STRUCTURE GEOTECHNICAL REPORT
CULVERT AT STATION 598+48.00
ILLINOIS 47 OVER KISHWAUKEE RIVER TRIBUTARY
EX SN 056-0247, PR SN 056-0309
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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9. Prepared by Wang Engineering, Inc. 1145 N Main Street Lombard, IL 60148	**Contributor(s)** Authors: Andri A.Kurnia, PE Nesam S. Balakumaran, PEng QA/QC: Corina T.Farez, PE,PG PM: Liviu Iordache, PG	**Contact** (630) 953-9928 ext. 1025 akurnia@wangeng.com
10. Prepared for Strand Associates, Inc. 1170 South Houbolt Rd Joliet, IL, 60431	**Contact(s)** Marc Grigas, PE	**Contact Information** (815)744-4200 Marc.Grigas@strand.com

11. Abstract

The existing 6-foot wide by 5-foot tall, concrete box culvert carrying Illinois Route 47 over Kishwaukee River Tributary will be removed and replaced with a longer, 8-foot wide by 6-foot tall box culvert. The proposed culvert will be 164-foot long. New fill will be placed on top and around both culvert's ends. The culvert end will be retained by apron with vertical wingwalls.

Beneath topsoil, the general lithologic profile 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.

Design scour elevations are proposed to be at the bottom of the cutoff wall. A layer of soft to medium stiff organic clay to silty clay was encountered beneath the proposed base of the culvert at the center and the downstream end; 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 0.6 inches with a differential settlement of about 0.4 inches over 65 feet.

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.

We estimate a temporary steel sheet piling according to IDOT Design Guide 3.13.1 is feasible and sufficient to accommodate stage construction.

12. Path to archived file

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Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

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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 removal and replacement of a culvert on Illinois Route 47 (IL 47) at Station 598+48 that is about 400 feet north of the intersection between Pleasant Valley Road and IL 47. The proposed structure replacement 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 existing 6-foot wide by 5-foot tall culvert will be removed and replaced with a 8-foot wide by 6-foot tall culvert. The proposed culvert will be 164-foot long, which is about 66 feet longer than the existing one. The proposed culvert will have the upstream invert elevation at 898.76 feet and the downstream invert elevation at 898.53 feet; with flow directed from southwest to northeast. The proposed culvert will have bottom elevation slightly lower than the existing. Apron with vertical wingwalls are proposed to support the widened roadway embankment at both the upstream and downstream 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

The existing 6-foot by 5-foot concrete box culvert was originally constructed in 1936 and has a total length of 60 feet then widened in 1971 by about 38 feet at the west end with concrete drainage ditch. The existing culvert has a horizontal wingwalls at both ends.

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 replacement 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 fields. The surface topography is generally flat with elevation of about 905 feet. At culvert location the elevation along IL 47 roadway is about 908 feet and at the drainage ditch bottom is about 900 feet. The water along the drainage ditch flows from southwest to northeast through a 6-foot wide concrete box culvert.

2.2 Surficial Cover

The project area was shaped during the Wisconsin-age glaciation and about 200-foot thick overburden covers the bedrock. The glacigenic 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 feet 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

The subsurface investigation consisted 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, two peat delineation borings drilled south of the culvert, designated PT6-03 and PT7-06, were included in the report. The borings were drilled by Wang on October and December 2017 and were advanced to depths of 6 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 shelby 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 22 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 and PT6-03 revealed 2 to 7 feet of fill material. The fill material is cohesive, consisting of medium stiff to stiff, dark 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 892 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 interbeds. The unit has Q_u values of 1.3 to 4.6 tsf and moisture content values of 9 to 15%. The sandy gravel to gravelly sand interbeds have 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 889 (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 culvert and wingwalls are included in the following sections. The proposed culvert replacement will have upstream and downstream invert elevations of 898.76 and 898.53 feet, respectively. The base of the culvert barrel will be installed slightly deeper than the existing. Apron with 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 Scour Considerations

The design scour elevation should be taken at the bottom of the cutoff wall (IDOT 2012). At the horizontal cantilever wingwalls, the cutoff walls are established 3.0 feet below the culvert invert elevations; whereas for T-type wingwalls, the cutoff walls are established 4.0 feet below the invert elevations. The design scour elevations with cutoff walls established at 4.0 feet below the invert elevations, as shown in the GPE drawing, are summarized in Table 2. To prevent local erosion, we recommend placing stone riprap or a concrete apron at the ends of the culvert; this will be particularly important if precast sections are used. This will also prevent sediments from entering and accumulating in the culvert, minimize long term maintenance, and provide protection to the stream bed at the interface.

Table 2 : Design Scour Elevations

	Upstream	Downstream
Design Scour Elevations (feet)	894.76	894.53

5.2 Ground Improvement

The subsurface investigation indicates the soils along the culvert base are primarily 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:

- From the downstream end of the culvert going 65 feet upstream, for a depth of 5.5 feet below the proposed bottom of the culvert or to elevation 892 feet; and
- From 65 feet of downstream to upstream end, for a depth of 1.0 foot below the proposed bottom of the culvert or to elevation 897 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"

5.3 Bearing Capacity

After the proposed removal and replacement, the walls should be designed based on a maximum factored bearing resistance of 4,000 psf, determined with a bearing resistance factor (ϕ_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 sheet pile 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*."

5.4 Settlement

As discussed in Section 5.2, soft to medium stiff soil will be encountered below the base of proposed culvert. Without removal and replacement, we estimate up to 3 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 0.6 inches, with differential settlement of 0.5 inches over 65 feet. We estimate the settlements are suitable for the construction of the proposed culvert and wingwalls.

5.5 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 downstream 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 3.3 for undrained soil condition and a FOS of 1.6 for a drained soil condition. The FOSs meet the minimum FOS requirement of 1.5 (IDOT 2015).

5.6 Cast-In-Place or Precast Culvert Considerations

After the recommended removal of unsuitable soil, 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 65 feet, which will not cause excessive separation of the precast sections. For precast end sections, we recommend considering either a concrete apron or riprap armoring at the downstream invert to protect against scour and erosion that could undermine the precast end section assuming a hydraulic analysis does not indicate a low-scour condition.

5.7 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 16.5 feet (from elevation 908.5 to 892.0 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

The existing culvert will be removed and any vegetation, surface topsoil, and debris should be cleared and stripped where the new 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 the 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 encountered at elevation ranging from 885 to 900 feet. The proposed barrel and wingwalls will be established between 894.5 and 898.8 feet elevation, which is below the encountered groundwater elevations. 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. Depending upon prevailing climate conditions and the time of the year when culvert construction takes place, control runoff and maintenance of existing flows may require temporary water diversion and control.

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 soils 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 Provisons. 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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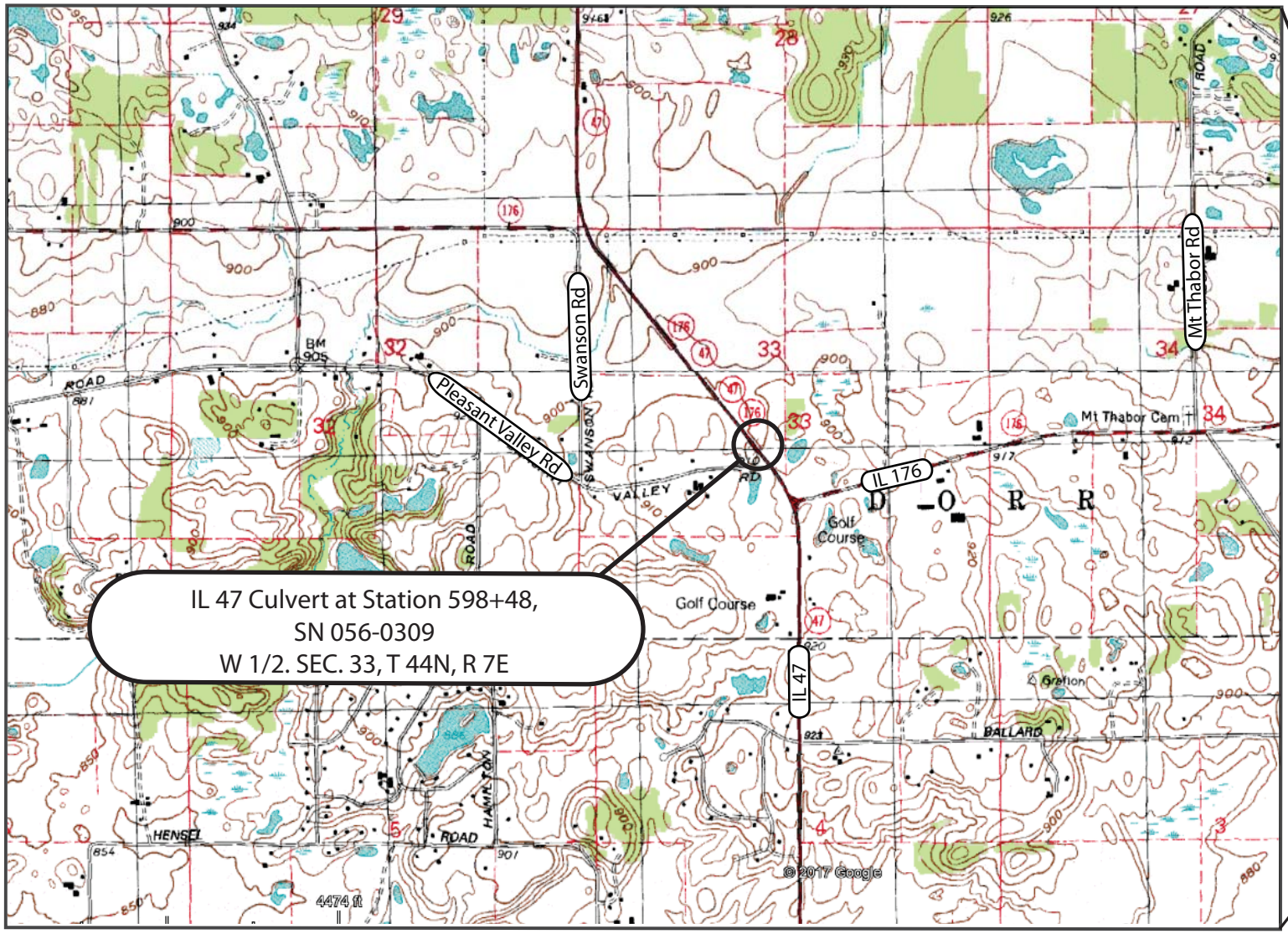
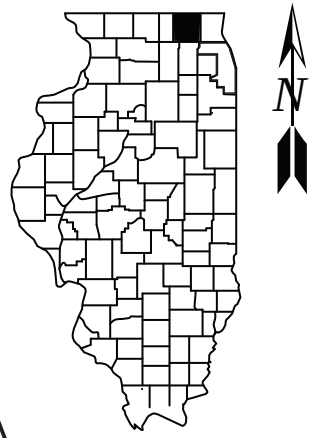
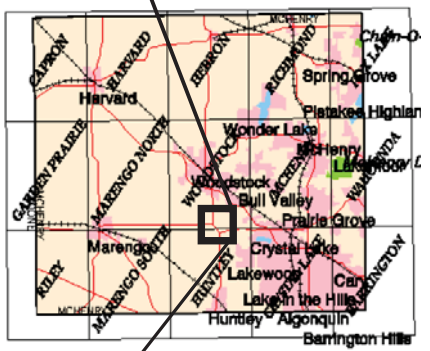
Wang Engineering
1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

EXHIBITS







McHenry County

Scale

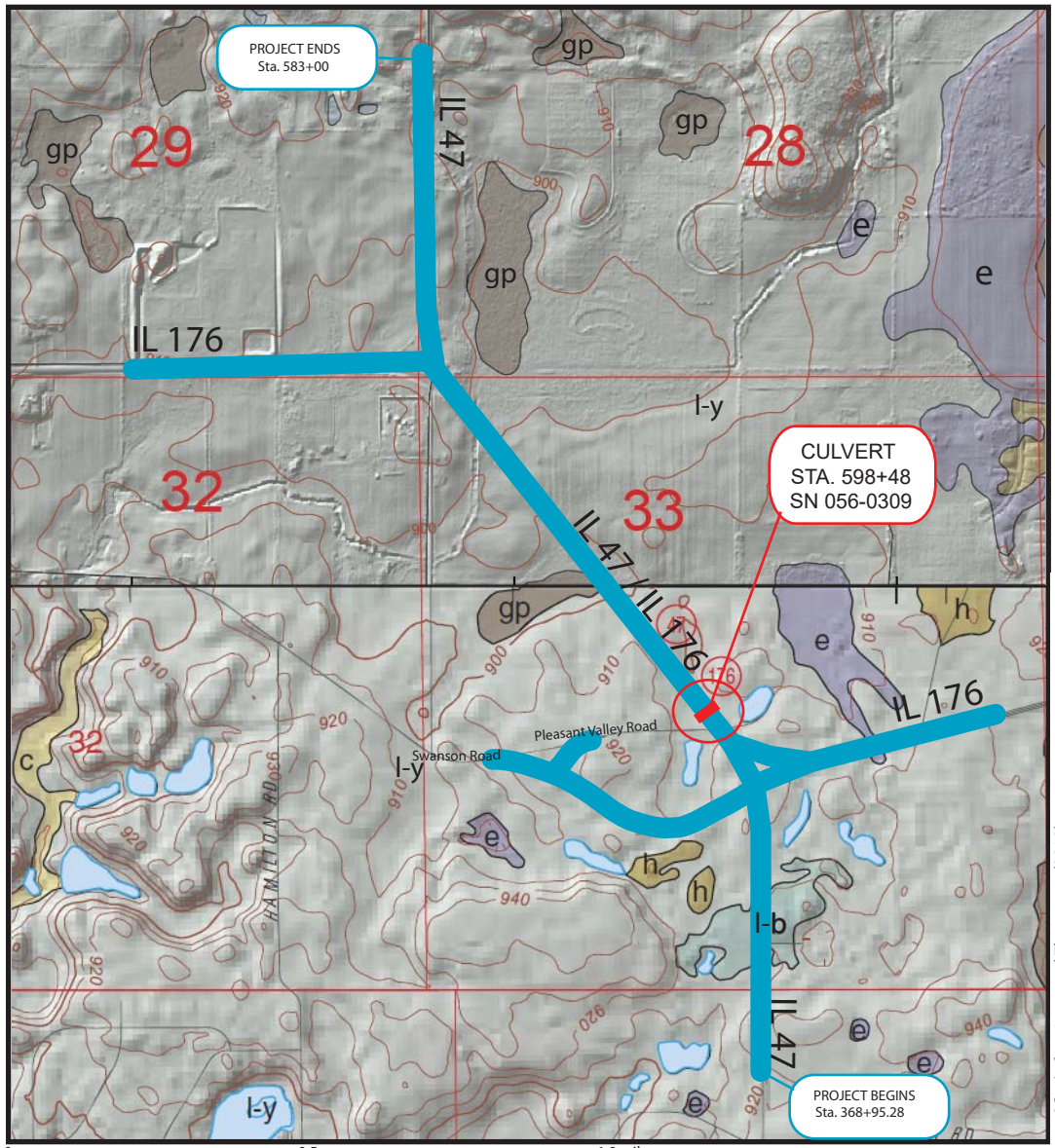
0 1 2 Mile

SITE LOCATION MAP: IL 47 CULVERT AT STATION 598+48, SN 056-0309, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: RKC CHECKED BY: A. Kurnia

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

FOR STRAND ASSOCIATES, INC. 195-13-01



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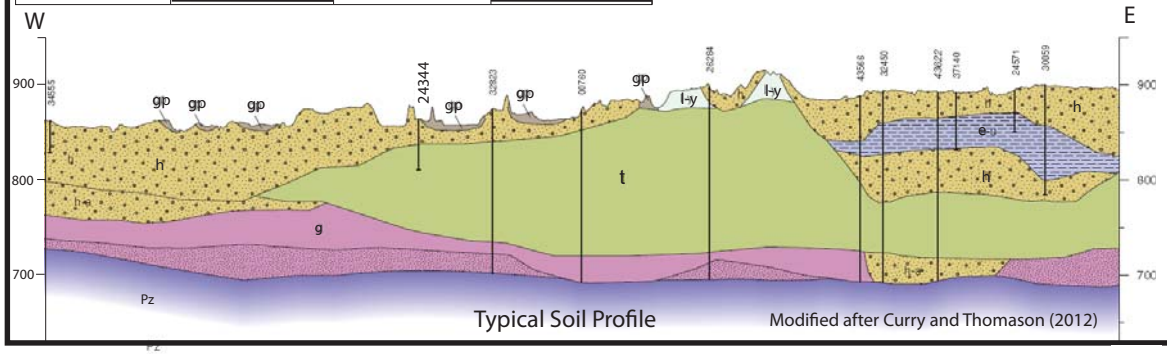
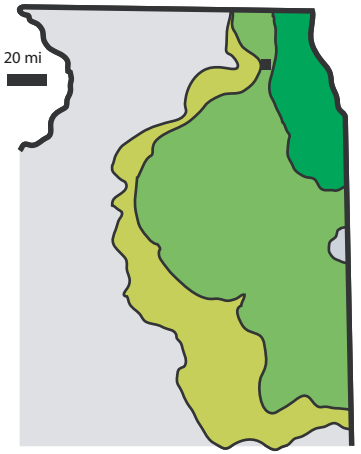
Modified after Curry and Thomason (2012)



Typical Soil Profile

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 Fornation, 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)

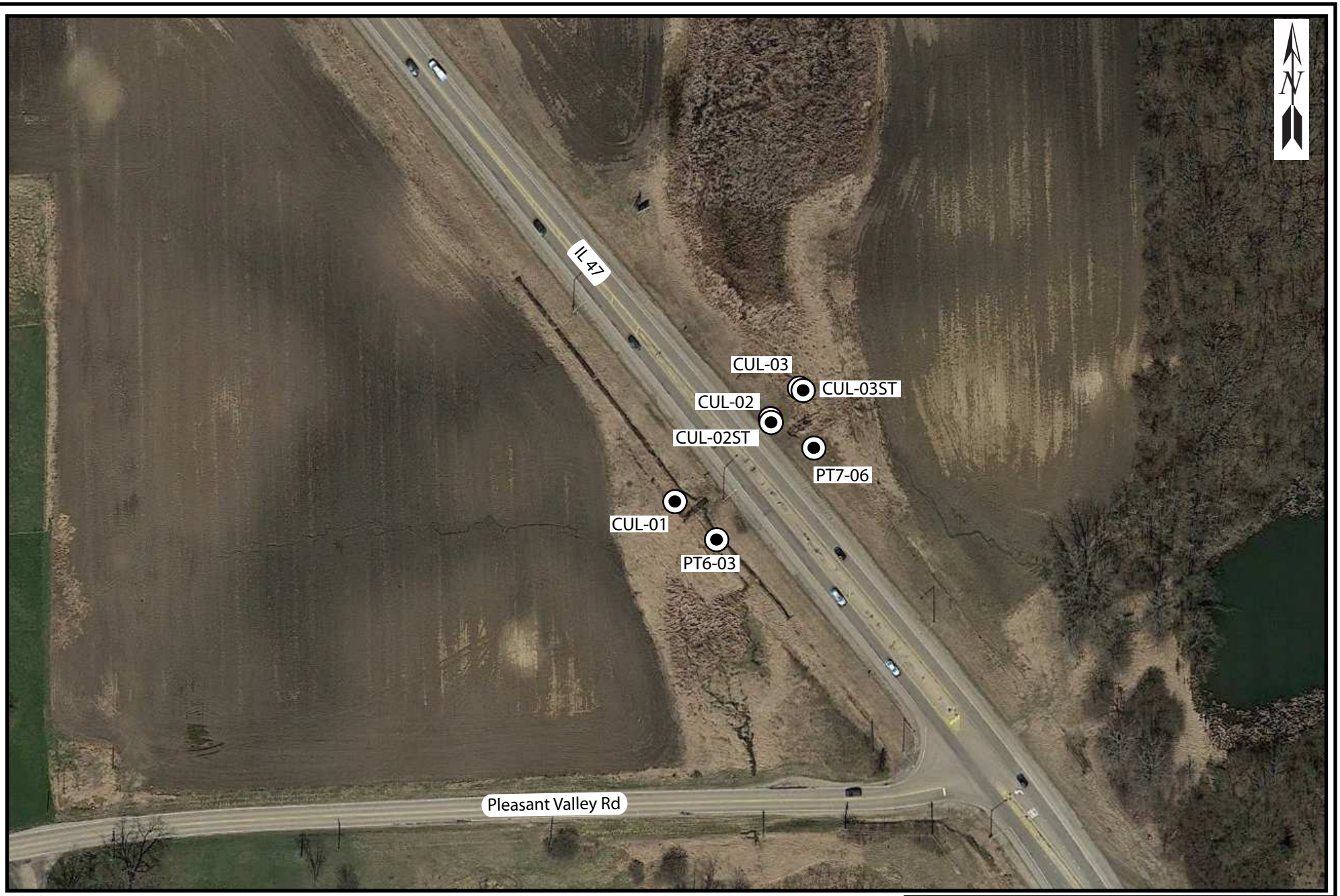
SITE AND REGIONAL GEOLOGY: IL 47 CULVERT AT STATION 598+48, SN 056-0309, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: C. Marin CHECKED BY: L. Iordache

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

FOR STRAND ASSOCIATES, INC.

195-13-01



Legend

◉ Soil Borings

Scale

0 200 400 Feet

BORING LOCATION PLAN: IL 47 CULVERT AT STATION 598+48, SN 056-0309, MCHENRY COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 3-1	DRAWN BY: RKC CHECKED BY: A. Kurnia

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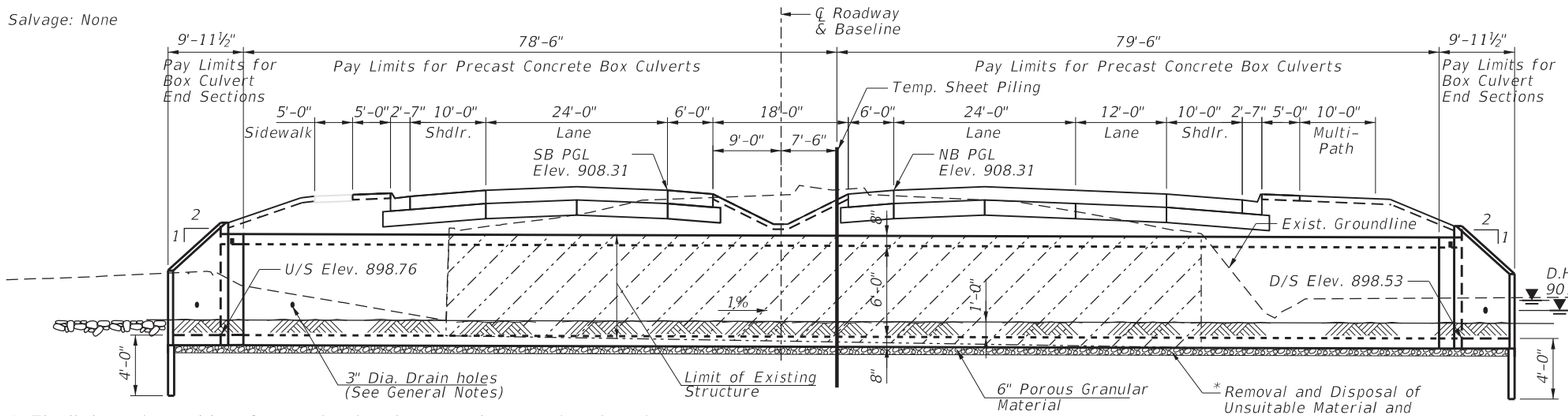
FOR STRAND ASSOCIATES, INC. 195-13-01

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

Existing Structure: SN 056-0247 was built in 1936 as SBI 47 Section 105X.
It is a single Box Culvert 6' x 5', 100'-0" Face to Face of Headwalls.

Traffic Control: Traffic to be maintained utilizing Stage Construction.

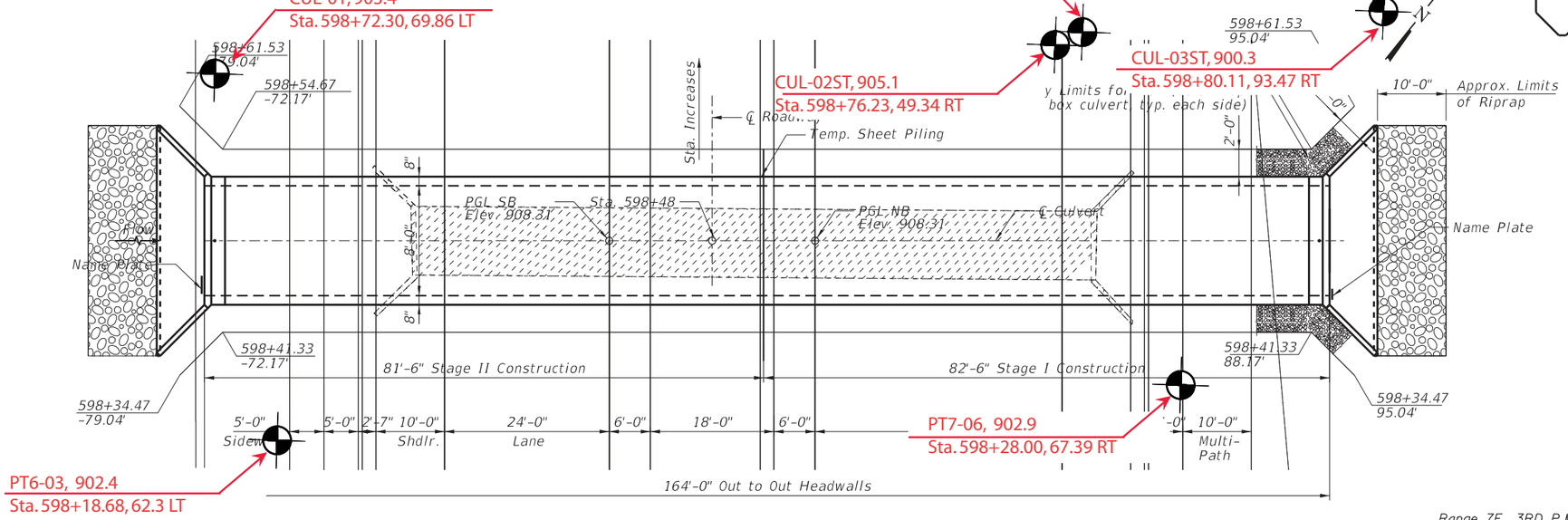
Salvage: None



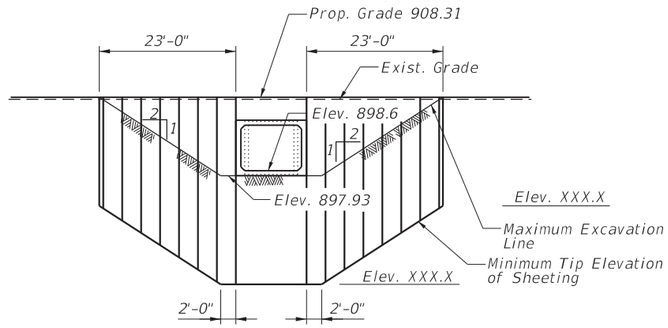
* The limits and quantities of removal and replacement shown are based on the boring data and may be modofied by the District Geotechnical and Field Engineers for variable subsurface conditions encountered in the field.

The Rockfill shall be capped with 6 in.
Specifications unless otherwise indicat ost
of the capping material shall be included in the pay item for Rockfill.

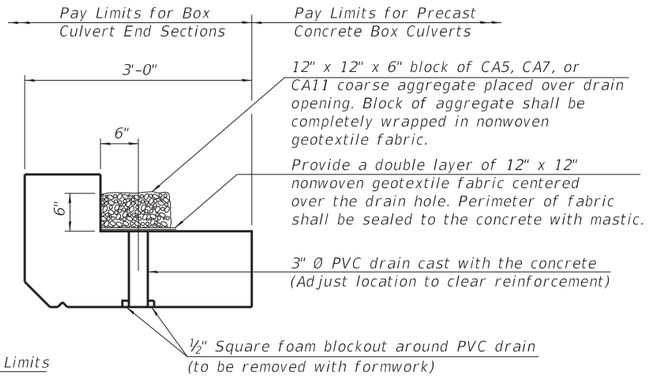
ELEVATION



PLAN



TEMP. SHEET PILING DETAIL



DRAIN DETAIL

(All costs associated with furnishing and constructing the above drain detail will not be measured for payment but shall be included in the contract unit price for the associated work.)

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications
8th Edition

LOADING HL-93

50 PSF Futurwe Wearing Surface

WATERWAY INFORMATION

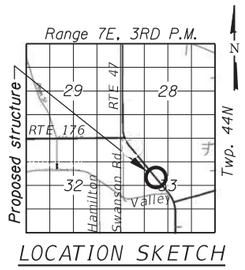
Drainage Area = 0.0544 sq. mi. Low Grade Elev. = 908.05 @ Sta. 599+00

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	17.04	6.4	8.6	900.83	0.05	0.18	900.88	901.01
Design	50	27.41	7.8	10.3	901.05	0.21	0.34	901.26	901.39
Base	100	38.82	8.9	11.8	901.24	0.40	0.50	901.64	901.74
Overtopping									
Max. Calc.	500	65.90	11.1	14.7	901.60	0.83	0.84	902.43	902.44

GENERAL PLAN AND ELEVATION
IL RTE. 47 OVER
KISHWAUKEE RIVER TRIBUTARY
F.A.P. RTE. 326 SEC 105-N-2(15)
McHENRY COUNTY
STATION 598+48.00
S.N. 056-0309

STATION 598+48.00
BUILT BY
STATE OF ILLINOIS
F.A.P. RT. 326 SEC.
LOADING HL-93
STR. NO. 056-0309

NAME PLATE
See Std. 515001



LOCATION SKETCH

Legend

Soil Borings

BORING LOCATION PLAN: IL 47 CULVERT AT STATION 598+48, SN 056-0309, 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

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

MODEL: Default
FILE NAME: N:\dot\170353\CEBE\LS\Struct\056-0309-GPE_170353.sht

USER NAME = prazalan
PLOT SCALE = 20.0000 ' / in.
PLOT DATE = 4/11/2018

DESIGNED - AS | REVISED -
DRAWN - PDR | REVISED -
CHECKED - MM | REVISED -
DATE - SPLANDATE$ | REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

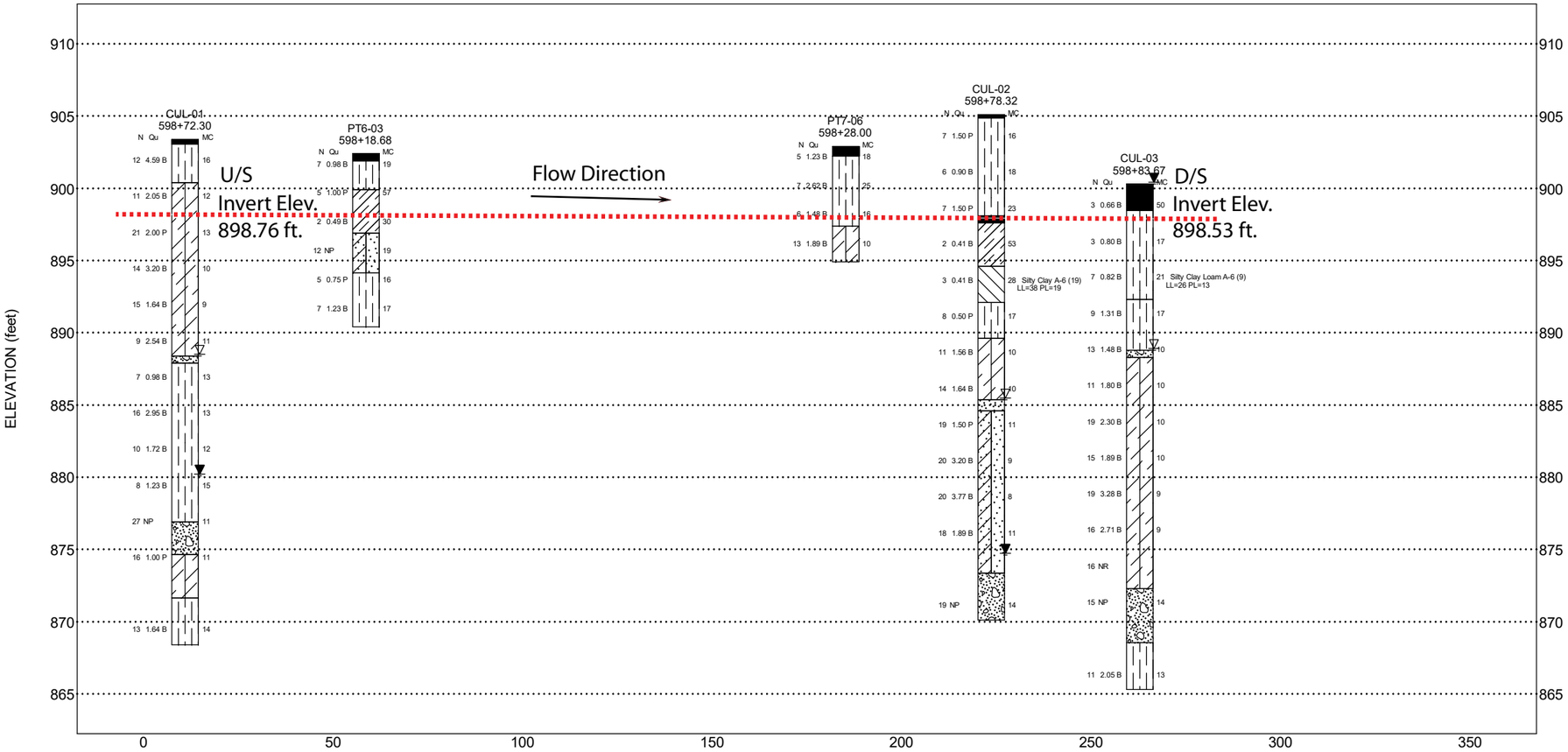
GENERAL PLAN AND ELEVATION
STRUCTURE NO. 056-0309

SCALE: N.T.S. | SHEET 1 OF 8 SHEETS | STA. 598+48 | TO STA. ---

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	105-N-2(15)	MCHENRY	473	346
		CONTRACT NO. 62B43		
	ILLINOIS	FED. AID PROJECT		

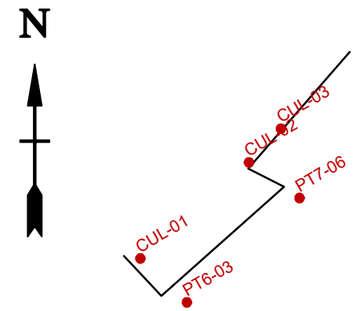
◄ SW

NE ►



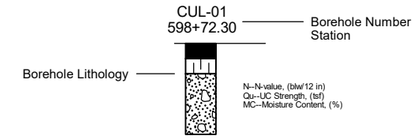
Lithology Graphics

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



Site Map Scale 1 inch equals 130 feet

Explanation:



Water Level Reading at time of drilling.

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

Vertical Exaggeration: 4x

Wang Engineering, Inc.
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Lombard, IL 60148

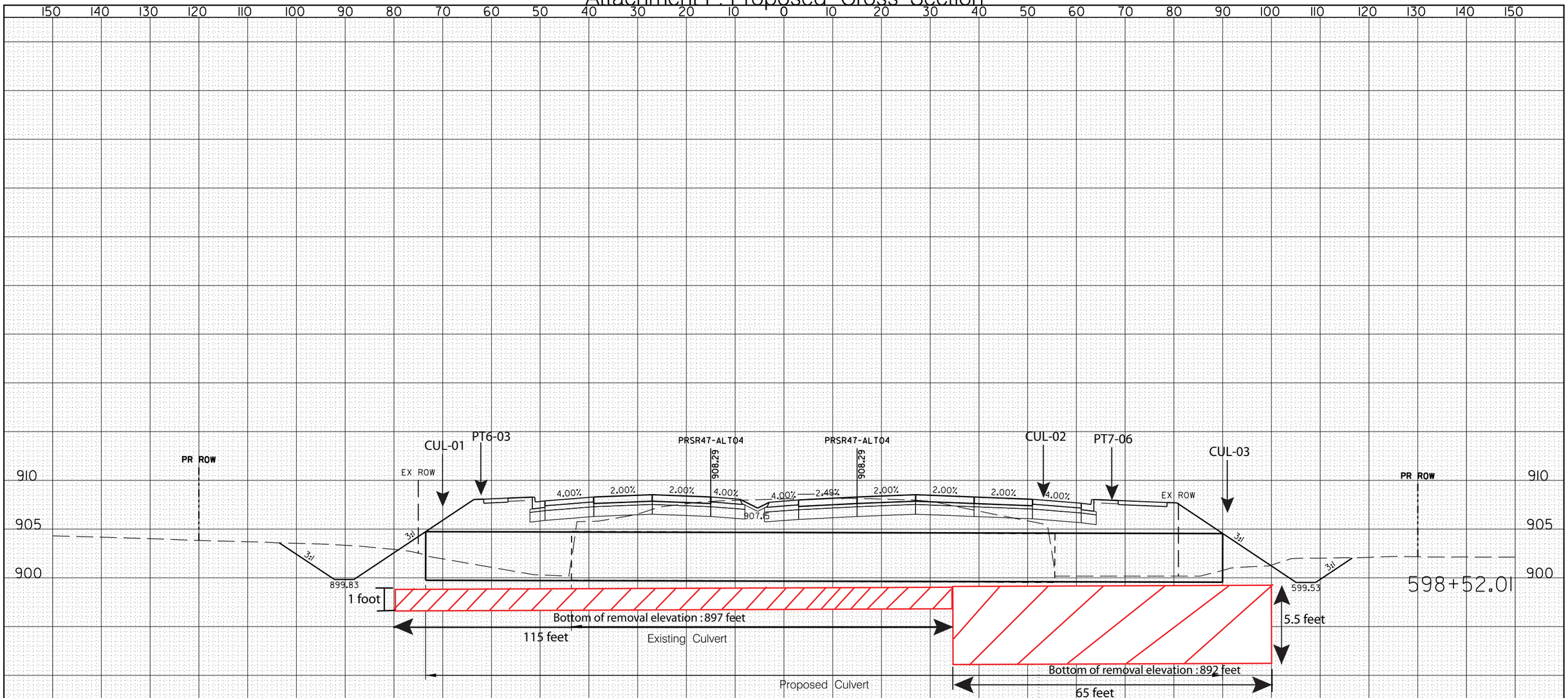
Subsruface Data Profile
Culvert at Station 598+48, SN 056-0309

WEI SINCE 1982

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 8/10/18



FINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

ORIGINAL SURVEY	NOTE BOOK	NO.
SURVEYED		
PLOTTED		
TEMPLATE		
AREAS		
AREAS CHECKED		

BY	DATE

REMOVAL AND REPLACEMENT SKETCH: IL 47 CULVERT AT STATION 598+48, SN 056-0309. McHENRY COUNTY

SCALE: GRAPHICAL | EXHIBIT 5 | DRAWN BY: N. Balakumaran | CHECKED BY: A. Kurnia

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

FILE NAME = $FILE1$	USER NAME = $USER$	DESIGNED -	REVISED -
		DRAWN -	REVISED -
XS.SHEET	PLOT SCALE = $SCALE$	CHECKED -	REVISED -
	PLOT DATE = $DATE$	DATE -	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION
Page 139 of 252

PROPOSED CROSS SECTIONS
IL ROUTE 47

SCALE: 1" = 10' | SHEET OF SHEETS | STA. 598+36.76 TO STA.599+00.00

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
47	REED ROAD TO US 14	MCHENRY	210	91
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

Wang Engineering
1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

APPENDIX A

Wang Engineering

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 Qu, 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

		Percent of Dry Weight
Trace	1-9	
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

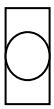
Term	Description
Dry	Dusty, No visible moisture
Damp	Cohesives hard to mold; Granulars do not flow easily
Moist	Cohesives can be molded; Granulars start to stick together
Wet	Cohesives can be very easily molded and sticky; Granulars stick together easily
Saturated	Only granular soils; Water drains freely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


No Recovery


Geoprobe


Rock Core


Shelby Tube


Auger Cuttings


In-situ Vane Shear Test

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

(Rev. 05/23/2018)

Wang Engineering
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: NAVD 88
Elevation: 903.40 ft
North: 2032766.30 ft
East: 959415.12 ft
Station: 598+72.30
Offset: 69.86 LT

Elevation (ft)	Depth (ft)	SOIL AND ROCK DESCRIPTION	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
903.1	0	4-inch thick, black SILTY CLAY LOAM					
		--TOPSOIL--					
		Hard, brown SILTY CLAY, trace gravel; damp		1	5 6 6	4.59 B	16
		--RDR 2--					
900.4		Stiff to very stiff, brown to gray SILTY CLAY LOAM to CLAY LOAM, trace gravel; damp		2	3 6 5	2.05 B	12
		--RDR 2--					
	5			3	7 10 11	2.00 P	13
		--cobbles--		4	5 6 8	3.20 B	10
	10			5	4 7 8	1.64 B	9
888.4	15			6	3 5 4	2.54 B	11
887.9		GRAVEL; saturated					
		Medium stiff to very stiff, gray SILTY CLAY LOAM, trace gravel; damp to moist		7	2 2 5	0.98 B	13
		--RDR 2--					
	20			8	3 5 11	2.95 B	13
	25			9	3 5 5	1.72 B	12
				10	4 4 4	1.23 B	15
876.9		Medium dense, gray SANDY GRAVEL; saturated		11	27 16 11	NP	11
		--RDR 3--					
874.7		Stiff, gray CLAY LOAM, trace gravel; damp		12	6 4 12	1.00 P	11
	30	--RDR 2--					
871.7		Stiff, gray SILTY CLAY LOAM, trace gravel; damp					
		--RDR 2--		13	7 8 5	1.64 B	14
868.4	35	Boring terminated at 35.00 ft					
	40						

GENERAL NOTES

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**

WATER LEVEL DATA

While Drilling: **15.00 ft**
At Completion of Drilling: **23.30 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.

WANGENGINC 1951301.GPJ WANGENG.GDT 8/10/18

Wang Engineering
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: NAVD 88
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 (%)
	904.9	3-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
			5		2	4 3 3	0.90 B	18
	898.1				3	3 4 3	1.50 P	23
	897.6	Black CLAY LOAM						
		--BURIED TOPSOIL--						
		Soft, dark gray ORGANIC SILTY CLAY to CLAY with organic matter; moist						
		--RDR 1--						
		--organic content= 7.0%--	10		4	1 1 1	0.41 B	53
	894.6	Soft, light gray CLAY to SILTY CLAY; wet						
		--RDR 1--						
		--L_L(%)=38, P_L(%)=19--						
		--%Gravel=0.1--						
	892.1	--%Sand=3.9--						
		--%Silt=57.2--						
		--%Clay=38.8--						
		--A-6 (19)--						
		--sand seams; moist--						
					5	1 1 2	0.41 B	28
			15		6	3 4 4	0.50 P	17
	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
	885.4		20		8	3 5 9	1.64 B	10

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	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
			25		10	7 8 12	3.20 B	9
					11	6 8 12	3.77 B	8
					12	5 7 11	1.89 B	11
			30					
	873.4	Medium dense, gray SANDY GRAVEL; saturated						
		--RDR 2--						
					13	3 9 10	NP	14
	870.1	Boring terminated at 35.00 ft	35					
			40					

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: **T. Rothschild** Checked by: **C. Marin**
Drilling Method: **2.25 IDA HSA; 140 lb autohammer; Boring backfilled upon completion**

WATER LEVEL DATA

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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Wang Engineering
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: NAVD 88
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 (%)
		Blind drilled to 9 feet						
	896.1	Gray SILTY CLAY; moist --C_c=0.491, OCR=1.3--	10		1	PUSH		44
	894.1	Boring terminated at 11.00 ft						

GENERAL NOTES

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**

WATER LEVEL DATA

While Drilling: **DRY**
At Completion of Drilling: **DRY**
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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Wang Engineering
wangeng@wangeng.com
1145 North Main Street
Lombard, IL 60148
Telephone: 630-953-9928
Fax: 630-953-9938

BORING LOG CUL-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: NAVD 88
Elevation: 900.30 ft
North: 2032876.10 ft
East: 959534.10 ft
Station: 598+83.67
Offset: 91.63 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		22-inch thick, medium stiff, black SILTY CLAY LOAM, some organic matter						
	898.5	--TOPSOIL--						
		Medium stiff, brown to gray SILTY CLAY LOAM, some fine sand and clay interbeds; wet						
		--RDR 1--						
					1	1 1 2	0.66 B	50
					2	2 2 1	0.80 B	17
			5					
		--L_L(%)=26, P_L(%)=13--						
		--%Gravel=4.2--						
		--%Sand=11.4--						
		--%Silt=61.3--						
		--%Clay=23.1--						
		--A-6 (9)--			3	2 3 4	0.82 B	21
	892.3	Stiff, gray SILTY CLAY, trace gravel; damp						
		--RDR 2--						
					4	3 4 5	1.31 B	17
			10					
	888.8							
	888.3	Gray SANDY GRAVEL; wet			5	9 7 6	1.48 B	10
		Stiff to very stiff, pinkish gray CLAY LOAM to SILTY LOAM, trace gravel; damp						
		--RDR 2--						
					6	4 5 6	1.80 B	10
			15					
					7	10 10 9	2.30 B	10
					8	5 7 8	1.89 B	10
			20					
					9	5 8 11	3.28 B	9
					10	6 8 8	2.71 B	9
			25					
					11	5 5 11	NR	
	872.3	Medium dense, gray GRAVELLY COARSE SAND; wet						
		--RDR 2--						
					12	2 5 10	NP	14
			30					
	868.6							
		Very stiff, gray SILTY CLAY LOAM; trace gravel						
		--RDR 2--						
					13	6 5 6	2.05 B	13
	865.3		35					
		Boring terminated at 35.00 ft						
			40					

GENERAL NOTES

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**

WATER LEVEL DATA

While Drilling: **11.50 ft**
At Completion of Drilling: **0.00 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.

WANGENGINC 1951301.GPJ WANGENG.GDT 8/10/18

Wang Engineering
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: NAVD 88
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 (%)
		Drilled to 4 feet without sampling						
	896.3	Medium stiff, brown to gray SILTY CLAY LOAM	5		1	PUSH	0.75 P	
	894.3	Boring terminated at 6.00 ft	10					
			15					
			20					

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)

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: **DRY**
At Completion of Drilling: **DRY**
Time After Drilling: **NA**
Depth to Water: **NA**

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

Wang Engineering
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: NAVD 88
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 (%)
	901.9	6-inch thick, black SILTY CLAY LOAM						
		--TOPSOIL--			1	1 3 4 4	0.98 B	19
		Medium stiff, brown and black SILTY CLAY; damp						
	899.9	--FILL--						
		Soft to stiff, black and gray SILTY CLAY, little to some organic matter; moist			2	2 2 3 4	1.00 P	57
		--RDR 2--	5		3	1 1 1 2	0.49 B	30
	896.9	Medium dense, gray LOAM; moist to wet						
		--RDR 2--			4	1 3 9 6	NP	19
	894.2	Medium stiff to stiff, gray SILTY CLAY LOAM, trace gravel; damp			5	3 2 3 6	0.75 P	16
		--RDR 2--	10		6	2 3 4 7	1.23 B	17
	890.4	Boring terminated at 12.00 ft	15					
			20					

GENERAL NOTES

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**

WATER LEVEL DATA

While Drilling: **DRY**
At Completion of Drilling: **DRY**
Time After Drilling: **NA**
Depth to Water: **NA**

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

Wang Engineering
wangeng@wangeng.com
1145 North 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 88
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 (%)
	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	1 2 3 4	1.23 B	18
					2	3 3 4 4	2.62 B	25
			5		3	2 3 3 5	1.48 B	16
	897.4							
		Stiff, brown CLAY LOAM, trace gravel; damp			4	5 6 7 6	1.89 B	10
	894.9							
		Boring terminated at 8.00 ft						
			10					
			15					
			20					

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

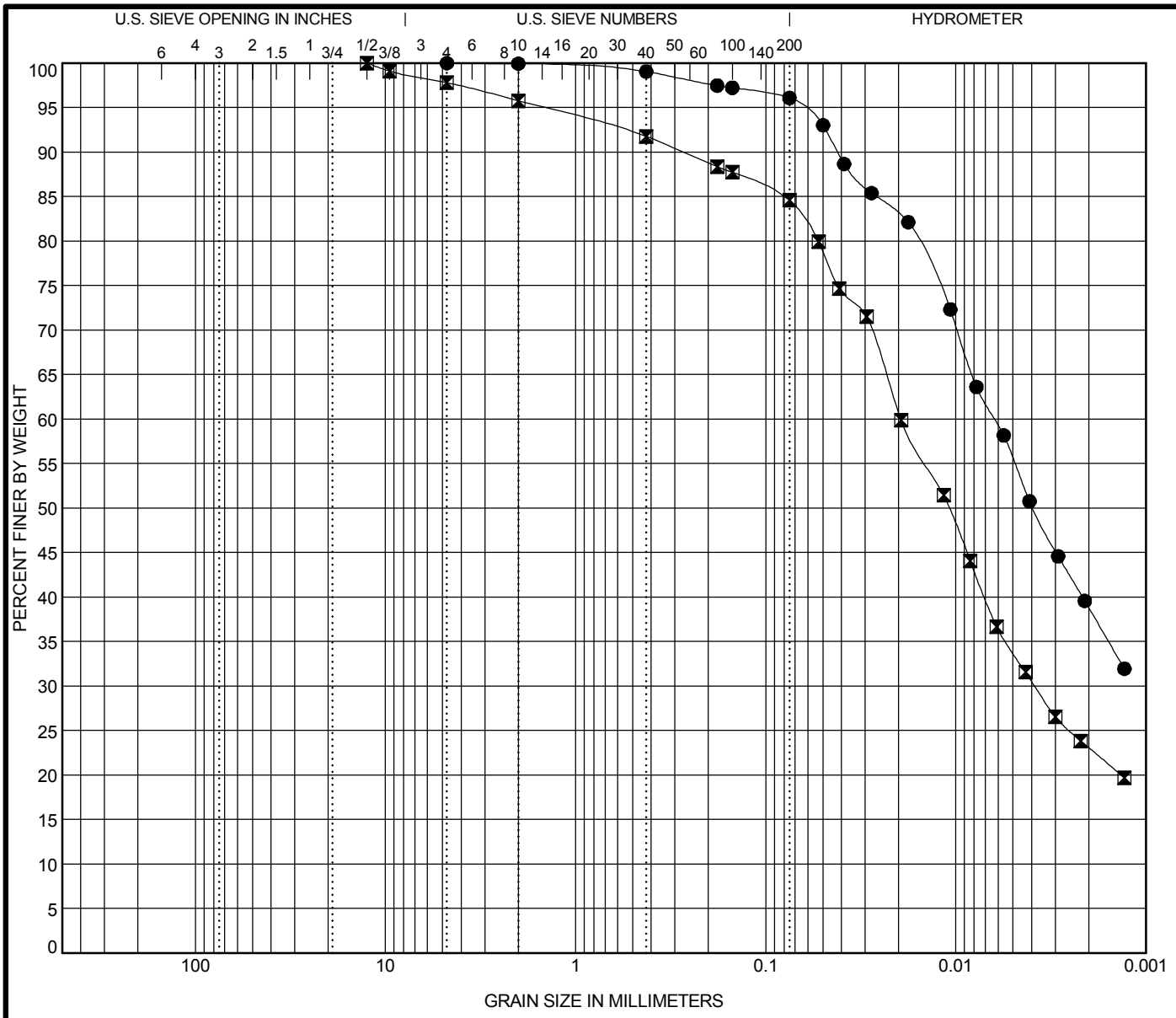
While Drilling: **DRY**
At Completion of Drilling: **DRY**
Time After Drilling: **NA**
Depth to Water: **NA**

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

WANGENGINC 1951301.GPJ WANGENG.GDT 8/10/18

Wang Engineering
1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

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	**Silty Clay**	**38**	**19**	**19**		
⊠	CUL-03#3	6.0 ft	**Silty Clay Loam**	**26**	**13**	**13**		

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

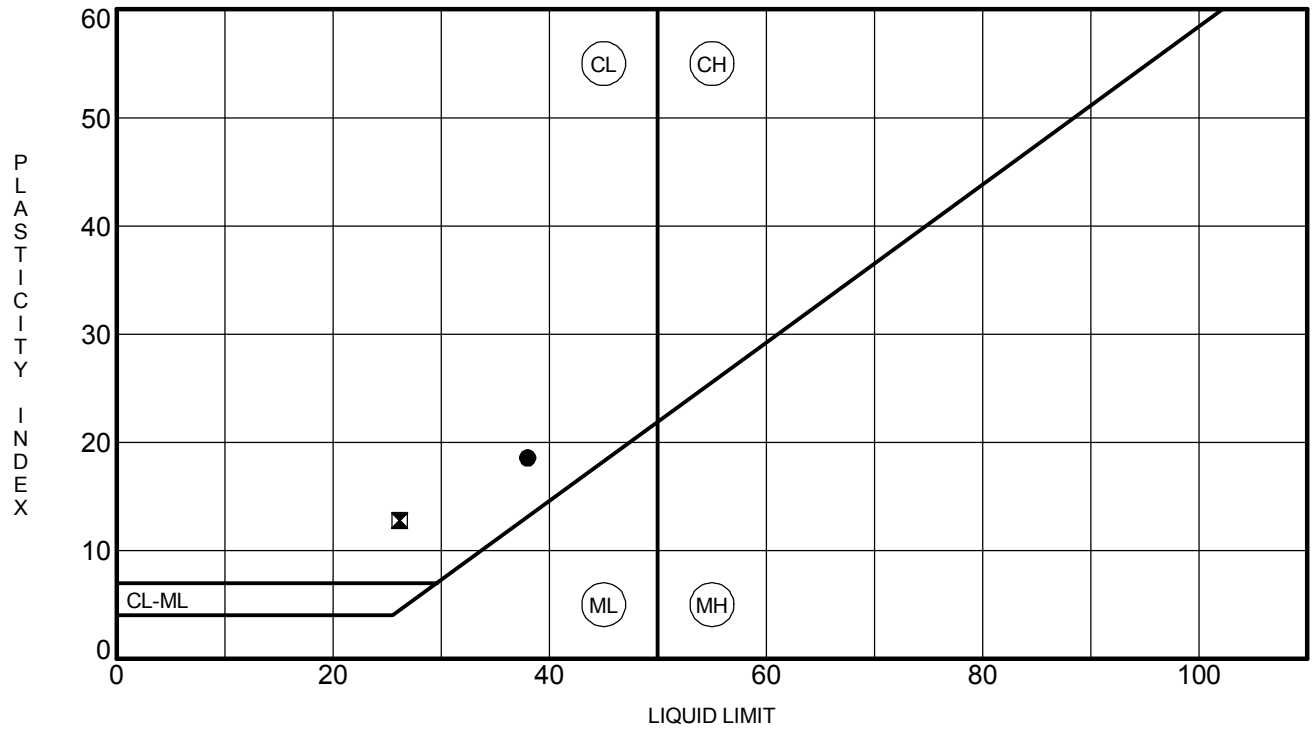
Wang Engineering, Inc.
1145 North Main Street
Lombard, IL 60148
Telephone: 630-953-9928
Fax: 630-953-9938

GRAIN SIZE DISTRIBUTION

Project: IL 47 between US 14 and S of IL 176

Location: McHenry County, Illinois

Number: 195-13-01



Specimen Identification		LL	PL	PI	Fines	IDH Classification
● CUL-02#5	11.0 ft	38	19	19	96	**Silty Clay**
⊠ CUL-03#3	6.0 ft	26	13	13	85	**Silty Clay Loam**

WEI SINCE 1982

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

ATTERBERG LIMITS' RESULTS

Project: IL 47 between US 14 and S of IL 176

Location: McHenry County, Illinois

Number: 195-13-01

Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

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=		
			In-Situ Vertical Effective Stress =	1400	psf

Compression and Swelling Indices

Compression index C_c =	0.448	**Preconsolidation pressure,s_C**	
Field corrected C_c =	0.491	Casagrande Method =	1835 psf
Swelling index C_s =	0.112	**Over-Consolidation Ratio (OCR) =**	1.31

Load number	Vertical stress	Dial reading	System deflection	Vertical strain	Void ratio	C_v	Cae	Elapsed time
	psf	in	in	%		ft^2/day	%	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: _____

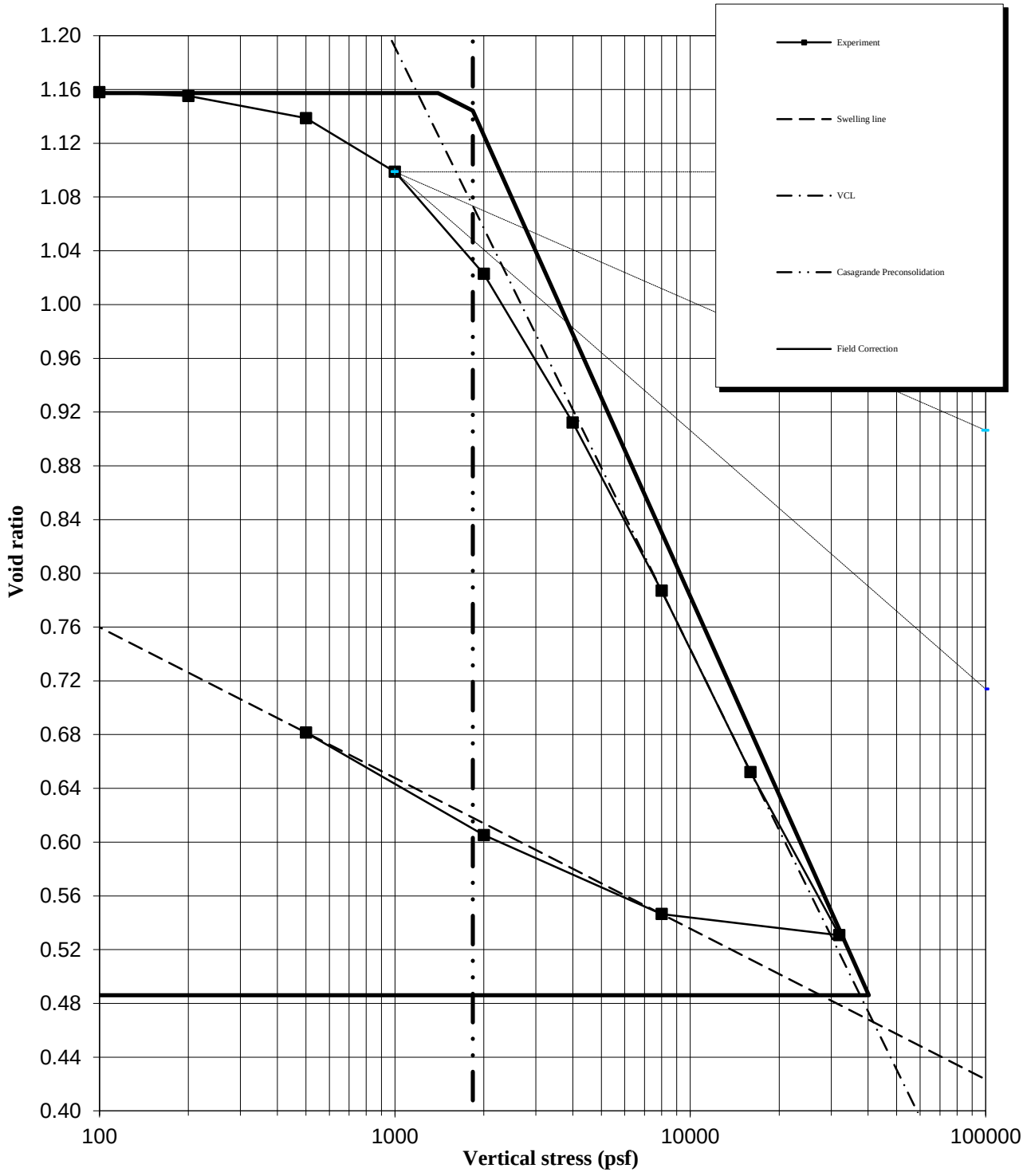
AASHTO R18

Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

CONSOLIDATION CURVE

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



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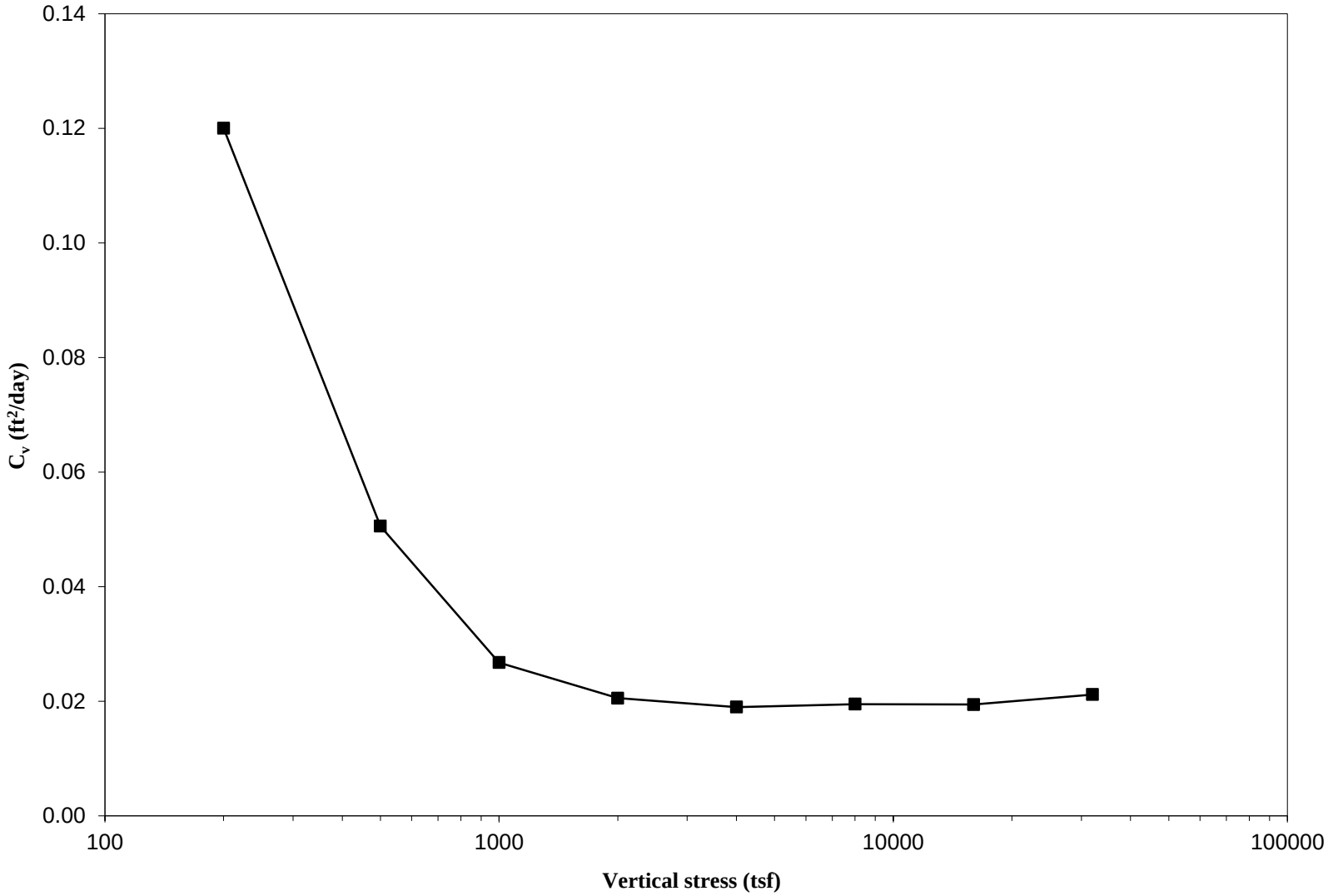
CONSOLIDATION COEFFICIENT (C_v) vs. VERTICAL STRESS

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



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1145 North Main Street
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Phone (630) 953-9928
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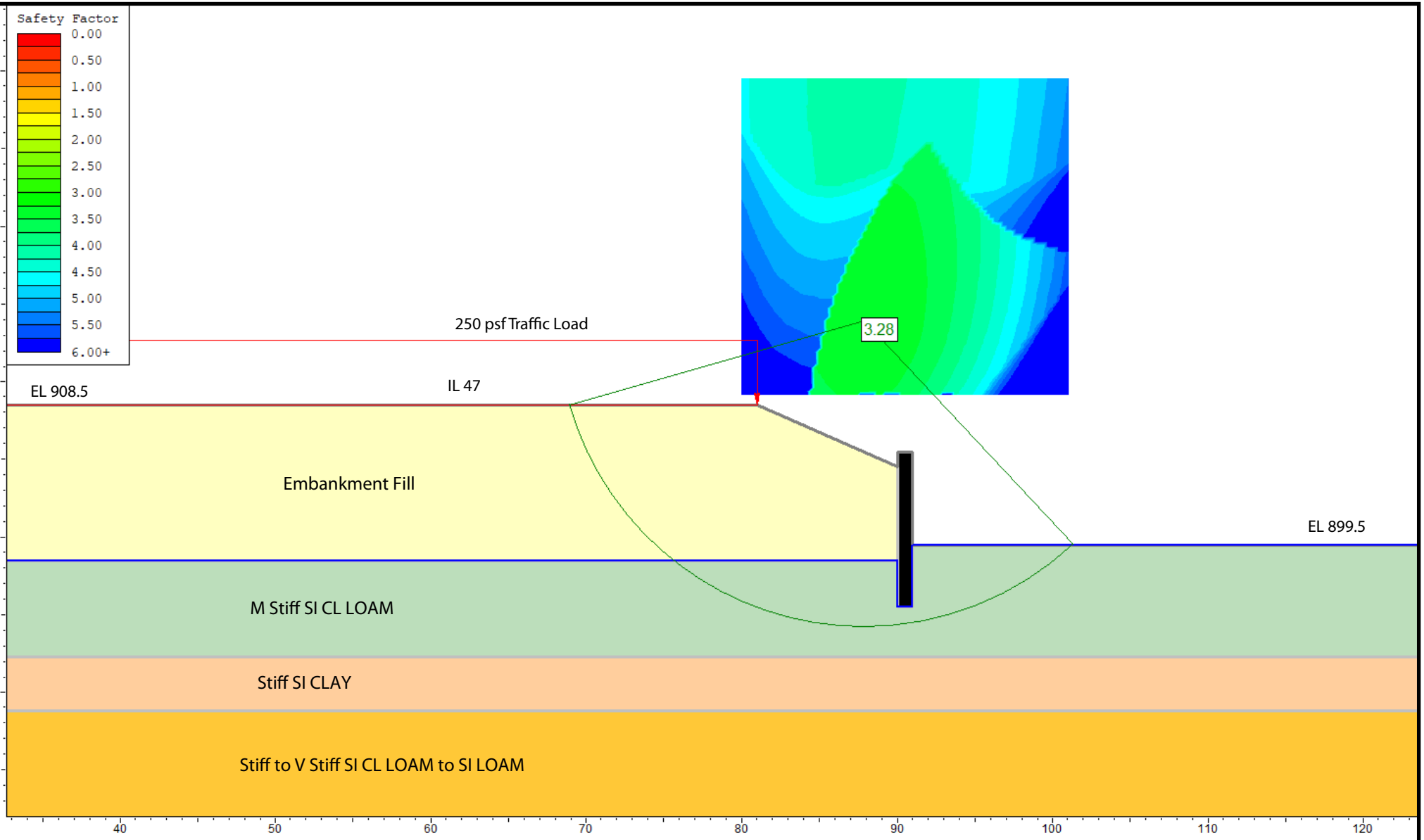
APPENDIX C



Undrained Analysis for Culvert, Reference Boring: CUL-03

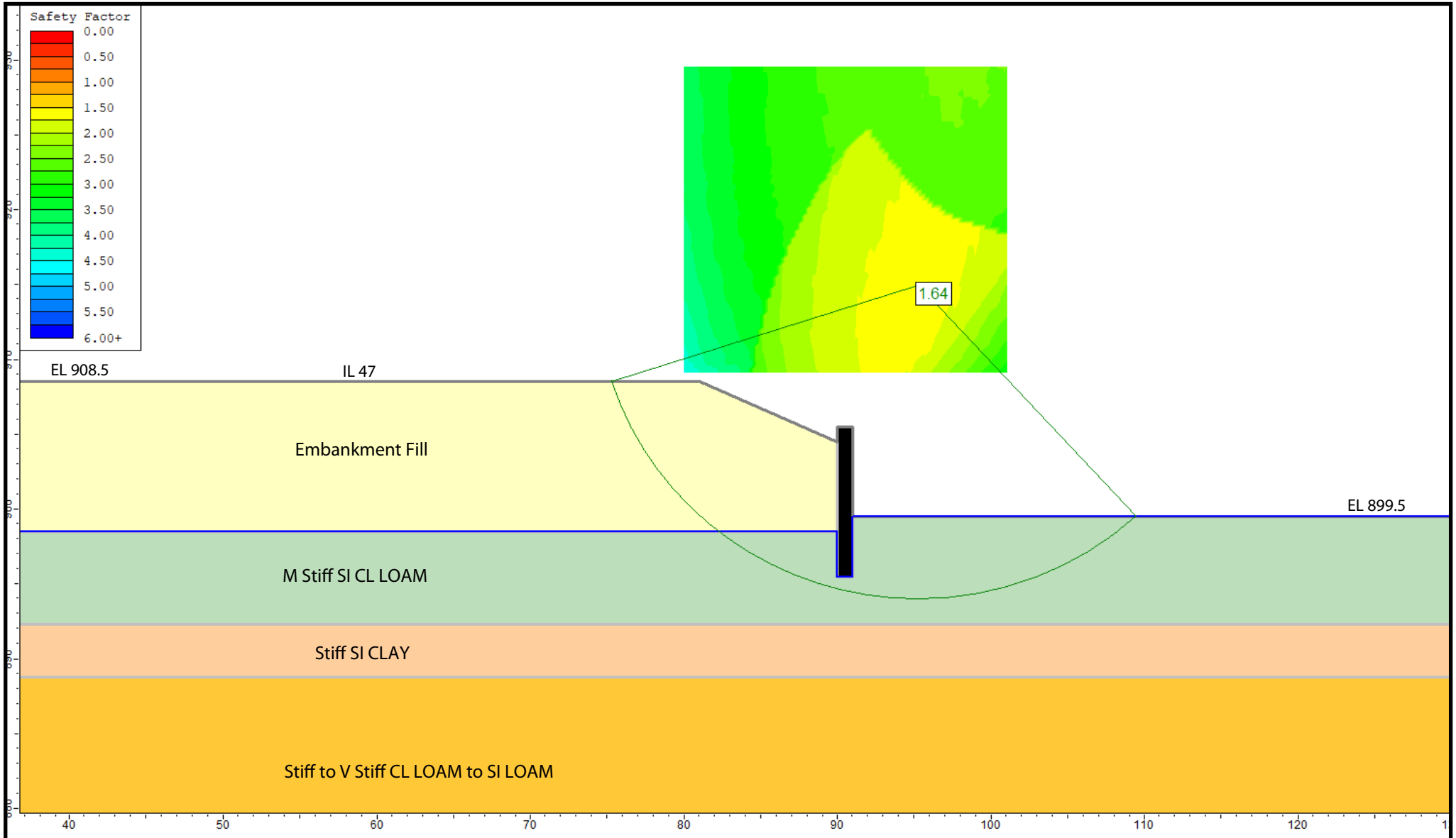
Layer ID	Description	Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	Embankment FILL	125	1000	0
2	M Stiff SI CL LOAM	115	700	0
3	Stiff SI CLAY	120	1300	0
4	Stiff to V Stiff CL LOAM to SI LOAM	120	2200	0

GLOBAL STABILITY ANALYSIS: IL 47 CULVERT AT STATION 598+48, SN 056-0309, MCHENRY COUNTY

SCALE: GRAPHICAL | APPENDIX C-1 | DRAWN BY: N. Balakumaran, CHECKED BY: A. Kurnia

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

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



Drained Analysis for Culvert, Reference Boring: CUL-03

Layer ID	Description	Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	Embankment FILL	125	100	30
2	M Stiff SI CL LOAM	115	0	28
3	Stiff SI CLAY	120	100	30
4	Stiff to V Stiff CL LOAM to SI LOAM	120	100	30

GLOBAL STABILITY ANALYSIS: IL 47 CULVERT AT STATION 598+48, SN 056-0309, MCHENRY COUNTY

SCALE: GRAPHICAL | APPENDIX C-2 | DRAWN BY: N. Balakumaran | CHECKED BY: A. Kurnia

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

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

Wang Engineering
1145 North Main Street
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Phone (630) 953-9928
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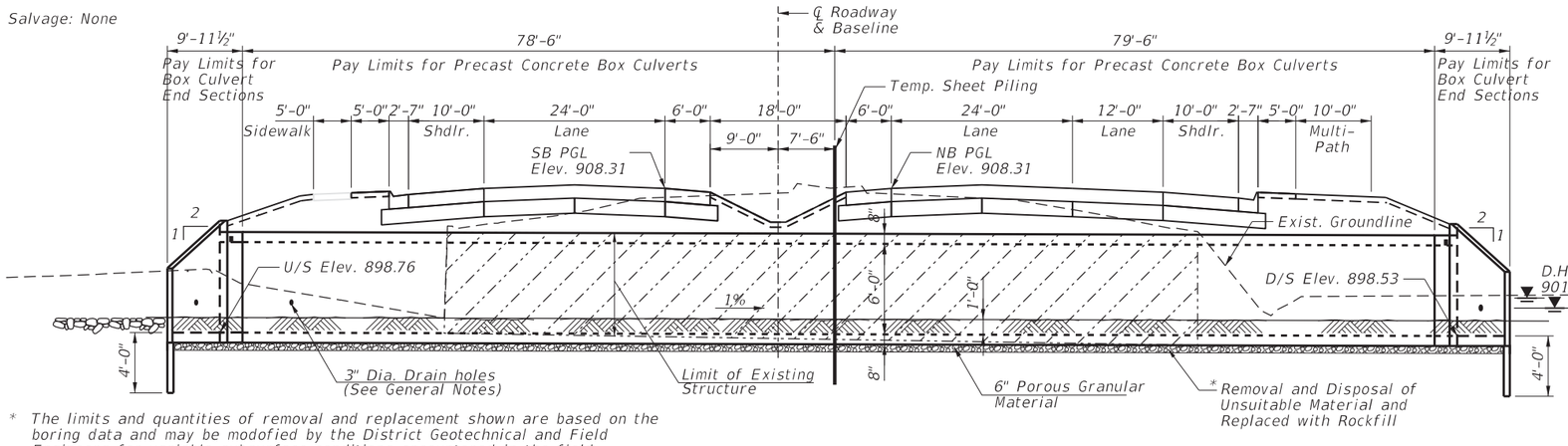
APPENDIX D

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

Existing Structure: SN 056-0247 was built in 1936 as SBI 47 Section 105X.
It is a single Box Culvert 6' x 5', 100'-0" Face to Face of Headwalls.

Traffic Control: Traffic to be maintained utilizing Stage Construction.

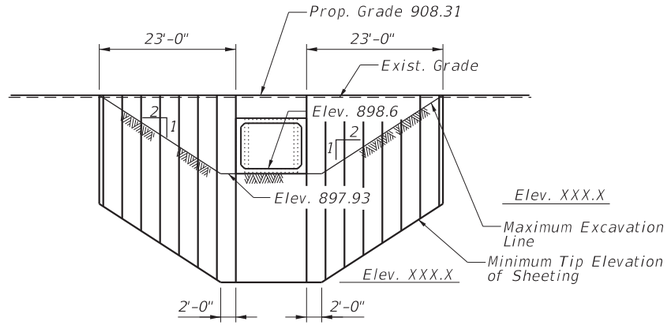
Salvage: None



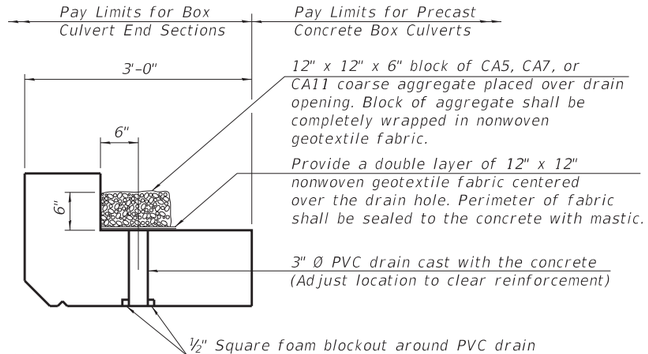
* The limits and quantities of removal and replacement shown are based on the boring data and may be modofied by the District Geotechnical and Field Engineers for variable subsurface conditions encountered in the field.

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.

ELEVATION

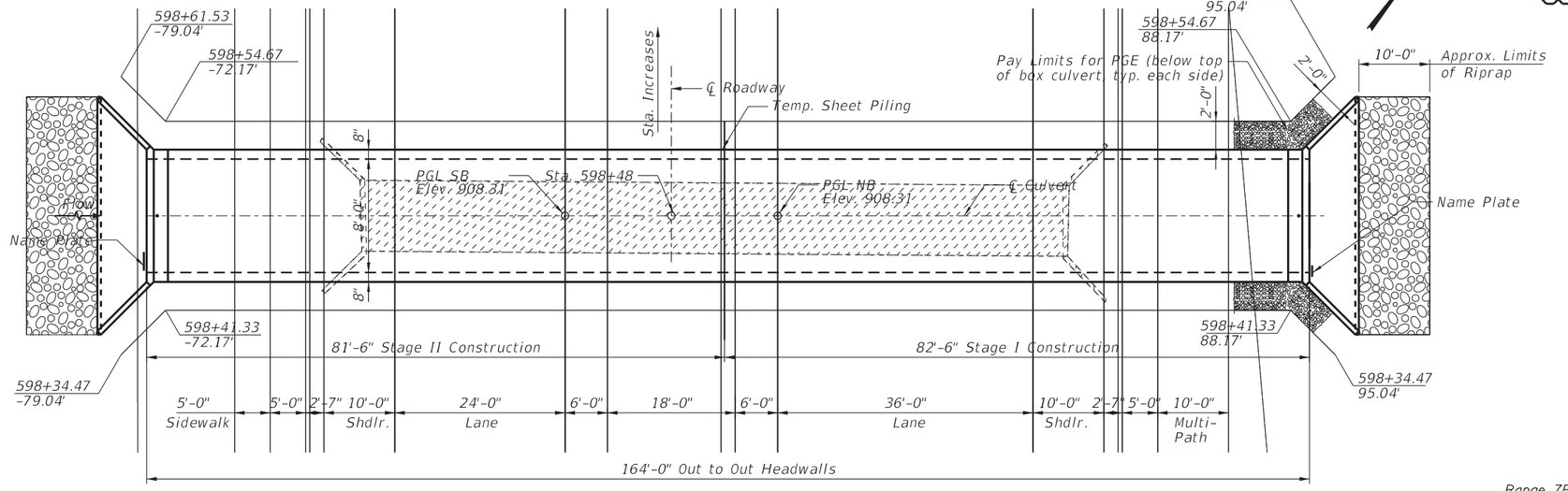


TEMP. SHEET PILING DETAIL



DRAIN DETAIL

(All costs associated with furnishing and constructing the above drain detail will not be measured for payment but shall be included in the contract unit price for the associated work.)

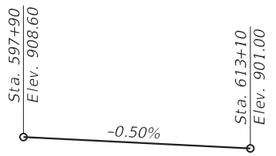


PLAN

WATERWAY INFORMATION

Drainage Area = 0.0544 sq. mi. Low Grade Elev. = 908.05 @ Sta. 599+00

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	17.04	6.4	8.6	900.83	0.05	0.18	900.88	901.01
Design	50	27.41	7.8	10.3	901.05	0.21	0.34	901.26	901.39
Base	100	38.82	8.9	11.8	901.24	0.40	0.50	901.64	901.74
Overtopping									
Max. Calc.	500	65.90	11.1	14.7	901.60	0.83	0.84	902.43	902.44



PROFILE GRADE - NB AND SB

STATION 598+48.00
BUILT BY
STATE OF ILLINOIS
F.A.P. RT. 326 SEC.
LOADING HL-93
STR. NO. 056-0309

NAME PLATE

See Std. 515001

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications
8th Edition

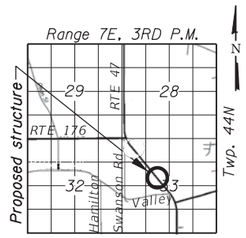
LOADING HL-93

50 PSF Futurwe Wearing Surface

DESIGN STRESSES

PRECAST UNITS

f'c = 5,000 psi
fy = 65,000 psi (Welded Wire Reinforcement)



LOCATION SKETCH

GENERAL PLAN AND ELEVATION
IL RTE. 47 OVER
KISHWAUKEE RIVER TRIBUTARY
F.A.P. RTE. 326 SEC 105-N-2(15)
McHENRY COUNTY
STATION 598+48.00
S.N. 056-0309

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

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

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
STRUCTURE NO. 056-0309

SCALE: N.T.S. | SHEET 1 OF 8 SHEETS | STA. 598+48 | TO STA. ---

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	105-N-2(15)	MCHENRY	473	346
		CONTRACT NO. 62B43		
	ILLINOIS	FED. AID PROJECT		

MODEL: Default
FILE NAME: N:\dot\170353\CBBEL\Struct\056-0309-GPE_170353.dht

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.

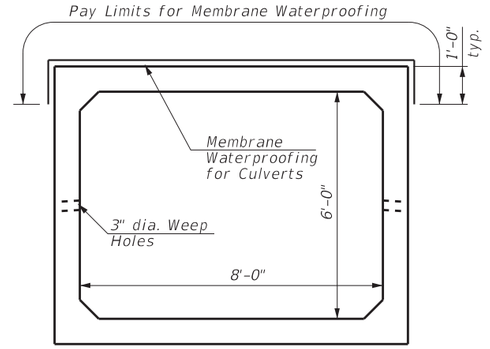
4. Nonwoven geotextile fabric shall conform to the requirements of Art. 1080.01 of the Standard Specifications. The minimum weight of the fabric shall be 6 ounces per square yard.

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

TOTAL BILL OF MATERIAL

ITEM	UNIT	TOTAL
Porous Granular Embankment	Cu. Yd.	247
Stone Riprap, Class A4	Sq. Yd.	56
Filter Fabric	Sq. Yd.	56
Removal of Existing Structures No. 1	Each	1
Structure Excavation	Cu. Yd.	566
Removal and Disposal of Unsuitable Material for Structures	Cu. Yd.	81
Name Plates	Each	1
Temporary Sheet Piling	Sq. Ft.	747
Box Culvert End Sections, Culvert No. 2	Each	2
Precast Concrete Box Culverts 8' X 6'	Foot	158
Membrane Waterproofing for Buried Structures	Sq. Yd.	207
Dewatering	L. Sum	0.25
Rock Fill	Cu. Yd.	81



MEMBER WATERPROOFING FOR PRECAST CULVERTS

Forr Fill Height ≤ 3 ft.

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

USER NAME = prazalan	DESIGNED - AS	REVISED -	
	DRAWN - PDR	REVISED -	
PLOT SCALE = 2.0000 ' / in.	CHECKED - MM	REVISED -	
PLOT DATE = 4/11/2018	DATE - SPLANDATES	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL NOTES, INDEX OF SHEETS AND TOTAL BILL OF MATERIALS
STRUCTURE NO. 056-0309

SCALE: N.T.S. | SHEET 2 OF 8 SHEETS | STA. | TO STA. ----

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	105-N-2(15)	MCHENRY	473	347
		CONTRACT NO. 62B43		
	ILLINOIS	FED. AID PROJECT		

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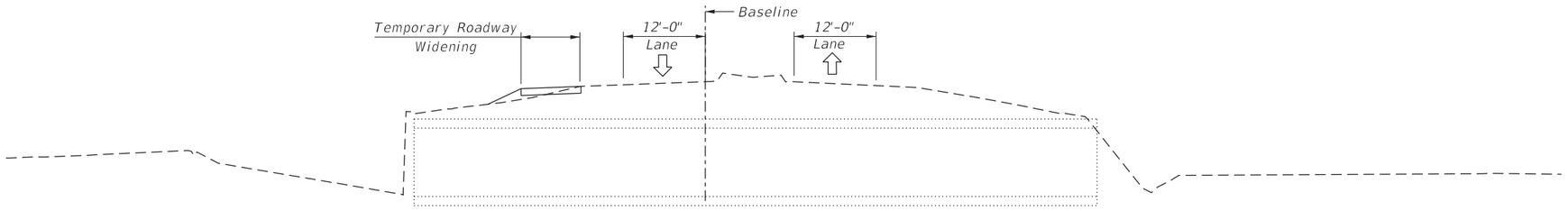
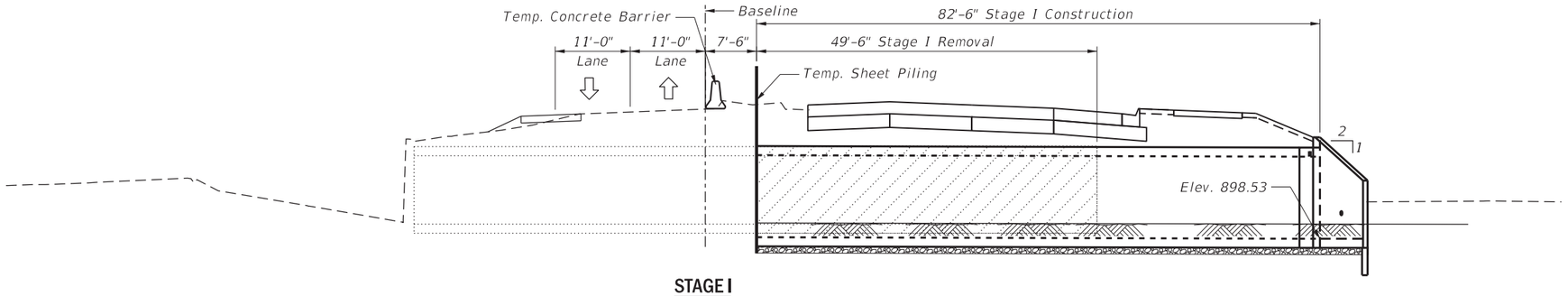
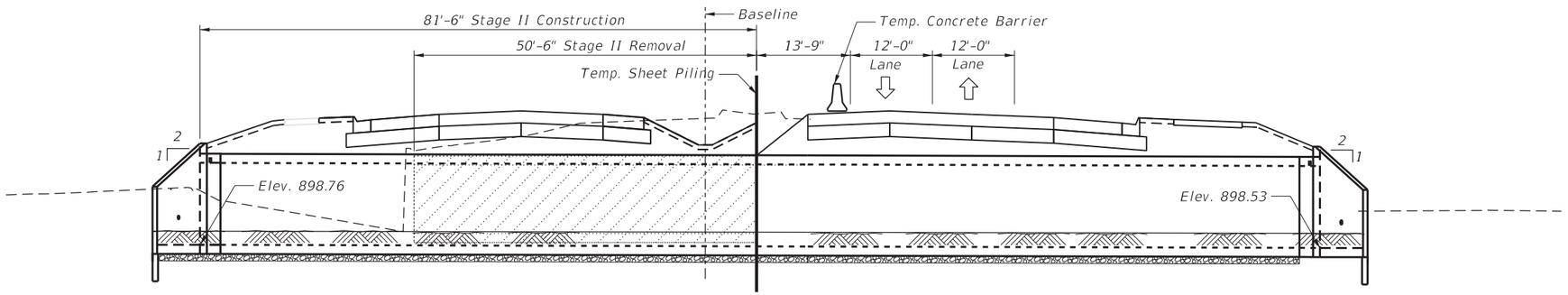


PRE-STAGE



STAGE I



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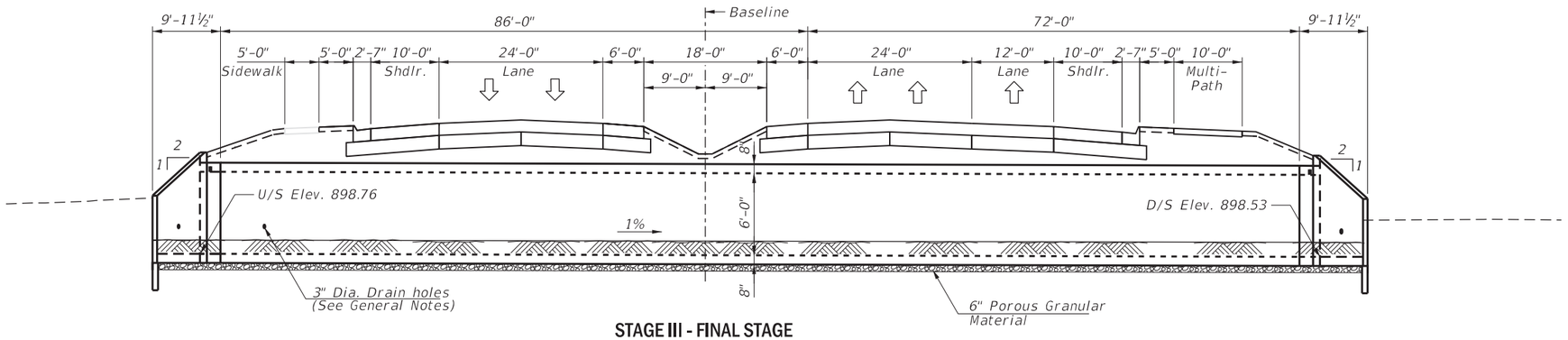

STAGE III - FINAL STAGE

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PLOT DATE = 4/11/2018	DATE - SPLANDATES	REVISED -	

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STAGE CONSTRUCTION DETAILS
STRUCTURE NO. 056-0309

SCALE: N.T.S. | SHEET 3 OF 8 SHEETS | STA. 598+48 | TO STA. ---

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
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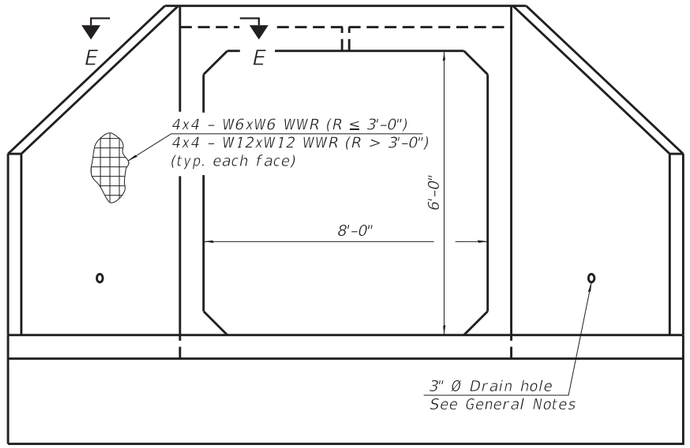
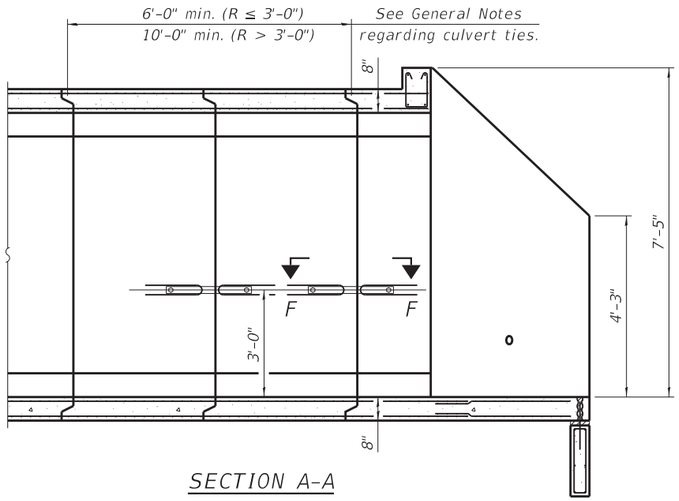
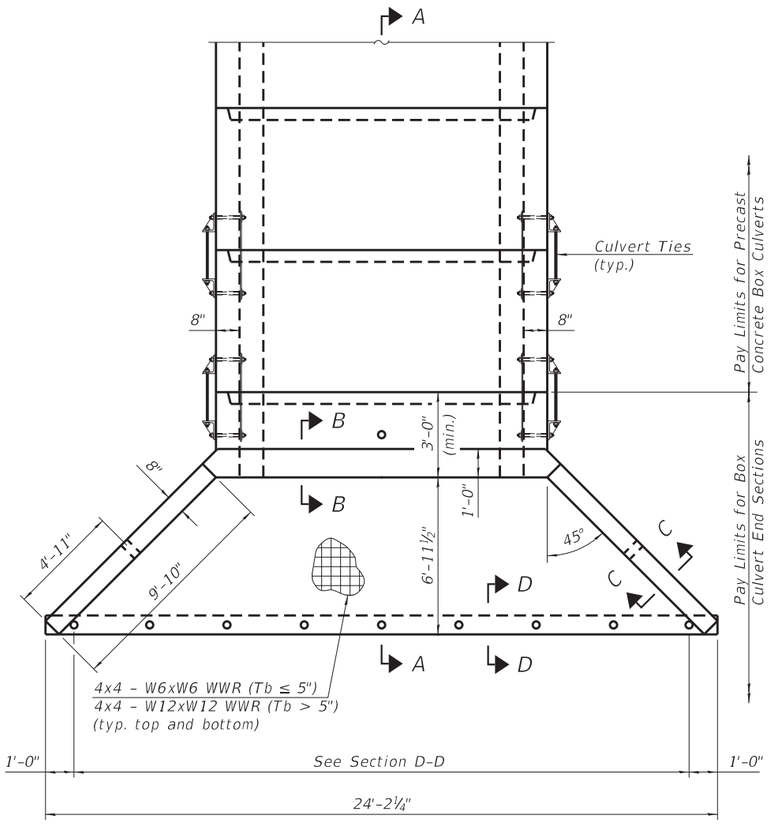
		CONTRACT NO. 62B43		
		ILLINOIS	FED. AID PROJECT	



END VIEW



SECTION A-A



PLAN

APRON END SECTION DIMENSIONS

Span (S)	Rise (R)	Tt	Tb	Ts	A	B	C	D	E	Concrete Cu. Yd.	Culvert Ties Required
8'-0"	6'-0"	8"	8"	8"	7'-5"	4'-3"	6'-11½"	9'-10"	24'-2¼"	11.0	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.

GENERAL NOTES

SCB-AES

2-17-2017

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PLOT DATE = 4/11/2018	DATE - $PLANDATE$	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

PRECAST CONCRETE BOX CULVERT APRON END
SECTION DETAILS – STRUCTURE NO. 056-0309

SCALE: N.T.S. | SHEET 4 OF 8 SHEETS | STA. 598+48 | TO STA. ---

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	105-N-2(15)	MCHENRY	473	349
		CONTRACT NO. 62B43		
	ILLINOIS FED. AID PROJECT			

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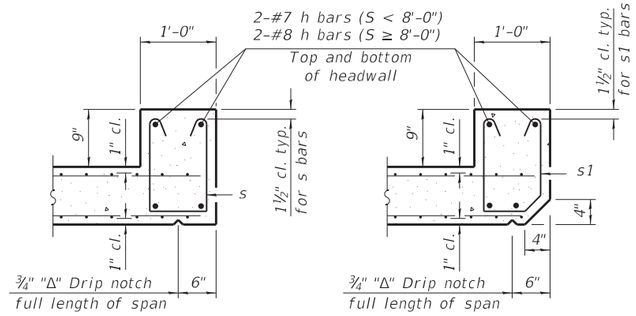
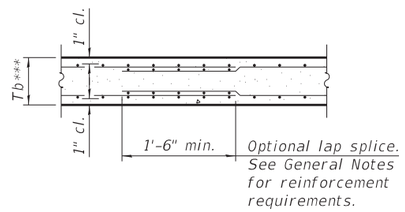


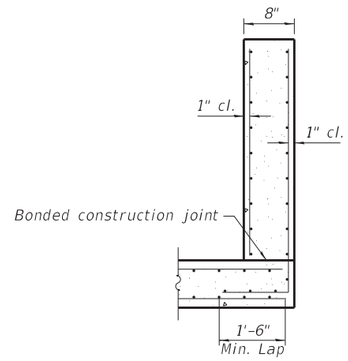
SECTION B-B
(Top slab at downstream end)

SECTION B-B
(Top slab at upstream end)

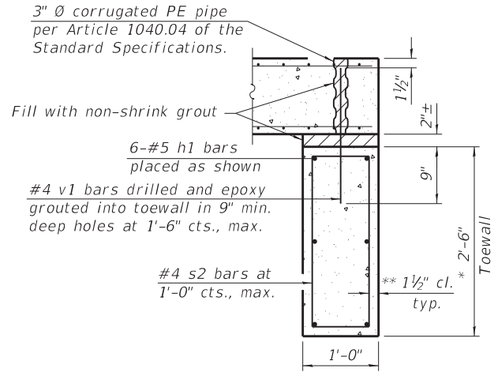


SECTION B-B
(Bottom Slab)

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



SECTION C-C



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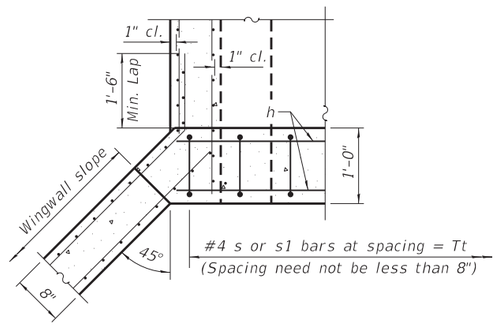
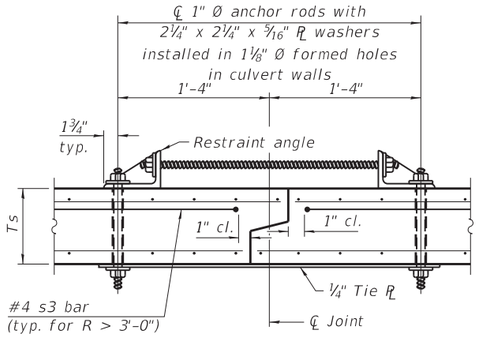


SECTION E-E



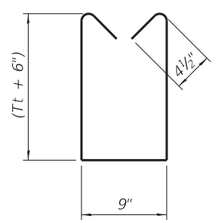
SECTION F-F
(Showing culvert tie details)

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.



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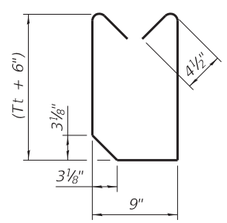

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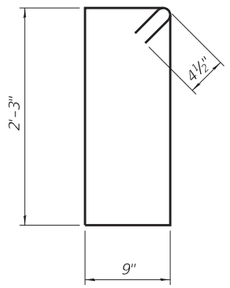

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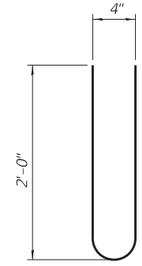

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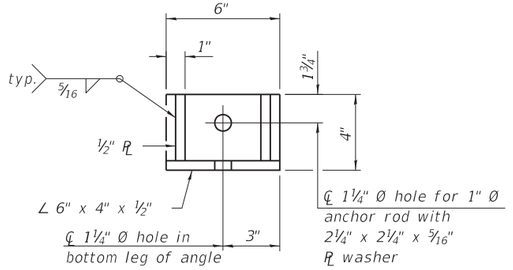
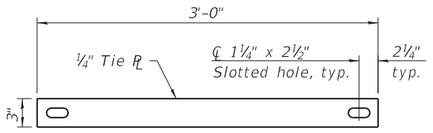


RESTRAINT ANGLE DETAIL



TIE PLATE DETAIL

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. 2¼"x2¼"x5/16" 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 ½ 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.

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STATE OF ILLINOIS
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PRECAST CONCRETE BOX CULVERT APRON END
SECTION DETAILS – STRUCTURE NO. 056-0309

SCALE: N.T.S. | SHEET 5 OF 8 SHEETS | STA. 598+48 | TO STA. ---

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	ILLINOIS FED. AID PROJECT			

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