STRUCTURE GEOTECHNICAL REPORT
ILLINOIS ROUTE 47 OVER BLACKBERRY CREEK BRIDGE
EX SN 045-2000, PR SN 045-2050
KANE COUNTY, ILLINOIS

For
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11. Abstract

A new single span bridge will replace the existing four cell culvert carrying IL Route 47 over Blackberry Creek. The proposed integral abutment bridge will be wider than existing culvert and will have a back-to-back abutment length of 84.2 feet. The profile grade elevation along IL Route 47 will be raised 5.5 feet at the bridge location and the approach embankments will be widened. This report provides geotechnical recommendations for the design of proposed structure foundations and approach embankments.

Beneath the stiff to very stiff silty clay, the soil is made up of medium stiff to stiff silty clay or very loose to loose silty loam followed by medium dense to very dense sand to sandy gravel interbedded with layers of very stiff to hard silty clay to clay loam. The site classifies in the Seismic Class D.

The proposed integral abutments could be supported on metal shell or steel H-piles. Tables are provided for each pile size. For 12-inch diameter metal shell pile with 0.25-inch walls, 19 to 28-foot long piles provide 80 to 195 kips factored capacity. We provide geotechnical parameters for pile analysis under lateral loads and analyses should be carried out when selecting pile sizes.

A long-term consolidation settlement resulting from grade raise is estimated to be 0.5 inch or less and residual settlement at the end of the construction will be about 0.4 inch or less. Downdrag load allowances will not be required for new bridge piles. Global stability analyses at the approach embankment show FOS of 2 to 3 and meet the minimum required FOS of 1.5.

Temporary steel sheet piling is not feasible according to IDOT Design Guide 3.13.1 to accommodate stage construction due to the fill. Therefore, the pay item *Temporary Soil Retention System* will be necessary.

12. Path to archived file

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MILHOUSE ENGINEERING & CONSTRUCTION, INC.

1.0 INTRODUCTION

This report presents the results of subsurface investigation, laboratory testing, and geotechnical evaluations and recommendations for the proposed replacement of the existing four cell box culvert carrying IL Route 47 (IL 47) over the Blackberry Creek in Kane County, Illinois. A *Site Location Map* is presented as Exhibit 1.

1.1 Proposed Structure

Wang Engineering, Inc. (Wang) understands Milhouse Engineering & Construction, Inc. (Milhouse) envisions a new single span bridge over the Blackberry Creek replacing the existing culvert. A type, size, and location (TSL) plan provided by Milhouse and dated September 14, 2017 indicates the bridge will be supported by integral abutments and will have a back-to-back abutment length of 84.2 feet between Stations 502+07.88 and 502+90.06. The proposed bridge will have an out-to-out width of 61.2 feet to accommodate 38-foot wide roadway and two 10-foot wide shoulders. The profile grade along IL 47 will be raised by approximately 5.5 feet. This report addresses the proposed single span bridge over the Blackberry Creek.

A three-sided arch structure was initially proposed and Wang submitted an SGR in March 2016. This report covers the updated structure type and supersedes the March 2016 SGR.

1.2 Existing Structure and Land Use

Based on the TSL Plan and a Bridge Condition Report (BCR), the existing structure was constructed in 1968 as a four barrel, cast-in-place reinforced concrete box culvert. The total length of the structure is 41.3 feet from the back of the north cell wall to the back of the south cell wall. The total structure width is 32.0 feet. The existing structure will be removed and replaced using stage construction to maintain traffic along IL 47.

The purpose of our investigation was to characterize the site soil and groundwater conditions, perform geotechnical analyses, and provide recommendations for the design and construction of the new structure foundations.

2.0 GEOLOGICAL SETTING

The project area is located in Blackberry Township in southern Kane County. On the USGS *Sugar Grove Quadrangle 7.5 Minute Series* map, the project is located in the SW ¼ of Section 20, Tier 39 N, Range 7 East 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, thus, to confirm the dependability and consistency of the present subsurface investigation results. For the study of the regional geologic framework, Wang considered northeastern Illinois area in general and Kane County in particular. Exhibit 2 illustrates the *Site and Regional Geology*.

2.1 Physiography

Southern Kane County is situated within the Bloomington Ridge Plain Subsection of the Till Plains Physiographic Section of Illinois (Leighton et al. 1948). Continental glaciers and their associated lakes and meltwater streams deposited most of the surficial deposits within the project area. Wisconsin-age deposits of the Elburn Complex form an array of landforms that are typically associated with stagnating ice, including kames, kettles, and eskers (Curry et al. 2001). Blackberry Creek flows from the northeast to the southwest forming a valley through the center of the project area. Surface elevations range from 720 feet at Blackberry Creek and rise to the east and west up to 750 feet.

2.2 Surficial Cover

The surficial cover within the project area is mainly the result of Wisconsin-age glacial activity. The glacigenic deposits were emplaced during pulsating advances and retreats of an ice sheet lobe responsible for the formation of end moraines and associated low-relief till and lake plains (Hansel and Johnson 1996). Along the Blackberry Creek drainageway, organic deposits of peat, muck, and organic silt and clay, known as the Grayslake Peat, have accumulated since the last glaciation. Underlying the Grayslake Peat, large volumes of glacial meltwater deposited thick sand and gravel outwash deposits of Henry Formation. Major glacial events, during the Wisconsin Episode and the preceding Illinois Episode, created a complex stratigraphy that includes diamictons of the Batestown Member of the Lemont Formation, the Tiskilwa Formation, and the Glasford Formation. The Lemont and Tiskilwa Formations (Wisconsin Episode) are characterized by sandy loam to clay loam diamictons with lenses of sand and gravel. The Glasford Fomation (Illinois Episode) is characterized by a compact sandy and bouldery diamicton with abundant lenses of coarse sand and gravel (Curry et al. 2001). Glacial drift thickness along the project alignments ranges from 100 to 120 feet thick (Curry 2002).

2.3 Bedrock

In the project area, the glacigenic deposits unconformably rest over Silurian and Ordivician dolostone and shaly dolostone between 100 to 120 feet below ground surface (bgs), at elevations of 600 to 625 feet (Curry 2002). The project is located approximately 15 miles northeast of the inactive Sandwich Fault Zone. No underground mines have been mapped in the area (ISGS 2014).

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area revealed the native sediments consist of organic silt and clay of the Grayslake Peat, sand and gravel outwash deposits of the Henry Formation, silty clay loam diamicton of the the Tiskilwa Formation, and diamicton, sand, and gravel of the Glasford Formation. Diamicton of the Batestown Member of the Lemont Formation was likely eroded during the recession of Wisconsin Episode glaciers. The bedrock was not encountered during this investigation.

3.0 METHODS OF INVESTIGATION

The following sections outline the subsurface and laboratory investigations performed by Wang. Elevations are referenced to the North American Vertical Datum (NAVD) 1988.

3.1 Field Investigation

The subsurface investigation was performed by Wang between April and June 2015 and consisted of three structure borings. The borings, designated as Boring BB-03, BB-03A, and BB-04, were drilled from elevation of 730.0 to 732.0 feet to depths of 45.0 to 70.0 feet bgs. Boring BB-03 A was drilled as a continuation of Boring BB-03. The coordinates were surveyed by Wang using a mapping-grade GPS unit; stations and offsets were obtained from a plan drawing provided by Milhouse. The as-drilled boring locations are shown in the *Boring Logs* (Appendix A) and in the *Boring Location Plan* (Exhibit 3).

A truck mounted drilling rig, equipped with hollow stem augers and mud rotary drilling equipment, 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 30.0 feet bgs and at 5.0-foot intervals thereafter. Soil samples collected from each interval were placed in sealed jars for further examination and laboratory testing.

Field boring logs, prepared and maintained by a Wang geologist, included lithological descriptions, visual-manual soil classifications (IDH textural classification), results of pocket penetrometer or Rimac unconfined compressive strength (Q_u) testing on cohesive soils, and results of Standard Penetration Test (SPT) recorded as blows per 6 inches of penetration.

Groundwater observations were made during and at completion of drilling operations. The borings were backfilled with soil cuttings and bentonite chips, and the surface was restored as close as possible to the original condition.

3.2 Laboratory Testing

Soil samples were tested in the laboratory for moisture content (AASHTO T 265). Particle size (AASHTO T 88) analysis was also performed on selected sample. Field visual descriptions of the soil samples were verified in the laboratory and classified according to the IDH Soil Classification System. Laboratory test results are shown on 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 on 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 were drilled along the existing roadway shoulder from elevations of 730.0 to 732.0 feet. The shoulder pavement consists of 14.0 inches of asphalt or 12.0 inches of aggregate. In descending order, the general lithologic succession encountered beneath the surface includes: 1) man-made ground (fill); 2) very loose to loose silty loam; and 3) medium dense to very dense sandy gravel.

1) Man-made ground(fill)

Below the asphalt or aggregate shoulder, the borings revealed 5.0 to 7.0 feet of stiff to very stiff, brown silty clay to silty clay loam fill. The fill is characterized by unconfined compressive strength (Q_u) values of 1.3 to 2.0 tsf with an average of 1.5 tsf and moisture contents values of 15 to 27% with an average of 21%.

2) Very loose to loose silty loam

At elevations of 721.2 to 722.8 feet or about 9.0 feet bgs, the borings advanced through 2.0 to 4.0 feet of very loose to loose, brown and black silty loam with SPT N-values of 2 to 4 blows per foot with an average of 3 blows per foot and moisture content values of 31 to 64% with an average of 43%. Some organic matter was encountered in Boring BB-04.

3) Medium dense to very dense sandy gravel

From elevations of 719.0 to 719.5 feet and extending to the termination depths of 45.0 to 70.0 feet bgs, borings advanced through medium dense to dense, brown to gray loam to sandy gravel with interbeds of cohesive soil. The sandy gravel has N-values of 10 to 65 blows per foot with an average of 33 blows per foot and moisture content values of 6 to 22% with an average of 14%. The interbeds of cohesive material consist of very stiff to hard, pinkish gray to gray silty clay and clay loam. The clayey soil is characterized by Q_u values of 2.3 to 6.7 tsf with an average of 4.0 tsf and moisture content of 10 to 20% with an average of 14%. Hard drilling conditions and heaving sand were encountered during drilling from 36.5 to 52.5 feet bgs (elevations of 695.5 to 677.9 feet), indicating cobbles and groundwater under excess pressure.

4.2 Groundwater Conditions

While drilling, the groundwater was first observed at elevations of 719.5 to 721.0 feet (10.5 to 11.0 feet bgs) with a second groundwater bearing layer at elevations of 680.4 and 668.6 feet (50.0 and 61.8 feet bgs) in Boring BB-03A. The deeper layer is confined and the groundwater was observed to be under artesian condition. At the completion of drilling, the water level was recorded at elevations of 724.0 to

732.0 feet (0.0 and 6.0 feet bgs). The Design High Water Elevation (DHWE) of 727.91 feet is shown the TSL plan which is about 2 to 4 feet below the ground surface elevation at the boring locations.

5.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS

The geotechnical evaluations and recommendations for the approach embankments, wingwalls and abutment foundations are included in the following sections. Wang has evaluated possible foundation types that can be considered for support of the proposed bridge structure.

5.1 Seismic Design Considerations

The soils within the top 100 feet have a weighted average N-value of 29 blows per foot (AASHTO 2012; Method C controlling), and the results classify the site in the Seismic Site Class D in accordance with the IDOT method. The project location belongs to the Seismic Performance Zone 1. The seismic spectral acceleration parameters recommended for design in accordance with AASHTO (AASHTO 2012) are summarized in Table 1. According to Bridge Manual (IDOT 2012), liquefaction analysis is not required for structure located in Seismic Performance Zone 1.

Table 1: Seismic Design Parameters

Spectral Acceleration Period (sec)	Spectral Acceleration Coefficient[1)] (% g)	Site Factors	Design Spectrum for Site Class D[2)] (% g)
0.0	PGA= 4.8	F_{pga}= 1.6	**A_s= 7.7**
0.2	S_s= 10.1	F_a= 1.6	**S_{DS}= 16.1**
1.0	S_1= 3.7	F_v= 2.4	**S_{D1}= 8.9**

1) Spectral acceleration coefficients based on Site Class D

2) Site Class D Spectrum to be included on plans; $A_s = PGA*F_{pga}$; $S_{DS}= S_s*F_a$; $S_{D1}= S_1*F_v$

5.2 Scour Considerations

The TSL plan shows a proposed streambed elevation of 718.7 feet. Both abutments will be armored with stone riprap for scour protection. For open abutments protected with stone riprap, the design and check scour elevations are set at the bottom of the abutments in accordance with IDOT ABD 14.2 and IDOT (2012). The design scour elevations for the proposed structure are presented in Table 2.

Table 2: Project Design Scour Elevations

Event/Limit State	Design Scour Elevation (ft)		Item 113
	South Abutment	North Abutment	
Q100	726.32	726.73	8
Q500	726.32	726.73	
Design	726.32	726.73	
Check	726.32	726.73	

5.3 Approach Embankments

Based on the draft Roadway Plan & Profile Drawing, we understand the roadway profile grade will be raised by approximately 5.5 feet at the abutment locations. In addition, the existing embankment will be widened to accommodate the new shoulders and will include up to 7.0 feet of new fill.

5.3.1 Settlement

Based on soil conditions encountered, we estimate the cohesive foundation soils under the new approach embankment fill loads will undergo 0.5 inch or less long-term consolidation settlement. About 2 to 4 feet of very loose to loose, silty loam soil is expected to be encountered in south and north approaches, respectively. We estimate the settlement of these soils will occur during the placement of embankment fill and will be completed by the end of construction. The estimated residual settlement at the completion of approach embankment construction will be 0.4 inch or less. These settlement estimates are appropriate for the construction of approach slabs and we do not anticipate downdrag load allowances will be required for the piles.

5.3.2 Global Stability

The global stability of approach embankment side slope was analyzed based on the soil profile described in Section 4.1. The analyses for the 6-foot tall embankment widening were performed with the Simplified Bishop Method incorporated in *Slide 6.0*, and the results of the evaluations are shown in Appendix C. The side slope for the proposed approach embankment is designed at 1:2 (V:H). Wang estimates a minimum FOS of 3.0 and 2.0 for undrained and drained conditions (Appendices C-1 and C-2), respectively. The FOS is satisfactory and meets the IDOT required FOS of 1.5.

5.4 Structure Foundations

The plan shows pile cap base elevations of 726.32 and 726.73 feet at the south and north abutments, respectively. Preliminary total service and factored loads for the foundations provided by Milhouse are shown in Table 3.

Table 3: Preliminary Foundation Loads

Substructure ID	Estimated Total Service Load (kips)	Estimated Total Factored Load (kips)
Bridge Abutments	1025	1465

We have evaluated various foundation types that can be considered for the support of the proposed bridge and we recommend driven piles to support the integral abutments. Due to the granular soil conditions, high groundwater table, and presence of groundwater pressure, we do not recommend considering drilled shafts foundations. Geotechnical parameters for the design of the deep foundations are presented in the following sections.

5.4.1 Driven Piles

IDOT specifies the maximum nominal required bearing (R_{NMAX}) for each pile and states the factored resistance available (R_F) for a steel H-pile should be based on a geotechnical resistance factor (Φ_G) of 0.55 (IDOT 2012). Nominal tip and side resistance were estimated using the methods and empirical equations presented in *AGMU Memorandum 10.2 – Geotechnical Pile Design.* We have performed evaluations for a range of MSP and H-pile sizes and nominal and factored loads. The R_F, R_N, estimated pile tip elevations, and pile lengths for 12-inch diameter MSP with 0.25-inch walls, 14-inch diameter MSP with 0.312-inch walls, 16-inch diameter MSP with 0.375-inch walls, HP12x53, HP12x63, HP14x73, and HP14x89 are presented in Tables 4 through 10. The pile lengths shown in Tables 4 through 10 include 2 feet pile embedment into the abutment pile caps.

The R_F estimates are governed by the relationship $R_F = \phi_G R_N - \phi_G(DD_R+S_C+L_{iq})I_G - (\gamma_p)(\lambda_{IS})DD_L$ (IDOT 2012). We estimate residual settlement at the completion of construction will be 0.4-inch or less and there will be a riprap protection for the abutment piles. Therefore, we do not anticipate downdrag and scour load reductions on the piles.

Table 4 : Estimated Pile Lengths and Tip Elevations for MSP 12”ϕ w/ .25” walls

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment (BB-04)	726.32	145	0	0	80	20	708.3
		218	0	0	120	21	708.3
		291	0	0	160	26	702.3
		392	0	0	216	26	702.3
North Abutment (BB-03, BB-03A)	726.73	145	0	0	80	20	708.7
		218	0	0	120	28	700.7
		291	0	0	160	28	700.7
		392	0	0	216	28	700.7

Table 5 : Estimated Pile Lengths and Tip Elevations for MSP 14”ϕ w/ .312” walls

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment (BB-04)	726.32	145	0	0	80	15	713.2
		218	0	0	120	20	708.3
		291	0	0	160	21	707.3
		364	0	0	200	26	702.3
		436	0	0	240	26	702.3

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
		509	0	0	280	26	702.3
		570	0	0	314	26	702.3
North Abutment (BB-03, BB-03A)	726.73	145	0	0	80	12	716.7
		218	0	0	120	27	701.7
		291	0	0	160	28	700.7
		364	0	0	200	28	700.7
		436	0	0	240	28	700.7
		509	0	0	280	28	700.7
		570	0	0	314	38	690.7

Table 6 : Estimated Pile Lengths and Tip Elevations for MSP 16”ϕ w/ .375” walls

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment (BB-04)	726.32	291	0	0	160	20	708.3
		364	0	0	200	21	707.3
		436	0	0	240	24	704.3
		509	0	0	280	26	702.3
		582	0	0	320	26	702.3

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
		622	0	0	360	26	702.3
		727	0	0	400	26	702.3
		782	0	0	430	33	695.3
North Abutment (BB-03, BB-03A)	726.73	291	0	0	160	28	700.7
		364	0	0	200	28	700.7
		436	0	0	240	28	700.7
		509	0	0	280	28	700.7
		582	0	0	320	28	700.7
		622	0	0	360	36	692.7
		727	0	0	400	38	690.7
		782	0	0	430	38	690.7

Table 7: Estimated Pile Lengths and Tip Elevations for HP12x53 Steel H-Piles

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment (BB-03, BB-03A	726.32	145	0	0	80	30	698.3
		218	0	0	120	45	683.3
		291	0	0	160	53	675.3

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
and BB-04)		364	0	0	200	61	667.3
		418	0	0	230	66	662.3
North Abutment (BB-03, BB-03A)	726.73	145	0	0	80	30	698.7
		218	0	0	120	35	693.7
		291	0	0	160	48	680.7
		364	0	0	200	52	676.7
		418	0	0	230	60	668.7

Table 8 : Estimated Pile Lengths and Tip Elevations for HP12x63 Steel H-Piles

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment (BB-03, BB-03A and BB-04)	726.32	145	0	0	80	30	698.3
		218	0	0	120	45	683.3
		291	0	0	160	53	675.3
		364	0	0	200	61	667.3
		447	0	0	246	68	660.3
North Abutment	726.73	145	0	0	80	30	698.7
		218	0	0	120	35	693.7

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
(BB-03, BB-03A)		291	0	0	160	47	681.7
		364	0	0	200	59	669.7
		436	0	0	240	60	668.7
		497	0	0	273	67	661.7

Table 9 : Estimated Pile Lengths and Tip Elevations for HP14x73 Steel H-Piles

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment (BB-03, BB-03A and BB-04)	726.32	145	0	0	80	28	700.3
		218	0	0	120	34	694.3
		291	0	0	160	48	680.3
		364	0	0	200	59	669.3
		436	0	0	240	61	667.3
		509	0	0	280	65	663.3
		550	0	0	302	68	660.3
North Abutment (BB-03,	726.73	145	0	0	80	28	700.7
		218	0	0	120	32	696.7

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
BB-03A)		291	0	0	160	41	687.7
		364	0	0	200	49	679.7
		436	0	0	240	59	669.7
		509	0	0	280	60	668.7
		578	0	0	318	62	666.7

Table 10 : Estimated Pile Lengths and Tip Elevations for HP14x89 Steel H-Piles

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
South Abutment (BB-03, BB-03A and BB-04)	726.32	145	0	0	80	28	700.3
		218	0	0	120	34	694.3
		291	0	0	160	48	680.3
		364	0	0	200	59	669.3
		437	0	0	240	60	668.3
		509	0	0	280	63	665.3
		557	0	0	306	68	660.3

Structure Unit	Pile Cap Base Elevations (feet)	Nominal Required Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Loss Load (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
North Abutment (BB-03, BB-03A)	726.73	145	0	0	80	28	700.7
		218	0	0	120	32	696.7
		291	0	0	160	39	689.7
		364	0	0	200	47	681.7
		436	0	0	240	59	669.7
		509	0	0	280	60	668.7
		582	0	0	320	61	667.7
		628	0	0	347	68	660.7

5.4.2 Lateral Loading

Lateral loads on all piles should be analyzed for maximum moments and lateral deflections. The geotechnical resistance factor of 1.0 should be used. Recommended lateral soil modulus parameters and soil strain parameters required for analysis via the p-y curve method are included in Tables 11 and 12.

Table 11 : Recommended Soil Parameters for Lateral Load Pile Analysis at South Abutment
(Reference Borings: BB-03, BB-03A and BB-04)

Soil Description	Moist Unit Weight, γ_e (lbs/ft^3)	Undrained Shear Strength, c_u (lbs/ft^2)	Friction angle, ϕ (°)	Soil Lateral Modulus Parameter, k (lb/in^3)**	Soil Strain Parameter, ε_{50} (%)
726.3* to 722 Silty Clay Fill	120	1200	0	500	0.7

Soil Description	Moist Unit Weight, γ_e (lbs/ft^3)	Undrained Shear Strength, c_u (lbs/ft^2)	Friction angle, ϕ (°)	Soil Lateral Modulus Parameter, k (lb/in^3)**	Soil Strain Parameter, ε_{50} (%)
722 to 721 Silty Clay	115	500	0	100	1.0
721 to 719** Silty Loam	110	0	28	20	--
719 to 712 Sand to Sandy Gravel	115	0	30	60	--
712 to 709 Sand and Gravel	130	0	36	125	--
709 to 693 Sand to sandy gravel	120	0	32	60	--
693 to 670 Loam to Sandy Gravel	130	0	35	125	--
670 to 668 Silty Clay Loam	125	4500	0	2000	0.4
668 to 660 Sandy Gravel	135	0	37	125	--

*Pile Cap Base Elevation.
** Submerged condition for granular soil

Table 12 : Recommended Soil Parameters for Lateral Load Pile Analysis at North Abutment (Reference Borings: BB-03 and BB-03A)

Layer Elevation/ Soil Description	Moist Unit Weight, γ_e (lbs/ft^3)	Undrained Shear Strength, c_u (lbs/ft^2)	Friction angle, ϕ (°)	Soil Lateral Modulus Parameter, k (lb/in^3)**	Soil Strain Parameter, ε_{50} (%)
726.8* to 724 Silty Clay Loam Fill	120	1200	0	500	0.7
724 to 723 Silty Clay	120	1000	0	500	0.7

Layer Elevation/ Soil Description	Moist Unit Weight, γ_e (lbs/ft^3)	Undrained Shear Strength, c_u (lbs/ft^2)	Friction angle, ϕ (°)	Soil Lateral Modulus Parameter, k (lb/in^3)**	Soil Strain Parameter, ε_{50} (%)
723 to 719** Silty Loam	110	0	27	20	--
719 to 709 Sand with Gravel	130	0	35	60	--
709 to 708 Silty Clay	125	3000	0	1000	0.5
708 to 704 Sandy Gravel	125	0	34	60	--
704 to 700 Silty Clay Loam	125	2300	0	1000	0.5
700 to 695 Sandy Gravel	130	0	37	125	--
695 to 690 Clay Loam	125	4500	0	2000	0.4
690 to 670 Sand to Sandy Gravel	130	0	35	60	--
670 to 668 Silty Clay Loam	125	4500	0	2000	0.4
668 to 660 Sandy Gravel	135	0	37	125	--

*Pile Cap Base Elevation.
** Submerged Condition for Granular Soil from elevation 721.0 feet.

5.5 Stage Construction

The TSL plan shows the bridge construction occurring in two stages. Temporary sheet piling designed according to IDOT Design Guide 3.13.1 (2012) is not feasible to accommodate the stage construction due to the potential fill section. Therefore, the pay item *Temporary Soil Retention System* should be included and designed by the Contractor to be approved by IDOT prior to construction.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

All vegetation, surface topsoil, existing pavement, and debris should be cleared and stripped where foundations and fill will be placed. The site shall be prepared as required per IDOT Standard Specification Any unstable or unsuitable materials should be removed and replaced with compacted fill as described in Section 6.3.

6.2 Excavation, Dewatering, and Utilities

Foundation 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. For the pile cap construction, temporary open cut excavations to a depth of 5 feet should have a slope of 1:1.5 (V:H) or flatter. For the excavations that extend below 5 feet, a soil retention system will be required

During the subsurface investigation, the shallow groundwater was encountered at elevations ranging from 719.5 to 721.0 feet. Therefore, groundwater will be encountered about 5 to 7 feet below pile cap base elevations of 726.3 to 726.8 feet and we do not anticipate the need for special dewatering efforts. Depending upon prevailing climate conditions and the time of the year when structure construction takes place, control runoff and maintenance of existing flows may require temporary water diversion and control. Water that does accumulate into open excavations by seepage or runoff should be immediately removed by the sump/pump method.

6.3 Filling and Backfilling

Fill material used to attain the final design elevations should be as per IDOT Standard Specifications. 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). All backfill materials must be as per IDOT Standard Specifications.

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.

6.5 Pile Installation

The driven piles shall be furnished and installed according to the requirements of IDOT Section 512, *Piling* (IDOT, 2016). Wang recommends that at a minimum of one test pile be performed at each abutment location. The test piles shall be driven to 110 percent of the nominal required bearing indicated in Section 5.2.1. Since hard driving is expected, the piles should be installed with metal shoes.

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 Milhouse Engineering & Construction, Inc. on this project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

WANG ENGINEERING, INC.

Andri Kurnia, P.E.
Senior Geotechnical Engineer

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

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

REFERENCES

AASHTO (2012) *LRFD Bridge Design Specifications*. American Association of State Highway and Transportation Officials, Washington, D.C.

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Curry, B.B., 2002, Topographic Map of the Bedrock Surface, Sugar Grove 7.5-minute Quadrangle, Kane County, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ Sugar Grove-BT, 1:24,000.

Hansel, A.K., and Johnson, W.H., 1996, Wedron and Mason Groups: Lithostratigraphic Reclassification of the Wisconsin Episode, Lake Michigan Lobe Area. ISGS Bulletin 104. Champaign, Illinois State Geological Survey.

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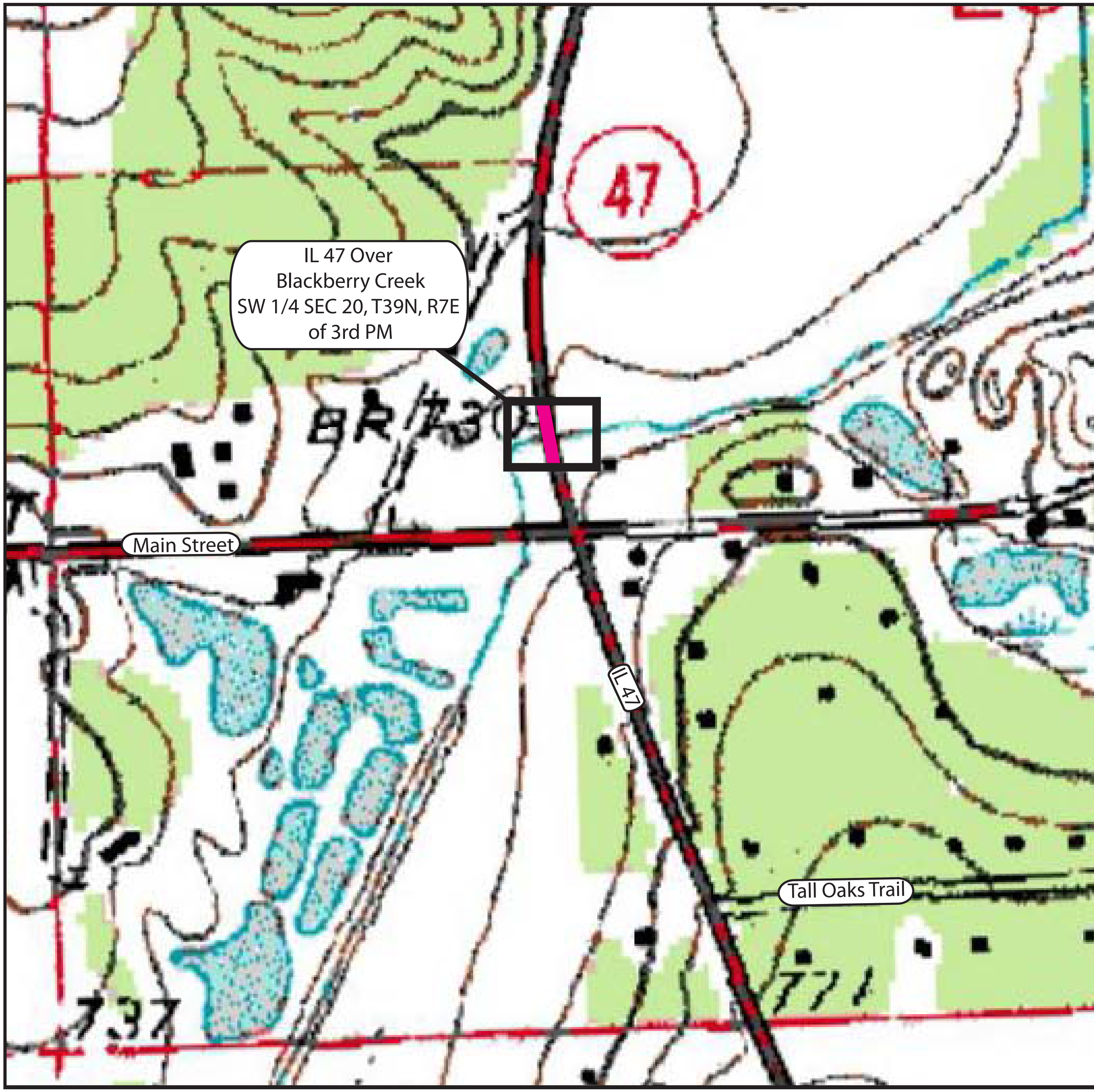
ISGS (2010) *Circluar 576 - G*roundwater flow modelling as a tool to understand watershed geology: Blackberry Creek Watershed, Kane and Kendall Counties in Illinois. Illinois State Geological Survey.

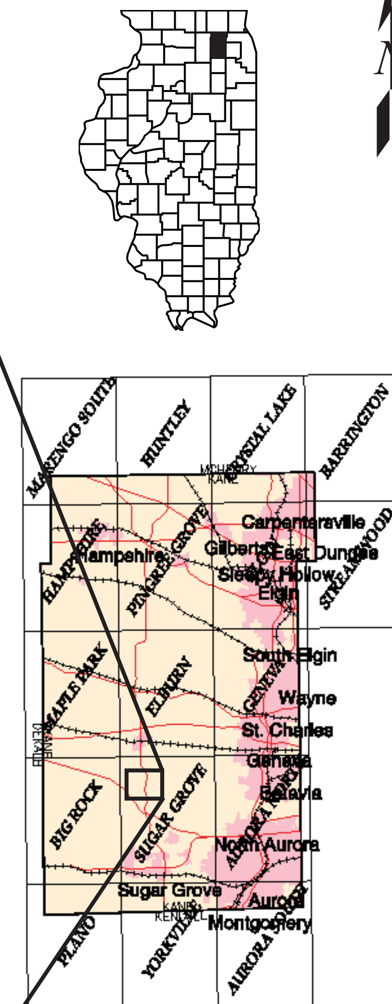
J Leighton, M.M., Ekblaw, G.E., and Horberg, L., 1948, Physiographic Divisions of Illinois. The Journal of Geology, v. 56, p. 16-33.

EXHIBITS



Scale

0 750 1500 Feet



N

Kane County

SITE LOCATION MAP: IL 47 OVER BLACKBERRY CREEK, SN. 045-2050, KANE COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: R. KC CHECKED BY: A. Kurnia

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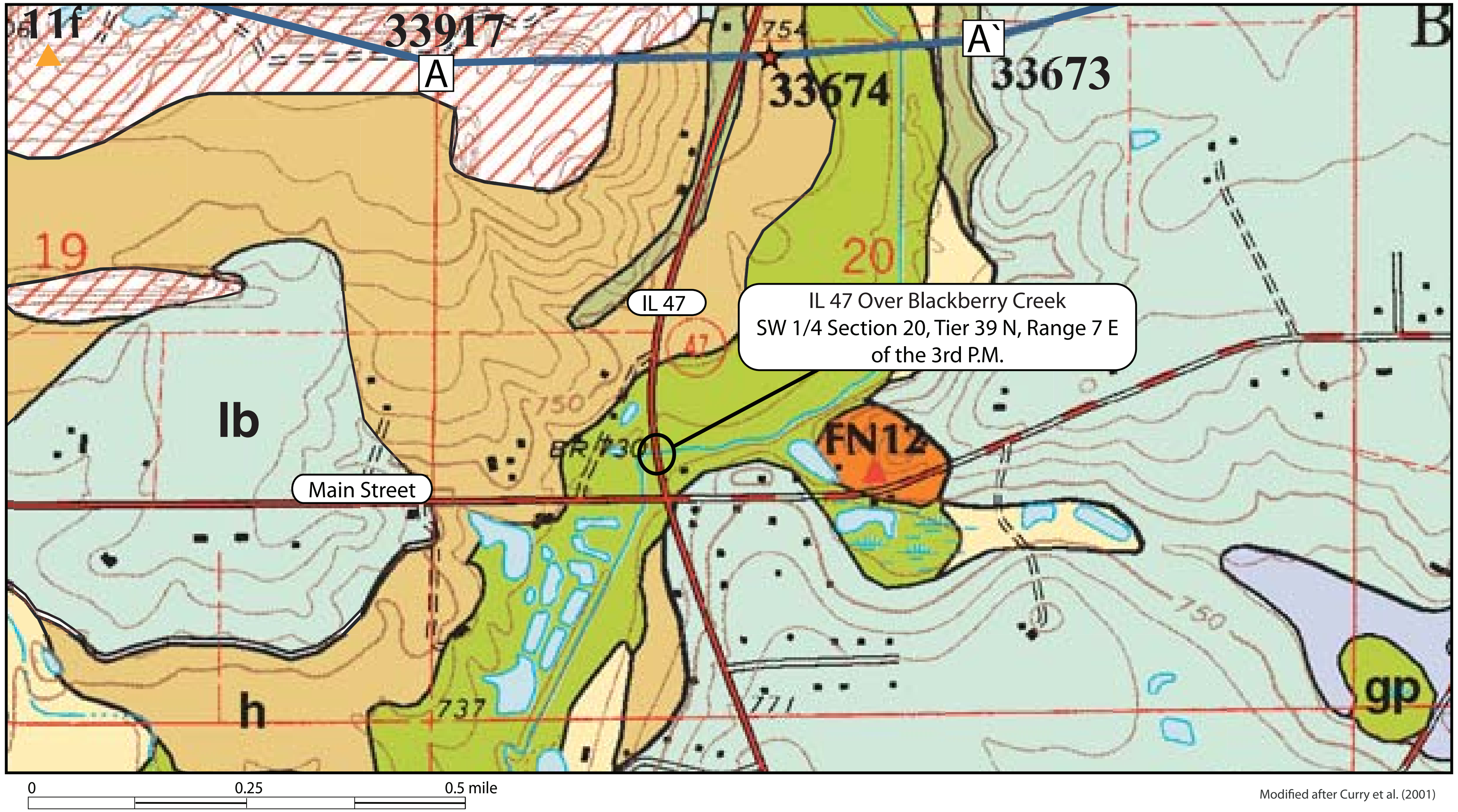
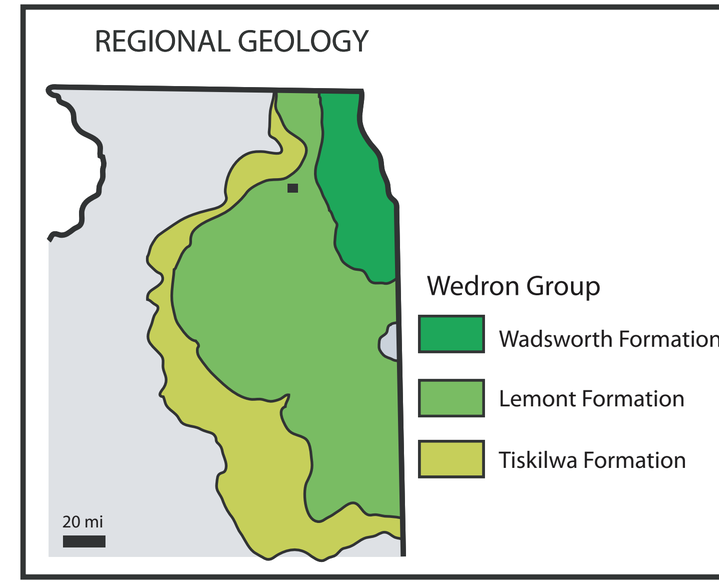
FOR MILHOUSE ENGINEERING AND CONSTRUCTION, INC. 192-03-01



Modified after Curry et al. (2001)



Modified after Hansel and Johnson (1996)

LEGEND

QUATERNARY DEPOSITS

HUDSON EPISODE (postglacial)

- **Disturbed Ground** — Fill or disturbed earth material in pits and quarries
- gp — **Grayslake Peat** — Decomposed wetland vegetation and sediment; peat and muck, interbedded sand, silty clay, and marl
- c — **Cahokia Formation** — Floodplain alluvium along rivers and streams; well-sorted sand and gravel with lenses of peat and fossiliferous silt and clay

WISCONSIN EPISODE (last glaciation)

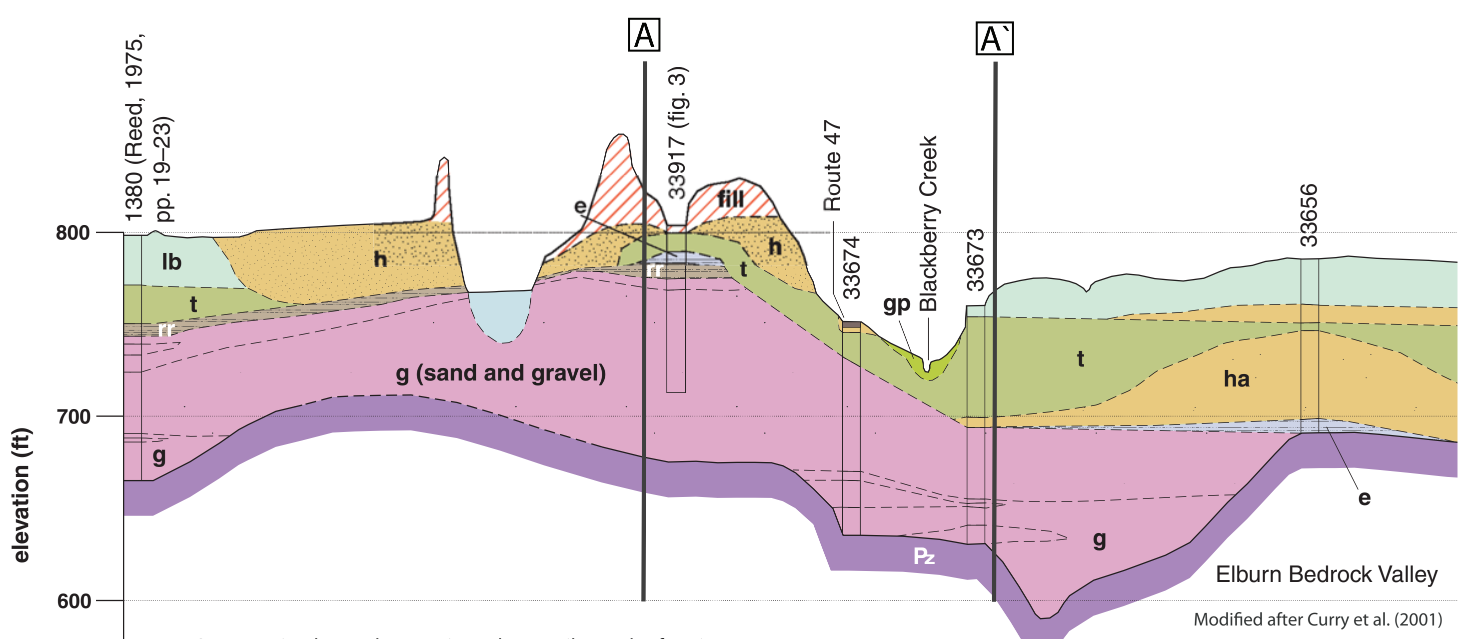
- e — **Equality Formation** — Lake deposits in kettles and valleys; silt, clay, and fine sand; layered to massive
- h — **Henry Formation** — Proglacial outwash plains downslope of glacial margins; sand and gravel, or sand; with lenses of silt and clay, or diamicton
- h(w) — **Henry Formation (Wasco Facies)** — Sorted ice-contact sediment associated with kames and eskers; silty sand and gravel, sand, gravel, and sandy diamicton
- l-b — **Batestown Member, Lemont Formation** — Diamicton; till, debris flow, and subglacial sand and gravel; sandy loam to loam with abundant cobbles; includes layers of sand and gravel or sorted sediment
- t — **Tiskilwa Formation** — Diamicton; till, debris flow, and subglacial sand and gravel; loam to clay loam with lenses of sand and gravel
- rr — **Robein Member, Roxana Silt (Cross section only)** — Weathered loess, slope deposits, and peat; silt and clay, organic-rich, leached of carbonate minerals; contains wood fragments

IILLINOIS EPISODE (next-to-last glaciation)

- g — **Glasford Formation (Cross section only)** — Diamicton; till, debris flow, lake, outwash, and subglacial sand and gravel deposits; compact, sandy and bouldery with abundant lenses of sand and gravel

PALEOZOIC BEDROCK

- Pz — **Kankakee and Joliet Formations (Silurian), Maquoketa Group (Ordivician); (Cross section only)** — Dolomite with chert lenses; gray to yellowish brown, fossiliferous, vuggy; also shaly dolomite and brown shale



Note: Cross section located approximately 0.5 mile north of project area

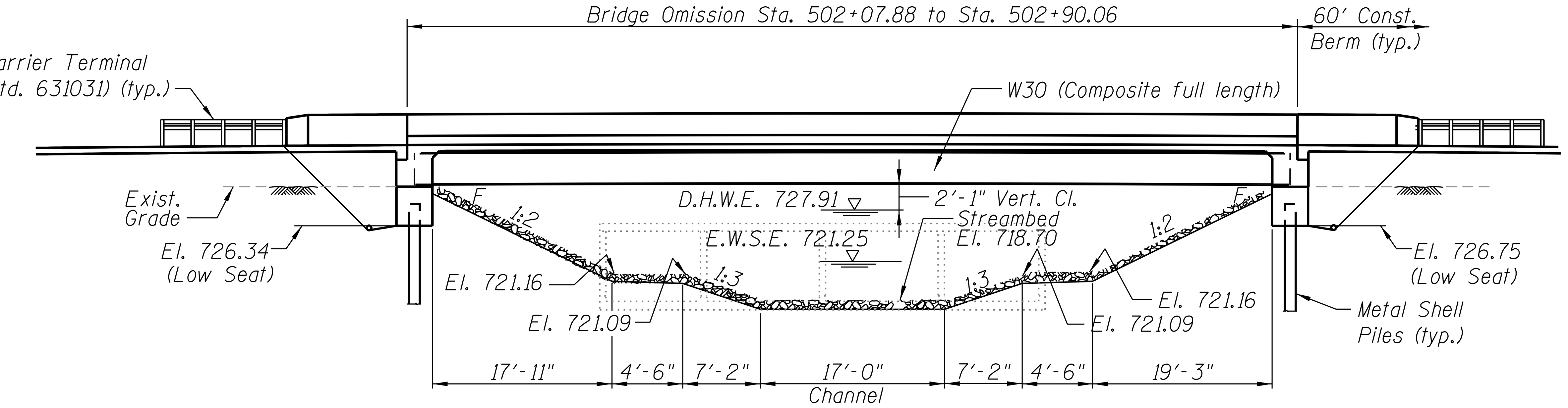
Modified after Curry et al. (2001)

SITE AND REGIONAL GEOLOGY: IL 47 OVER BLACKBERRY CREEK; SN. 045-2050, KANE COUNTY, ILLINOIS		
SCALE: GRAPHICAL	EXHIBIT 2	DRAWN BY: B. Wilson CHECKED BY: A. Kurnia
Wang Engineering		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR MILHOUSE ENGINEERING AND CONSTRUCTION, INC.		192-03-01

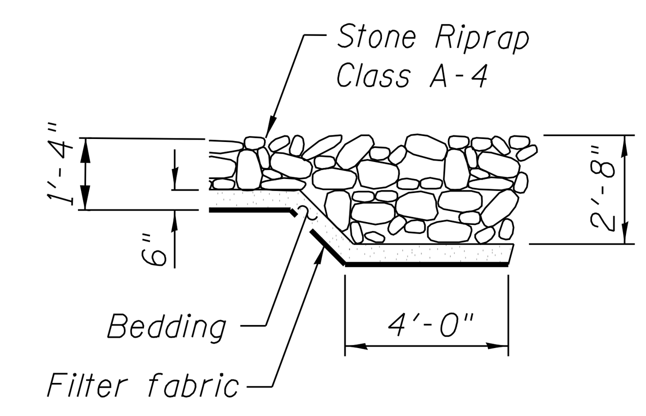
Bench Mark: "□" cut on top of Southwest Wingwall on Main St. bridge over Blackberry Creek El. 728.26

Existing Structure: S.N. 045-2000 was originally constructed in 1968 as a four cell reinforced concrete box culvert under Section 107B-I-1. Existing structure shall be removed and replaced. Traffic shall be maintained using Stage Construction.

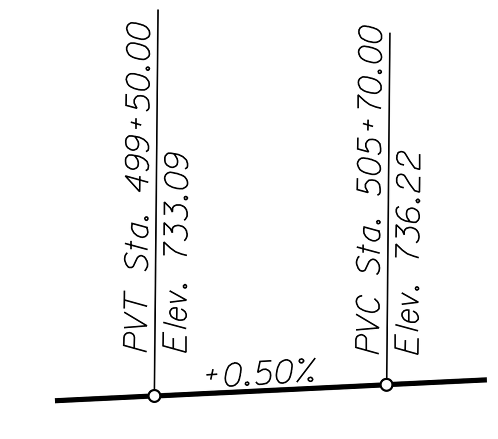
No Salvage.



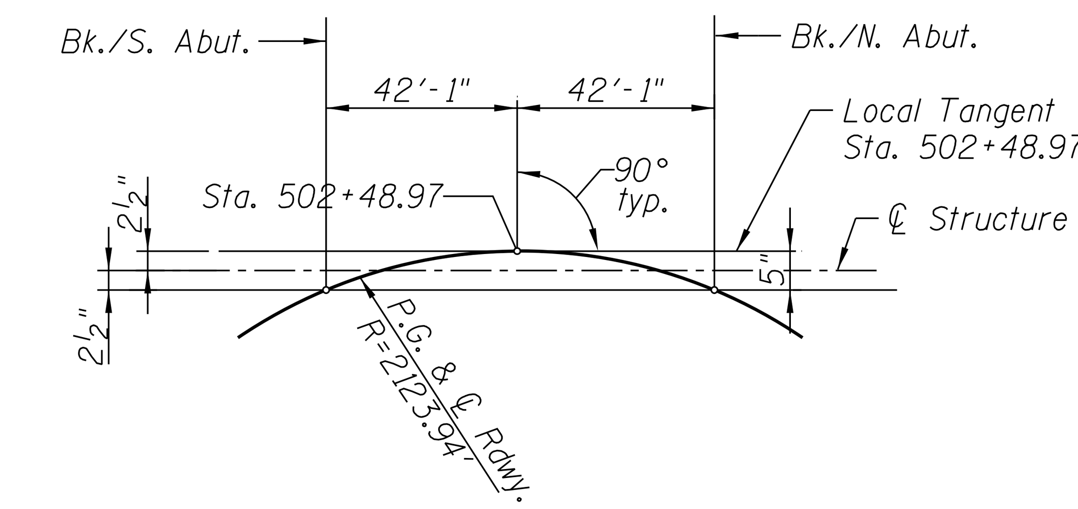
ELEVATION



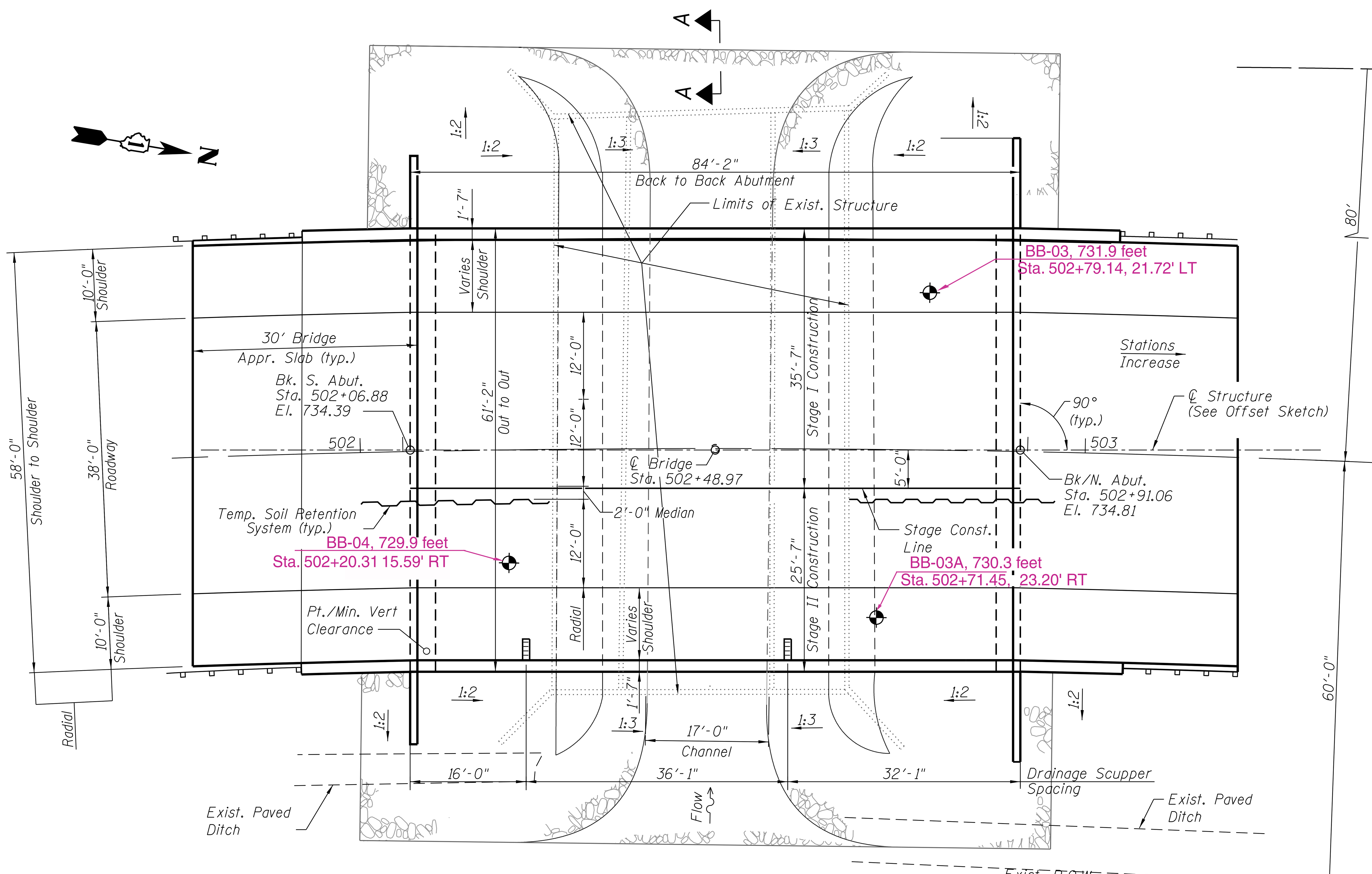
SECTION A-A



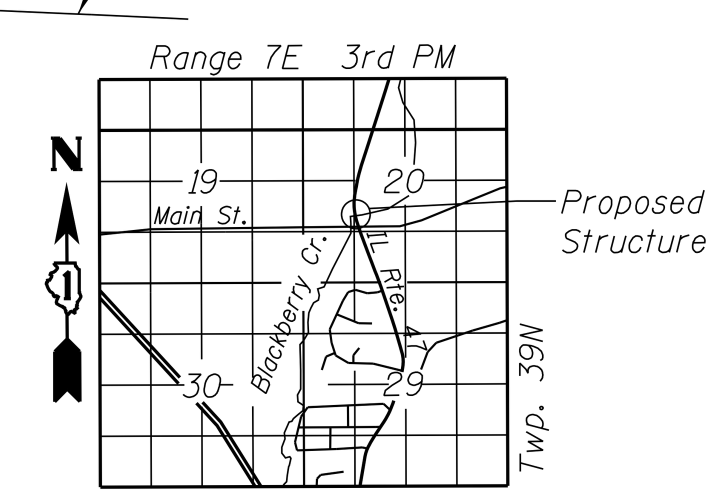
PROFILE GRADE
(along ℄ IL Route 47)



OFFSET SKETCH



PLAN



LOCATION SKETCH

GENERAL PLAN
IL 47 OVER BLACKBERRY CREEK
FAP 326
SEC. 107N-4
KANE COUNTY
STA. 502+48.97
STRUCTURE NO. 045-2050

BORING LOCATION PLAN: IL 47 OVER BLACKBERRY CREEK; SN. 045-2050, KANE COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 3	DRAWN BY: H. Bista CHECKED BY: A. Kurnia

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FOR MILHOUSE ENGINEERING AND CONSTRUCTION, INC. 192-03-01

MILHOUSE ENGINEERING & CONSTRUCTION

USER NAME = tsledge	DESIGNED - LAS	REVISED -	
	CHECKED - DAZ	REVISED -	
PLOT SCALE = 10.0000 ' / in.	DRAWN - TCS	REVISED -	
PLOT DATE = 3/3/2017	CHECKED - LAS	REVISED -	

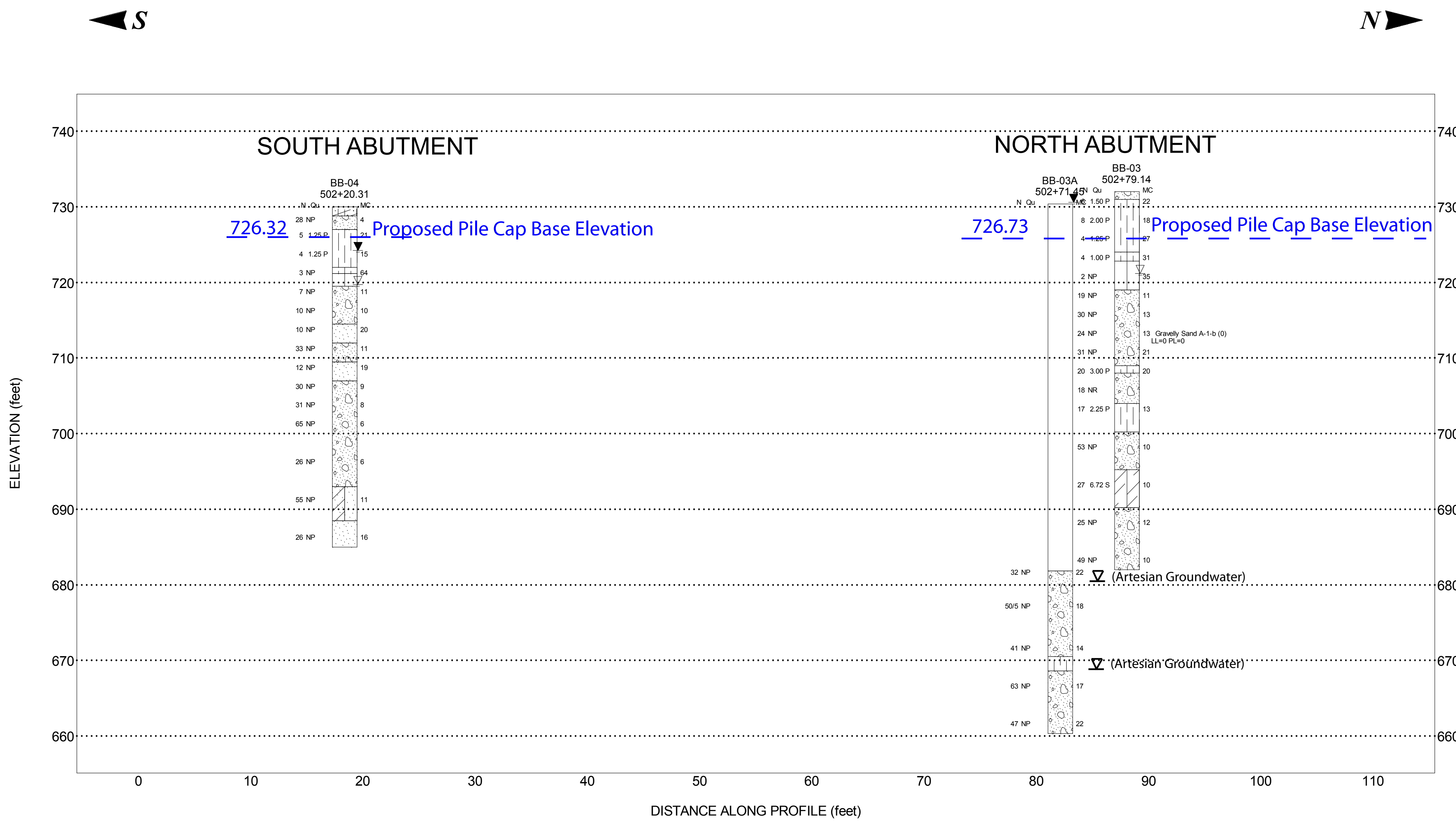
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN
SN 045-2050
SHEET NO. 1 OF 2 SHEETS

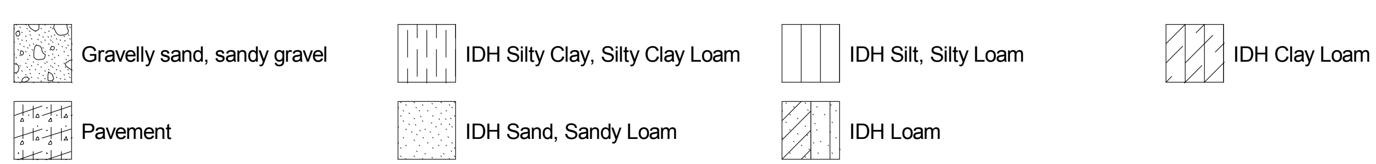
F.A.P. RTE	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	107N-4	KANE		

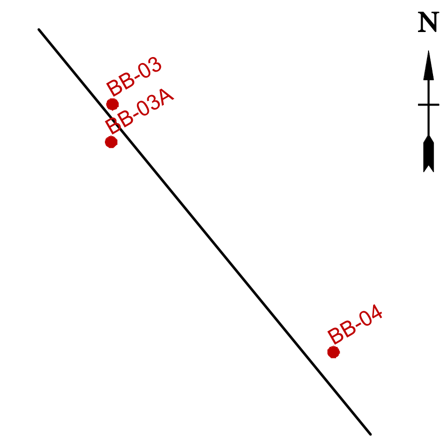
CONTRACT NO. 60T21
ILLINOIS FED. AID PROJECT

FILE NAME = P:\2015\0558 IDOT Dist1 IL Route 47 at Main S of Elburn (PTB 171-04)\CADD\dgn\CADD\IL 47 Bridge\0144909_sht_TSL.dgn



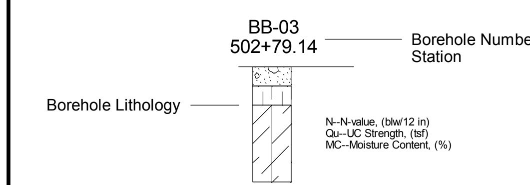
Lithology Graphics





Site Map Scale 1 inch equals 40 feet

Explanation:



▽ Water Level Reading at time of drilling.

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

Horizontal Scale (feet)

Vertical Exaggeration: 0.5x

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Lombard, IL 60148

Soil Profile
IL 47 over Blackberry Creek,
SN. 045-2050

WEI SINCE 1982

IL 47 at Main Street Intersection Improvements
Elburn, Kane County, IL

JOB NUMBER	PLATE NUMBER
192-03-01	EXHIBIT 4

WEI 11X17 1920301.GPJ WANGENG.GDT 2/2/17

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APPENDIX A

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Fax: 630 953-9938

BORING LOG BB-03

WEI Job No.: 192-03-01

Client: **Milhouse Engineering & Construction, Inc.**
Project: **IL 47 at Main Street Intersection Improvements**
Location: **Elburn, Kane County, IL**

Datum: NAVD 88
Elevation: 731.98 ft
North: 1885090.79 ft
East: 947499.90 ft
Station: 502+79.14
Offset: 21.72' LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	12-inch thick, brown SANDY GRAVEL					
731.0	--AGGREGATE SHOULDER-- --moist--					
	Stiff to very stiff, brown SILTY CLAY LOAM, trace to little gravel --FILL--		1	3, 3, 3	1.50 P	22
		5	2	4, 4, 4	2.00 P	18
			3	2, 2, 2	1.25 P	27
724.0	Stiff, black and green SILTY CLAY					
722.8	Very loose to loose, black SILTY LOAM, little gravel, trace shells	10	4	2, 2, 2	1.00 P	31
	--wet--		5	0, 1, 1	NP	35
719.0	Medium dense to dense, brown SAND with GRAVEL to GRAVELLY SAND --saturated--	15	6	4, 7, 12	NP	11
			7	13, 15, 15	NP	13
	--%Gravel=39.6-- --%Sand=52.5-- --%Silt=6.6-- --%Clay=1.3--	20	8	12, 12, 12	NP	13
	--fine sand--		9	11, 14, 17	NP	21
709.0	Very stiff, gray SILTY CLAY					
708.0	Medium dense, gray SANDY GRAVEL -saturated--	25	10	5, 9, 11	3.00 P	20
	--no Recovery--		11	7, 8, 10	NR	
704.0	Very stiff, pinkish gray SILTY CLAY LOAM, trace gravel	30	12	7, 8, 9	2.25 P	13
700.2	Dense, brown SANDY GRAVEL --saturated--	35	13	10, 35, 18	NP	10
	--hard drilling--					
695.2	Hard, gray CLAY LOAM, little gravel	40	14	17, 14, 13	6.72 S	10

GENERAL NOTES

Begin Drilling **04-20-2015** Complete Drilling **04-21-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R & J** Logger **D. Kolpacki** Checked by **B. Wilson**
Drilling Method **2.25" IDA SSA to 10', Mud rotary from 10', auto hammer, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **11.00 ft**
At Completion of Drilling **NA**
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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BORING LOG BB-03

WEI Job No.: 192-03-01

Client **Milhouse Engineering & Construction, Inc.**
Project **IL 47 at Main Street Intersection Improvements**
Location **Elburn, Kane County, IL**

Datum: NAVD 88
Elevation: 731.98 ft
North: 1885090.79 ft
East: 947499.90 ft
Station: 502+79.14
Offset: 21.72' LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	690.2	Medium dense to dense, brown coarse SAND to SANDY GRAVEL, little gravel --saturated--						
			45		15	5 12 13	NP	12
	682.0		50		16	30 27 22	NP	10
		Boring terminated at 50.00 ft						
			55					
			60					

GENERAL NOTES

Begin Drilling **04-20-2015** Complete Drilling **04-21-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R & J** Logger **D. Kolpacki** Checked by **B. Wilson**
Drilling Method **2.25" IDA SSA to 10', Mud rotary from 10', auto hammer, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **11.00 ft**
At Completion of Drilling **NA**
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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BORING LOG BB-03A

WEI Job No.: 192-03-01

Client: **Milhouse Engineering & Construction, Inc.**
Project: **IL 47 at Main Street Intersection Improvements**
Location: **Elburn, Kane County, IL**

Datum: NAVD 88
Elevation: 730.35 ft
North: 1885082.89 ft
East: 947499.61 ft
Station: 502+71.45
Offset: 23.20' 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 drilling to 48.5 feet--	▼					
			5					
			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 (%)
			25					
			30					
			35					
		--hard drilling at 38 feet, possible cobbles--						
			40					

GENERAL NOTES

Begin Drilling **06-09-2015** Complete Drilling **06-09-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **K & K** Logger **A. Happel** Checked by **B. Wilson**
Drilling Method **3.25" IDA HSA, auto hammer, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **NA**
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.

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BORING LOG BB-03A

WEI Job No.: 192-03-01

Client: **Milhouse Engineering & Construction, Inc.**
Project: **IL 47 at Main Street Intersection Improvements**
Location: **Elburn, Kane County, IL**

Datum: NAVD 88
Elevation: 730.35 ft
North: 1885082.89 ft
East: 947499.61 ft
Station: 502+71.45
Offset: 23.20' RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	--heaving sand--	45					
681.8	Dense to very dense, gray SANDY GRAVEL --wet--	50	SS	1	9 15 17	NP	22
	--groundwater pressure--						
	--heaving sand--						
	--wet--		SS	2	50/5	NP	18
		55					
670.5		60	SS	3	10 16 25	NP	14
	Hard (4.5P), gray SILTY CLAY LOAM, trace gravel --wet--						
668.6	Dense to very dense, gray SANDY GRAVEL --wet--						
	--groundwater pressure--	65	SS	4	8 34 29	NP	17
660.3	--wet--	70	SS	5	27 21 26	NP	22
	Boring terminated at 70.00 ft						
		75					
		80					

GENERAL NOTES

Begin Drilling **06-09-2015** Complete Drilling **06-09-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **K & K** Logger **A. Happel** Checked by **B. Wilson**
Drilling Method **3.25" IDA HSA, auto hammer, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **NA**
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.

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

BORING LOG BB-04

WEI Job No.: 192-03-01

Client: **Milhouse Engineering & Construction, Inc.**
Project: **IL 47 at Main Street Intersection Improvements**
Location: **Elburn, Kane County, IL**

Datum: NAVD 88
Elevation: 729.99 ft
North: 1885038.80 ft
East: 947546.38 ft
Station: 502+20.31
Offset: 15.59' RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	14-inch thick, ASPHALT --PAVEMENT--					
728.8	Medium dense, brown SANDY GRAVEL --BASE COURSE-- --moist--		1	7, 16, 12	NP	4
727.0	Stiff, brown SILTY CLAY, trace gravel --FILL--	5	2	2, 2, 3	1.25 P	21
			3	1, 2, 2	1.25 P	15
722.0	Medium stiff (0.5P), greenish brown, SILTY CLAY					
721.2	Very loose, brown SILTY LOAM, trace gravel, shells, and organic matter --moist--	10	4	1, 1, 2	NP	64
719.5	Loose to medium dense, brown SANDY GRAVEL --saturated--		5	1, 2, 5	NP	11
		15	6	3, 3, 7	NP	10
714.5	Medium dense, brown, medium SAND, trace gravel --saturated--		7	3, 3, 7	NP	20
712.0	Dense, brown SAND and GRAVEL --saturated--	20	8	17, 21, 12	NP	11
709.5	Medium dense, brown, fine SAND --saturated--		9	4, 6, 6	NP	19
707.0	Medium dense to very dense, brown SAND and GRAVEL to SANDY GRAVEL --saturated--	25	10	7, 12, 18	NP	9
			11	7, 10, 21	NP	8
		30	12	22, 32, 33	NP	6
	--possible cobbles--					
		35	13	6, 11, 15	NP	6
693.0	Very dense, gray LOAM, some gravel --wet--	40	14	9, 26, 29	NP	11

GENERAL NOTES

Begin Drilling **05-20-2015** Complete Drilling **05-20-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R & J** Logger **D. Kolpacki** Checked by **B. Wilson**
Drilling Method **3.25" IDA HSA, auto hammer, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **10.50 ft**
At Completion of Drilling ▼ **6.00 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.

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BORING LOG BB-04

WEI Job No.: 192-03-01

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Location: **Elburn, Kane County, IL**

Datum: NAVD 88
Elevation: 729.99 ft
North: 1885038.80 ft
East: 947546.38 ft
Station: 502+20.31
Offset: 15.59' RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	688.5							
		Medium dense, brown, medium SAND, trace gravel --saturated--			15	10 9 17	NP	16
	685.0		45					
		Boring terminated at 45.00 ft						
			50					
			55					
			60					

GENERAL NOTES

Begin Drilling **05-20-2015** Complete Drilling **05-20-2015**
Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR**
Driller **R & J** Logger **D. Kolpacki** Checked by **B. Wilson**
Drilling Method **3.25" IDA HSA, auto hammer, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ▽ **10.50 ft**
At Completion of Drilling ▼ **6.00 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.

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Phone (630) 953-9928
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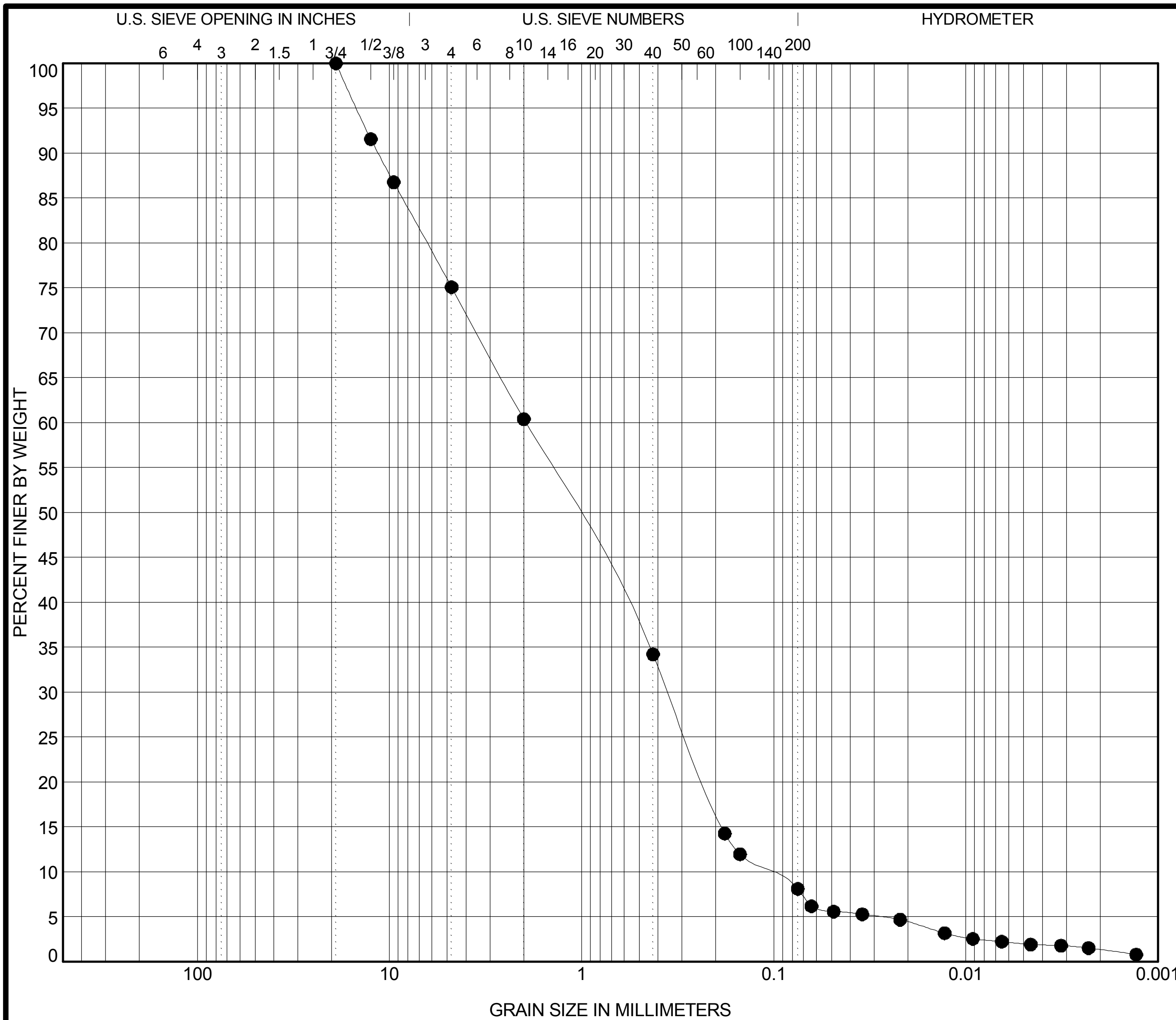
APPENDIX B



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	**BB-03#8**	**18.5 ft**	**Gravelly Sand**	**NP**	**NP**	**NP**	**0.61**	**18.54**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**BB-03#8**	**18.5 ft**	**19**	**1.953**	**0.354**	**0.105**	**39.6**	**52.5**	**6.6**	**1.3**

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GRAIN SIZE DISTRIBUTION

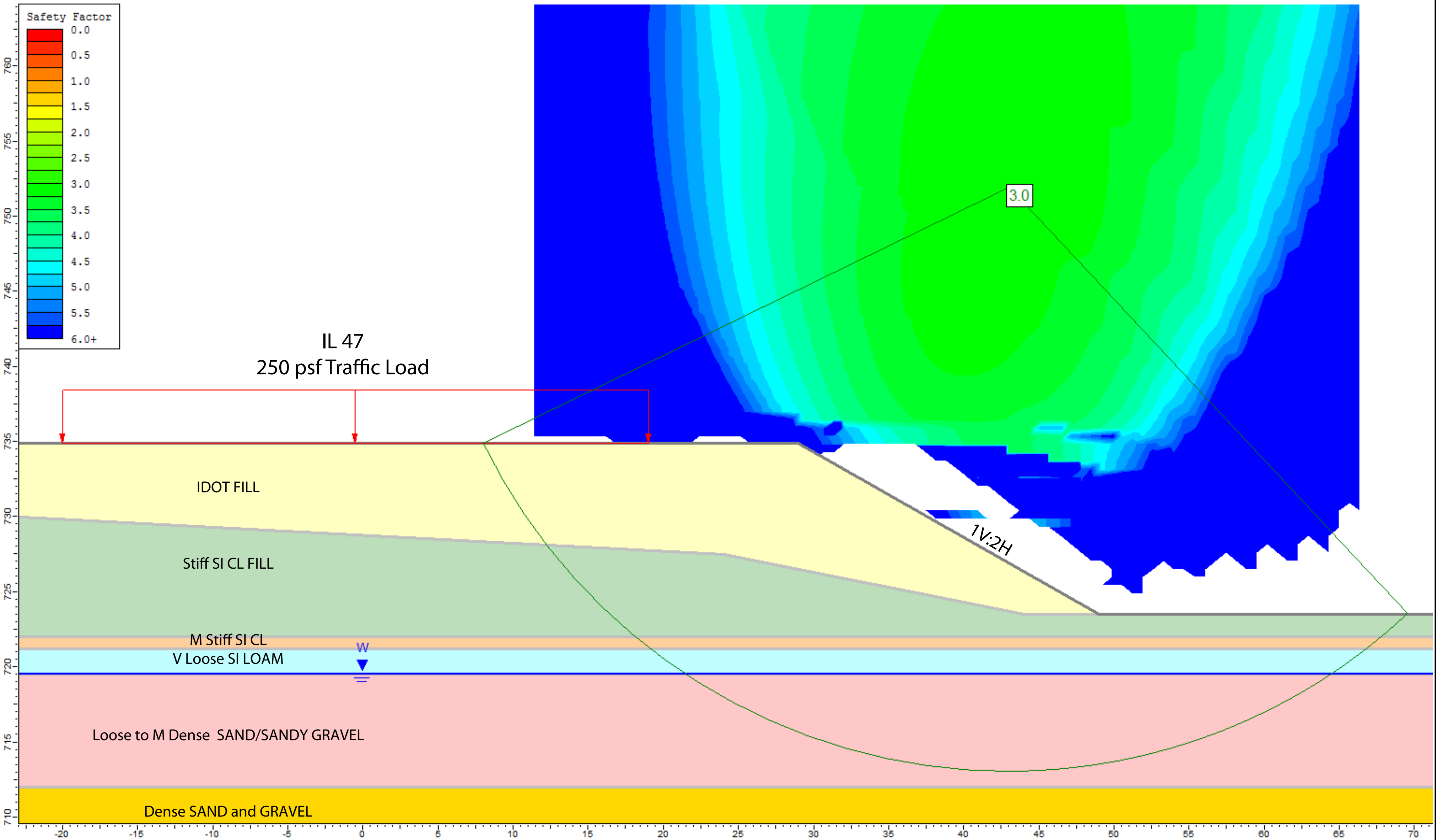
Project: IL 47 at Main Street Intersection Improvements

Location: Elburn, Kane County, IL

Number: 192-03-01

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

APPENDIX C



Undrained Analysis for South Approach Embankment at Station 502+00, Ref Boring BB-04

Layer ID	Description	Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	IDOT FILL	125	1000	0
2	Stiff SI CL FILL	120	1200	0
3	M Stiff SI CL	115	500	0
4	V Loose SI LOAM	110	0	27
5	Loose to M Dense SAND/SANDY GRAVEL	115	0	30
6	Dense SAND and GRAVEL	130	0	36

SLOPE STABILITY ANALYSIS: IL 47 OVER BLACKBERRY CREEK BRIDGE, SN. 045-2050, KANE COUNTY, ILLINOIS

SCALE: GRAPHICAL

APPENDIX C-1

DRAWN BY: HKB
CHECKED BY: NSB

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Lombard, IL 60148
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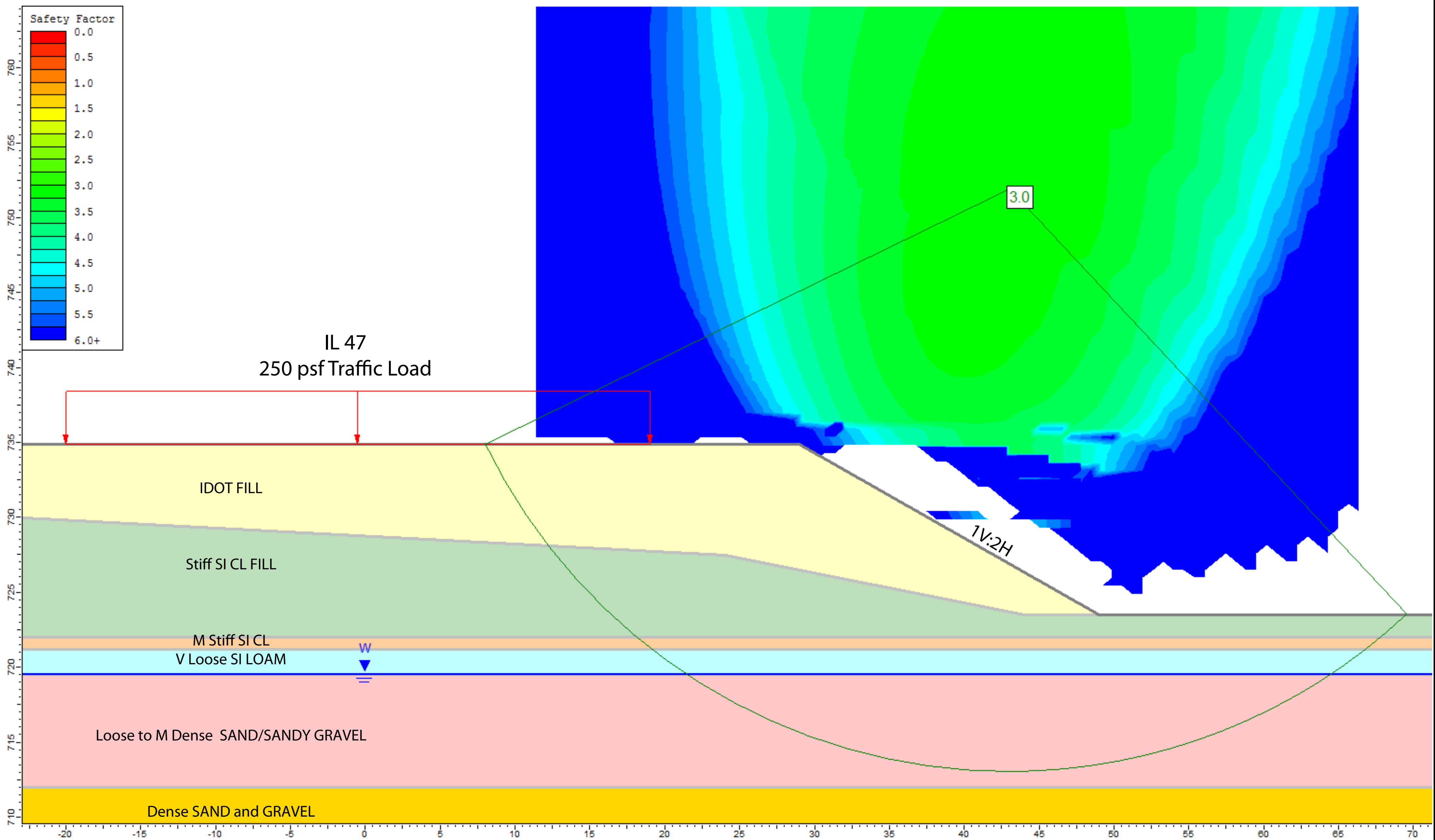
FOR MILHOUSE ENGINEERING AND CONSTRUCTION, INC. 192-03-01



Undrained Analysis for South Approach Embankment at Station 502+00, Ref Boring BB-04

Layer ID	Description	Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	IDOT FILL	125	1000	0
2	Stiff SI CL FILL	120	1200	0
3	M Stiff SI CL	115	500	0
4	V Loose SI LOAM	110	0	27
5	Loose to M Dense SAND/SANDY GRAVEL	115	0	30
6	Dense SAND and GRAVEL	130	0	36

SLOPE STABILITY ANALYSIS: IL 47 OVER BLACKBERRY CREEK, SN. 045-2050, KANE COUNTY, ILLINOIS

SCALE: GRAPHICAL

APPENDIX C-1

DRAWN BY: HKB
CHECKED BY: NSB

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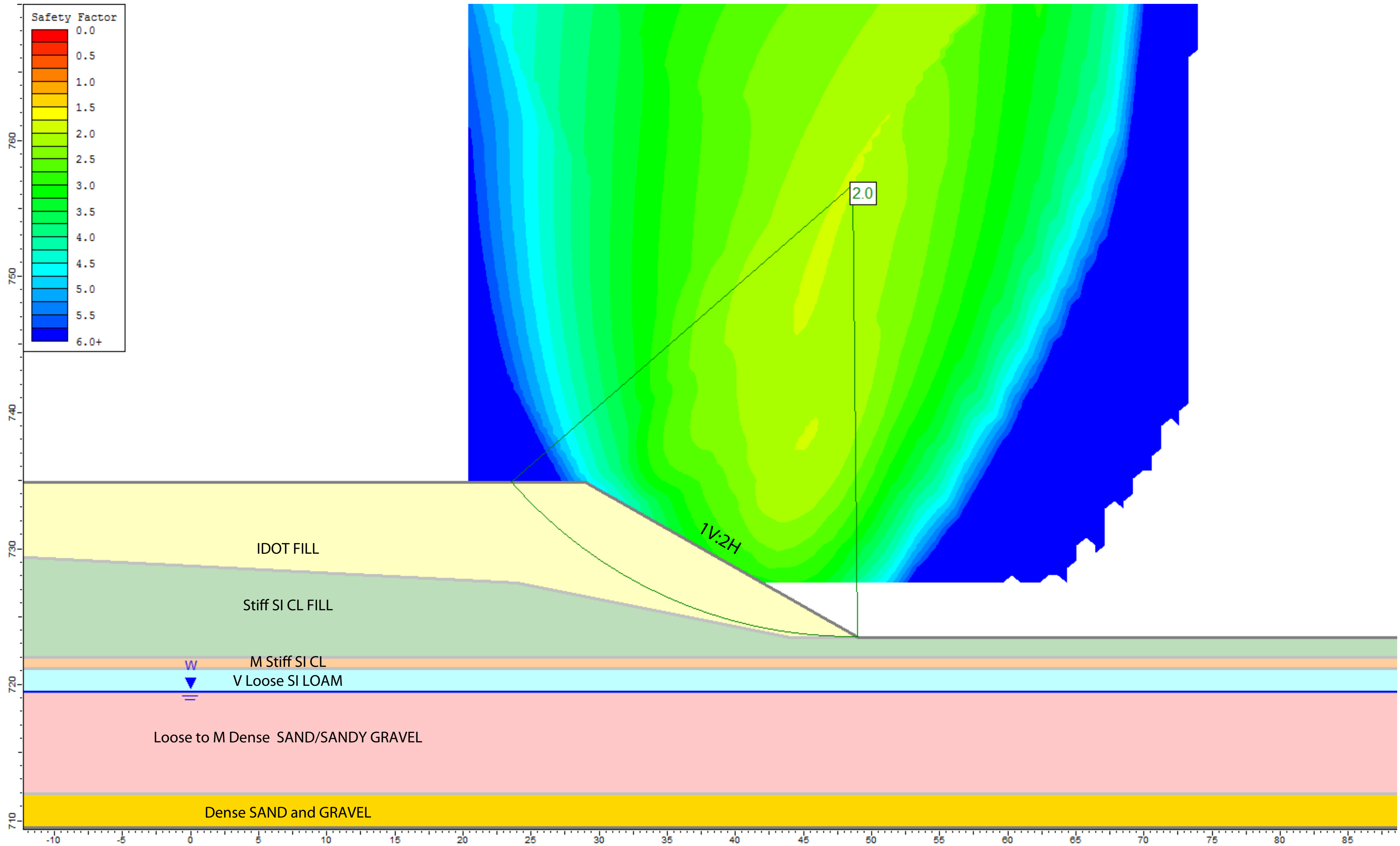
FOR MILHOUSE ENGINEERING AND CONSTRUCTION, INC.

192-03-01



Drained Analysis for South Approach Embankment at Station 502+00, Ref Boring BB-04

Layer ID	Description	Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	IDOT FILL	125	100	30
2	Stiff SI CL FILL	120	100	30
3	M Stiff SI CL	115	80	28
4	V Loose SI LOAM	110	0	27
5	Loose to M Dense SAND/SANDY GRAVEL	115	0	30
6	Dense SAND and GRAVEL	130	0	36

SLOPE STABILITY ANALYSIS: IL 47 OVER BLACKBERRY CREEK, SN. 045-2050, KANE COUNTY, ILLINOIS

SCALE: GRAPHICAL

APPENDIX C-2

DRAWN BY: HKB
CHECKED BY: NSB

Wang Engineering

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FOR MILHOUSE ENGINEERING AND CONSTRUCTION, INC.

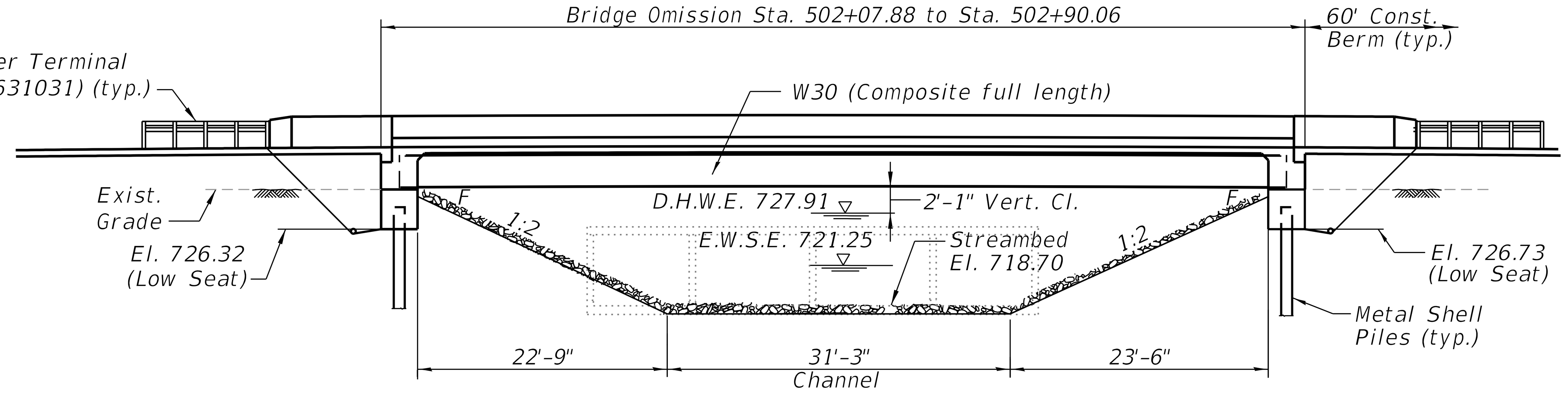
192-03-01

APPENDIX D

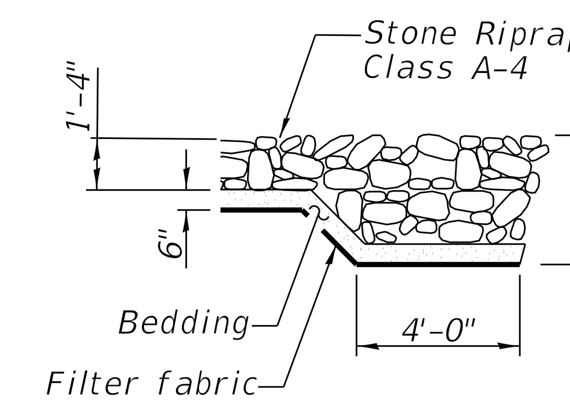
Bench Mark: "□" cut on top of Southwest Wingwall on Main St. bridge over Blackberry Creek El. 728.26

Existing Structure: S.N. 045-2000 was originally constructed in 1968 as a four cell reinforced concrete box culvert under Section 107B-I-1. Existing structure shall be removed and replaced. Traffic shall be maintained using Stage Construction.

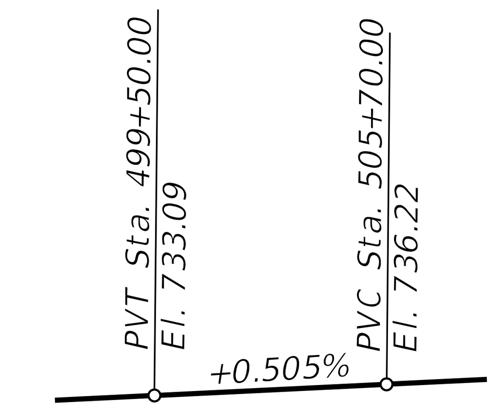
No Salvage.



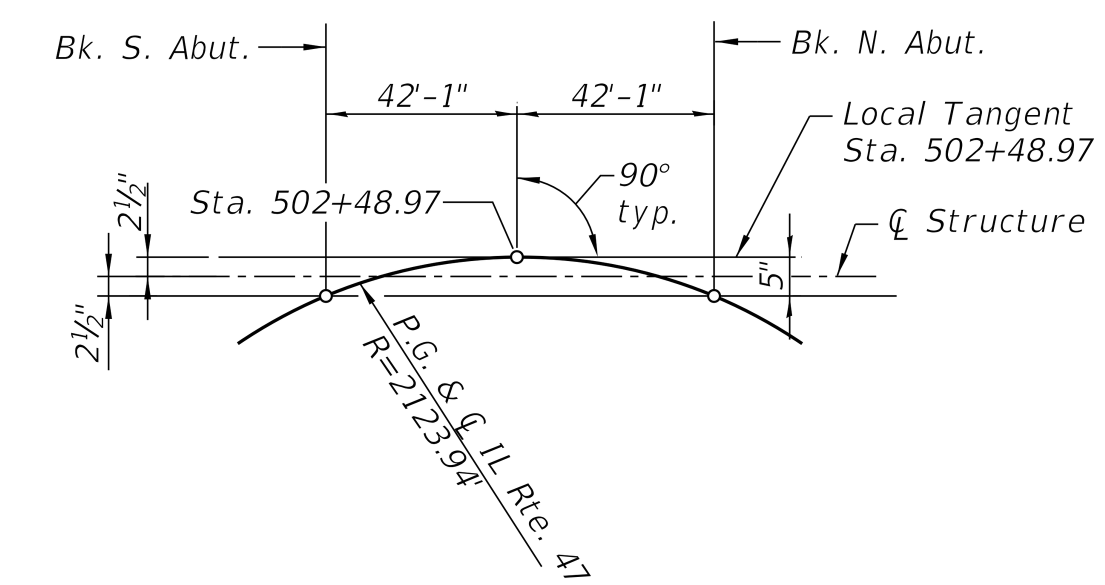
ELEVATION



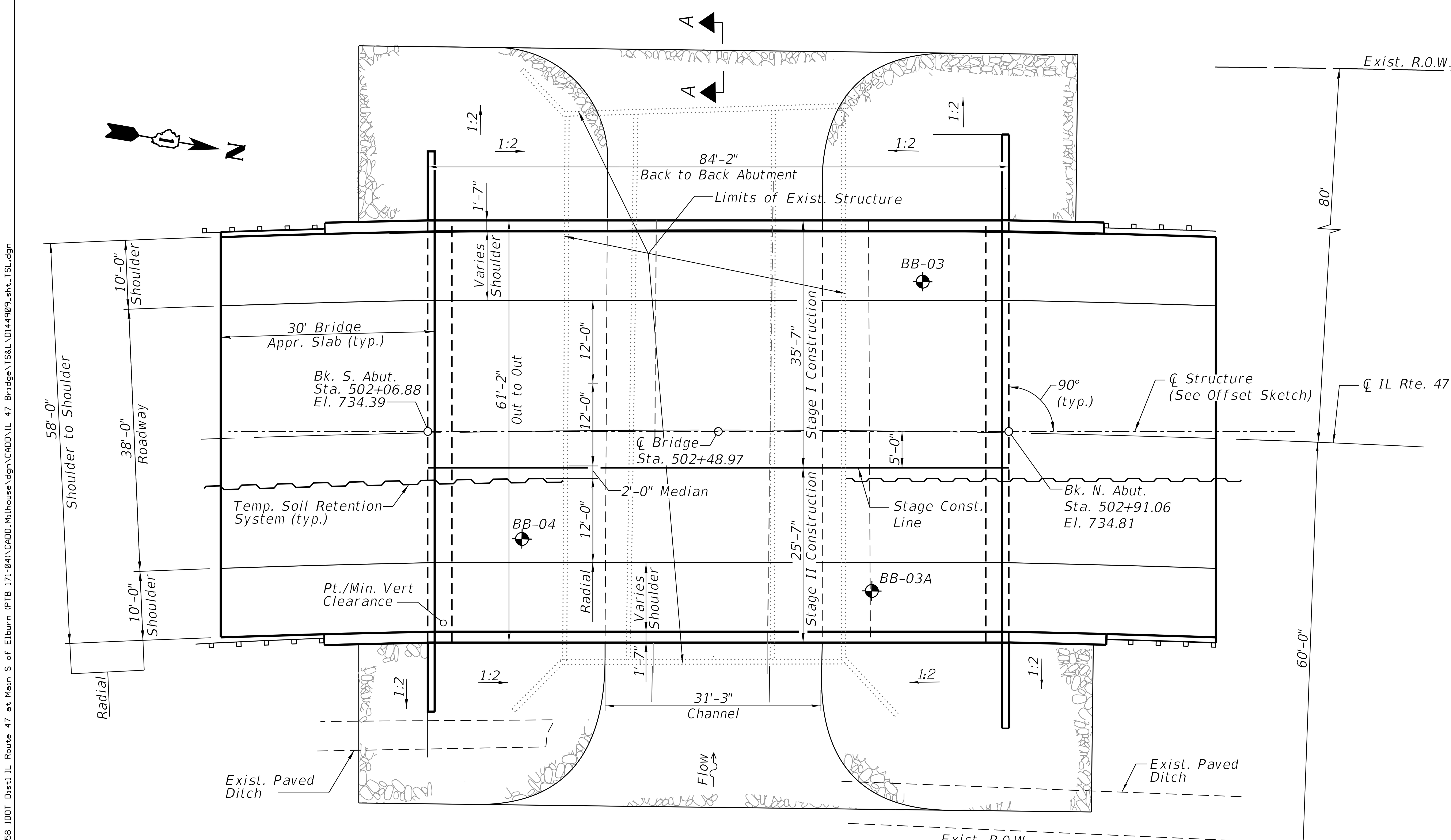
SECTION A-A



PROFILE GRADE
(along ℄ IL Route 47)



OFFSET SKETCH



PLAN

PROP. CURVE E IL 47-2

PI Sta. = 506+43.12
Δ= 35° 09' 27" (RT)
D = 2° 41' 51"
R = 2,123.94'
T = 672.89'
L = 1,303.28'
E = 104.04'
* S.E.=5.25%
T.R. = 42'
S.E. Run = 175'
P.C. Sta. = 499+70.23
P.T. Sta. = 512+73.51

* Superelevation to be held at a constant 4.0% over the bridge & approaches.

HIGHWAY CLASSIFICATION

Route: IL Rte 47
Functional Class: Other Principal Arterial
ADT: 8,200 (2010), 15,000 (2040)
DHV = 690
ADTT = 1706 (2010), 3120 (2040)
Design Speed: 60 mph
Posted Speed: 55 mph
Two-Way Traffic
Directional Distribution: 50/50

LOADING HL-93

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

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications 7th Edition w/ 2015 and 2016 Interims

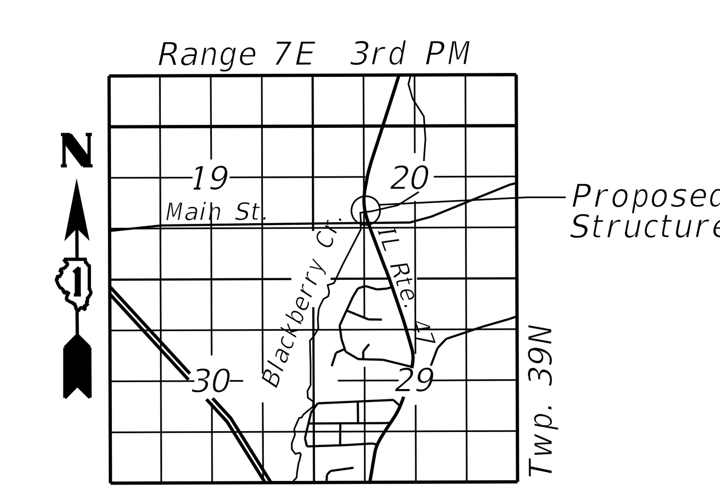
DESIGN STRESSES

FIELD UNITS

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

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = .089g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = .161g
Soil Site Class = D



LOCATION SKETCH

GENERAL PLAN
ILLINOIS ROUTE 47 OVER
BLACKBERRY CREEK
F.A.P. RTE. 326 - SEC. 107N-4
KANE COUNTY
STATION 502+48.97
STRUCTURE NO. 045-2050

FILE NAME = P:\2015\0558 IDOT Distl IL Route 47 at Main S of Elburn (PTB 171-04)\CADD\Milhouse\dgn\CADD\IL 47 Bridge\TS&L\D144909_sht_TSL.dgn

MILHOUSE ENGINEERING & CONSTRUCTION

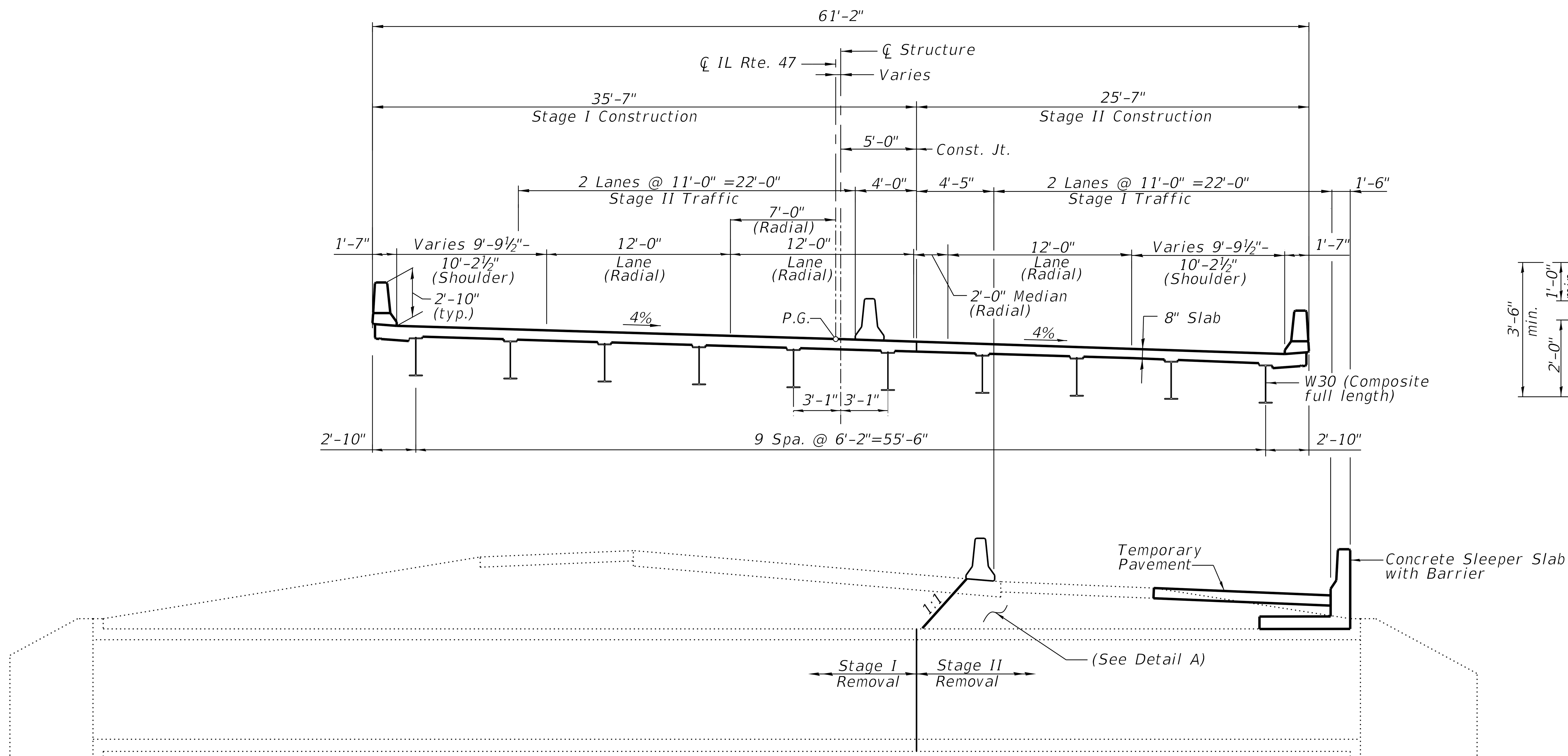
USER NAME = tsledge		DESIGNED - LAS	REVISED -
		CHECKED - DAZ	REVISED -
PLOT SCALE = 120:0.0000 ':' / ft.		DRAWN - TCS	REVISED -
PLOT DATE = 9/14/2017		CHECKED - LAS	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

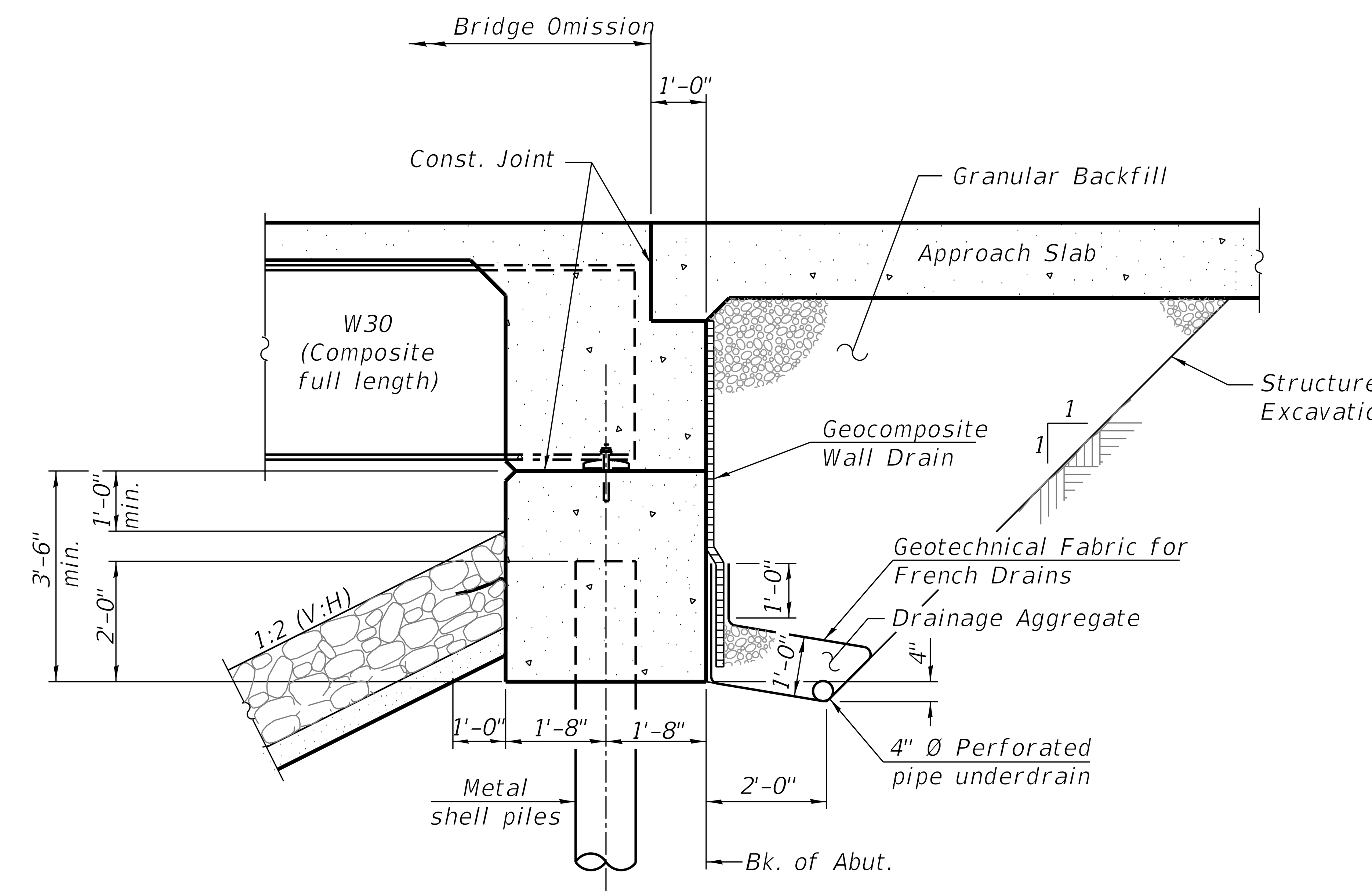
GENERAL PLAN
SN 045-2050
SHEET NO. 1 OF 2 SHEETS

F.A.P. RTE	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	107N-4	KANE		

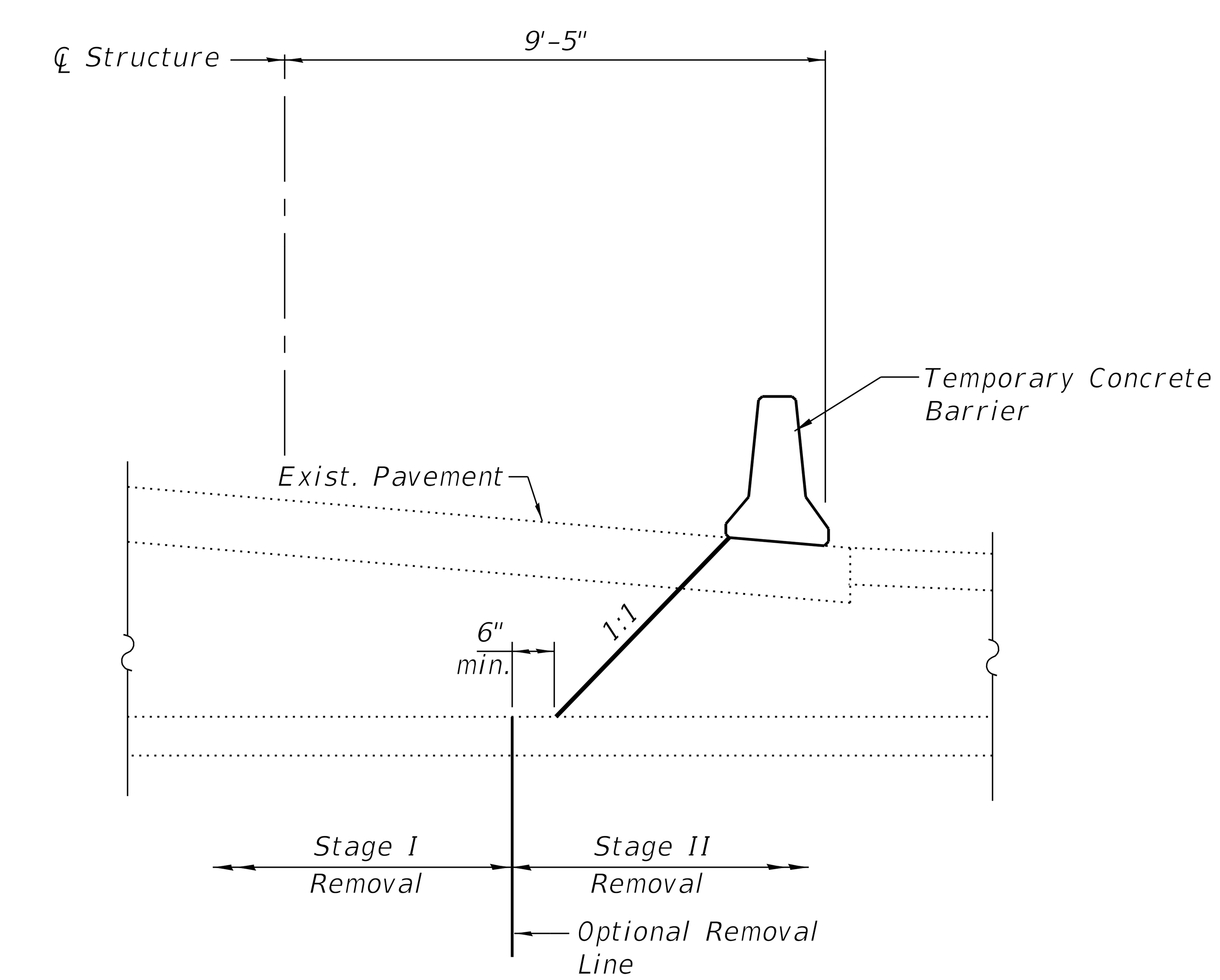
CONTRACT NO. 60T21
ILLINOIS FED. AID PROJECT



CROSS SECTION
(Looking North)



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



DETAIL A

WATERWAY INFORMATION

Drainage Area = 11.32 sq. mi.

Exist. Low Grade Elev. =729.53 @ Sta. 501+17
Prop. Low Grade Elev. =734.50 @ Sta. 501+17

Flood	Freq. Yr.	Existing Discharge C.F.S.	Proposed Discharge C.F.S.	Opening Sq. Ft.		Nat. H.W.E.	Head - Ft.		Headwater El.	
				Exist.	Prop.		Exist.	Prop.	Exist.	Prop.
	10	634	634	203.2	334.5	726.33	0.12	0.13	726.45	726.46
Design	50	1120	1120	203.2	439.7	727.91	0.48	0.17	728.39	728.08
Base	100	1376	1376	203.2	472.8	728.44	0.51	0.32	728.95	728.76
Max. Calc.	500	2097	2097	516.8	570.3	729.88	0.04	0.23	729.92	730.11

10-Year Velocity through Existing Bridge = 3.12 fps
10-Year Velocity through Proposed Bridge = 1.90 fps

DESIGN SCOUR ELEVATION TABLE

Event/Limit State	Design Scour Elevations (ft.)		
	S. Abut.	N. Abut.	Item 113
Q100	726.32	726.73	8
Q500	726.32	726.73	
Design	726.32	726.73	
Check	726.32	726.73	

FILE NAME = P:\2015\0558 IDOT Distl IL Route 47 at Main S of Elburn (PTB 171-04)\CADD-Milhouse\dgn\CADD\IL 47 Bridge\TSL\D144909_sht_TSL*1.dgn

MILHOUSE ENGINEERING & CONSTRUCTION

USER NAME = tsledge	DESIGNED - LAS	REVISED -
	CHECKED - DAZ	REVISED -
PLOT SCALE = 120:0.0000 ':' / ft.	DRAWN - TCS	REVISED -
PLOT DATE = 9/14/2017	CHECKED - LAS	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SECTION
SN 045-2050
SHEET NO. 2 OF 2 SHEETS

F.A.P. RTE	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
326	107N-4	KANE		

CONTRACT NO. 60T21

ILLINOIS FED. AID PROJECT