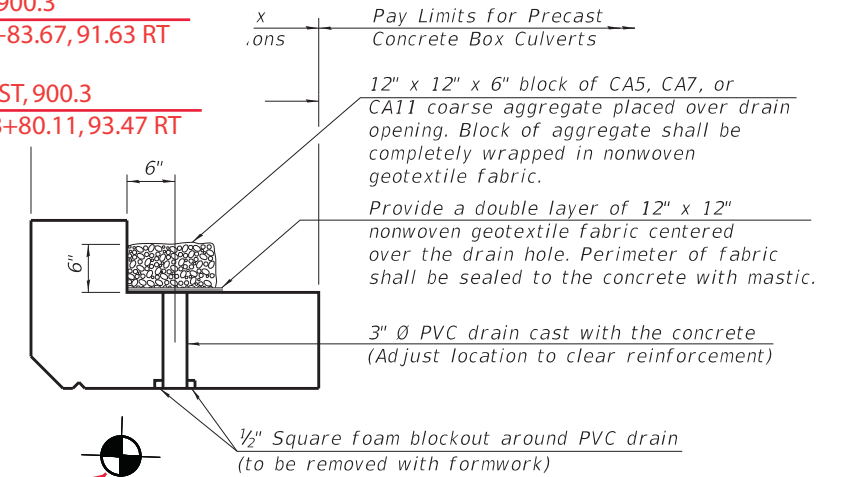
CUL-01, 903.4  
Sta. 598+72.30, 69.86 LT

CUL-02, 905.1  
Sta. 598+78.32, 52.77 RT

CUL-02ST, 905.1  
Sta. 598+76.23, 49.34 RT

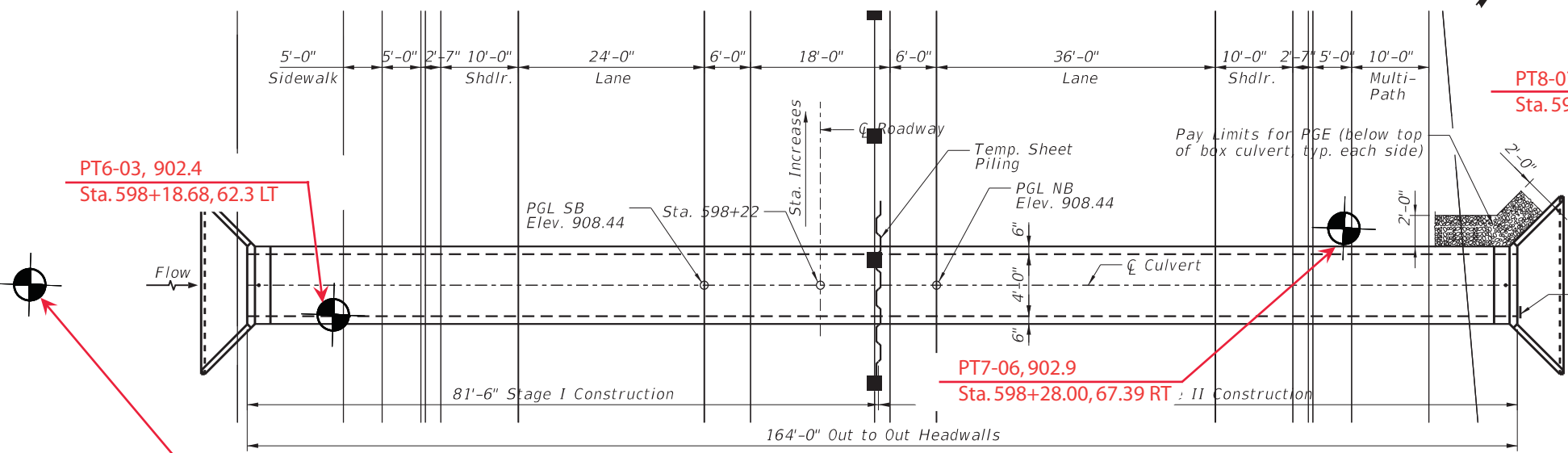
CUL-03, 900.3  
Sta. 598+83.67, 91.63 RT

CUL-03ST, 900.3  
Sta. 598+80.11, 93.47 RT



PT8-07, 901.8  
Sta. 598+55.93, 128.77 RT

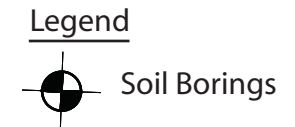
DESIGN SPECIFICATIONS  
2017 AASHTO LRFD Bridge Design Specifications  
8th Edition  
LOADING HL-93  
50 PSF Future Wearing Surface  
DESIGN STRESSES  
PRECAST UNITS  
f'c = 5,000 psi  
fy = 65,000 psi (Welded Wire Reinforcement)



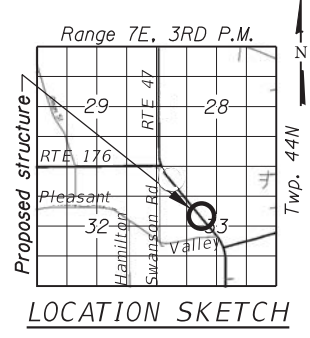
PROFILE GRADE - NB AND SB

Sta. 597+90 Elev. 908.60  
Sta. 613+10 Elev. 901.00  
-0.50%

\*Note: Out of Sheet, PT5-04  
2032697.342N, 959409.243E



STATION 598+22.00  
BUILT BY  
STATE OF ILLINOIS  
F.A.P. RT. 326 SEC.  
LOADING HL-93  
NAME PLATE  
See Std. 515001



GENERAL PLAN AND ELEVATION  
IL RTE. 47 ANIMAL CROSSING  
F.A.P. RTE. 326 SEC 105-N-2(15)  
McHENRY COUNTY  
STATION 598+22.00

SITE LOCATION MAP: IL 47 ANIMAL CROSSING CULVERT AT STATION 598+48, MCHENRY COUNTY, ILLINOIS

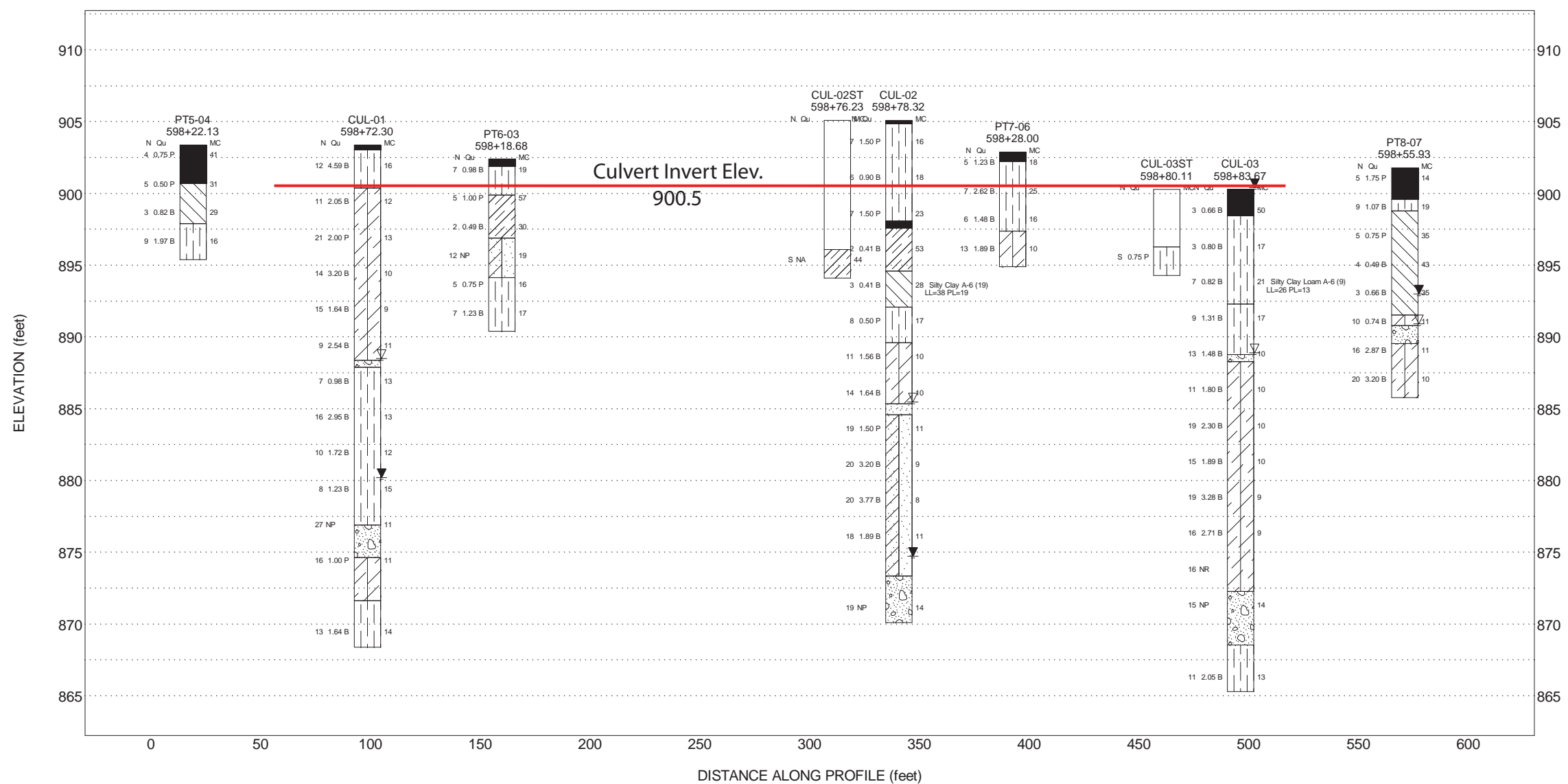
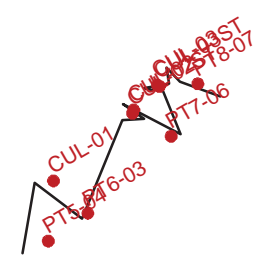
SCALE: GRAPHICAL EXHIBIT 3-2 DRAWN BY: RKC CHECKED BY: NSB

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FOR STRAND ASSOCIATES, INC. 195-13-01

MODEL: D:\d\p\170353\CBBEL\Struct\170353-09-DEER-CULVERT.dwg

CHRISTOPHER B. BURKE ENGINEERING, LTD. 9575 W. HOGANS ROAD, SUITE 600 ROSEMONT, ILLINOIS 60018 (847) 823-0500	USER NAME = prazalan PLOT SCALE = 20,0000' / in. PLOT DATE = 4/11/2018	DESIGNED - AS DRAWN - PDR CHECKED - MM DATE - SPLANDATES	REVISED - REVISED - REVISED - REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	GENERAL PLAN AND ELEVATION PROPOSED ANIMAL CROSSING SCALE: N.T.S. SHEET 1 OF 6 SHEETS STA. 598+22 TO STA. ---	F.A.P. RTE. 326 SECTION 105-N-2(15) COUNTY MCHENRY TOTAL SHEETS 473 SHEET NO. 340 CONTRACT NO. 62B43 ILLINOIS FED. AID PROJECT
	PROJECT INFORMATION: IL 47 ANIMAL CROSSING CULVERT AT STATION 598+48, MCHENRY COUNTY, ILLINOIS					

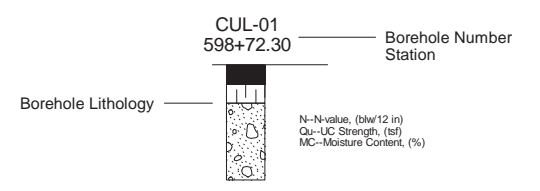


**Lithology Graphics**

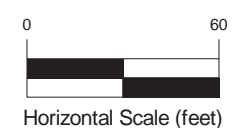
- Topsoil
- USCS High Plasticity Organic silt or clay
- IDH Silty Clay, Silty Clay Loam
- IDH Clay Loam
- Gravelly sand, sandy gravel
- IDH Sand, Sandy Loam
- IDH Clay
- IDH Loam

Site Map Scale 1 inch equals 220 feet

**Explanation:**



- Water Level Reading at time of drilling.
- Water Level Reading 24-hr after drilling or at end of drilling



Vertical Exaggeration: 6.5x

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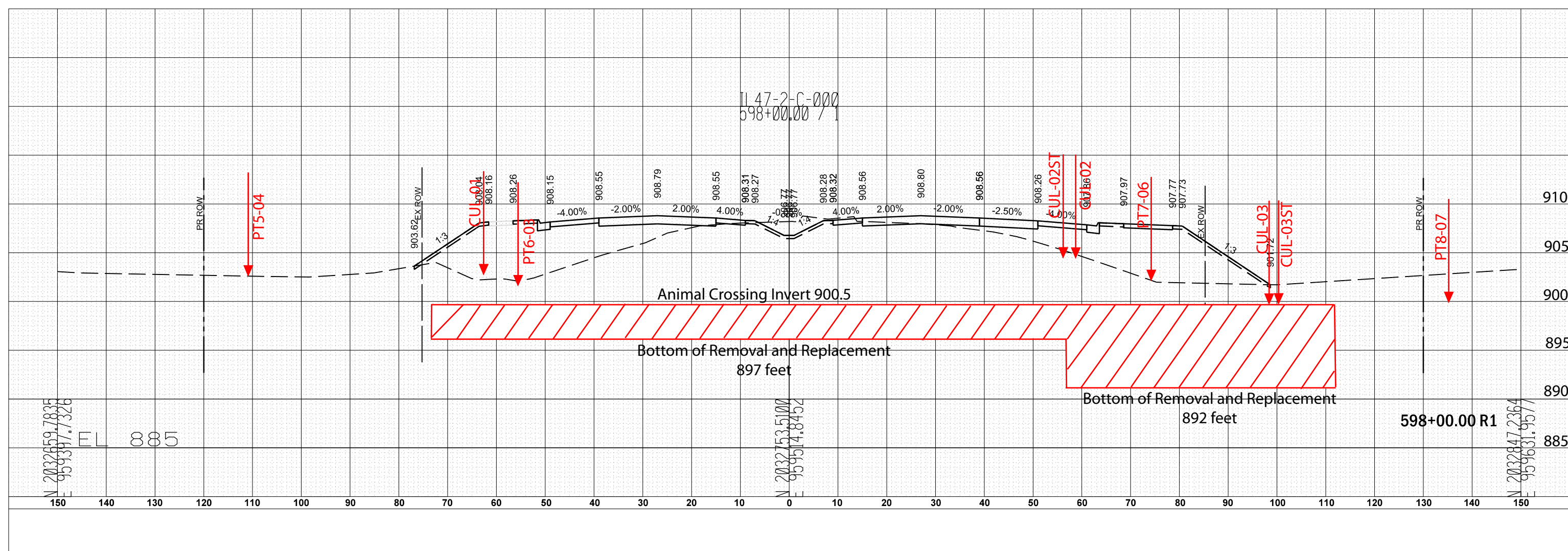
**Subsurface Data Profile**  
**IL 47 Animal Crossing Culvert at Sta. 598+22,**  
**McHenry County, Illinois**



IL 47 between US 14 and S of IL 176  
McHenry County, Illinois

JOB NUMBER	PLATE NUMBER
195-13-01	EXHIBIT 4

WEI 11X17\_1951301.GPJ WANGENG.GDT 8/13/18



REMOVAL AND REPLACEMENT SKETCH: IL 47 ANIMAL CROSSING  
 CULVERT AT STATION 598+48, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL	<b>EXHIBIT 5</b>	DRAWN BY: RKC CHECKED BY: NSB
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 1145 N. Main Street  
 Lombard, IL 60148  
 www.wangeng.com

FOR STRAND ASSOCIATES, INC. 195-13-01

## **APPENDIX A**

## LEGEND FOR BORING LOG

Relative Density of Non-Cohesive Soils	
N-Blows/ 12 inches	Relative Density Term
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80+	Very Dense

Consistency of Cohesive Soils	
Unconfined Compressive Strength $Q_u$ , tsf	Consistency Term
<0.25	Very Soft
0.25-0.49	Soft
0.50-0.99	Medium Stiff
1.00-1.99	Stiff
2.00-3.99	Very Stiff
>4.00	Hard

Rock Quality Designation (RQD)	
0-25%	Very Poor
25-50%	Poor
50-75%	Fair
75-90%	Good
90-100%	Excelent

SS = Split Spoon  
 ST = Shelby Tube  
 SPT = Standard Penetration Test  
 $Q_u$  = Unconfined Compressive Strength  
 NP = Non Plastic  
 P = Pocket Penetrometer  
 S = Shear failure of sample, Rimac test  
 B = Bulge failure of sample, Rimac test  
 SSA = Solid Stem Augers,  
 HSA = Hollow Stem Augers,

Proportional Terms		
Trace	1-9	Percent of Dry Weight
Little	10-19	
Some	20-34	
And	35-50	
Gradation Terminology		
Boulders	>200mm	
Cobbles	200mm to 75mm	
Gravel	75mm to 2mm	
Sand	2-0mm to 0.074mm	
Silt	0.074mm to 0.002mm	
Clay	<0.002mm	

Relative Moisture Conditions	
Term	Description
Dry	Dusty, No visible moisture
Damp	Cohesives hard to mold; Granulars do not flow easily
Moist	Cohesives can be molded; Granulars start to stick together
Wet	Cohesives can be very easily molded and sticky; Granulars stick together easily
Saturated	Only granular soils; Water drains freely from sample

Relative Drilling Resistance (RDR)	
1	No Chatter - Very Easy Drilling
2	No Chatter - Easy Drilling
3	Some Chatter - Moderate Advancement
4	Frequent Chatter - Slow Advancement
5	Constant Chatter - Very Slow Advanement

### Sample Type Symbols



Split Spoon



Rock Core



In-situ Vane Shear Test



No Recovery



Shelby Tube

SPT = Standard Penetration Test  
N Value is the sum of the second and the third numbers



Geoprobe



Auger Cuttings





wangeng@wangeng.com  
 1145 North Main Street  
 Lombard, IL 60148  
 Telephone: 630-953-9928  
 Fax: 630-953-9938

# BORING LOG CUL-01

WEI Job No.: 195-13-01

Client **Strand Associates, Inc.**  
 Project **IL 47 between US 14 and S of IL 176**  
 Location **McHenry County, Illinois**

Datum: NGVD  
 Elevation: 903.40 ft  
 North: 2032766.30 ft  
 East: 959415.12 ft  
 Station: 598+72.30  
 Offset: 69.86 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	903.14	14-inch thick, black SILTY CLAY LOAM --TOPSOIL-- Hard, brown SILTY CLAY, trace gravel; damp --RDR 2--			1	5 6 6	4.59 B	16									
	900.4	Stiff to very stiff, brown to gray SILTY CLAY LOAM to CLAY LOAM, trace gravel; damp --RDR 2--			2	3 6 5	2.05 B	12									
					3	7 10 11	2.00 P	13		876.9	Medium dense, gray SANDY GRAVEL; saturated --RDR 3--				27 16 11	NP	11
		--cobbles--			4	5 6 8	3.20 B	10		874.7	Stiff, gray CLAY LOAM, trace gravel; damp --RDR 2--30				6 4 12	1.00 P	11
					5	4 7 8	1.64 B	9		871.7	Stiff, gray SILTY CLAY LOAM, trace gravel; damp --RDR 2--						
					6	3 5 4	2.54 B	11							7 8 5	1.64 B	14
	888.4	GRAVEL; saturated	15							868.4	Boring terminated at 35.00 ft						
	887.9	Medium stiff to very stiff, gray SILTY CLAY LOAM, trace gravel; damp to moist --RDR 2--			7	2 2 5	0.98 B	13									
					8	3 5 11	2.95 B	13									

### GENERAL NOTES

### WATER LEVEL DATA

Begin Drilling **11-27-2017** Complete Drilling **11-27-2017**  
 Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**  
 Driller **K&N** Logger **T. Rothschild** Checked by **C. Marin**  
 Drilling Method **2.25 IDA HSA; 140 lb. autohammer; Boring backfilled upon completion**

While Drilling  $\nabla$  **15.00 ft**  
 At Completion of Drilling  $\nabla$  **23.30 ft**  
 Time After Drilling **NA**  
 Depth to Water  $\nabla$  **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

WANGENGINC 1951301.GPJ WANGENG.GDT 8/8/18



wangeng@wangeng.com  
 1145 North Main Street  
 Lombard, IL 60148  
 Telephone: 630-953-9928  
 Fax: 630-953-9938

# BORING LOG CUL-02

WEI Job No.: 195-13-01

Client **Strand Associates, Inc.**  
 Project **IL 47 between US 14 and S of IL 176**  
 Location **McHenry County, Illinois**

Datum: NGVD  
 Elevation: 905.10 ft  
 North: 2032847.66 ft  
 East: 959507.08 ft  
 Station: 598+78.32  
 Offset: 52.77 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	904.93	93-inch thick, black to dark brown SILTY CLAY LOAM --TOPSOIL-- Medium stiff to stiff, dark brown SILTY CLAY LOAM; trace gravel --FILL-- --RDR 2--			1	2 2 5	1.50 P	16		884.6	Gray SANDY GRAVEL; saturated --RDR 2-- Stiff to very stiff, pinkish gray CLAY LOAM to LOAM, little gravel; damp --RDR 2--			9	7 8 11	1.50 P	11
					2	4 3 3	0.90 B	18				25		10	7 8 12	3.20 B	9
	898.1	Black CLAY LOAM --BURIED TOPSOIL-- Soft, dark gray ORGANIC SILTY CLAY to CLAY with organic matter; moist --RDR 1-- --organic content= 7.0%--10			3	3 4 3	1.50 P	23						11	6 8 12	3.77 B	8
	897.6				4	1 1 1	0.41 B	53				30		12	5 7 11	1.89 B	11
	894.6	Soft, light gray CLAY to SILTY CLAY; wet --RDR 1-- --L <sub>L</sub> (%)=38, P <sub>L</sub> (%)=19-- --%Gravel=0.1-- --%Sand=3.9-- --%Silt=57.2-- --%Clay=38.8-- --A-6 (19)-- --sand seams; moist--			5	1 1 2	0.41 B	28		873.4	Medium dense, gray SANDY GRAVEL; saturated --RDR 2--						
	892.1				6	3 4 4	0.50 P	17				35		13	3 9 10	NP	14
	889.6	Medium stiff, gray SILTY CLAY, trace gravel; moist --RDR 2-- Stiff, pinkish gray CLAY LOAM to LOAM; trace to little gravel; damp --RDR 2--			7	3 4 7	1.56 B	10		870.1	Boring terminated at 35.00 ft						
	885.4				8	3 5 9	1.64 B	10				40					

### GENERAL NOTES

### WATER LEVEL DATA

Begin Drilling **10-23-2017** Complete Drilling **10-23-2017**  
 Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**  
 Driller **K&N** Logger **T. Rothschild** Checked by **C. Marin**  
 Drilling Method **2.25 IDA HSA; 140 lb. autohammer; Boring backfilled upon completion**

While Drilling **19.75 ft**  
 At Completion of Drilling **30.50 ft**  
 Time After Drilling **NA**  
 Depth to Water **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

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wangeng@wangeng.com  
 1145 North Main Street  
 Lombard, IL 60148  
 Telephone: 630-953-9928  
 Fax: 630-953-9938

# BORING LOG CUL-02ST

WEI Job No.: 195-13-01

Client **Strand Associates, Inc.**  
 Project **IL 47 between US 14 and S of IL 176**  
 Location **McHenry County, Illinois**

Datum: NGVD  
 Elevation: 905.10 ft  
 North: 2032843.89 ft  
 East: 959505.71 ft  
 Station: 598+76.23  
 Offset: 49.34 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Blind drilled to 9 feet	5														
	896.1	Gray SILTY CLAY; moist -C <sub>c</sub> =0.491, OCR=1.3-	10		1			44	P U S H								
	894.1	Boring terminated at 11.00 ft	15														
			20														

### GENERAL NOTES

### WATER LEVEL DATA

Begin Drilling **10-24-2017** Complete Drilling **10-24-2017**  
 Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**  
 Driller **K&N** Logger **F. Bozga** Checked by **C. Marin**  
 Drilling Method **3.25 IDA HSA; 140 lb. autohammer; Boring backfilled upon completion**

While Drilling  $\nabla$  **DRY**  
 At Completion of Drilling  $\nabla$  **DRY**  
 Time After Drilling **NA**  
 Depth to Water  $\nabla$  **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.





wangeng@wangeng.com  
 1145 North Main Street  
 Lombard, IL 60148  
 Telephone: 630-953-9928  
 Fax: 630-953-9938

# BORING LOG CUL-03ST

WEI Job No.: 195-13-01

Client **Strand Associates, Inc.**  
 Project **IL 47 between US 14 and S of IL 176**  
 Location **McHenry County, Illinois**

Datum: NGVD  
 Elevation: 900.30 ft  
 North: 2032874.72 ft  
 East: 959536.58 ft  
 Station: 598+80.11  
 Offset: 93.47 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Drilled to 4 feet without sampling															
	896.3	Medium stiff, brown to gray SILTY CLAY LOAM	5	P	1	I S C P	0.75	P									
	894.3																
		Boring terminated at 6.00 ft															
			10														
			15														
			20														

### GENERAL NOTES

Begin Drilling **10-23-2017** Complete Drilling **10-23-2017**  
 Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**  
 Driller **K&N** Logger **F. Bozga** Checked by **CLM**  
 Drilling Method **3.25 IDA HSA; 140 lb. autohammer; Boring backfilled upon completion**

### WATER LEVEL DATA

While Drilling  $\nabla$  **DRY**  
 At Completion of Drilling  $\nabla$  **DRY**  
 Time After Drilling **NA**  
 Depth to Water  $\nabla$  **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.



wangeng@wangeng.com  
 1145 North Main Street  
 Lombard, IL 60148  
 Telephone: 630-953-9928  
 Fax: 630-953-9938

# BORING LOG PT5-04

WEI Job No.: 195-13-01

Client **Strand Associates, Inc.**  
 Project **IL 47 between US 14 and S of IL 176**  
 Location **McHenry County, Illinois**

Datum: NGVD  
 Elevation: 902.95 ft  
 North: 2032697.34 ft  
 East: 959409.24 ft  
 Station: 598+22.13  
 Offset: 117.55 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		32-inch thick, medium stiff, black SILTY CLAY LOAM, trace organic --TOPSOIL--			1	1 2 2 2	0.75 P	41									
	900.3	Medium stiff to stiff, brown and gray CLAY to SILTY CLAY; moist --RDR 1--			2	1 2 3 3	0.50 P	31									
	897.4	Stiff, brown SILTY CLAY LOAM, trace gravel; damp --RDR 2--	5		3	2 1 2 3	0.82 B	29									
	894.9	Boring terminated at 8.00 ft			4	3 4 5 6	1.97 B	16									

### GENERAL NOTES

Begin Drilling **12-19-2017** Complete Drilling **12-19-2017**  
 Drilling Contractor **Wang Testing Services** Drill Rig **D25 ATV [93%]**  
 Driller **R&K** Logger **F. Bozga** Checked by **C. Marin**  
 Drilling Method **2.25 IDA HSA; 140 lb. autohammer; Boring backfilled upon completion**

### WATER LEVEL DATA

While Drilling  $\nabla$  **DRY**  
 At Completion of Drilling  $\nabla$  **DRY**  
 Time After Drilling **NA**  
 Depth to Water  $\nabla$  **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.



wangeng@wangeng.com  
 1145 North Main Street  
 Lombard, IL 60148  
 Telephone: 630-953-9928  
 Fax: 630-953-9938

# BORING LOG PT6-03

WEI Job No.: 195-13-01

Client **Strand Associates, Inc.**  
 Project **IL 47 between US 14 and S of IL 176**  
 Location **McHenry County, Illinois**

Datum: NGVD  
 Elevation: 902.40 ft  
 North: 2032729.17 ft  
 East: 959454.53 ft  
 Station: 598+18.68  
 Offset: 62.3 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	901.9	6-inch thick, black SILTY CLAY LOAM --TOPSOIL-- Medium stiff, brown and black SILTY CLAY; damp	0		1	1 3 4 4	0.98 B	19									
	899.9	--FILL-- Soft to stiff, black and gray SILTY CLAY, little to some organic matter; moist	1		2	2 2 3 4	1.00 P	57									
	896.9	--RDR 2-- Medium dense, gray LOAM; moist to wet	5		3	1 1 1 2	0.49 B	30									
	894.2	--RDR 2-- Medium stiff to stiff, gray SILTY CLAY LOAM, trace gravel; damp	10		4	1 3 9 6	NP	19									
	890.4	--RDR 2-- Boring terminated at 12.00 ft	12		5	3 2 3 6	0.75 P	16									
			15		6	2 3 4 7	1.23 B	17									

### GENERAL NOTES

### WATER LEVEL DATA

Begin Drilling **12-19-2017** Complete Drilling **12-19-2017**  
 Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**  
 Driller **N&J** Logger **T. Rothschild** Checked by **C. Marin**  
 Drilling Method **2.25 IDA HSA; 140 lb. autohammer; Boring backfilled upon completion**

While Drilling  $\nabla$  **DRY**  
 At Completion of Drilling  $\nabla$  **DRY**  
 Time After Drilling **NA**  
 Depth to Water  $\nabla$  **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.



wangeng@wangeng.com  
 1145 N Main Street  
 Lombard, IL 60148  
 Telephone: 630 953-9928  
 Fax: 630 953-9938

# BORING LOG PT7-06

WEI Job No.: 195-13-01

Client **Strand Associates, Inc.**  
 Project **IL 47 between US 14 and S of IL 176**  
 Location **McHenry County, Illinois**

Datum: NAVD  
 Elevation: 902.90 ft  
 North: 2032817.50 ft  
 East: 959549.94 ft  
 Station: 598+28.00  
 Offset: 67.39 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	902.2	8-inch thick, black SILTY CLAY LOAM, trace gravel --TOPSOIL-- Stiff to very stiff, black, brown and gray SILTY CLAY, trace gravel; damp	1 2 3 4		1	1.23 B	18										
		--FILL-- Stiff, brown CLAY LOAM, trace gravel; damp	3 3 4 4		2	2.62 B	25										
	897.4		5 3 3 5		3	1.48 B	16										
	894.9		5 6 7 6		4	1.89 B	10										
		Boring terminated at 8.00 ft															

### GENERAL NOTES

Begin Drilling **12-07-2017** Complete Drilling **12-07-2017**  
 Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**  
 Driller **N&J** Logger **T. Rothschild** Checked by **C. Marin**  
 Drilling Method **2.25 IDA HSA; 140 lb. autohammer; Boring backfilled upon completion**

### WATER LEVEL DATA

While Drilling  $\nabla$  **DRY**  
 At Completion of Drilling  $\nabla$  **DRY**  
 Time After Drilling **NA**  
 Depth to Water  $\nabla$  **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.





wangeng@wangeng.com  
 1145 North Main Street  
 Lombard, IL 60148  
 Telephone: 630-953-9928  
 Fax: 630-953-9938

# BORING LOG PT8-07

WEI Job No.: 195-13-01

Client **Strand Associates, Inc.**  
 Project **IL 47 between US 14 and S of IL 176**  
 Location **McHenry County, Illinois**

Datum: NGVD  
 Elevation: 901.80 ft  
 North: 2032877.64 ft  
 East: 959580.43 ft  
 Station: 598+55.93  
 Offset: 128.77 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		26-inch thick, black SILTY CLAY LOAM															
		--TOPSOIL--			1	1	1.75	14									
	899.6				2	2											
					3	3											
					4	4											
	898.8	Stiff, brown SILTY CLAY LOAM, trace gravel; damp			2	3	1.07	19									
		--FILL--			4	4											
					5	4											
		Soft to medium stiff, black and gray CLAY to SILTY CLAY; moist			3	2	0.75	35									
		--RDR 2--			3	2											
					4	3											
					4	2	0.49	43									
					4	2											
					4	2											
					5	1	0.66	35									
					5	1											
					5	2											
					5	3											
	891.6				6	3	0.74	11									
		Medium stiff, brown CLAY LOAM, trace gravel; damp			6	4											
	890.8				6	6											
		Brown GRAVELLY SAND; saturated			6	4											
	889.6				7	5	2.87	11									
		Very stiff, brown CLAY LOAM, trace gravel; damp			7	6											
		--RDR 2--			7	10											
					7	11											
					8	7	3.20	10									
					8	9											
					8	11											
					8	12											
	885.8																
		Boring terminated at 16.00 ft															

### GENERAL NOTES

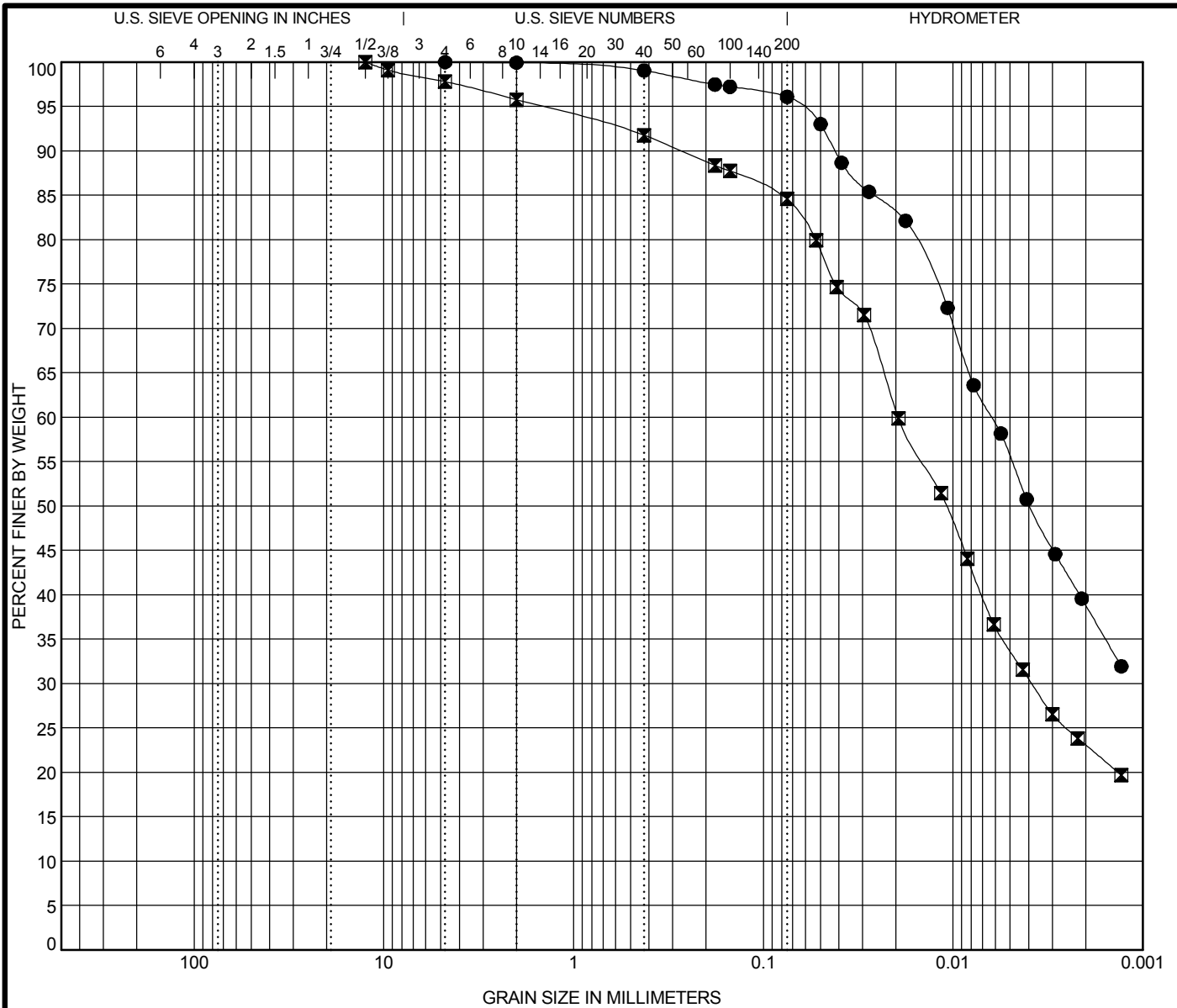
Begin Drilling **12-05-2017** Complete Drilling **12-05-2017**  
 Drilling Contractor **Wang Testing Services** Drill Rig **D50 ATV [88%]**  
 Driller **N&J** Logger **T. Rothschild** Checked by **C. Marin**  
 Drilling Method **2.25 IDA HSA; 140 lb. autohammer; Boring backfilled upon completion**

### WATER LEVEL DATA

While Drilling  $\nabla$  **11.00 ft**  
 At Completion of Drilling  $\nabla$  **8.90 ft**  
 Time After Drilling **NA**  
 Depth to Water  $\nabla$  **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

## **APPENDIX B**



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification	IDH Classification	LL	PL	PI	Cc	Cu
● CUL-02#5 11.0 ft	<b>Silty Clay</b>	<b>38</b>	<b>19</b>	<b>19</b>		
☒ CUL-03#3 6.0 ft	<b>Silty Clay Loam</b>	<b>26</b>	<b>13</b>	<b>13</b>		

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● CUL-02#5 11.0 ft	<b>4.75</b>	<b>0.006</b>			<b>0.1</b>	<b>3.9</b>	<b>57.2</b>	<b>38.8</b>
☒ CUL-03#3 6.0 ft	<b>12.5</b>	<b>0.019</b>	<b>0.004</b>		<b>4.2</b>	<b>11.4</b>	<b>61.3</b>	<b>23.1</b>



Wang Engineering, Inc.  
 1145 North Main Street  
 Lombard, IL 60148  
 Telephone: 630-953-9928  
 Fax: 630-953-9938

**GRAIN SIZE DISTRIBUTION**  
 Project: IL 47 between US 14 and S of IL 176  
 Location: McHenry County, Illinois  
 Number: 195-13-01

WEI GRAIN SIZE IDH 1951301.GPJ US LAB.GDT 8/8/18





**ONE-DIMENSIONAL CONSOLIDATION TEST**  
**AASHTO T 216 / ASTM D 2435**

**Project: Illinois Route 47**  
**Client: Strand Associates, Inc.**  
**Soil Sample ID: Boring CUL-02ST, ST#1, 9 to 11 feet**  
**Sample Description: Gray SI CLAY**

**Tested by: M. Snider**  
**Prepared by: M. Snider**  
**Test date: 12/15/2017**  
**WEI: 195-13-01**

Initial sample height =	0.787 in	Ring diameter =	2.505 in
Initial sample mass =	110.25 g	Ring mass =	63.49 g
Initial water content =	44.02%	Initial sample and ring mass =	173.74 g
Initial dry unit weight =	75.20 pcf	Tare mass =	63.49 g
Initial void ratio =	1.157	Final ring and sample mass =	161.65 g
Initial degree of saturation =	98.89%	Mass of wet sample and tare =	162.18 g
		Mass of dry sample and tare =	140.04 g
Final sample mass =	98.69 g	Initial dial reading =	0.01000 in
Final dry sample mass =	76.55 g	Final dial reading =	0.18018 in
Final water content =	28.92%	LL=	%
Final dry unit weight =	95.95 pcf	PL=	%
Final void ratio =	0.691	% Sand=	
Final degree of saturation =	100.00%	% Silt=	
Estimated specific gravity =	2.60	% Clay=	
		<b>In-Situ Vertical Effective Stress =</b>	1400 psf

**Compression and Swelling Indices**

Compression index  $C_c$  = 0.448  
 Field corrected  $C_c$  = 0.491  
 Swelling index  $C_s$  = 0.112

**Preconsolidation pressure,  $s_c$**

Casagrande Method = 1835 psf

**Over-Consolidation Ratio (OCR) = 1.31**

Load number	Vertical stress psf	Dial reading in	System deflection in	Vertical strain %	Void ratio	$C_v$ ft <sup>2</sup> /day	$C_{ae}$ %	Elapsed time min
1	100.0	0.00932	0.00047	-0.03	1.158	N/A	N/A	720
2	200.0	0.01015	0.00066	0.10	1.155	0.1200	0.00	720
3	500.0	0.01597	0.00087	0.87	1.139	0.0506	0.14	720
4	1000.0	0.03003	0.00138	2.72	1.099	0.0267	0.37	960
5	2000.0	0.05713	0.00198	6.24	1.023	0.0205	0.79	960
6	4000.0	0.09524	0.00425	11.37	0.912	0.0190	0.98	1440
7	8000.0	0.13865	0.00648	17.17	0.787	0.0195	1.28	1440
8	16000.0	0.18529	0.00903	23.42	0.652	0.0194	1.42	1440
9	32000.0	0.22799	0.01063	29.05	0.531	0.0212	0.91	720
10	8000.0	0.22479	0.00809	28.32	0.546	N/A	N/A	2880
11	2000.0	0.20759	0.00386	25.60	0.605	N/A	N/A	720
12	500.0	0.18180	0.00183	22.06	0.681	N/A	N/A	1440

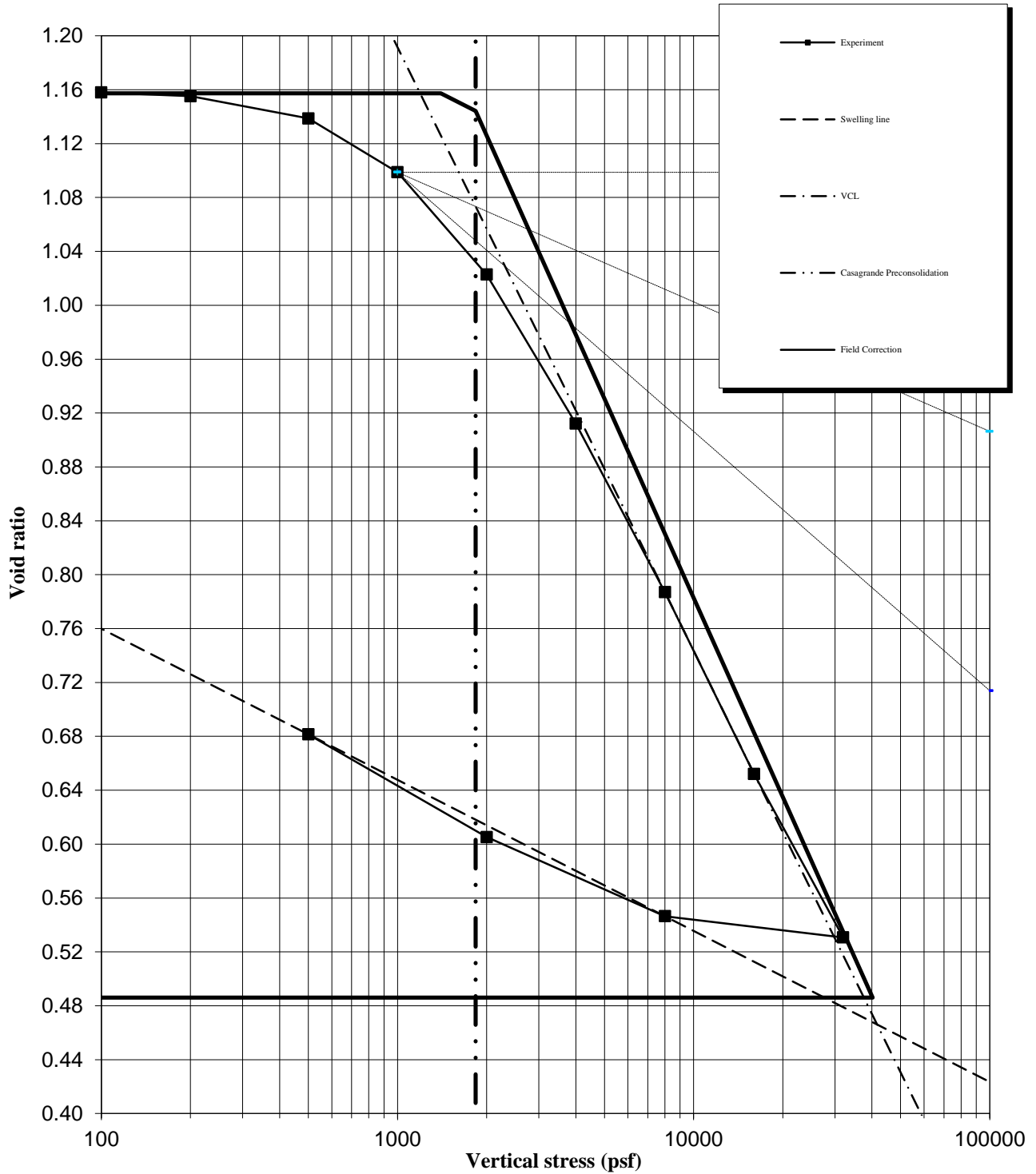
Prepared by: \_\_\_\_\_ Date: \_\_\_\_\_

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_



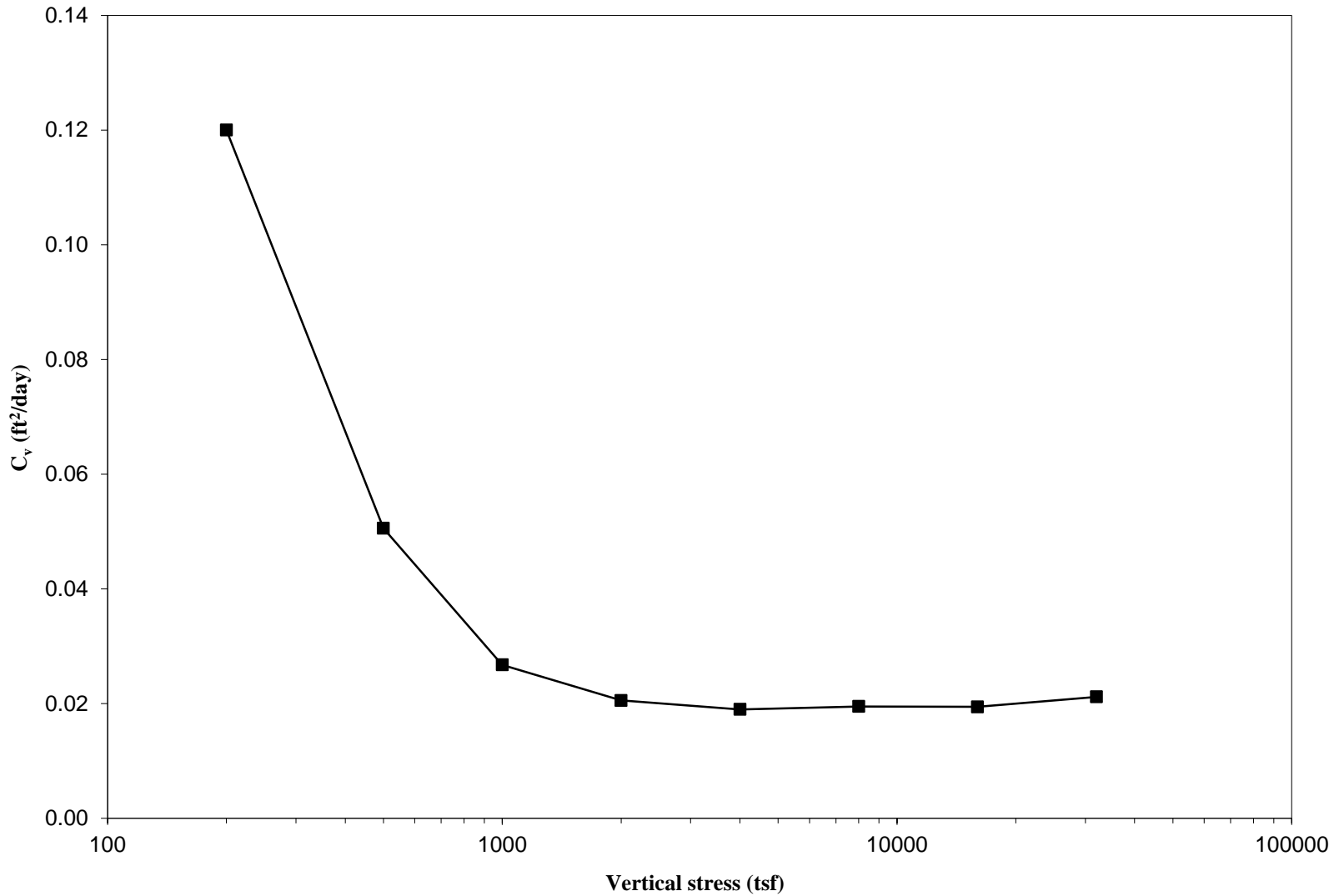
## CONSOLIDATION CURVE

Sample CUL-02ST, ST#1, 9 to 11 feet



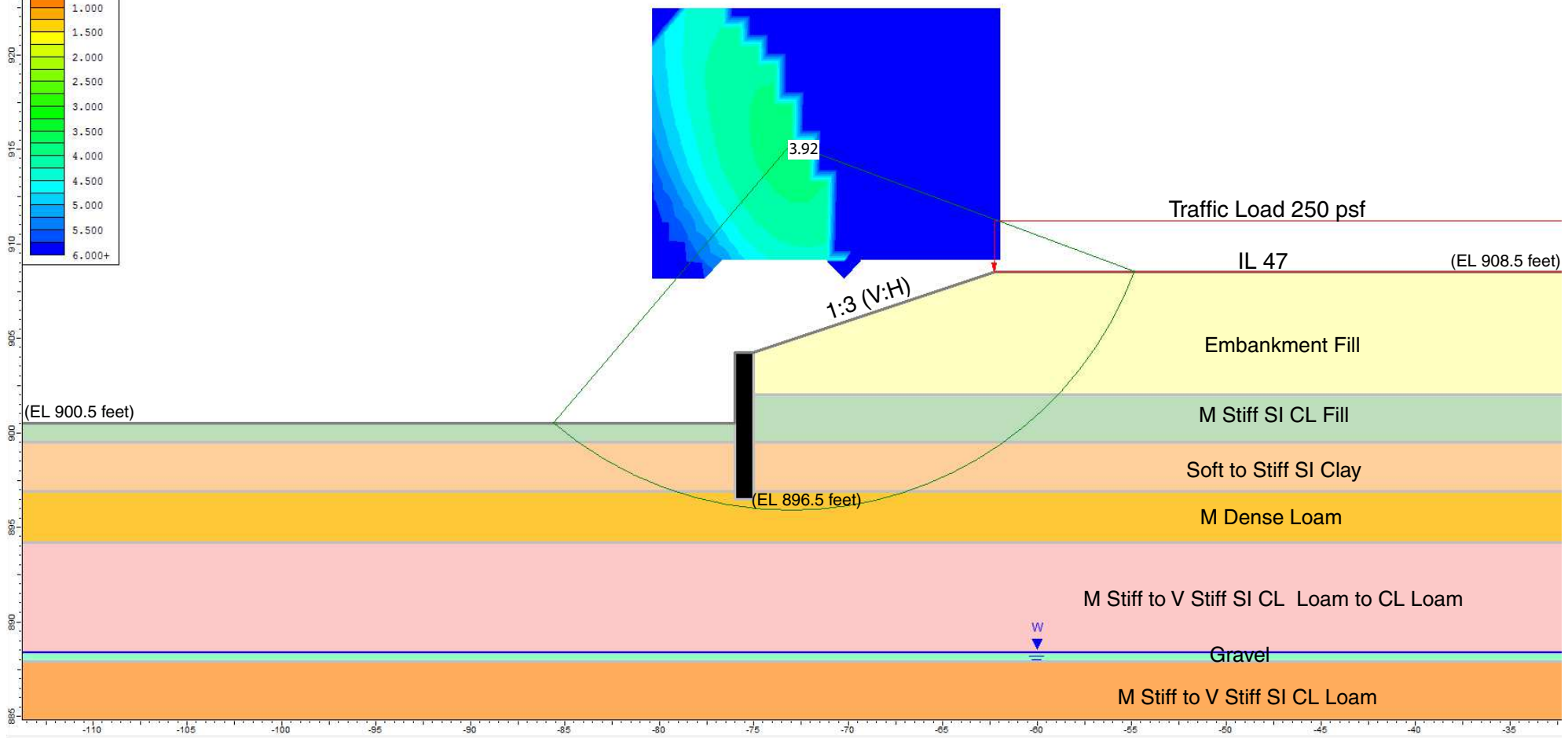
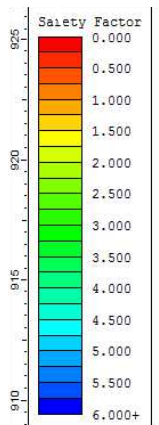
## CONSOLIDATION COEFFICIENT ( $C_v$ ) vs. VERTICAL STRESS

Sample CUL-02ST, ST#1, 9 to 11 feet



## APPENDIX C





Undrained Analysis, Animal Crossing at Sta. 598+22, Ref. Borings: PT6-03 and CUL-01

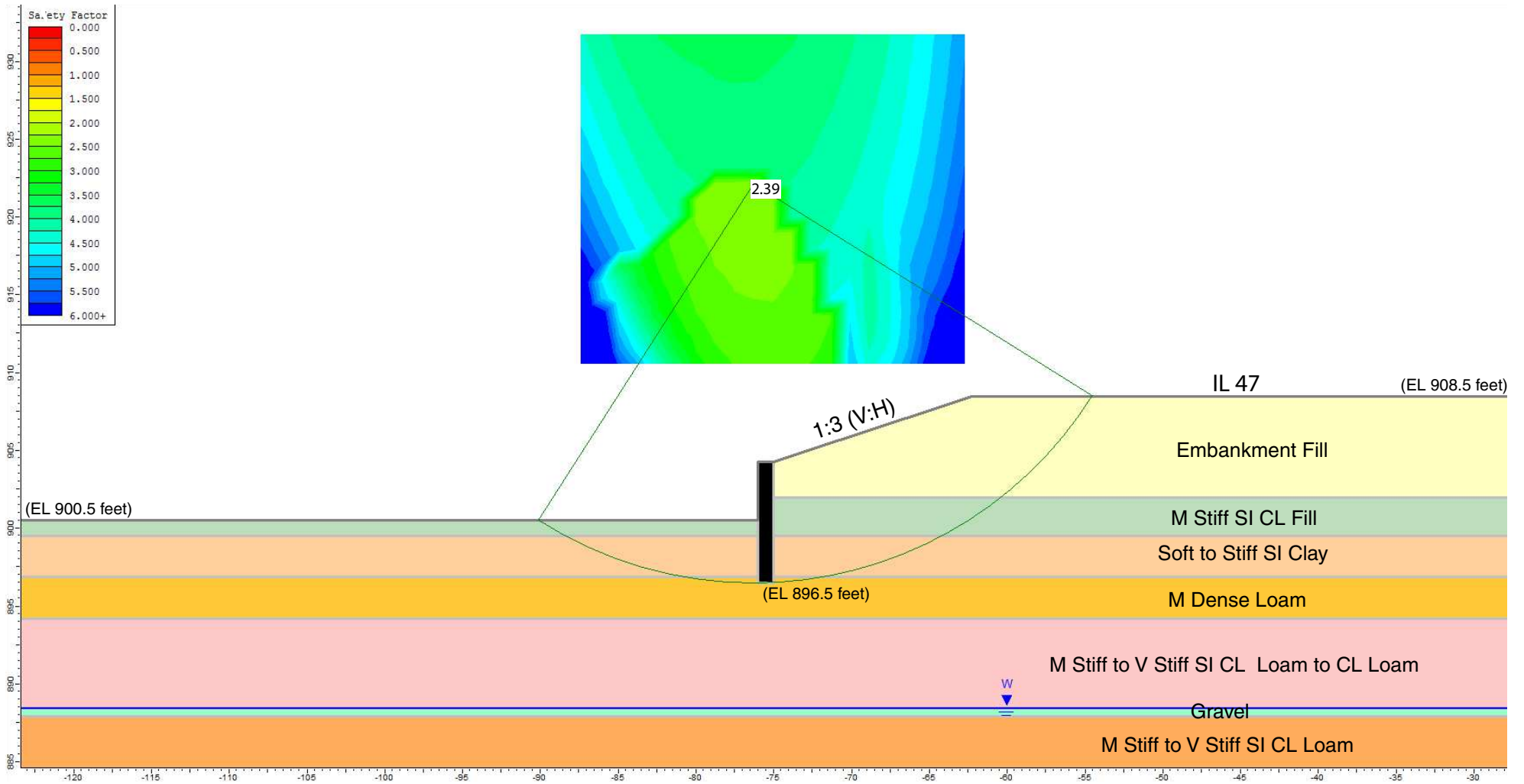
Layer ID	Description	Total Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	Embankment Fill	125	1000	0
2	M Stiff SI CL Fill	115	950	0
3	Soft to Stiff SI Clay	115	750	0
4	M Dense Loam	115	0	30
5	M Stiff to V Stiff SI CL Loam to CL Loam	120	2000	0
6	Gravel	115	0	30
7	M Stiff to V Stiff SI CL Loam	120	1700	0

GLOBAL STABILITY ANALYSIS: IL 47 ANIMAL CROSSING CULVERT AT STATION 598+22, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-1 | DRAWN BY: RKC | CHECKED BY: NSB



FOR STRAND ASSOCIATES, INC. | 195-13-01



Drained Analysis, Animal Crossing at Sta. 598+22, Ref. Borings: PT6-03 and CUL-01

Layer ID	Description	Total Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	Embankment Fill	125	100	30
2	M Stiff SI CL Fill	115	0	29
3	Soft to Stiff SI Clay	115	0	29
4	M Dense Loam	115	0	30
5	M Stiff to V Stiff SI CL Loam to CL Loam	120	100	31
6	Gravel	115	0	30
7	M Stiff to V Stiff SI CL Loam	120	100	31

GLOBAL STABILITY ANALYSIS: IL 47 ANIMAL CROSSING CULVERT AT STATION 598+22, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL

APPENDIX C-2

DRAWN BY: RKC  
CHECKED BY: NSB



1145 N. Main Street  
Lombard, IL 60148  
www.wangeng.com

FOR STRAND ASSOCIATES, INC.

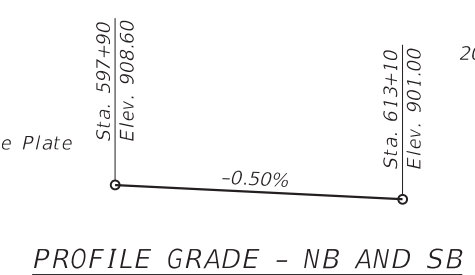
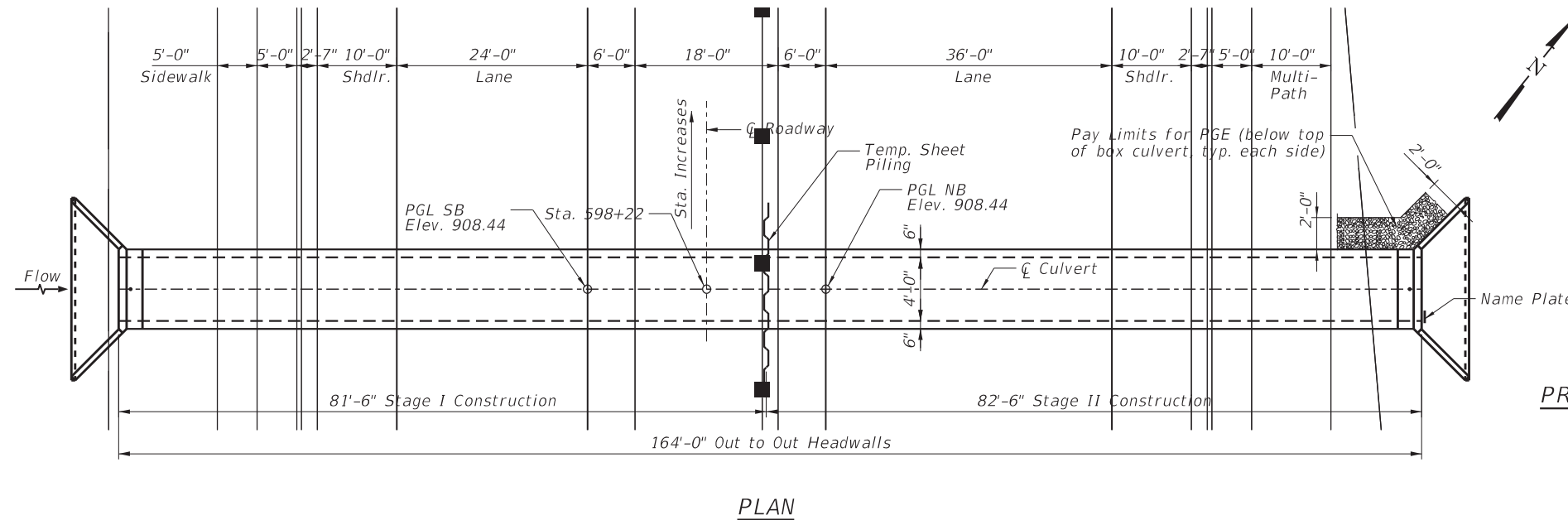
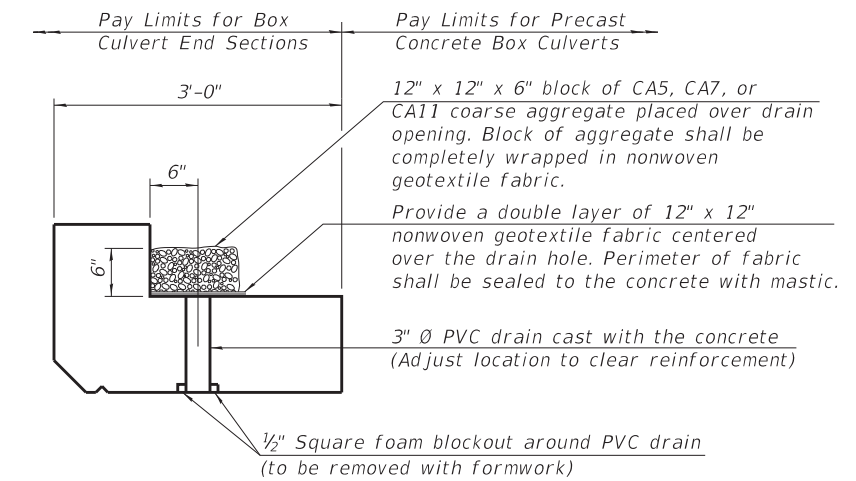
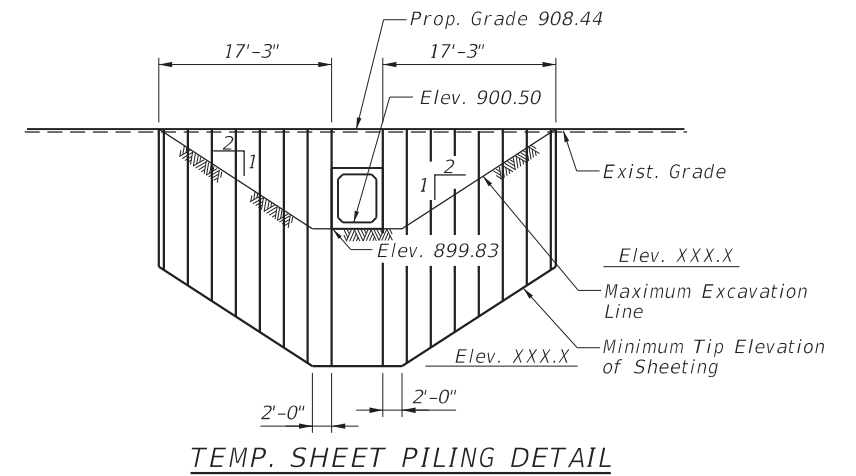
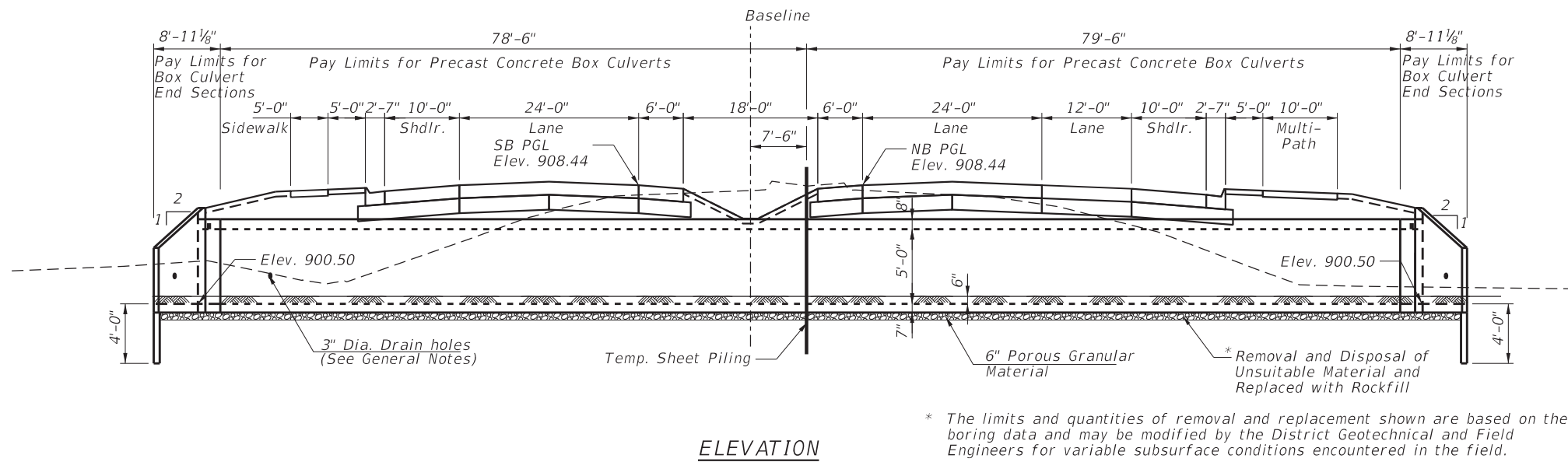
195-13-01

## **APPENDIX D**

Benchmark: BM #6, Set cut square on light pole base along Illinois Rte. 47  
130± North of intersection of Pleasant Valley Road. Elev. 908.52

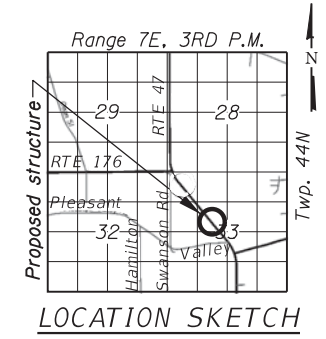
Traffic Control: Traffic to be maintained utilizing Stage Construction.

Salvage: None



**NAME PLATE**  
See Std. 515001

STATION 598+22.00  
BUILT BY  
STATE OF ILLINOIS  
F.A.P. RT. 326 SEC.  
LOADING HL-93



**DESIGN SPECIFICATIONS**  
2017 AASHTO LRFD Bridge Design Specifications  
8th Edition

**LOADING HL-93**  
50 PSF Future Wearing Surface

**DESIGN STRESSES**  
PRECAST UNITS  
f'c = 5,000 psi  
fy = 65,000 psi (Welded Wire Reinforcement)

**GENERAL PLAN AND ELEVATION**  
**IL RTE. 47 ANIMAL CROSSING**  
F.A.P. RTE. 326 SEC 105-N-2(15)  
McHENRY COUNTY  
STATION 598+22.00

MODEL: D:\m\170353\CBBEL\Struct\170353-GRF-DEER-CULVERT.dwg

CHRISTOPHER B. BURKE ENGINEERING, LTD. 9575 W. HOGANS ROAD, SUITE 600 ROSEMONT, ILLINOIS 60018 (847) 823-0500	USER NAME = prazalan	DESIGNED - AS	REVISED -	<b>STATE OF ILLINOIS</b> <b>DEPARTMENT OF TRANSPORTATION</b>	<b>GENERAL PLAN AND ELEVATION</b> <b>PROPOSED ANIMAL CROSSING</b>	F.A.P. RTE. 326	SECTION 105-N-2(15)	COUNTY MCHENRY	TOTAL SHEETS 473	SHEET NO. 340
	PLOT SCALE = 20.0000" / in.	CHECKED - MM	REVISED -			SCALE: N.T.S.	SHEET 1 OF 6 SHEETS	STA. 598+22 TO STA. ---	CONTRACT NO. 62B43	
	PLOT DATE = 4/11/2018	DATE - SPLANDATES	REVISED -							

GENERAL NOTES

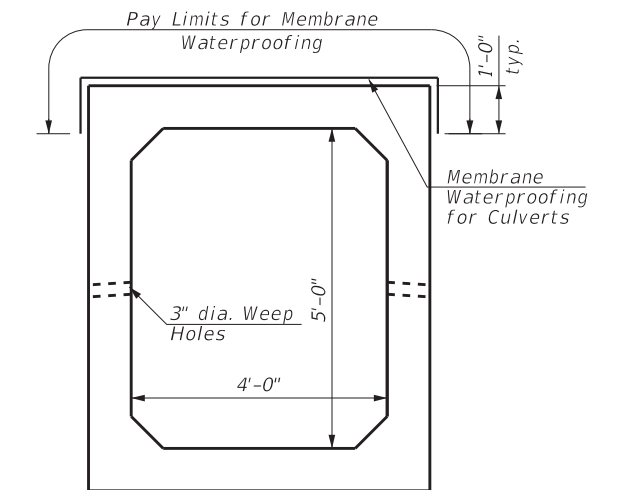
- 1 The design fill height for this box is 3'-0". The precast box culvert sections shall conform to the requirements of ASTM C 1577.
- 2 Drain holes shall be provided on exterior culvert walls for each precast box segment with a clear rise greater than 3 ft. The drain hole shall be located within 1/3 of the clear rise of the box culvert, shall not intercept the haunch, and shall conform to the requirements of Article 503.11 of the Standard Specification.
- 3 The 6 in. thick layer of porous granular material required for the precast concrete box culvert per Art. 540.06 of the Standard Specifications shall also apply to the end sections. Cost of the porous granular material will not be paid for separately but shall be included in the unit price of the work for which it is required.
- 4 Nonwoven geotextile fabric shall conform to the requirements of Art. 1080.01 of the Standard Specifications. The minimum weight of the fabric shall be 6 ounces per square yard.
- 5 Precast concrete box culverts and box culvert end sections shall be backfilled with Porous Granular Embankment below the top of the box culvert extending to a vertical plane 2 ft from the exterior sides of the culvert, 2 ft from the back face of the end sections, and not closer than 2 ft from the face of embankment.

INDEX OF SHEETS

- 1 General Plan and Elevation
- 2 General Notes, Index of Sheets and Total Bill of Materials
- 3 Stage Construction Details
- 4 Temporary Concrete Barrier for Stage Construction
- 5 - 6 Precast Concrete Box Culvert Apron End Section Details

TOTAL BILL OF MATERIAL

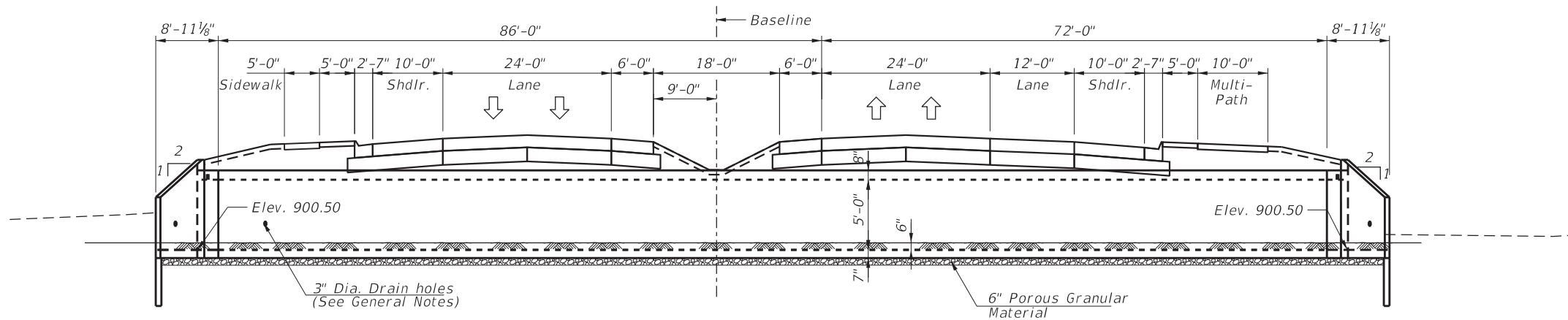
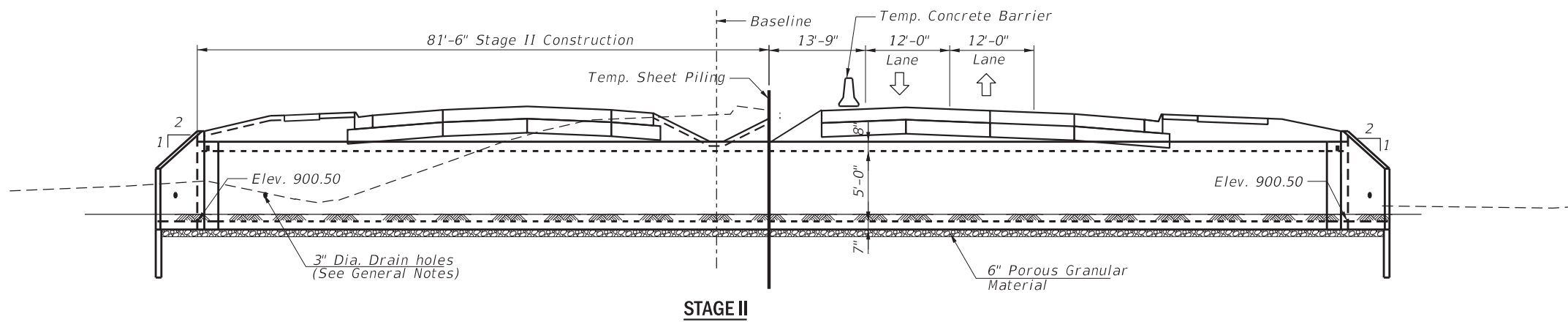
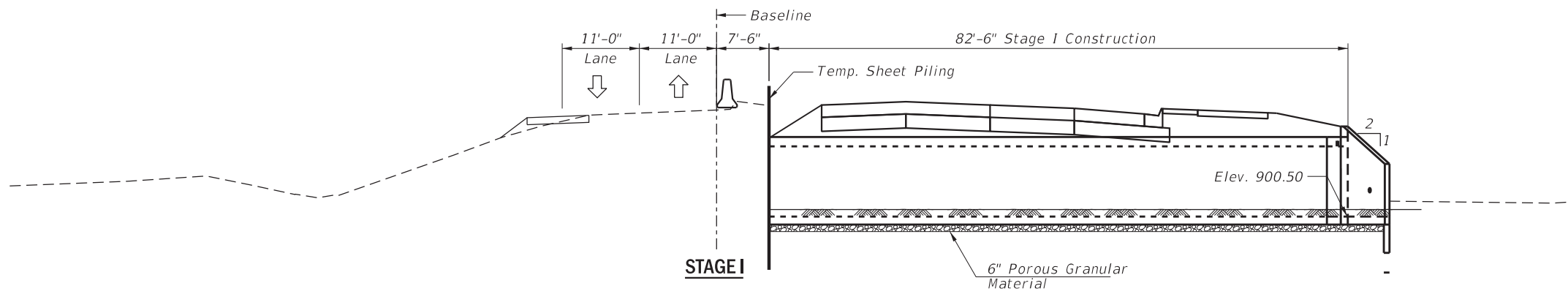
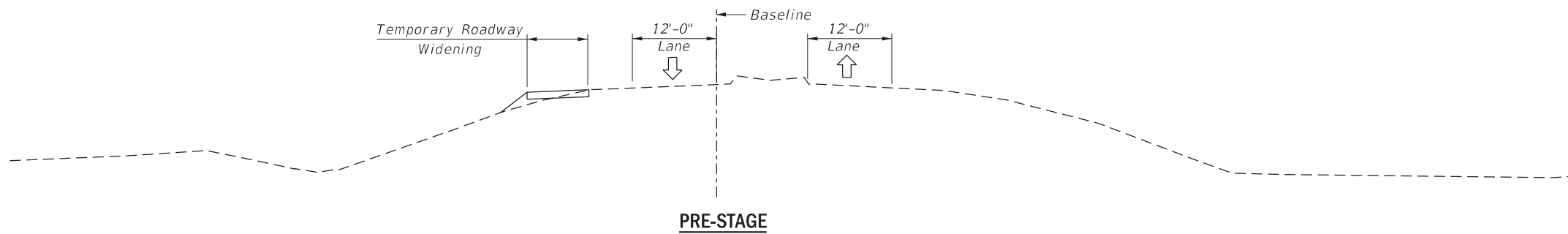
ITEM	UNIT	TOTAL
Porous Granular Embankment	Cu. Yd.	203
Structure Excavation	Cu. Yd.	314
Removal and Disposal of Unsuitable Material for Structures	Cu. Yd.	55
Name Plates	Each	1
Temporary Sheet Piling	Sq. Ft.	677
Box Culvert End Sections, Culvert No. 1	Each	2
Precast Concrete Box Culverts 4' X 5' (Special)	Foot	158
Membrane Waterproofing for Buried Structures	Sq. Yd.	128
Rock Fill	Cu. Yd.	55



MEMBER WATERPROOFING FOR PRECAST CULVERTS

MODEL D:\m\h\p\170353\CBBEL\Struct\170353-G\NOTES\MEMBR-CULVERT.dwg  
 FILE NAME: 170353\CBBEL\Struct\170353-G\NOTES\MEMBR-CULVERT.dwg

	CHRISTOPHER B. BURKE ENGINEERING, LTD. 9575 W. HOGGINS ROAD, SUITE 600 ROSEMONT, ILLINOIS 60018 (847) 823-0500	USER NAME = prazalan PLOT SCALE = 2.0000' / in. PLOT DATE = 4/11/2018	DESIGNED - AS DRAWN - PDR CHECKED - MM DATE - SPLANDATES	REVISED - REVISED - REVISED - REVISED -	<b>STATE OF ILLINOIS                  DEPARTMENT OF TRANSPORTATION</b>	<b>GENERAL NOTES, INDEX OF SHEETS AND TOTAL BILL OF MATERIALS                  PROPOSED ANIMAL CROSSING</b>	F.A.P. RTE. 326	SECTION 105-N-2(15)	COUNTY MCHENRY	TOTAL SHEETS 473	SHEET NO. 341
	SCALE: N.T.S.    SHEET 2 OF 6 SHEETS    STA. 598+22 TO STA. ---						CONTRACT NO. 62B43 ILLINOIS FED. AID PROJECT				



MODEL: D:\m\p\170353\CBBEL\Struct\170353-MOT-DEEP-CULVERT-01.dwg

**CB**  
 CHRISTOPHER B. BURKE  
 ENGINEERING, LTD.  
 9575 W. HOGGINS ROAD, SUITE 600  
 ROSEMONT, ILLINOIS 60018  
 (847) 823-0500

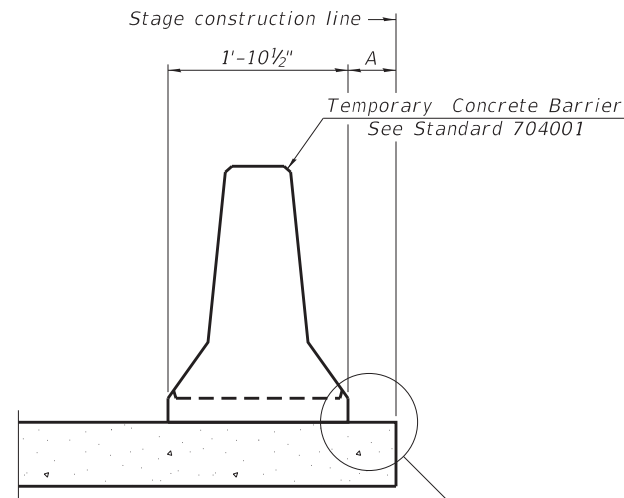
USER NAME = prazalan	DESIGNED - AS	REVISED -
PLOT SCALE = 20.0000' / in.	DRAWN - PDR	REVISED -
PLOT DATE = 4/11/2018	CHECKED - MM	REVISED -
	DATE - SPLANDATES	REVISED -

**STATE OF ILLINOIS  
 DEPARTMENT OF TRANSPORTATION**

**STAGE CONSTRUCTION DETAILS  
 PROPOSED ANIMAL CROSSING**

SCALE: N.T.S.    SHEET 3 OF 6 SHEETS    STA. 598+22 TO STA. ---

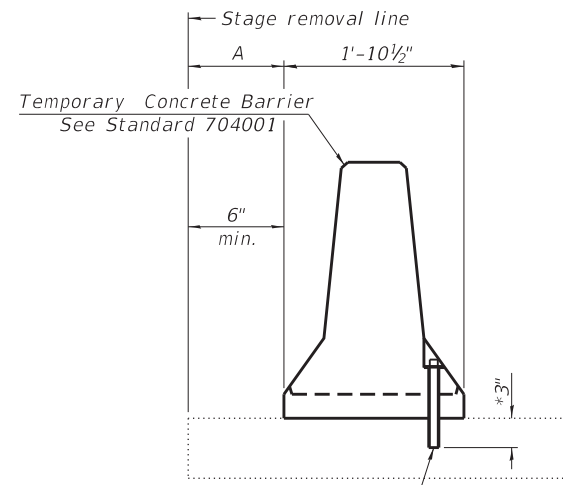
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	105-N-2(15)	MCHENRY	473	342
CONTRACT NO. 62B43			ILLINOIS FED. AID PROJECT	



When "A" is 3'-1" or less, the temporary concrete barrier shall be restrained to the new slab according to Detail I. No restraint is required when "A" is greater than 3'-1".

NEW PAVEMENT

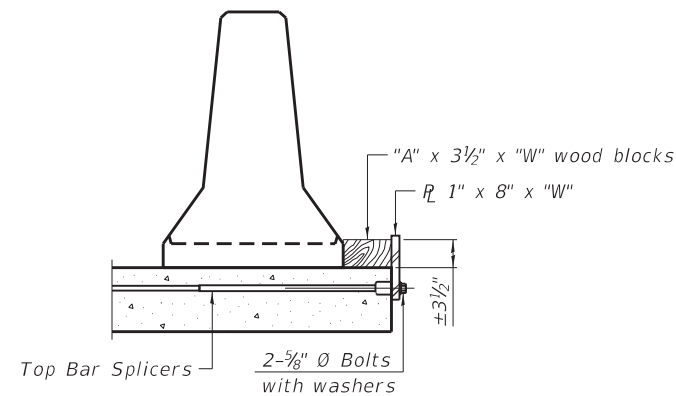
\* When hot-mix asphalt wearing surface is present, embedment shall be 3" plus the wearing surface depth.



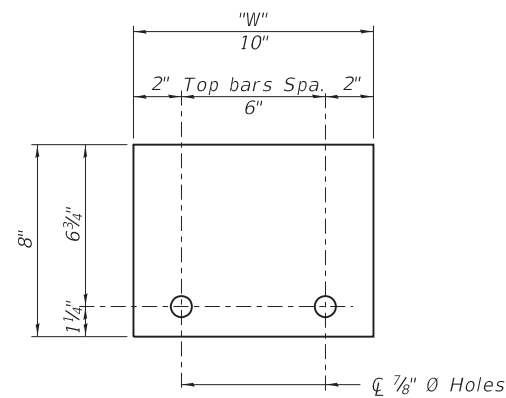
Drill 3-1/4" Ø Holes in existing slab for 1" Ø restraining pins. Traffic side only. Cost of restraining pins are included with Temporary Concrete Barrier. No restraint is required when "A" is greater than 3'-1".

EXISTING PAVEMENT

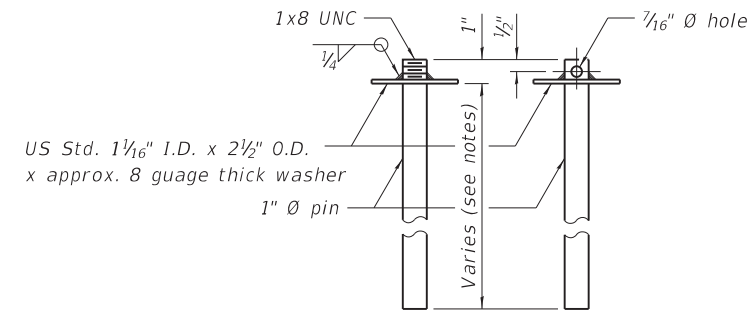
SECTIONS THRU PAVEMENT



DETAIL I



STEEL RETAINER 1" x 8" x "W"



RESTRAINING PIN

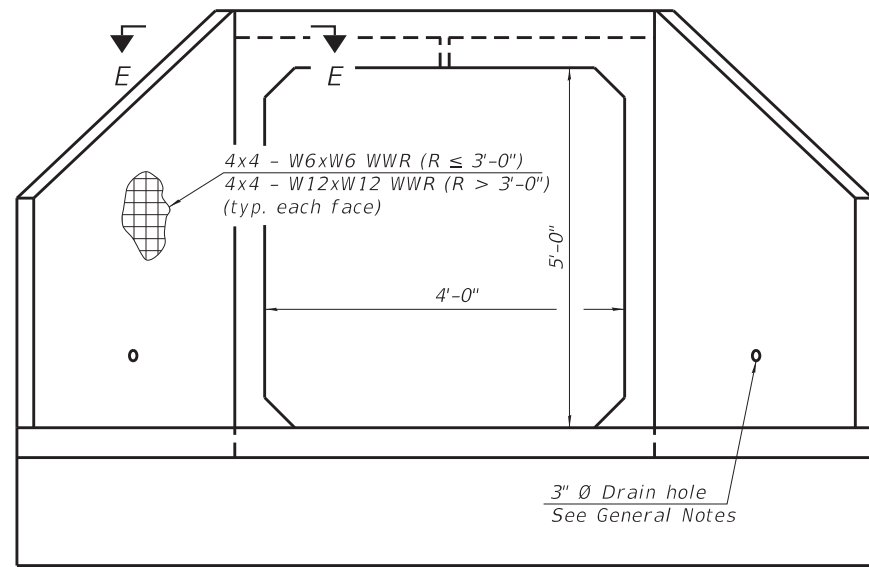
Notes:

- Cost of retainer assembly is included with Temporary Concrete Barrier.
- A retainer assembly shall be located at the approximate  $\bar{C}$  of each temporary concrete barrier.
- The retainer plate shall not be removed until the concrete on the adjacent stage is ready to be poured.
- When the 'A' dimension is less than 1 1/2", the wood block shall be omitted and the barrier shall be placed in direct contact with the steel retainer plate.

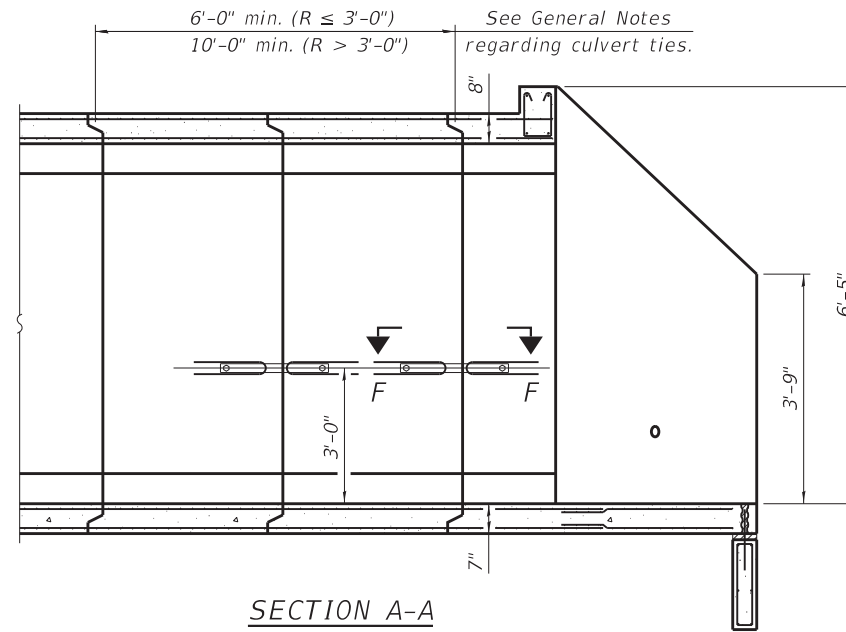
Detail I - Installation for a culvert.

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CHRISTOPHER B. BURKE ENGINEERING, LTD. 9575 W. HOGGINS ROAD, SUITE 600 ROSEMONT, ILLINOIS 60018 (847) 823-0500	USER NAME = prazalan	DESIGNED - AS	REVISED -	<b>STATE OF ILLINOIS</b> <b>DEPARTMENT OF TRANSPORTATION</b>	<b>TEMPORARY CONCRETE BARRIER FOR STAGE CONSTRUCTION</b>			F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
	PLOT SCALE = 2,0000' / in.	CHECKED - MM	REVISED -		SCALE: N.T.S.	SHEET 4	OF 6	SHEETS	STA. 598+22	TO STA. ---	105-N-2(15)	MCHENRY
PLOT DATE = 4/11/2018	DATE - SPLANDATES	REVISED -							CONTRACT NO. 62B43			
									ILLINOIS FED. AID PROJECT			



END VIEW



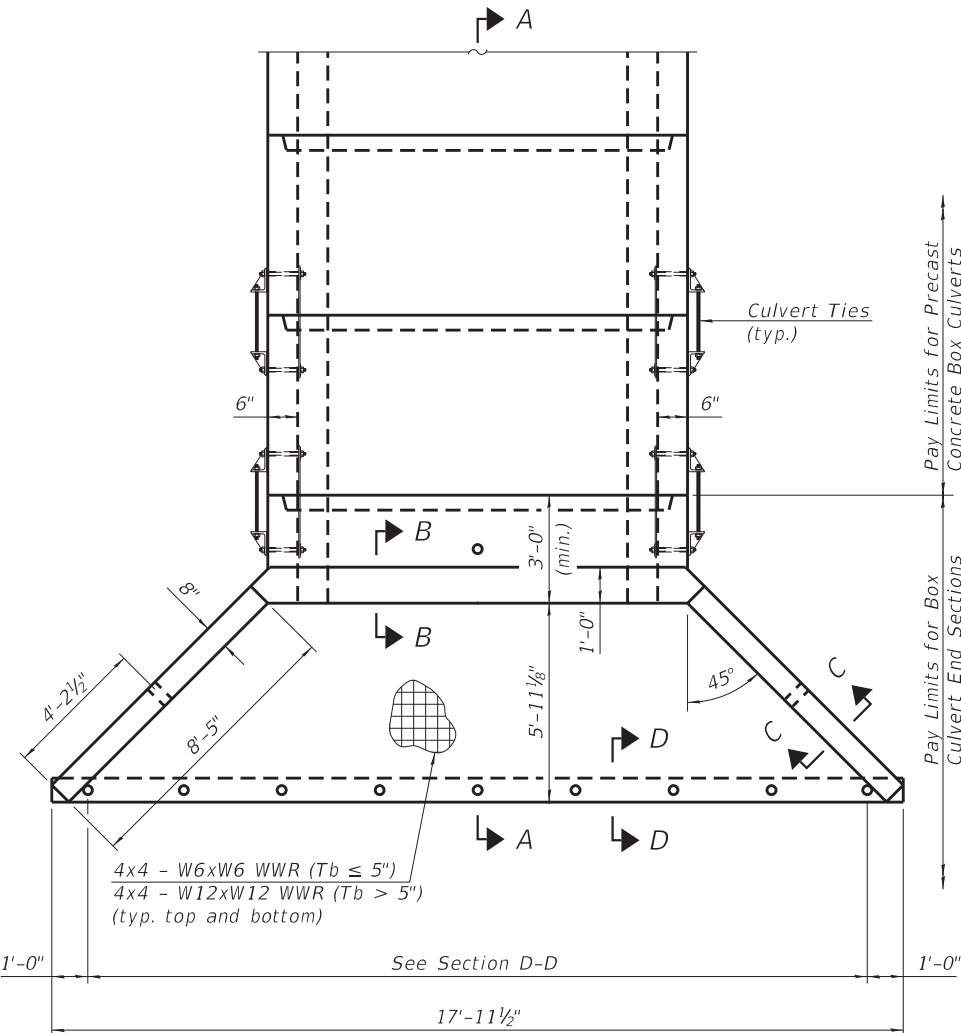
SECTION A-A

GENERAL NOTES

APRON END SECTION DIMENSIONS

Span (S)	Rise (R)	Tt	Tb	Ts	A	B	C	D	E	Concrete Cu. Yd.	Culvert Ties Required
4'-0"	5'-0"	8"	7"	6"	6'-5"	3'-9"	5'-11 1/8"	8'-5"	17'-11 1/2"	7.1	Yes

Note:  
Two sets of apron end section dimensions are shown above for some box culvert sizes due to the top and bottom slabs having different thicknesses per ASTM C 1577 for design fill heights less than 2 ft.



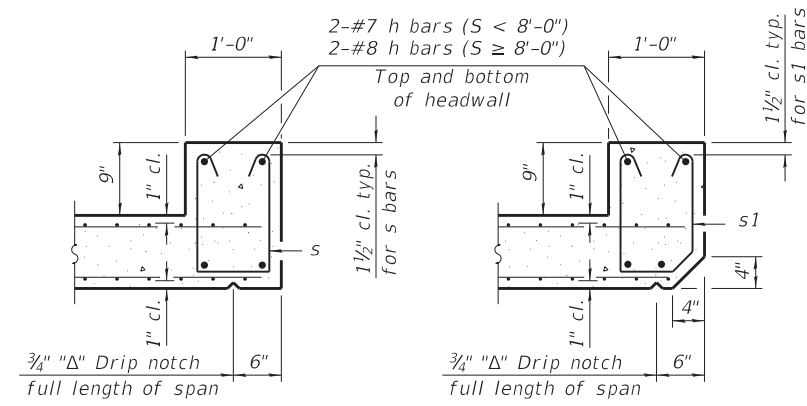
PLAN

(Sheet 1 of 2)

MODEL: D:\cadd\170353\CBBEL\Struct\170353-DETAIL-DEER-CULVERT-01.rvt

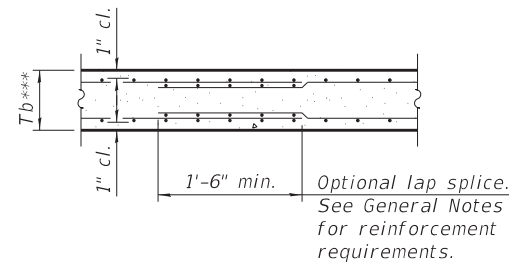
	CHRISTOPHER B. BURKE ENGINEERING, LTD. 9575 W. HOGGINS ROAD, SUITE 600 ROSEMONT, ILLINOIS 60018 (847) 823-0500	USER NAME = prazalan DESIGNED - AS DRAWN - PDR CHECKED - MM DATE - SPLANDATES	REVISED - REVISED - REVISED - REVISED -	<b>STATE OF ILLINOIS</b> <b>DEPARTMENT OF TRANSPORTATION</b>	<b>PRECAST CONCRETE BOX CULVERT APRON END</b> <b>SECTION DETAILS - PROPOSED ANIMAL CROSSING</b>	F.A.P. RTE. 326	SECTION 105-N-2(15)	COUNTY MCHENRY	TOTAL SHEETS 473	SHEET NO. 344
	PLOT SCALE = 2,000' / 1"	PLOT DATE = 4/11/2018	SCALE: N.T.S.			SHEET 5 OF 6 SHEETS	STA. 598+22 TO STA. ---	CONTRACT NO. 62B43	ILLINOIS FED. AID PROJECT	





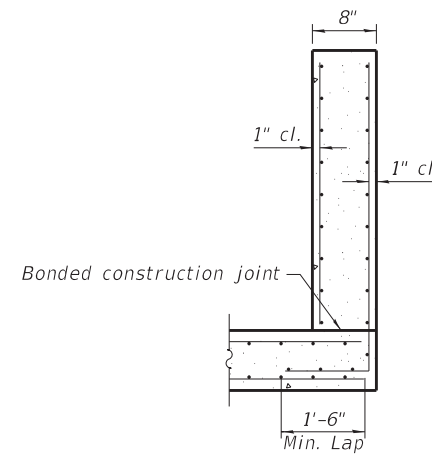
SECTION B-B  
(Top slab at downstream end)

SECTION B-B  
(Top slab at upstream end)

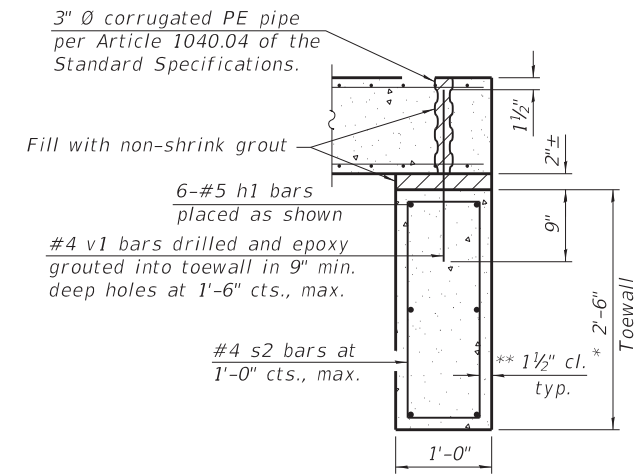


SECTION B-B  
(Bottom Slab)

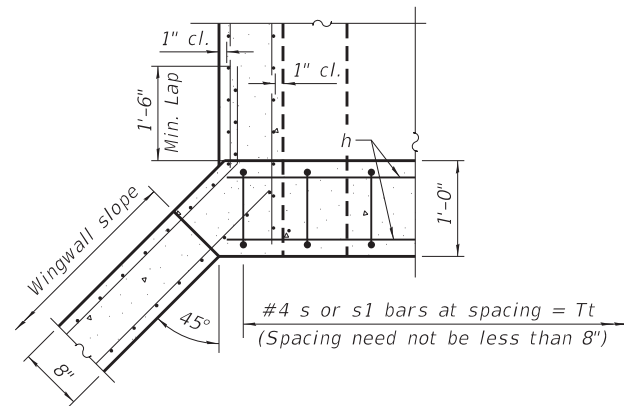
\*\*\* This dimension shall be increased by 2" for CIP construction.



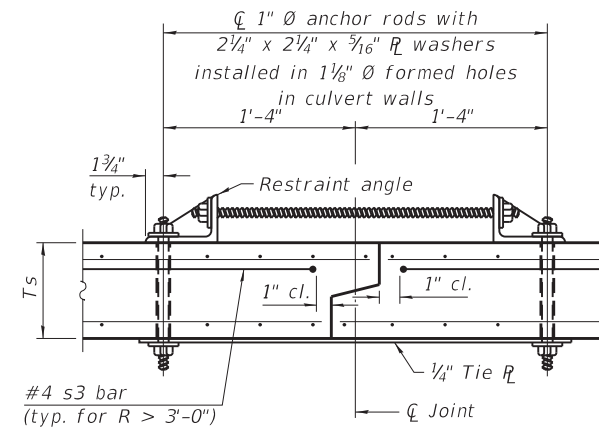
SECTION C-C



SECTION D-D



SECTION E-E



SECTION F-F  
(Showing culvert tie details)

**TOEWALL CONSTRUCTION SEQUENCE**

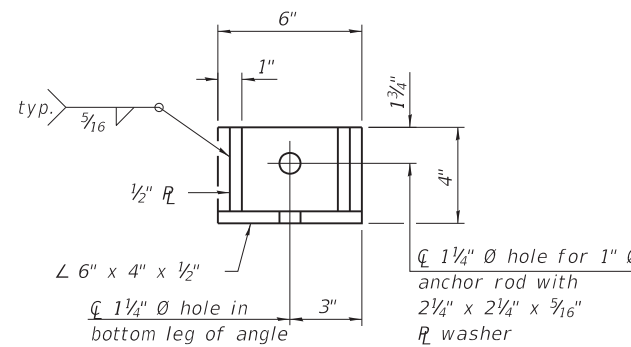
1. Perform excavation and construct toewall.
2. Backfill accordingly and place bedding for precast box culvert end sections.
3. Set precast box culvert end section.
4. Drill and epoxy grout reinforcement in toewall in accordance with Section 584 of the Standard Specifications.
5. Pressure grout voids using non-shrink grout conforming to Section 1024 of the Standard Specifications.

\* The Contractor may furnish a precast or cast-in-place toewall. The Contractor shall be responsible for the strength and stability of the precast toewall during handling. Additional lifting points may be required depending upon the length of the toewall or the Contractor may need to modify the design of the toewall for the proposed handling method.

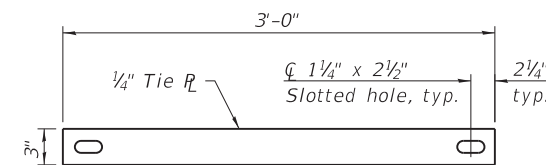
\*\* If soil conditions permit, the sides of the toewall may be poured directly against the soil. The clear cover on the sides of the toewall shall be increased to 3" by increasing the thickness of the toewall.

**Notes:**

1" Ø anchor rods for the culvert ties shall conform to the requirements of ASTM F1554, Grade 105. Structural steel for the tie plate and restraint angle shall conform to the requirements of Article 1006.04 of the Standard Specifications. All components of the culvert tie detail shall be galvanized according to the requirements of AASHTO M 111 or M 232 as applicable. 2 1/4" x 2 1/4" x 3/16" plate washers shall be provided under each nut required for the anchor rods. Anchor rods connecting precast sections shall be brought to a snug tight condition followed by an additional 1/2 turn on one of the nuts for anchor rods installed in the walls. Match marks shall be provided on the bolt and nut to verify relative rotation between the bolt and the nut. Holes in the walls for the culvert tie assembly may be drilled using core bits in lieu of using formed holes.



RESTRAINT ANGLE DETAIL



TIE PLATE DETAIL

(Sheet 2 of 2)

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FILE NAME: 170353\CBBEL\Struct\170353-DET\AIL-DEER-CULVERT-02.rvt

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	PLOT SCALE = 2,000' / in.	CHECKED - MM	REVISED -			SCALE: N.T.S.	SHEET 6 OF 6 SHEETS	STA. 598+22 TO STA. ---	ILLINOIS FED. AID PROJECT	CONTRACT NO. 62B43
	PLOT DATE = 4/11/2018	DATE - SPLANDATES	REVISED -							