STRUCTURE GEOTECHNICAL REPORT
FAP 334 (US 12) OVER IL 59 NORTH JUNCTION
EXISTING SN 049-0020, PROPOSED SN 049-0601
SECTION 22-2HB-1
IDOT JOB D-91-116-14
PTB 170 ITEM 002
LAKE COUNTY, ILLINOIS

for

CEMCON, Ltd.
2280 White Oak Circle, Suite 100
Aurora, IL 60502-9675
(630) 862-2100

submitted by

Wang Engineering, Inc.
1145 North Main Street
Lombard, IL 60148
(630) 953-9928

Original date: November 5, 2014
Revised date: April 2, 2015

Wang Ref. No. 303-08-01

Technical Report Documentation Page

1. Title and Subtitle Structure Geotechnical Report US 12 over IL 59 North Junction		**2. Report Date** April 2, 2015 **3. Report Type** ☒ SGR ☐ RGR ☐ Draft ☐ Final ☒ Revised
4. Route / Section / County FAP 334/ 22-2HB-1 / Lake		**5. IDOT Job** D-91-116-14
6. PTB / Item No. 170/002	**7. Existing Structure Number(s)** 049-0020	**8. Proposed Structure Number(s)** 049-0601
9. Prepared by Wang Engineering, Inc. 1145 N Main Street Lombard, IL 60148	**Contributor(s)** Author: Andri Kurnia, PE QC/QA: Jerry W.H. Wang, PhD, PE. PM: Corina T. Farez, PE, PG.	**Contact Phone Number** (630) 953-9928, Ext.1025 akurnia@wangeng.com
10. Prepared for CEMCON, Ltd. 2280 White Oak Circle, Suite100 Aurora, IL 60502-9675 (630) 862-2100	**Design / Structural Engineer** Nabi Fakroddin, PE, SE	**Contact Phone Number** (630) 862-2100 nabi.fakroddin@cemcon.com

11. Abstract

A new, single-span bridge will be constructed to carry US 12 over IL 59. The proposed structure will have a back-to-back abutment length of 123.8 feet and an out-to-out width of 45.7 feet. In addition, MSE walls will support the abutment slopes. This report provides geotechnical recommendations for the design and construction of the bridge substructures and walls.

The soil conditions encountered along the bridge site include medium dense to very dense sandy gravel fill medium dense over medium dense to very dense sand, sandy gravel, and silt. The site classifies in Seismic Class D and lies in Seismic Performance Zone 1.

The abutments could be supported on driven piles (steel H-Piles or metal shell piles). The abutment piles are designed within the MSE walls. Tables are provided with estimated tip elevations and lengths for pile capacities ranging from 130 to 317 kips per pile. Due to the granular nature of the subgrade soil, downdrag allowances will not be required for foundation piles.

The MSE walls have maximum factored bearing resistances of 7,500 and 9,000 psf at south and north abutments, respectively. Global stability analyses show suitable FOS of 1.7. We estimate the settlement will be minimal.

12. Path to archived file

S:\Netprojects\3030801\Reports\RPT_Wang_CTF_3030801US120verIL59_20150402.pdf

TABLE OF CONTENTS

Wang
Engineering

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

STRUCTURE GEOTECHNICAL REPORT
FAP 334 (US 12) OVER IL 59 NORTH JUNCTION
EXISTING SN 049-0020, PROPOSED SN 049-0601
SECTION 22-2HB-1
IDOT JOB D-91-116-14
PTB 170 ITEM 002
LAKE COUNTY, ILLINOIS
FOR
CEMCON, LTD.

1.0 INTRODUCTION

The following report presents the results of our subsurface investigation, laboratory testing, and geotechnical evaluations in support of the design and construction of the US 12 (NB) Bridge over IL 59 (SB), in Lake County, Illinois. A *Site Location Map* is included as Exhibit 1. Wang Engineering, Inc. (Wang) understands that Phase II engineering services are required for the replacement of the existing three-span US 12 Bridge with a single-span bridge.

1.1 Proposed Structure

Wang understands the new US 12 structure (SB 049-0601) will be a single-span bridge with semi-integral abutments and mechanically-stabilized earth (MSE) end wall. The bridge will have a back-to-back length of 123.8 feet with 30-foot long approach slab on each side and an out-to-out width of 45.7 feet. The proposed MSE walls will be located at the existing bridge end slopes. The lowest top of leveling pad elevation at the MSE wall face on abutment is approximately at 759.5 and 762.5 feet for north and south abutments, respectively. The back of abutment elevations are proposed at 786.5 and 785.0 feet at the north and south abutments, respectively. Therefore, the wall height will be a maximum of about 27.0 and 22.5 feet at the north and south abutments, respectively.

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.

1.2 Existing Structure

The existing structure (SN 049-0020) consists of a three-span bridge caring the NB US 12 over IL 59. The original structure was built in 1966 and has a back-to-back abutment length of 200.5 feet and overall deck width of 36.0 feet. The existing structure is to be removed and replaced.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The project site is situated in northwestern Illinois, Lake County, approximately 45 miles northwest of Chicago. On the USGS "Fox Lake" quadrangle map the site is located in the SW ¼ of Section 15, Tier 45 North, Range 9 East.

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

2.1 Physiography

The investigated area of US 12 and IL 59 is surrounded by gently rolling topography. Ground surface elevations within a half mile radius of the project site generally range from 750 to 815 feet (NAVD 88). Red Head Lake, part of the Fox River / Chain O'Lakes waterway system, lies one half mile to the west of the project area and is the predominant drainage features at the site.

2.2 Surficial Cover

The surficial cover and geomorphology in and around the project area is a result of sediment deposits emplaced during the pulsating retreats and advances of the Lake Michigan Ice Lobe of the Wisconsin Episode of continental glaciation (Hansel, 1996). The project area lies on top of the Fox Lake Moraine, which is an ice-contact, kamic moraine that lies at the western extent of the Valparaiso Morainic System (Kulczycki, 2001). The Fox Lake moraine formed as retreating ice stagnated near what is now the center of the Fox Lake Quadrangle. Sand, gravel, and diamicton filled depressions on the glacier surface and were subsequently re-deposited on the ground surface as melting continued. The surficial soils underlying the site therefore are associated with the Haeger Member of the Lemont Formation, which consist of a thick sequence of sandy loam diamicton frequently stratified with sand and gravels. Outwash sands and gravels of the Henry formation lie at the western margin of the Fox Lake moraine (approximately one half mile to the west), and Grayslake peat deposits fill low lands and swamp areas in the vicinity of the project area.

2.3 Bedrock

At the project site, the top of bedrock is mapped at an approximate elevation of 550 feet NGVD, or 200 feet below the ground surface (Larson, 1973). The bedrock beneath the site consists of Silurian-age dolomite underlies the unconsolidated deposits.

The subsurface investigation results fit into the local geologic context. The borings drilled in the project area confirm that native sediments consists of sands, sandy loams, and gravelly sands, silts and gravel with interbeds of gravel and silt.

3.0 METHODS OF INVESTIGATION

The following sections outline our subsurface and laboratory investigations.

3.1 Subsurface Investigation

Beginning on October 20th and concluding on October 22th, Wang drilled a total of 4 structure borings near the proposed corners of the envisioned Mechanically Stabilized Earth (MSE) wall supported bridge. The borings were drilled to depths ranging from 40 to 100 feet below ground surface (bgs). The as-drilled boring locations and elevations were obtained by Wang by means of a mapping grade Trimble GeoXH GPS, however signal interference from the adjacent overhead bridge structure required several of the GPS acquired positions be rectified by field measurements. Station, offset, and elevation information is provided by CEMCON on November 4, 2014. Boring locations, elevations, stations, and offsets are indicated on the *Boring Logs* (Appendix A). The as-drilled locations are shown on the *Boring Location Plan* (Exhibit 3).

A truck-mounted drilling rig, equipped mud rotary drilling equipment was used to advance and maintain an open borehole. 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 bgs and at 5-foot intervals thereafter. Samples collected from each interval were placed in sealed jars for further examination and laboratory testing.

Field boring logs were prepared and maintained by a Wang field engineer or geologist. The field logs include lithological descriptions, visual-manual soil classifications, and results of standard penetration tests (SPT), recorded as blows per 6 inches of penetration.

Groundwater observations were made in each boring during and at the completion of drilling operations. The borings were backfilled with soil cuttings and bentonite chips after completion, and the surface was restored to its original condition.

3.2 Laboratory Testing

Soil samples were tested in the laboratory for moisture content (AASHTO T-265), and particle size (AASHTO T 88) analyses were performed on selected samples to classify various layers identified. Field visual descriptions of the soil samples were verified in the laboratory. The soils were classified according to the IDH Soil Classification System. Laboratory test results are also shown on the *Boring Logs* (Appendix A) and in the *Laboratory Test Results* (Appendix B).

4.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

Detailed descriptions of the lithological units encountered by the borings are presented in the attached *Boring Logs* (Appendix A) and in the *Soil Profile* (Exhibit 4). Please note that the strata contact lines shown on the logs and profiles represent approximate boundaries between soil types. In the field, the actual transition between soil types might be gradual in horizontal and vertical directions.

4.1 Surface Characterization

The borings were drilled off or on the existing outside shoulders of the southbound IL 59 ramp to southbound US 12. The three borings were obtained through the shoulders reveal that the shoulder pavement consists of 3- to 9-inch thick asphalt pavement. Boring B-04 was drilled through the eastern grassy right-of-way, south of the bridge, and found 4 inches of brown sandy loam topsoil.

4.2 Soil Conditions

Beneath the roadway shoulder pavement structure or topsoil, the borings mainly encountered granular fill that overlies native granular soil. In descending order, the soils consist of the following major lithologic succession.

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

The thickness of the fill ranges from about 7.0 to 15.5 feet with an average of 10.3 feet. The fill material is medium dense to very dense, sandy gravel with crushed stone with SPT N-values of 13 to 59 (30 on average) blows/foot. A particle size analysis of the fill materials at Boring B-01 has silt and clay contents of 9.3 and 1.5%, respectively. No groundwater was encountered within the fill materials. It is possible the fill observed may represent the backfill around the shallow footing for the existing bridge pier structure.

(2) *Medium dense to very dense, Sand, Sandy Gravel, and Silt*

Beneath the fill and extending to the terminating depths, the borings advanced through medium dense to very dense, sand with interbeds of gravelly sands and silt; no cohesive soils were observed during drilling. SPT N-values within the native sediments range from 11 to 69 (31 on average). The borings encountered a saturated silt layer between 23 and 32 feet bgs that ranges between 11 and 25 feet in thickness. N-values within this layer range from 11 to 28 (25 on average) blows/foot with relatively high moisture contents (MC) ranging from 17 to 28% (23.0% on average). Particle size analysis of this interval reveals sand, silt and clay proportions of 17.5%, 82.1% and 0.4% respectively.

4.3 Groundwater Conditions

During drilling, groundwater was encountered in all four borings between 23 and 27 feet below ground surface. After-drilling groundwater measurements were not obtained because drilling was conducted by the mud-rotary method. Due to the granular nature of the subgrade soil, we estimate that static ground water level will closely mirror the as-drilling readings.

4.4 Seismic Design Considerations

Wang estimates the minimum factor of safety (FOS) against liquefaction for the soils encountered in the borings is greater than the AASHTO required FOS of 1.1. The soils within the top 100 feet have a weighted average N-value of 31 blows/foot, classifying the site in Seismic Site Class D (AASHTO 2012; Method B). The project location belongs to Seismic Performance Zone 1. The seismic spectral acceleration parameters recommended for design in accordance with the AASHTO *LRFD Design Specifications* are summarized in Table 1 (AASHTO 2012).

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= 3.7	F_{pga}= 1.6	**A_s= 5.9**
0.2	S_S= 8.0	F_a= 1.6	**S_{DS}= 12.7**

Spectral Acceleration Period (sec)	Spectral Acceleration Coefficient[1] (% g)	Site Factors	Design Spectrum for Site Class D[2] (% g)
1.0	S_1= 3.2	F_v= 2.4	**S_{D1}= 7.6**

1) Spectral acceleration coefficients from AASHTO, 2012

2) Site Class D Bridge Spectrum to be included in plans: A_s = PGA*F_{pga}; S_{DS}= S_S*F_a; S_{D1}= S_1*F_v

5.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS

Based on an approved TSL plan dated March 12, 2015 (Appendix D) provided by CEMCON, Wang understands the existing bridge carrying US 12 over IL 59 will be removed and a new single-span bridge will be constructed. Given the information provided by the borings, we recommend supporting the semi-integral abutments on steel H-piles or metal shell piles (MSP). Due to the lack of hard layer in the boring logs that will provide substantial end bearing resistance for H-piles, MSP should closely be considered. If MSP is selected, we recommend using the thicker wall such as MSP 14-inch diameter with 0.312-inch thick walls to ensure penetration through the dense granular soil near the surface. Vibrating and/or jetting the MSP through this material may be considered. Wang understands the abutments will be designed as MSE walls. The walls will have maximum exposed heights of 23.5 feet on the north side and 19.0 feet on the south side. The base of the walls will be established 3.5 feet bgs for maximum total wall heights of 27.0 feet on the north side and 22.5 feet on the south side.

5.1 Mechanically Stabilized Earth (MSE) Wall

The following section provides bearing capacity, settlement, and global stability analyses for designing MSE retaining walls. The borings drilled along the walls show generally competent soil conditions. Wang estimates these soils will provide adequate bearing capacity, global stability, and total and differential settlement performance for the retaining walls.

5.1.1 Bearing Capacity

Based on the assumed dimensions of the MSE abutment, we estimate an equivalent bearing pressure of 7,200 psf with a wall height of 27.0 feet and a wall width of 18.9 feet; the evaluation accounts for the eccentricity of the wall. Based on the general lithologic profile described in Section 4.2, we estimate the foundation soils have a maximum factored bearing resistance of 9,000 psf at the north abutment and 7,500 psf at the south abutment; the factored resistance is calculated with a geotechnical resistance factor (ϕ_b) of 0.65 (AASHTO 2012).

The estimated friction angle between the select MSE fill base and granular subgrade is 28° and the corresponding friction coefficient is 0.53 (AASHTO, 2012). MSE retaining walls are designed based on a geotechnical sliding resistance factor (ϕ_τ) of 1.0 for soil-on-soil contact (AASHTO, 2012). Our analysis shows MSE walls with widths of 0.7 times the wall height will be stable.

5.1.2 Settlement

The maximum new fill height is approximately 23.5 feet. The estimated immediate settlement at the highest wall is 1.0 inches. We do not envision any long-term settlement concerns for construction of the approach slabs. Due to the granular nature of the subgrade soil, downdrag allowances will not be required for foundation piles.

5.1.3 Global Stability

The global stability of the MSE abutment walls was analyzed based on the worst soil conditions encountered along the embankments, represented by Borings B-04 at the south abutment. The minimum required FOS for both short-term and long-term conditions is 1.5 (IDOT, 1999). Analyses were performed with Slide v6.0, and the result of slope stability evaluation is shown in Appendix C. We estimated factor of safety of 1.7. This condition meets the IDOT's minimum requirement. Internal wall stability will be designed by the MSE wall Contractor.

5.2 Bridge Foundations

Given the soil conditions encountered during the investigation and described in Section 4.1, Wang recommends supporting the semi-integral abutments on driven piles.

5.2.1 Driven Piles

The abutments could be supported on driven steel H-piles or MSP. IDOT specifies the maximum nominal required bearing (R_{NMAX}) for each pile and states the factored resistance available (R_F) for steel H-piles should be based on a geotechnical resistance factor (Φ_G) of 0.55 (IDOT, 2012a). Nominal tip and side resistance were estimated using the methods and empirical equations presented in the latest *AGMU Memorandum 10.2 – Geotechnical Pile Design* (IDOT, 2011). Based on data provided by CEMCON on November 4, 2014, the total preliminary factored load for abutment is 1671 kips per abutment. Assuming no vibrating and/or jetting during pile installation, the R_F, R_N, estimated pile tip elevations, and pile lengths for two steel H-pile sizes are summarized in Table 2 (HP12x63), Table 3

(HP14x73), and Table 4 (MSP 14-inch diameter). The lengths shown in the tables include a 1 foot 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, 2012a). Downdrag allowances are required for all piles experiencing relative deformations greater than 0.4 inch between the pile and foundation soil. Due to the granular nature of the subgrade soil, no downdrag allowances will be required.

Table 2: Estimated Pile Lengths and Tip Elevations for Steel HP 12x63

Structure Unit (Reference Boring)	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
North Abutment (B-01 and B-03)	777.95	236	0	0	130	79	700.0
		273	0	0	150	93	686.0
		309	0	0	170	110	669.0
		345	0	0	190	113	666.0
		382	0	0	210	117	662.0
		418	0	0	230$^{1)}$	124	655.0
		455	0	0	250$^{1)}$	131	648.0
		497	0	0	273$^{1)}$	139	640.0
South Abutment (B-02 and B-04)	776.50	236	0	0	130	83	694.5
		273	0	0	150	87	690.5
		309	0	0	170$^{1)}$	107	670.5
		345	0	0	190$^{1)}$	112	665.5
		382	0	0	210$^{1)}$	113	664.5
		418	0	0	230$^{1)}$	120	657.5
		455	0	0	250$^{1)}$	127	650.5
		497	0	0	273$^{1)}$	135	642.5

$^{1)}$ Pile length and tip elevation is extrapolated from Boring B-01.

Table 3: Estimated Pile Lengths and Tip Elevations for Steel HP 14x73

Structure Unit (Reference Boring)	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
North Abutment (B-01 and B-03)	777.95	236	0	0	130	73	706.0
		273	0	0	150	78	701.0
		309	0	0	170	100	679.0
		345	0	0	190	108	671.0
		382	0	0	210	110	669.0
		418	0	0	230	113	666.0
		455	0	0	250	116	663.0
		491	0	0	270 1)	120	659.0
		527	0	0	290 1)	126	653.0
		578	0	0	317 1)	134	645.0
South Abutment (B-02 and B-04)	776.50	236	0	0	130	75	702.5
		273	0	0	150	81	696.5
		309	0	0	170	86	691.5
		345	0	0	190 1)	107	670.5
		382	0	0	210 1)	107	670.5
		418	0	0	230 1)	111	666.5
		455	0	0	250 1)	112	665.5
		491	0	0	270 1)	116	661.5
		527	0	0	290 1)	121	656.5
		578	0	0	317 1)	129	648.5

1) Pile length and tip elevation is extrapolated from Boring B-01.

Table 4: Estimated Pile Lengths and Tip Elevations for MSP 14-inch Diameter with 0.312-inch walls

Structure Unit (Reference Boring)	Pile Cap Base Elevations (feet)	Required Nominal Bearing, R_N (kips)	Factored Geotechnical Loss (kips)	Factored Geotechnical Load Loss (kips)	Factored Resistance Available, R_F (kips)	Total Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
North Abutment (B-01 and B-03)	777.95	236	0	0	130	25	754.0
		273	0	0	150	27	752.0
		309	0	0	170	29	750.0
		345	0	0	190	30	749.0
		382	0	0	210	31	748.0
		418	0	0	230	32	747.0
		455	0	0	250	50	729.0
		491	0	0	270	51	728.0
		513	0	0	282	55	724.0
South Abutment (B-02 and B-04)	776.50	236	0	0	130	23	754.5
		273	0	0	150	25	752.5
		309	0	0	170	31	746.5
		345	0	0	190	33	744.5
		382	0	0	210	52	725.5
		418	0	0	230	55	722.5
		455	0	0	250	55	722.5
		491	0	0	270	55	722.5
		513	0	0	282	55	722.5

5.2.2 Lateral Loading

For a combination of MSE and deep foundation abutment, the majority of lateral load will be resisted by the soil reinforcement attached at the backface of abutments. As required by IDOT, the contract plans should include a note indicating the maximum horizontal service load applied to the abutments such that the load can be included during design (2012a). The lateral pile resistance for the abutments should be neglected.

5.3 Approach Slab

Two roadway borings, RB-02 and RB-05, were drilled approximately 30 feet and 60 feet from the existing abutment. The borings show medium dense fine sand and sandy loam below the pavement or aggregate shoulder. Due to the granular nature of the embankment soil, we estimate the settlement will be minimal and the foundation soils have a maximum factored bearing resistance of 2,500 psf.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Site Preparation

Vegetation, surface topsoil, existing pavement, and debris should be cleared and stripped where approach embankment fills, MSE walls, and bridge structures will be placed. The exposed subgrade should be evaluated by a qualified engineer using a dynamic or static cone penetrometer. Any unstable or unsuitable materials should be removed and replaced with compacted structural fill as described in Section 6.3.

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.

Groundwater was encountered at depths deeper than the base of the required excavations, and dewatering may not be required. During times of heavy precipitation, water allowed to accumulate in open excavations should be immediately removed by sump-pump.

No utility conflicts were identified that would impact the foundation design. However, the Contractor should ensure there are no utility conflicts during the final design and construction.

6.3 Filling and Backfilling

Fill material to attain the final design elevations should be structural fill material. Pre-approved, compacted, cohesive or granular soil conforming to IDOT Section 204 would be acceptable as structural fill (IDOT 2012b). The fill material should be free of organic matter and debris. The onsite clayey soil appears to be suitable as fill material. Structural fill should be placed in lifts and compacted according to Section 205, *Embankment* (IDOT 2012b).

All backfill materials must be pre-approved by the site engineer. To backfill the abutments we recommend the porous granular material conforming to the requirements specified in the IDOT Special Provision, *Granular Backfill for Structures* (2012). Backfill material should be placed and compacted in accordance with the Special Provision. Estimated design parameters for granular structural backfill materials are presented in Table 5.

Table 5: Estimated Granular Backfill Parameters

Soil Description	Porous Granular Material Backfill
Unit Weight	125 pcf
Angle of Effective Internal Friction	32°
Active Earth Pressure Coefficient	0.31 1)
Passive Earth Pressure Coefficient	3.26 1)
At-Rest Earth Pressure Coefficient	0.5

1) Straight backfill behind the wall

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 and replaced with structural fill according to Section 6.3. 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

Driven piles shall be furnished and installed according to the requirements of Section 512, *Piling* (IDOT 2012b) and steel H-piles shall be according to AASHTO M270, Grade 50. Wang recommends a minimum of one test pile be driven at each abutment location. Test piles should be driven to 110 percent of the nominal required bearing indicated above in Tables 2 through 4 of 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 bridge and MSE walls are planned, we should be timely informed so that our recommendations can be adjusted accordingly.

It has been a pleasure to assist CEMCON, Ltd. 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. Kurnia, P.E.
Geotechnical Engineer

Jerry WH Wang

Jerry W.H. Wang, PhD., P.E.
QA/QC Reviewer

Corina T. Farez, P.E., P.G.
Principal

JERRY W.H. WANG
062-034375

REFERENCES

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

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. Illinois State Geological Survey, Champaign, 116 pp.

IDOT, 1999, Geotechnical Manual, Illinois Department of Transportation.

IDOT, *2012a*, Bridge Manual, Illinois Department of Transportation.

IDOT, *2012b*, Standard Specifications for Road and Bridge Construction, Illinois Department of Transportation.

Johnson, W.H. and Hansel, A.K. 1990. Multiple Wisconsinan glacigenic sequences at Wedron, Illinois. *Journal of Sedimentary Petrology*, 60: 26-41.

Kulczycki, D., Gaskill, D., and Stravers, J., 2001. *Qaternary Geologic Map of the Fox Lake Quadrangle and Adjacent Areas, NE Illinois.* Illinois State Geological Survey,EDMAP, Fox Lake 1:24:000

Larsen, J.I. 1973. *Geology for Planning in Lake County, Illinois*. ISGS Circular C481. Illinois State Geological Survey, Urbana, 43 pp.

Lundstrom, Scott C., Williams, Van S., Stone, Byron D., and Kincare, Kevin A., (1) US Geol Survey, Michigan Geol Survey, Lansing, MI; North-Central Section - 35th Annual Meeting (April 23-24, 2001)

EXHIBITS

SITE LOCATION MAP: US ROUTE 12 OVER ILLINOIS ROUTE 59,
LAKE COUNTY, ILLINOIS

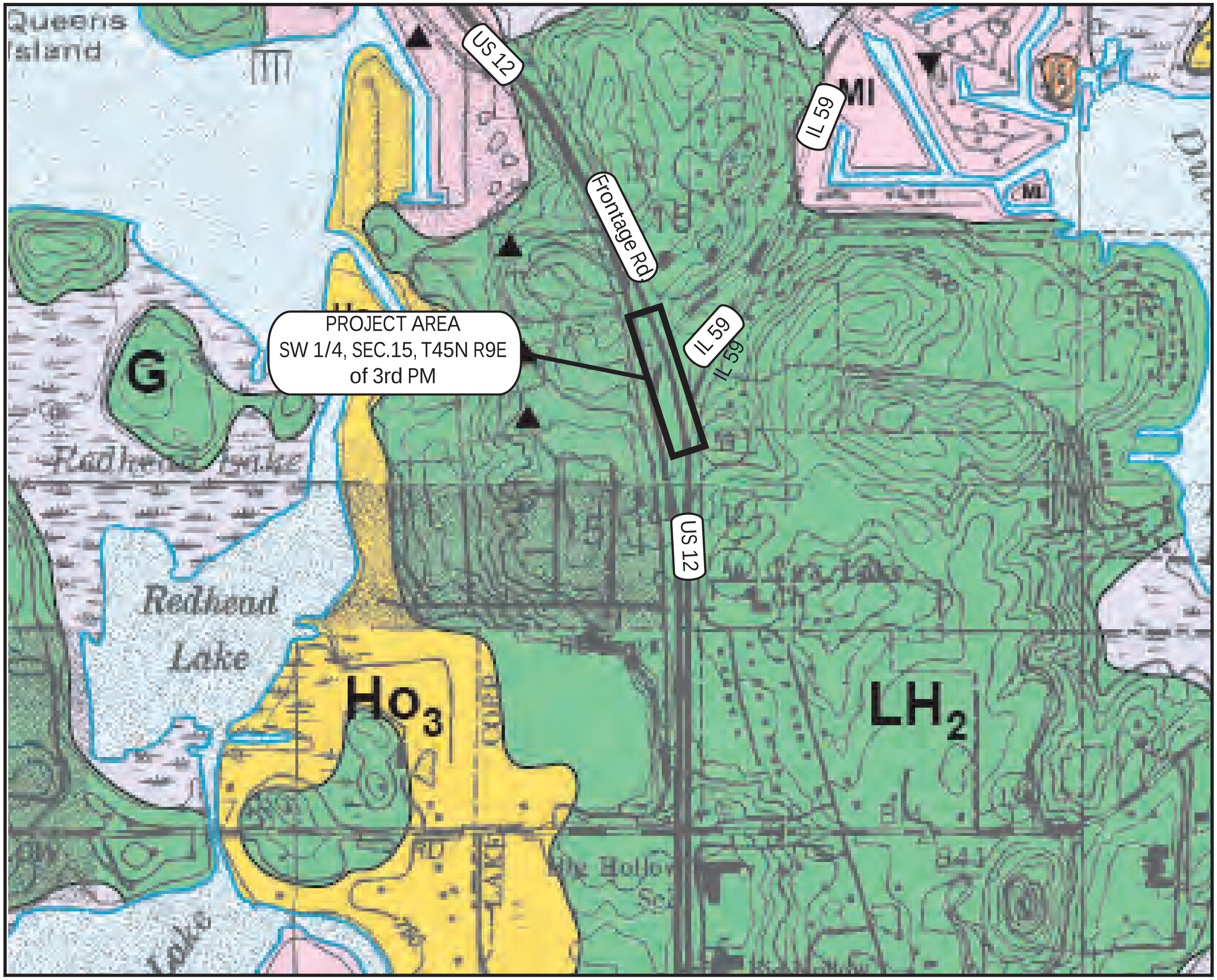
SCALE: GRAPHICAL	**EXHIBIT 1**	DRAWN BY: H. Bista CHECKED BY: A. Kurnia

Wang Engineering

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

FOR CEMCON, LTD.

303-08-01



PROJECT AREA
SW 1/4, SEC.15, T45N R9E
of 3rd PM

REGIONAL GEOLOGY

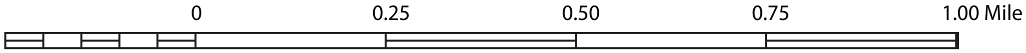
Wedron Group

- 🟩 Wadsworth Formation
- 🟩 Lemont Formation
- 🟩 Tiskilwa Formation

Modified after Hansel and Johnson (1996)

LEGEND

MI	**Made / Disturbed Land;** Primarily areas where swamps and lowlands were filled.
G	**Grayslake Peat;** Peat and organic rich fluvial or lacustrine sediment. Dpeosited in glacial and halocene lake basins and shallow gradient flood plains
Ho_3	**Henry Formation;** Stratified sand and gravel deposited as glacial outwash deposits.
LH_2	**Haeger Member of the Lemont Formation** Sandy to sandy loam diamiction with numerous intrastratified sand and gravel beds



SITE AND REGIONAL GELOGY: US ROUTE12 OVER ILLINOIS ROUTE 59, LAKE COUNTY, ILLINOIS

SCALE: GRAPHICAL

EXHIBIT 2

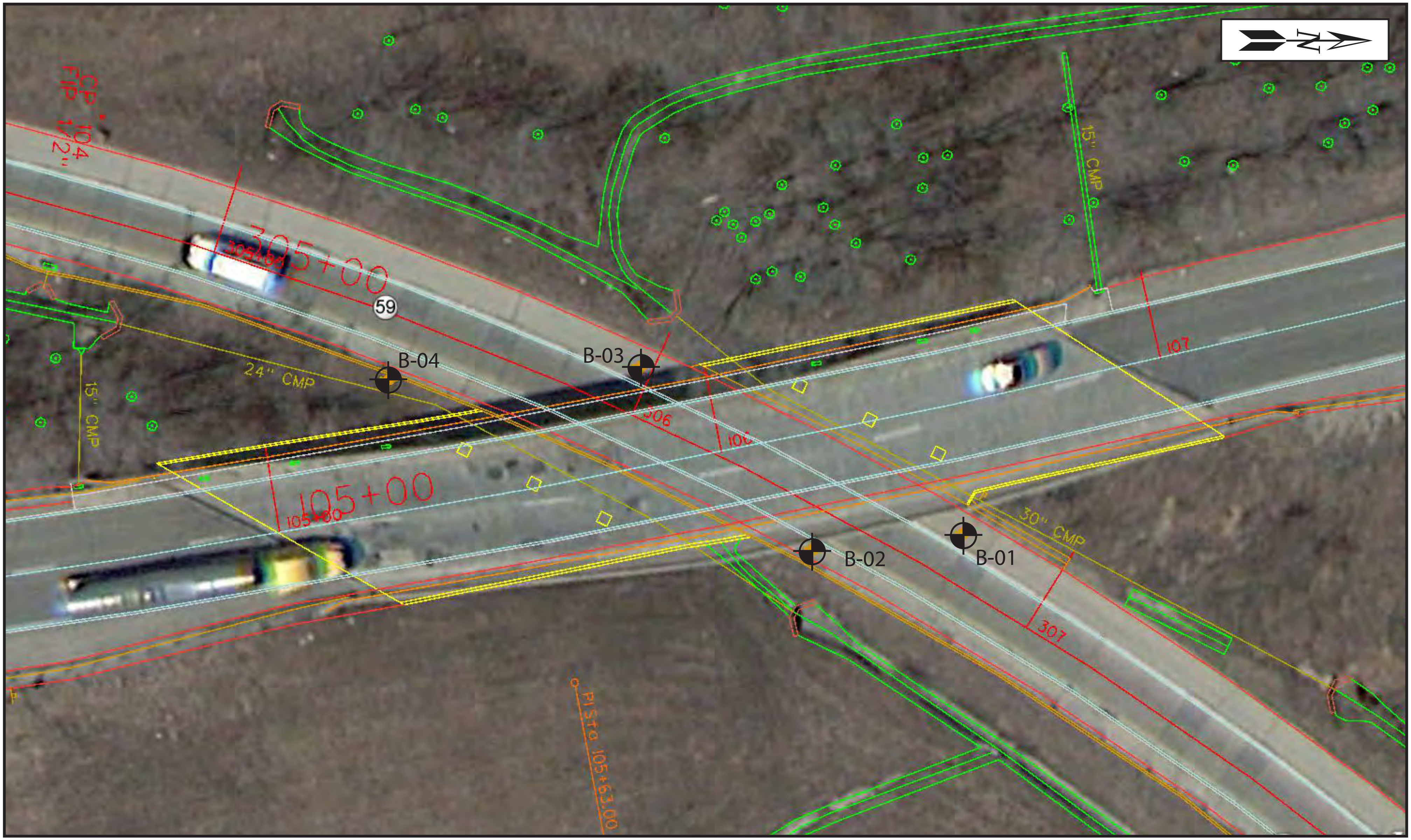
DRAWN BY: E. Datz
CHECKED BY: A. Kurnia

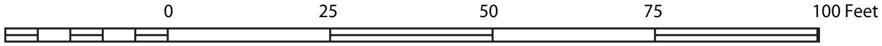
Wang Engineering

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

FOR CEMCON, LTD.

303-08-01





BORING LOCATION PLAN: US ROUTE12 OVER ILLINOIS ROUTE 59,
LAKE COUNTY, ILLINOIS

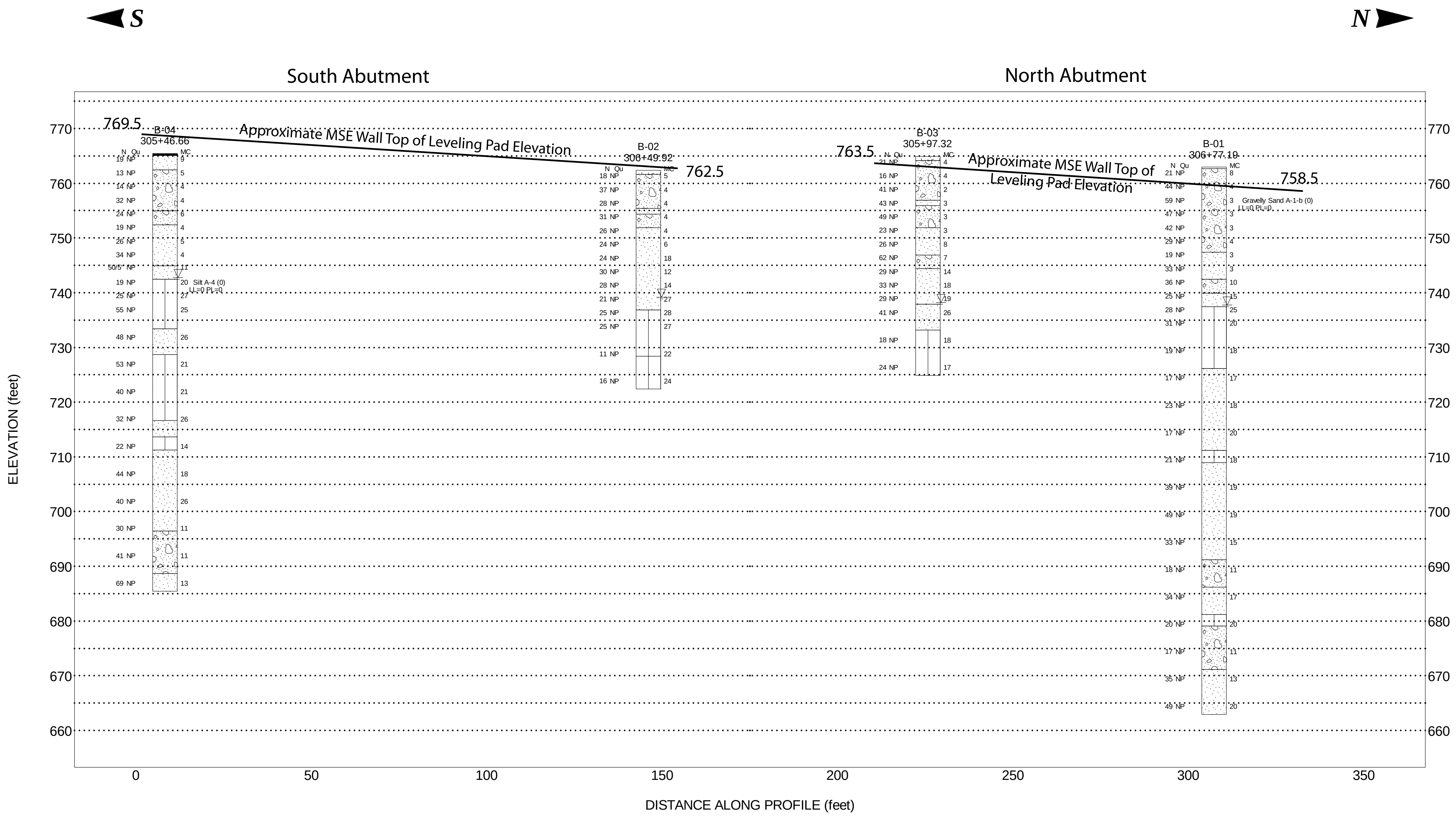
SCALE: GRAPHICAL	**EXHIBIT 3**	DRAWN BY: E. Datz CHECKED BY: A. Kurnia

Wang Engineering

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

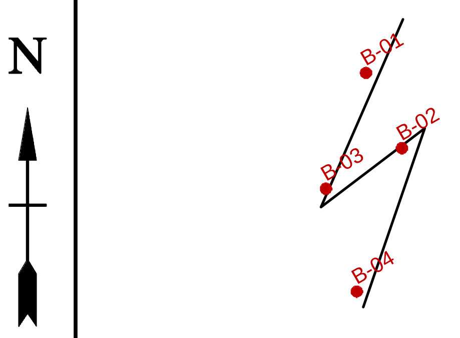
FOR CEMCON, LTD.

303-08-01



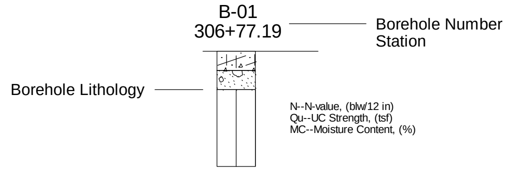
Lithology Graphics

- ▨ Pavement
- ▨ Gravelly sand, sandy gravel
- ▨ IDH Sand, Sandy Loam
- ▥ IDH Silt, Silty Loam
- ■ Topsoil



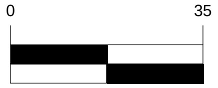
Site Map Scale 1 inch equals 130 feet

Explanation:



▽ Water Level Reading at time of drilling.

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



Horizontal Scale (feet)

Vertical Exaggeration: 1.5x

Wang Engineering, Inc.
1145 N Main Street
Lombard, IL 60148

Soil Profile
SN. 049-0601

WEI
SINCE 1982

US Route 12 over IL Route 59
Fox Lake, IL

JOB NUMBER	PLATE NUMBER
303-08-01	EXHIBIT 4

WEI 11X17 3030801.GPJ WANGENG.GDT 11/5/14

APPENDIX A

Wang Engineering

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

BORING LOG B-01

WEI Job No.: 303-08-01

Client **CEMCON, Ltd.**
Project **US Route 12 over IL Route 59**
Location **Fox Lake, IL**

Datum: NGVD
Elevation: 762.93 ft
North: 2080235.54 ft
East: 1028448.52 ft
Station: 306+77.19
Offset: 10.58 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	762.7	3-inch thick ASPHALT --PAVEMENT--						
		Medium dense to very dense, brown to gray, SANDY GRAVEL and CRUSHED STONE		☒	1	10 10 11	NP	8
		--moist-- --FILL--	5	☒	2	11 23 21	NP	4
		--dry--		☒	3	10 20 39	NP	3
			10	☒	4	17 20 27	NP	3
				☒	5	7 21 21	NP	3
		--dry-	15	☒	6	10 9 20	NP	4
	747.4	Medium dense to dense, brown, fine to coarse, SAND --moist--		☒	7	7 8 11	NP	3
		--with gravel--	20	☒	8	9 16 17	NP	3
	742.4	Dense, gray SANDY GRAVEL --wet--		☒	9	15 19 17	NP	10
	739.9	Medium dense, brown to gray, medium to coarse SAND, trace gravel --wet--	25	☒	10	10 10 15	NP	15

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	737.4	Medium dense to dense, brown to gray SILT --saturated--	▽	☒	11	11 12 16	NP	25
			30	☒	12	10 13 18	NP	20
			35	☒	13	9 10 9	NP	18
	726.2	Medium dense, gray, fine SAND --saturated--						
			40	☒	14	7 6 11	NP	17
			45	☒	15	8 12 11	NP	18
		-- with silt laminations--	50	☒	16	10 9 8	NP	20

GENERAL NOTES

Begin Drilling **10-20-2014** Complete Drilling **10-20-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **H. Bista** Checked by **E. Datz**
Drilling Method **2.25 IDA HSA, 140 lb auto, 30" drop, 2" DIA SS; Backfilled with soil cuttings**

WATER LEVEL DATA

While Drilling ▽ **25.50 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.

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

BORING LOG B-01

WEI Job No.: 303-08-01

Client **CEMCON, Ltd.**
Project **US Route 12 over IL Route 59**
Location **Fox Lake, IL**

Datum: NGVD
Elevation: 762.93 ft
North: 2080235.54 ft
East: 1028448.52 ft
Station: 306+77.19
Offset: 10.58 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	711.2	Medium dense, gray SILT						
	708.9	Dense, gray, very fine to medium SAND --saturated--	55		17	5 7 14	NP	18
			60		18	15 19 20	NP	19
			65		19	19 23 26	NP	19
			70		20	12 14 19	NP	15
	691.2	Medium dense, gray SANDY GRAVEL --wet--	75		21	7 10 8	NP	11
	686.2	Dense, gray, coarse SAND --saturated--	80		22	15 17 17	NP	17
	681.2	Medium dense, gray SILT						
	679.1	Medium dense, gray SANDY GRAVEL --wet--	85		23	10 10 10	NP	20
			90		24	11 9 8	NP	11
	671.2	Dense, gray, medium to coarse SAND, trace gravel --saturated--	95		25	16 17 18	NP	13
			100		26	17 20 29	NP	20
	662.9	Boring terminated at 100.00 ft						

GENERAL NOTES

Begin Drilling **10-20-2014** Complete Drilling **10-20-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **H. Bista** Checked by **E. Datz**
Drilling Method **2.25 IDA HSA, 140 lb auto, 30" drop, 2" DIA SS;**
Backfilled with soil cuttings

WATER LEVEL DATA

While Drilling ▽ **25.50 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.

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

BORING LOG B-02

WEI Job No.: 303-08-01

Client **CEMCON, Ltd.**
Project **US Route 12 over IL Route 59**
Location **Fox Lake, IL**

Datum: NGVD
Elevation: 762.38 ft
North: 2080185.35 ft
East: 1028472.57 ft
Station: 306+49.92
Offset: 9.01 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	761.6	9-inch thick ASPHALT --PAVEMENT--						
		Medium dense to dense, brown and gray SANDY GRAVEL --POSSIBLE FILL			1	6 9 9	NP	5
		-moist--	5		2	10 15 22	NP	4
	755.4				3	14 16 12	NP	4
	754.4	Medium dense, brown, fine SAND --moist--						
		Dense, brown and gray SANDY GRAVEL	10		4	10 18 13	NP	4
	751.9	Medium dense to dense, brown and gray, medium to coarse, fine SAND, little gravel			5	6 10 16	NP	4
			15		6	9 10 14	NP	6
					7	8 9 15	NP	18
			20		8	8 14 16	NP	12
					9	10 13 15	NP	14
		--saturated-- ∇	25		10	9 9 12	NP	27
	736.9	Medium dense, yellow, brown and gray SILT, saturated			11	10 11 14	NP	28
			30		12	13 11 14	NP	27
	728.4	Medium dense, gray SILTY LOAM --saturated--	35		13	4 5 6	NP	22
	722.4		40		14	9 6 10	NP	24
		Boring terminated at 40.00 ft						
			45					
			50					

GENERAL NOTES

Begin Drilling **10-22-2014** Complete Drilling **10-22-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **H. Bista** Checked by **E. Datz**
Drilling Method **2.25 IDA HSA, 140 lb auto, 30" drop, 2" DIA SS;**
Backfilled with soil cuttings and bentonite chips

WATER LEVEL DATA

While Drilling ∇ **23.50 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.

Wang Engineering

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

BORING LOG B-03

WEI Job No.: 303-08-01

Client **CEMCON, Ltd.**
Project **US Route 12 over IL Route 59**
Location **Fox Lake, IL**

Datum: NGVD
Elevation: 764.91 ft
North: 2080158.21 ft
East: 1028421.81 ft
Station: 305+97.32
Offset: 10.44 LT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
764.2	9-inch thick ASPHALT --PAVEMENT--						
	Medium dense to dense, brown and gray, SANDY GRAVEL and CRUSHED STONE --moist-- --FILL--			1	9 10 11	NP	4
		5		2	5 7 9	NP	4
				3	8 19 22	NP	2
756.9	Dense, brown and gray, medium SAND, little gravel --moist--						
755.9	Dense, brown and gray SANDY GRAVEL --moist--	10		4	8 19 24	NP	3
				5	17 22 27	NP	3
751.9	Medium dense, gray medium SAND, trace gravel --moist--	15		6	9 10 13	NP	3
				7	10 11 15	NP	8
746.9	Very dense, gray SANDY GRAVEL --moist--	20		8	23 36 26	NP	7
744.4	Medium dense to dense, brown and gray, fine to medium SAND, trace gravel --moist-- --wet--			9	15 14 15	NP	14
		25		10	12 15 18	NP	18
				11	9 14 15	NP	19
737.9	Medium dense to dense, brown and gray, medium to coarse SAND to SANDY LOAM --saturated--	30		12	10 18 23	NP	26
733.2	Medium dense, gray SILT --saturated--	35		13	8 8 10	NP	18
		40		14	11 11 13	NP	17
724.9	Boring terminated at 40.00 ft						
		45					
		50					

GENERAL NOTES

Begin Drilling **10-22-2014** Complete Drilling **10-22-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **H. Bista** Checked by **E. Datz**
Drilling Method **2.25 IDA HSA, 140 lb auto, 30" drop, 2" DIA SS; Backfilled with soil cuttings and bentonite chips**

WATER LEVEL DATA

While Drilling ▽ **27.00 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.

Wang Engineering

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

BORING LOG B-04

WEI Job No.: 303-08-01

Client **CEMCON, Ltd.**
Project **US Route 12 over IL Route 59**
Location **Fox Lake, IL**

Datum: NGVD
Elevation: 765.44 ft
North: 2080089.60 ft
East: 1028442.45 ft
Station: 305+46.66
Offset: 13.93 RT

Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
765.1	4-inch thick, dark brown, SANDY LOAM, little gravel --TOPSOIL--						
	Medium dense, yellow brown, fine SAND, little gravel --moist-- --FILL--		☒	1	6 8 11	NP	9
762.4	Medium dense to dense, brown SANDY GRAVEL and CRUSHED STONE --FILL-- --moist--	5	☒	2	8 6 7	NP	5
			☒	3	6 5 9	NP	4
		10	☒	4	12 19 13	NP	4
754.9	Medium dense, brown SANDY GRAVEL --moist--		☒	5	9 13 11	NP	6
752.4	Medium dense to dense, brown and gray, medium to coarse SAND, trace gravel --moist--	15	☒	6	4 8 11	NP	4
			☒	7	8 12 14	NP	5
	--interbedded silt--	20	☒	8	12 16 18	NP	4
744.9	Very dense, brown SANDY LOAM, some gravel --wet--		☒	9	28 50/5"	NP	11
742.4	Medium to very dense, brown SILT, trace gravel --wet--	25	☒	10	13 10 9	NP	20
			☒	11	8 9 16	NP	27
		30	☒	12	28 24 31	NP	25
733.4	Dense, brown, fine SAND to SANDY LOAM --saturated--	35	☒	13	22 24 24	NP	26
728.7	Dense to very dense, gray SILTY LOAM --saturated--	40	☒	14	19 25 28	NP	21
		45	☒	15	14 16 24	NP	21
716.6	Dense, gray, coarse SAND --saturated--	50	☒	16	15 14 18	NP	26

GENERAL NOTES

Begin Drilling **10-21-2014** Complete Drilling **10-21-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **H. Bista** Checked by **E. Datz**
Drilling Method **2.25 IDA HSA, 140 lb auto, 30" drop, 2" DIA SS; Backfilled with soil cuttings**

WATER LEVEL DATA

While Drilling ▽ **23.00 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.

Wang Engineering

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

BORING LOG B-04

WEI Job No.: 303-08-01

Client **CEMCON, Ltd.**
Project **US Route 12 over IL Route 59**
Location **Fox Lake, IL**

Datum: NGVD
Elevation: 765.44 ft
North: 2080089.60 ft
East: 1028442.45 ft
Station: 305+46.66
Offset: 13.93 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	713.7	Medium dense, gray SILT to SILTY LOAM --wet--						
	711.3	Medium dense to dense, gray, medium to coarse SAND	55	☒	17	7 8 14	NP	14
			60	☒	18	12 21 23	NP	18
			65	☒	19	15 17 23	NP	26
	696.4	Dense, gray SANDY GRAVEL --wet--	70	☒	20	9 13 17	NP	11
			75	☒	21	17 23 18	NP	11

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	688.7	Very dense, gray SANDY LOAM and gravel --wet--		☒	22	34 36 33	NP	13
	685.4	Boring terminated at 80.00 ft	80					
			85					
			90					
			95					
			100					

GENERAL NOTES

Begin Drilling **10-21-2014** Complete Drilling **10-21-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **H. Bista** Checked by **E. Datz**
Drilling Method **2.25 IDA HSA, 140 lb auto, 30" drop, 2" DIA SS; Backfilled with soil cuttings**

WATER LEVEL DATA

While Drilling ▽ **23.00 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.

Wang Engineering

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

BORING LOG RB-02

WEI Job No.: 303-08-01

Client **CEMCON, Ltd.**
Project **US Route 12 over IL Route 59**
Location **Fox Lake, IL**

Datum: NGVD
Elevation: 783.23 ft
North: 2080015.97 ft
East: 1028509.72 ft
Station: N/A
Offset: N/A

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	782.7	7-inch thick ASPHALT --PAVEMENT--						
	780.2	Medium dense, brown SANDY LOAM, trace gravel --FILL--			1	6 6 7 7	NP	10
	778.2	Medium dense, brown, very fine SAND, trace gravel --FILL--	▽ 5		2	9 8 7 7	NP	20
	776.2	Loose, brown SILTY LOAM --saturated--			3	3 2 3 3	NP	19
	774.7	Stiff, brown SILTY CLAY, interbedded with silt and sand			4	4 4 10 11	1.50 P	20
		Medium dense, brown SANDY GRAVEL --dry--	10		5	10 11 16 17	NP	4
					6	14 12 12 12	NP	3
	768.2		15		7	7 14 11 12	NP	4
		Boring terminated at 15.00 ft	20 25					

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 **10-23-2014** Complete Drilling **10-23-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **H. Bista** Checked by **MDLR**
Drilling Method **2.25 IDA HSA, 140 lb auto, 30" drop, 2" DIA SS;**
Backfilled with soil cuttings and bentonite chips

WATER LEVEL DATA

While Drilling ▽ **4.00 ft**
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 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

BORING LOG RB-03

WEI Job No.: 303-08-01

Client **CEMCON, Ltd.**
Project **US Route 12 over IL Route 59**
Location **Fox Lake, IL**

Datum: NGVD
Elevation: 785.14 ft
North: 2080280.86 ft
East: 1028388.79 ft
Station: N/A
Offset: N/A

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type *recovery*	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	784.1	3-inch thick, brown, coarse SAND over 9-inch thick, brown SANDY LOAM --SHOULDER--			1	6 7 7 7	NP	9
	781.9	Medium dense, brown, fine SAND --moist--			2	4 2 2 2	NP	15
	780.1	Loose, brown SANDY LOAM, trace gravel --moist--	5		3	0 2 3 2	1.00 P	28
	779.4	Stiff, brown SILTY CLAY						
		Loose, brown SANDY LOAM, trace gravel --moist--			4	4 3 4 5	NP	9
	776.1	Medium dense, brown, fine to coarse SAND --moist--	10		5	3 3 3 3	NP	4
					6	5 8 9 8	NP	4
	770.1		15		7	6 5 6 5	NP	11
		Boring terminated at 15.00 ft						
			20					
			25					

GENERAL NOTES

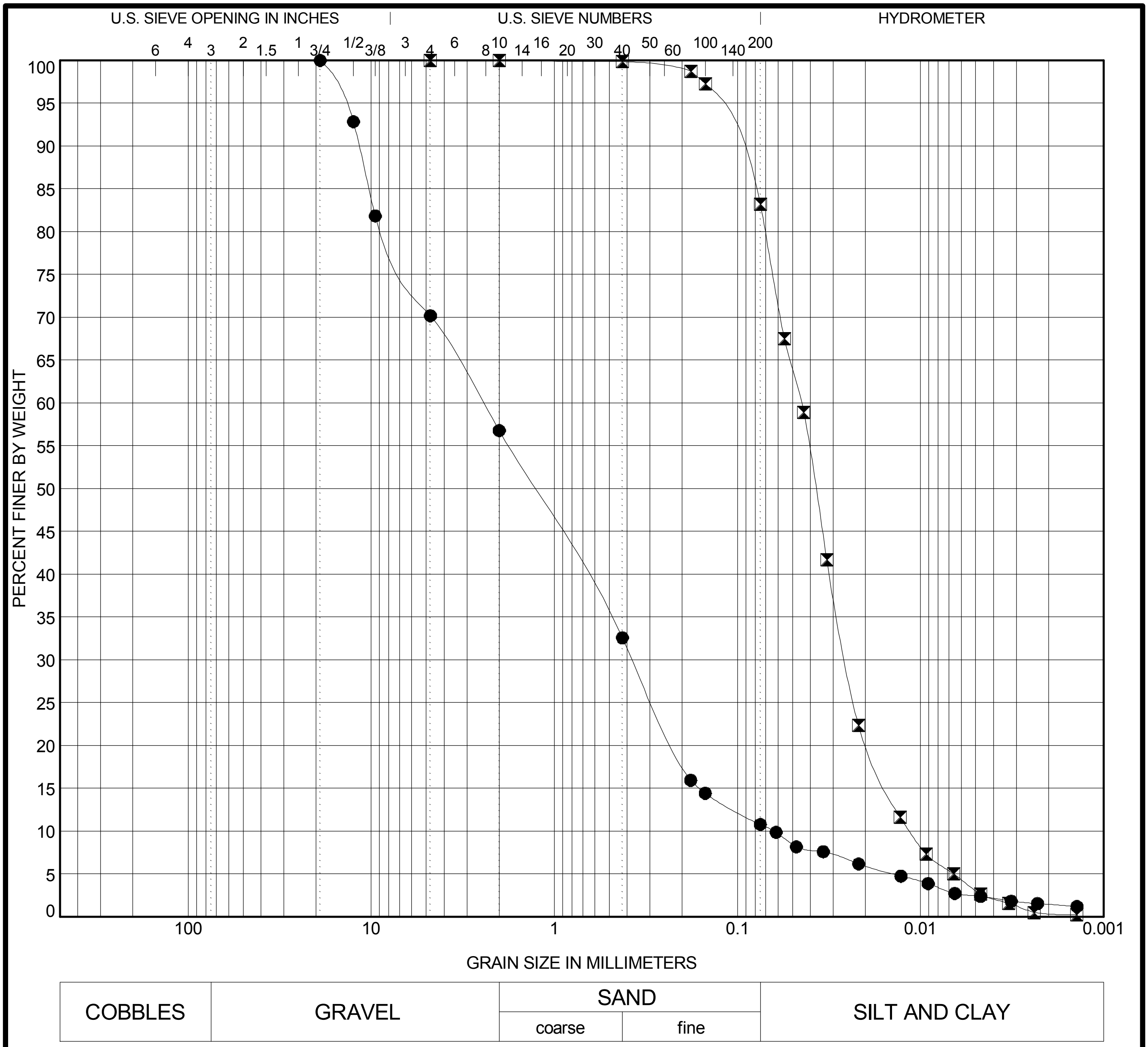
Begin Drilling **10-23-2014** Complete Drilling **10-23-2014**
Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR**
Driller **R&J** Logger **H. Bista** Checked by **MDLR**
Drilling Method **2.25 IDA HSA, 140 lb auto, 30" drop, 2" DIA SS; Backfilled with soil cuttings and bentonite chips**

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.

APPENDIX B



	Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
●	**B-01#3**	**6.0 ft**	**Gravelly Sand**	**NP**	**NP**	**NP**	**0.89**	**38.90**
⧗	**B-04#10**	**23.5 ft**	**Silt**	**NP**	**NP**	**NP**	**1.28**	**3.92**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-01#3**	**6.0 ft**	**19**	**2.462**	**0.372**	**0.063**	**43.2**	**46.1**	**9.3**	**1.5**
⧗	**B-04#10**	**23.5 ft**	**4.75**	**0.045**	**0.026**	**0.011**	**0.0**	**17.5**	**82.1**	**0.4**

WEI
SINCE 1982

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

GRAIN SIZE DISTRIBUTION

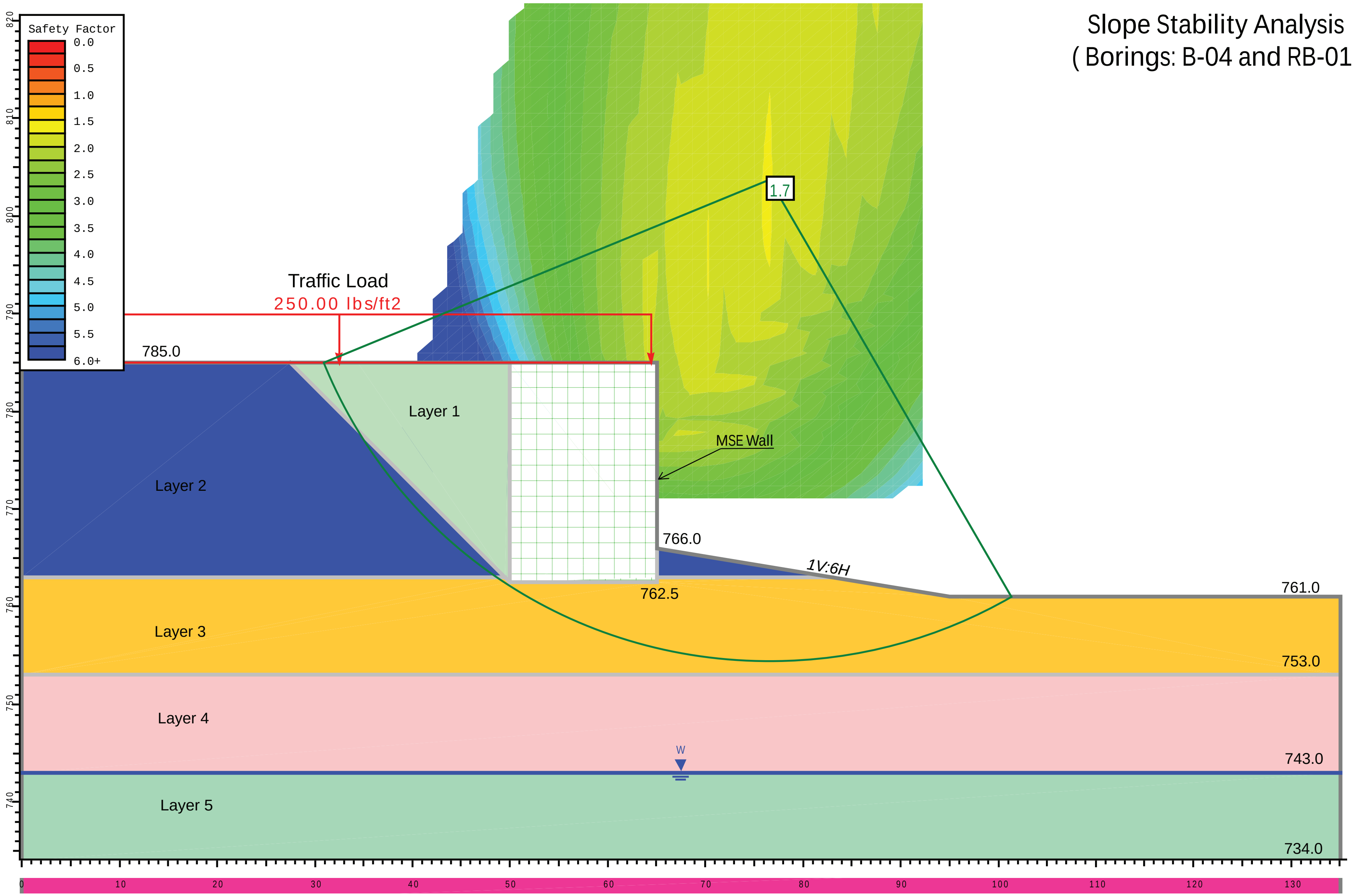
Project: US Route 12 over IL Route 59

Location: Fox Lake, IL

Number: 303-08-01

APPENDIX C

Slope Stability Analysis
(Borings: B-04 and RB-01)



Soil Properties:

Layer ID	Soil Type	Unit Weight	Soil Parameters	
		(pcf)	C (psf)	ϕ(deg.)
1	Porous Granular BACKFILL	125	0	32
2	Medium Dense Fine SAND	120	0	31
3	Medium Dense to Dense SANDY GRAVEL	120	0	33
4	Medium Dense to Dense SAND to SANDY LOAM	120	0	34
5	Medium Dense to Very Dense SILT	120	0	35

SLOPE STABILITY ANALYSIS: US ROUTE 12 OVER ILLINOIS ROUTE 59, LAKE COUNTY, ILLINOIS

SCALE: GRAPHIC

APPENDIX C

DRAWN BY: H. Bista
CHECKED BY: A. Kurnia

Wang Engineering

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

FOR CEMCON, LTD.

303-08-01

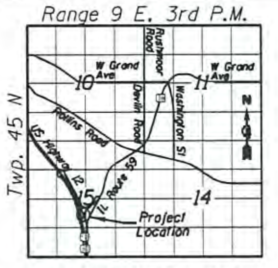
APPENDIX D

APPENDIX D

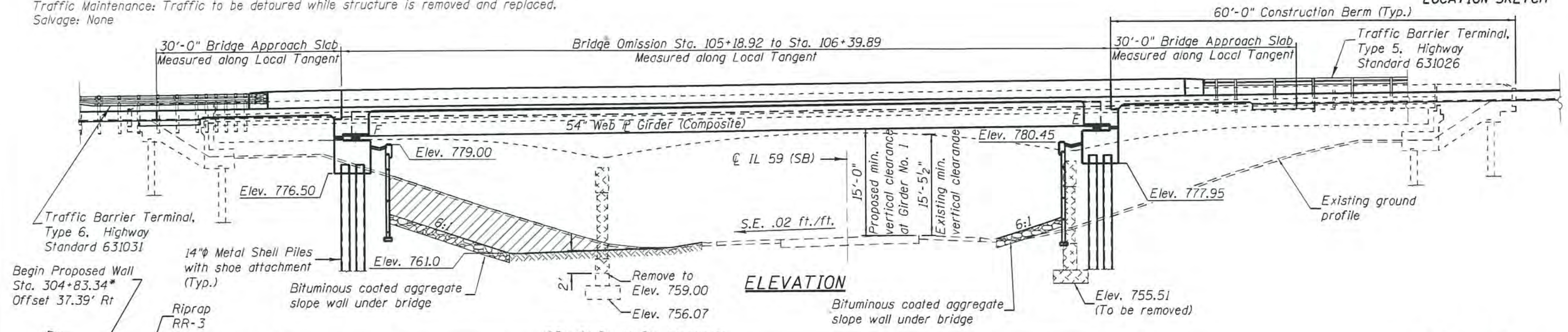
Benchmark:
TBM1 R.R. Spike 1' above finished grade in west face of 1st utility pole north of Willow Road on east side of east Frontage Road.
Elevation=786.05 (NAVD 88)

TBM7 R.R. Spike 1' above finished grade in west face of 1st utility pole south of Windsor Drive on west side of east Frontage Road.
Elevation=790.08 (NAVD 88)

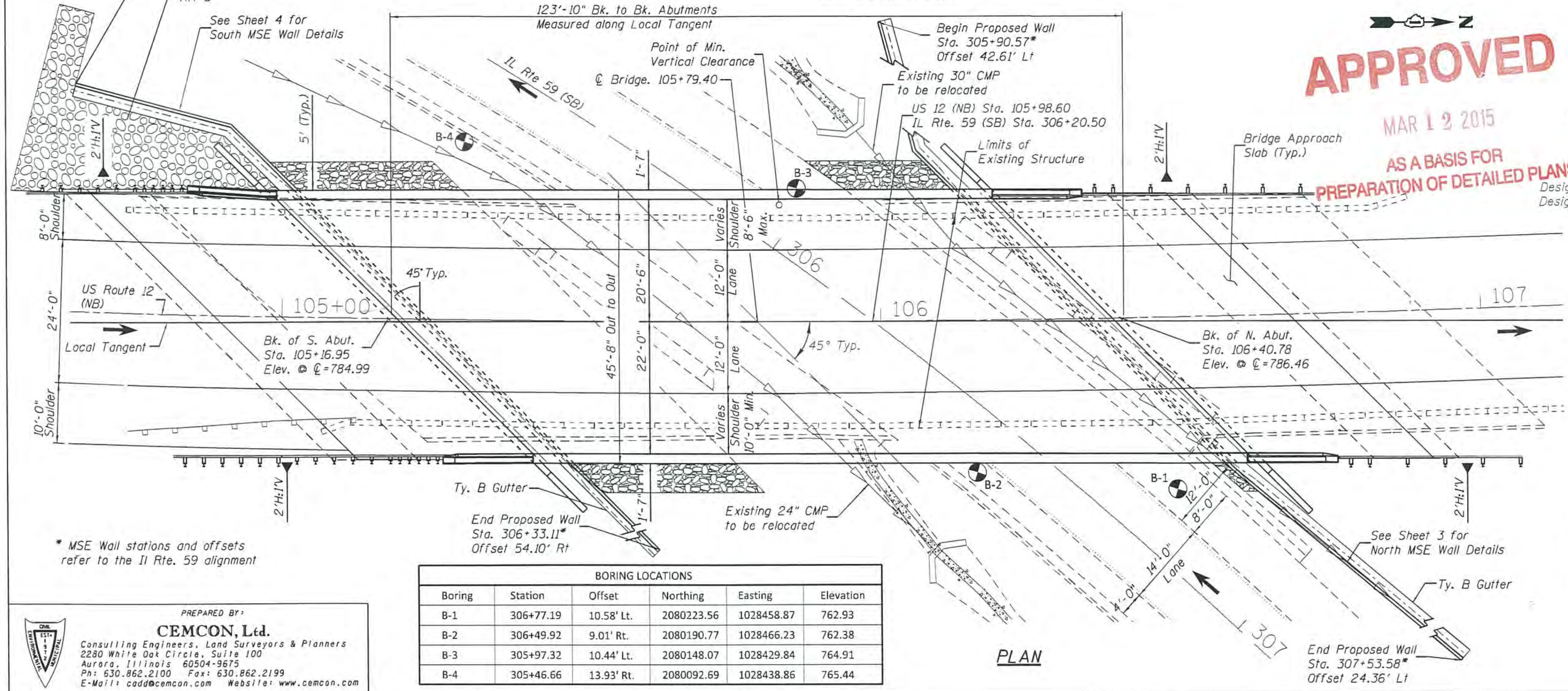
Existing Structure No. 049-0020, Built in 1966 as SBI Rt. 59
3-Span reinforced concrete haunched girder bridge on 3 column hammerhead piers and pile bent abutments supported on concrete piles.
The Structure is 200'-6" Bk.-Bk. and overall deck width is 36'-0".
Traffic Maintenance: Traffic to be detoured while structure is removed and replaced.
Salvage: None



LOCATION SKETCH



ELEVATION



PLAN

* MSE Wall stations and offsets refer to the Il Rte. 59 alignment

APPROVED
MAR 1 2 2015
AS A BASIS FOR
PREPARATION OF DETAILED PLANS

HIGHWAY CLASSIFICATION

US 12 (FAP 334)
Functional Class: Principal Arterial
ADT: (1-Way) 9,650 (2013)
11,019 (2032)
ADTT: 5%
DHV: 1,100 (2032)
Design Speed: 50 mph
Posted Speed: 45 mph
One-Way Traffic (Northbound)

HIGHWAY CLASSIFICATION

IL 59 (SB)
Functional Class: Principal Arterial
ADT: (1-Way) 11,000 (2013)
12,557 (2032)
ADTT: 3%
DHV: 1,250 (2032)
Design Speed: 50 mph
Posted Speed: 45 mph
One -Way Traffic (Southbound)

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge
Design Specifications, 7th Edition

DESIGN STRESSES

FIELD UNITS

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

PRECAST UNITS

f'c = 4,500 psi (Precast Panels)

LOADING HL-93

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

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.076g
Design Spectral Acceleration at 0.2 sec. (S_{DS}) = 0.127g
Soil Site Class = D

HORIZONTAL CURVE DATA

US 12 NORTHBOUND	IL 59 SOUTHBOUND
PI STA. = 105+63.00	PI STA. = 307+09.96
Δ = 18° 00' 54" (LT)	Δ = 66° 16' 54" (RT)
D = 1° 36' 48"	D = 7° 07' 10"
R = 3,551.60'	R = 804.78'
T = 563.00'	T = 525.44'
L = 1,116.71'	L = 930.99'
E = 44.35'	E = 156.35'
P.C. STA. = 100+00.00	P.C. STA. = 301+84.52
P.T. STA. = 111+16.71	P.T. STA. = 311+15.51
S.E. = 0.02 ft./ft.	S.E. = 0.02 ft./ft.

GENERAL PLAN AND ELEVATION
US 12 (NB) OVER IL 59 (SB)
FAP RTE 334 SEC. 22-2HB-1
LAKE COUNTY
STATION 105+79.40
STRUCTURE NO. 049-0601

BORING LOCATIONS

Boring	Station	Offset	Northing	Easting	Elevation
B-1	306+77.19	10.58' Lt.	2080223.56	1028458.87	762.93
B-2	306+49.92	9.01' Rt.	2080190.77	1028466.23	762.38
B-3	305+97.32	10.44' Lt.	2080148.07	1028429.84	764.91
B-4	305+46.66	13.93' Rt.	2080092.69	1028438.86	765.44

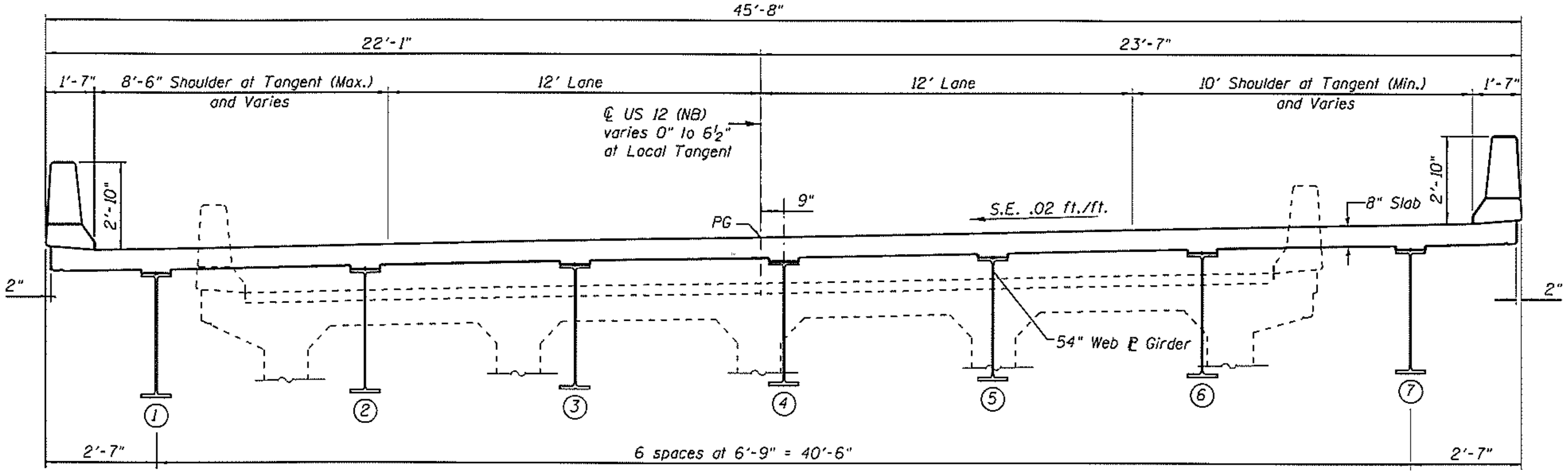
PREPARED BY:
CEMCON, Ltd.
Consulting Engineers, Land Surveyors & Planners
2280 White Oak Circle, Suite 100
Aurora, Illinois 60504-9675
Ph: 630.862.2100 Fax: 630.862.2199
E-Mail: cadd@cemcon.com Website: www.cemcon.com

FILE NAME =	USER NAME = RDS	DESIGNED - NRF	REVISED -
		CHECKED - MAM	REVISED -
	PLOT SCALE =	DRAWN - RDS	REVISED -
	PLOT DATE =	CHECKED - 03-10-15	REVISED -

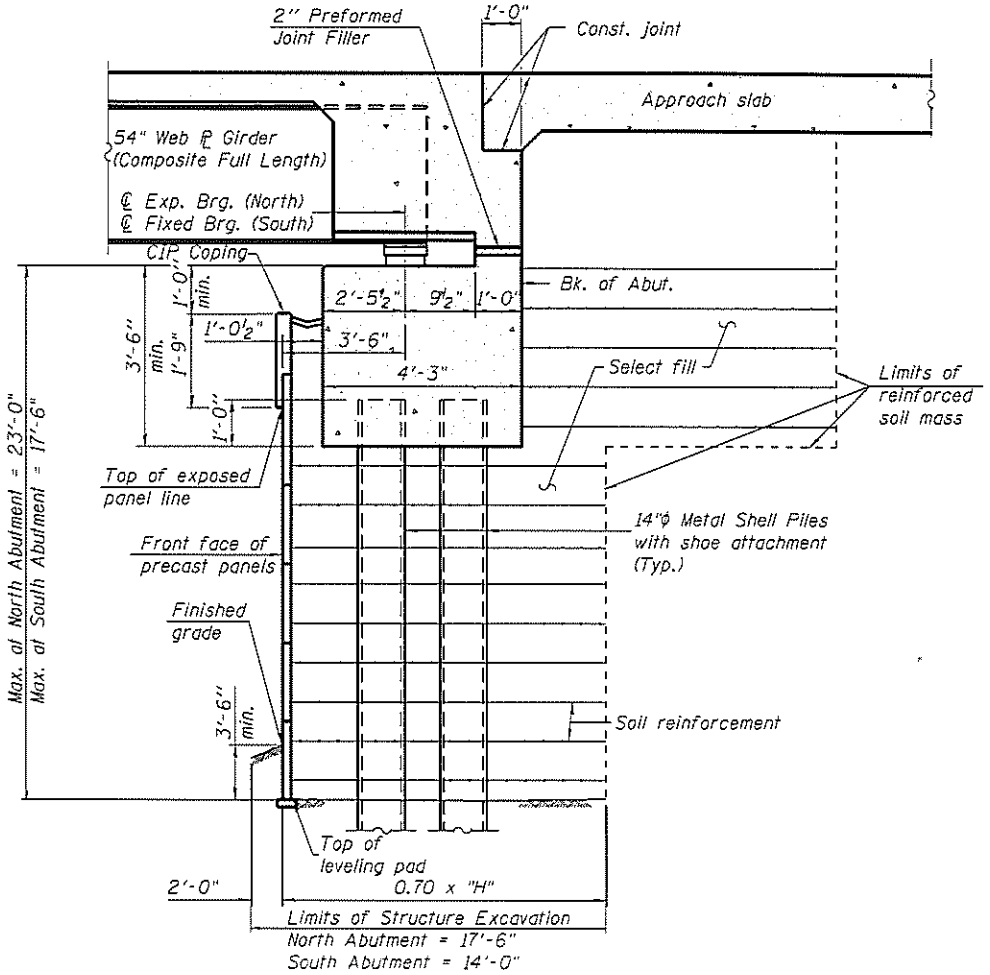
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
334	22-2HB-1	LAKE	4	1
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT			

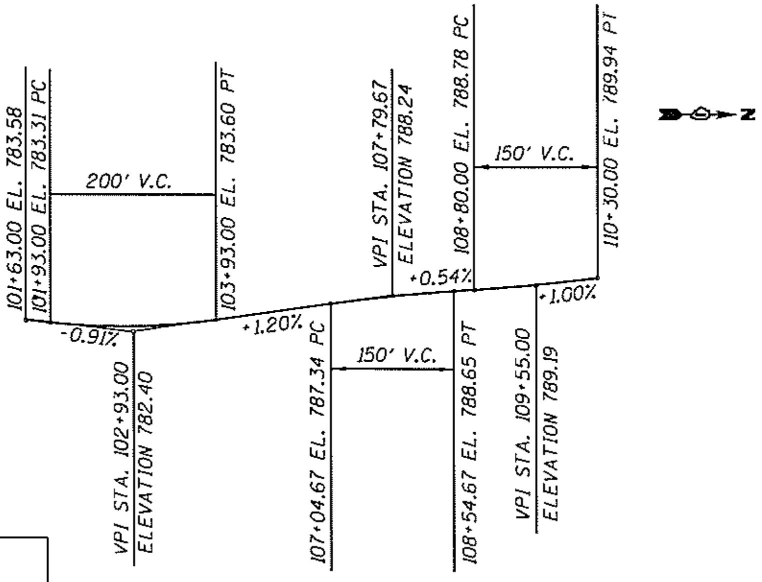


CROSS SECTION
(Looking North)

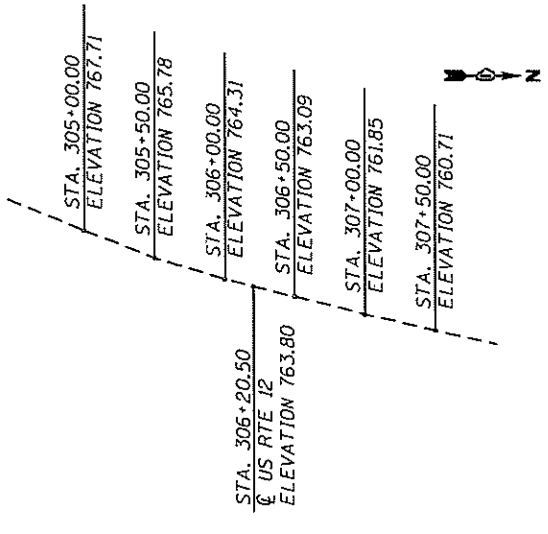


SECTION THRU SEMI-INTEGRAL ABUTMENT
(Horiz. dim. @ Rt. L's)

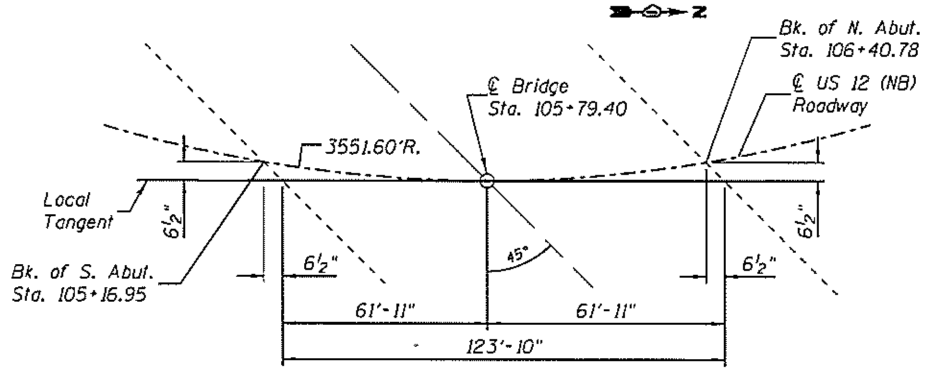
Note: The MSE Wall Supplier shall design the soil abutment soil reinforcement to resist a horizontal force of _____ k/ft. of abutment.



US 12 (NB) PROPOSED PROFILE GRADE



IL RTE 59 (SB) EXISTING PROFILE GRADE

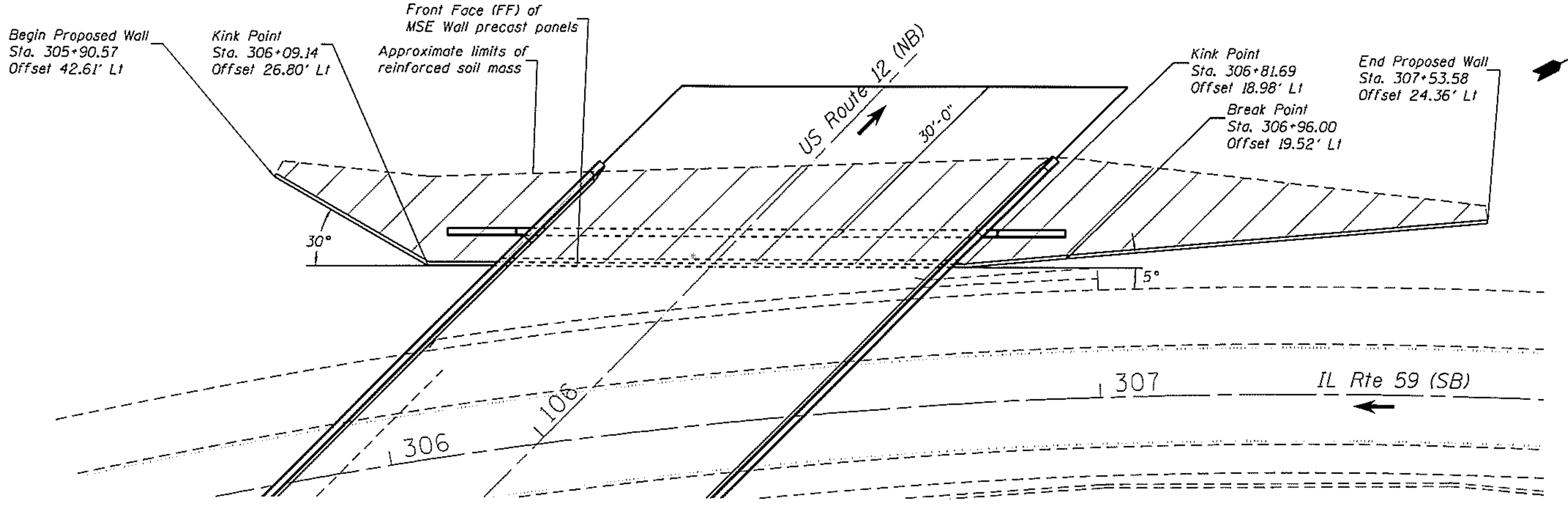


OFFSET SKETCH

PREPARED BY:
CEMCON, Ltd.
Consulting Engineers, Land Surveyors & Planners
2280 White Oak Circle, Suite 100
Aurora, Illinois 60504-9675
Ph: 630.862.2100 Fax: 630.862.2199
E-Mail: cadd@cemcon.com Website: www.cemcon.com

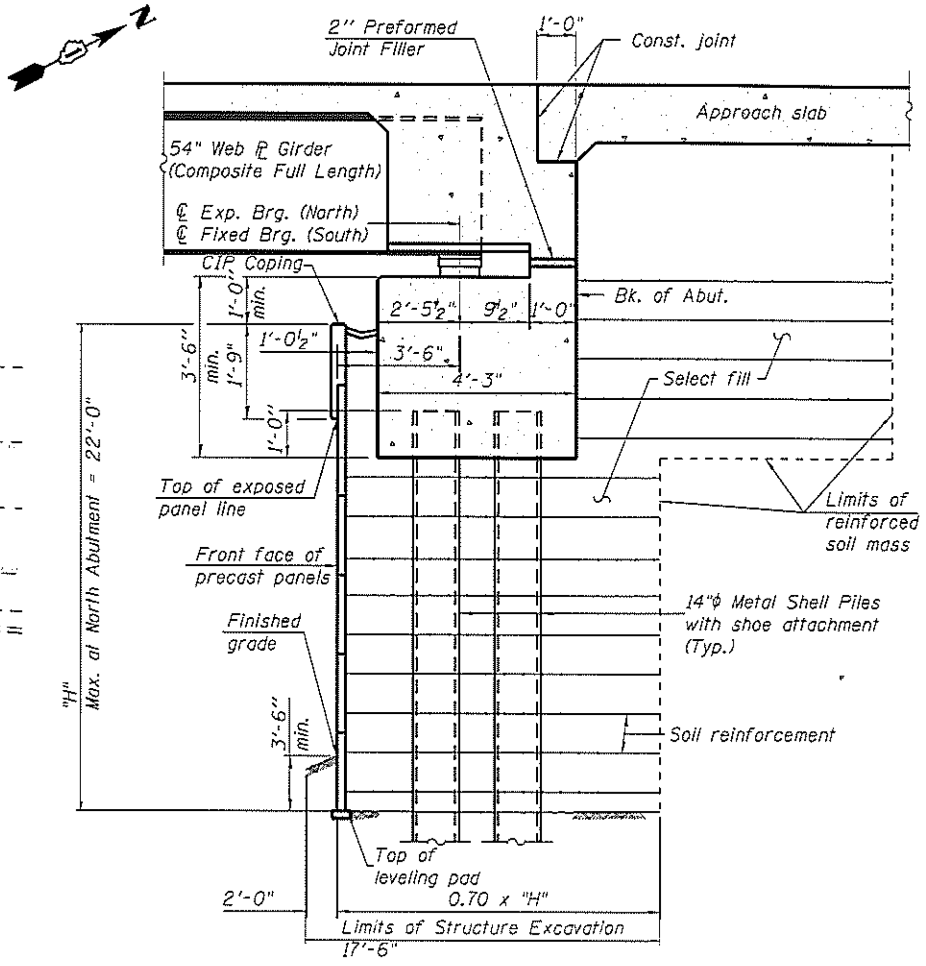
FILE NAME =	USER NAME = RDS	DESIGNED - NRF	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	CROSS SECTIONS	
		CHECKED - MAM	REVISED -			
	PLOT SCALE =	DRAWN - RDS	REVISED -			
	PLOT DATE =	CHECKED - 03-10-15	REVISED -			

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
334	22-2HB-1	LAKE	4	2
		CONTRACT NO.		
		ILLINOIS FED. AID PROJECT		

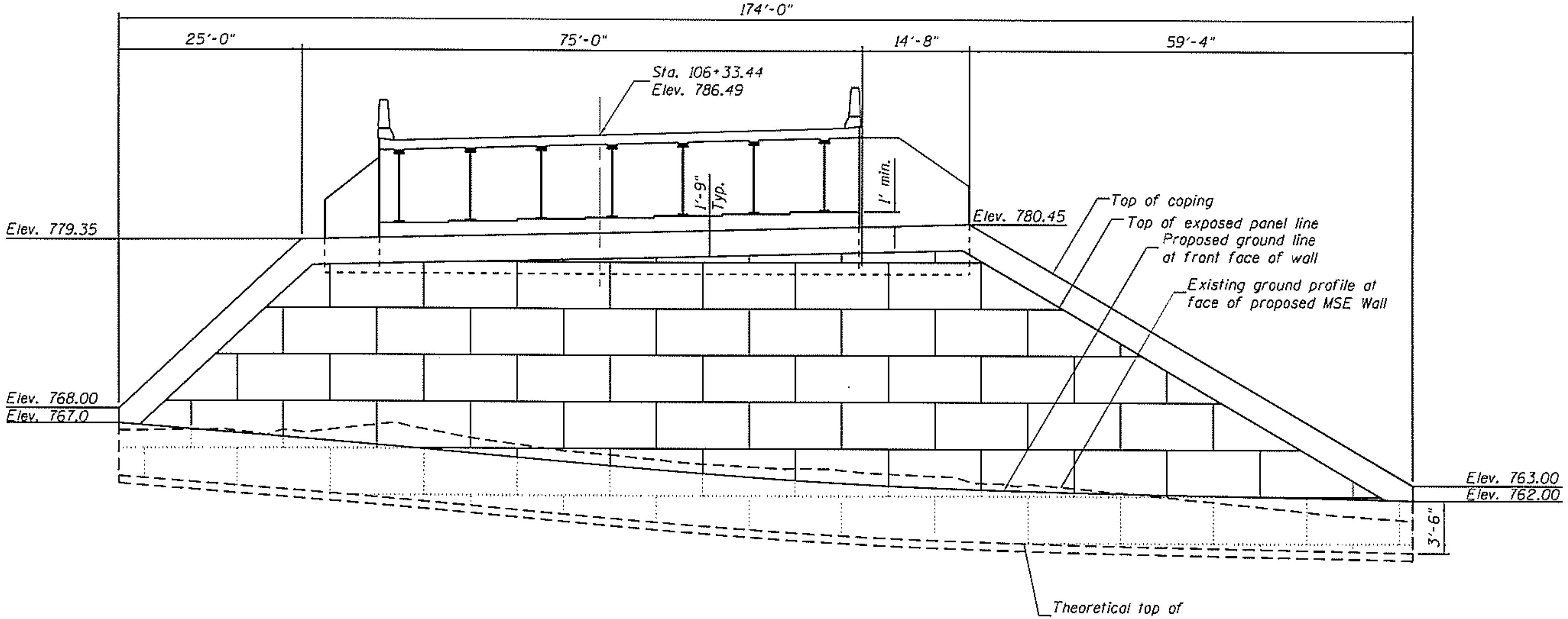


PLAN
(Looking North)

Note: All offsets are measured from the ℄ of Illinois Route 59 to the front face of the precast panels



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



NORTH MSE WALL ELEVATION
(Looking North)

MSE NORTH WALL DETAILS
US 12 (NB) OVER IL 59 (SB)
FAP RTE 334 SEC. 22-2HB-1
LAKE COUNTY
STATION 105+79.40
STRUCTURE NO. 049-0601

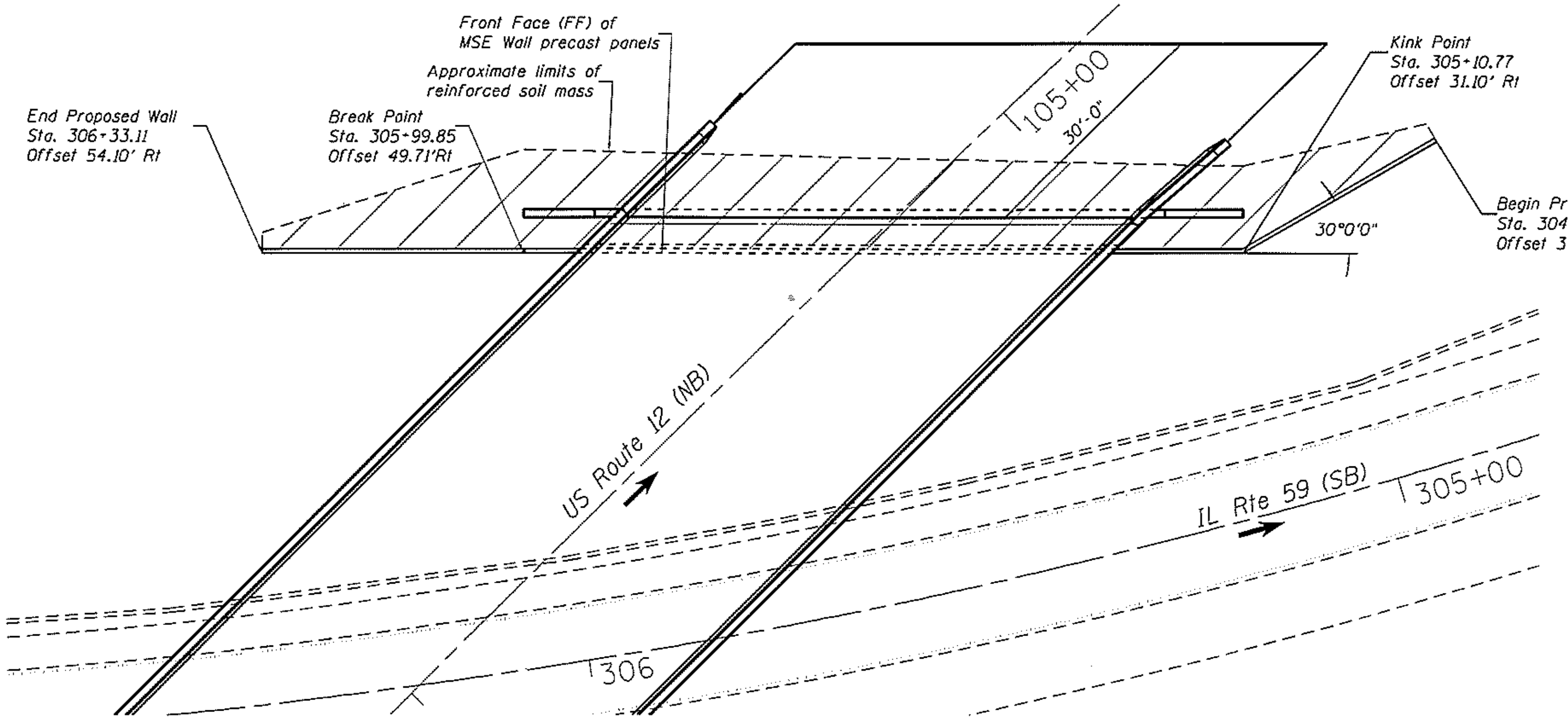
PREPARED BY:
CEMCON, Ltd.
Consulting Engineers, Land Surveyors & Planners
2280 White Oak Circle, Suite 100
Aurora, Illinois 60504-9675
Ph: 630.862.2100 Fax: 630.862.2199
E-Mail: cadd@cemcon.com Website: www.cemcon.com

FILE NAME =	USER NAME = RDS	DESIGNED - NRF	REVISED -
		CHECKED - MAM	REVISED -
	PLOT SCALE =	DRAWN - RDS	REVISED -
	PLOT DATE =	CHECKED - 03-10-15	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

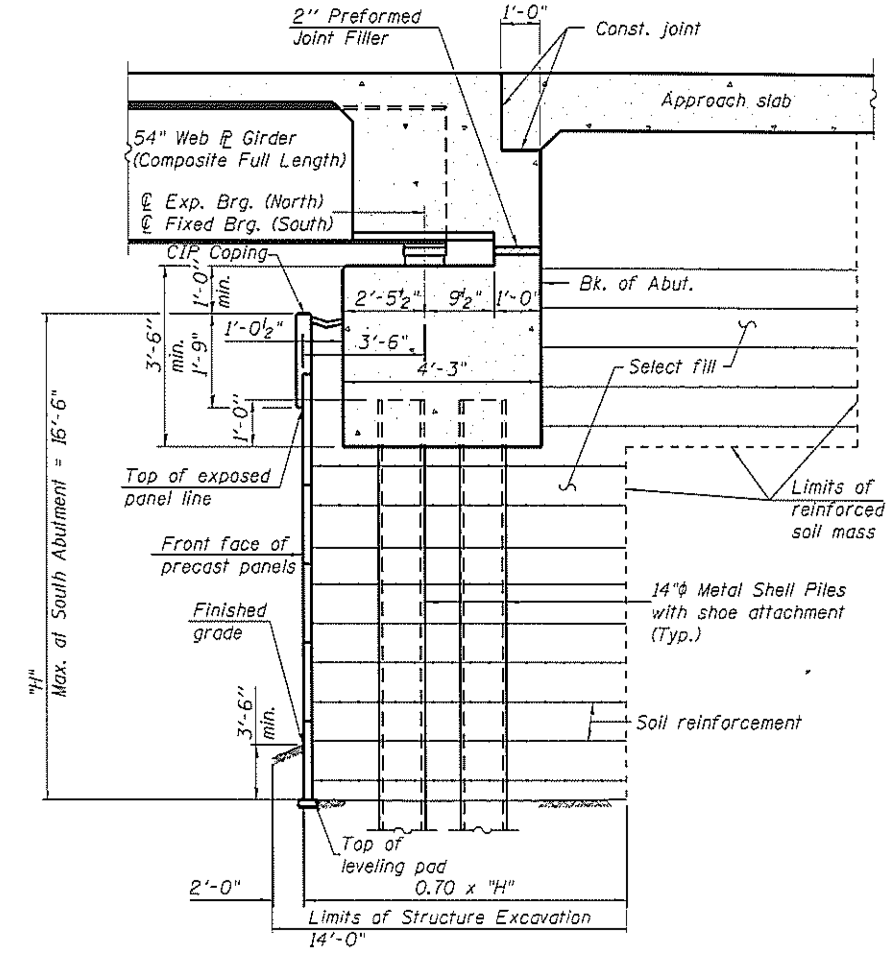
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
334	22-2HB-1	LAKE	4	3
		CONTRACT NO.		

ILLINOIS FED. AID PROJECT

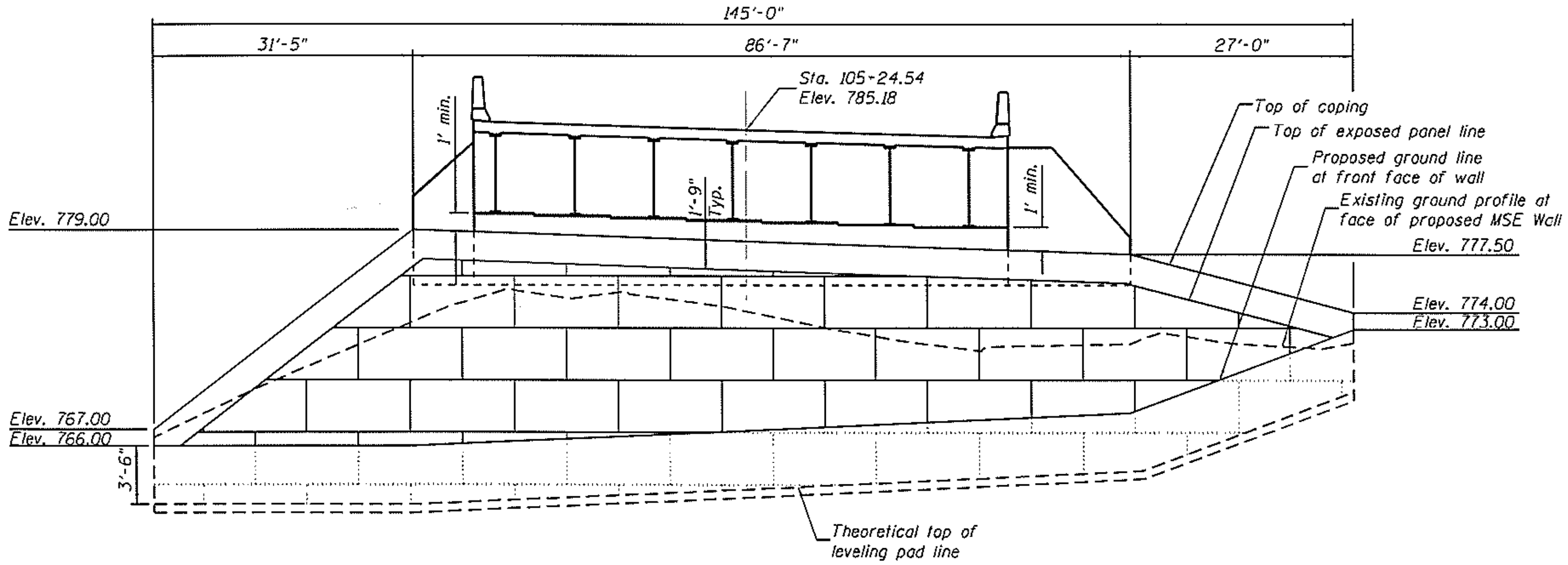


PLAN
(Looking South)

Note: All offsets are measured from the ℄ of Illinois Route 59 to the front face of the precast panels



SECTION THRU SEMI-INTEGRAL ABUTMENT
(Horiz. dim. @ Rt. ∟'s)



SOUTH MSE WALL ELEVATION
(Looking South)

MSE SOUTH WALL DETAILS
US 12 (NB) OVER IL 59 (SB)
FAP RTE 334 SEC. 22-2HB-1
LAKE COUNTY
STATION 105+79.40
STRUCTURE NO. 049-0601

PREPARED BY:
CEMCON, Ltd.
Consulting Engineers, Land Surveyors & Planners
2280 White Oak Circle, Suite 100
Aurora, Illinois 60504-9675
Ph: 630.862.2100 Fax: 630.862.2199
E-Mail: cadd@cemcon.com Website: www.cemcon.com

FILE NAME =	USER NAME = RDS	DESIGNED - NRF	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION
		CHECKED - MAM	REVISED -	
	PLOT SCALE =	DRAWN - RDS	REVISED -	
	PLOT DATE =	CHECKED - 03-10-15	REVISED -	

F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
334	22-2HB-1	LAKE	4	4
		CONTRACT NO.		
		ILLINOIS FED. AID PROJECT		