
**STRUCTURE GEOTECHNICAL REPORT
CIRCLE INTERCHANGE RECONSTRUCTION
RETAINING WALL 22B (PROPOSED SN 016-1839)
NB C-D ROAD
F.A.I ROUTE 90/94, (KENNEDY EXPRESSWAY)
IDOT D-91-227-13/ PTB 163-001
COOK COUNTY, ILLINOIS**

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11. Abstract <p>To facilitate the widening and reconstruction of Circle Interchange, Retaining Wall 22B will be constructed along NB C-D Road between Van Buren Street Bridge east abutment wingwall and north of I-290. The proposed 212.8-foot long Retaining Wall 22B will have a maximum retained height of 19.7 feet. This report provides geotechnical recommendations for the design and construction of the proposed retaining wall.</p> <p>Beneath the pavement or topsoil, the subsurface soils consists of up to 13 feet of fill materials, up to 5 feet medium stiff to very stiff clay crust, up to 41 feet of very soft to medium stiff silty clay, 32 feet of stiff to hard clay loam, and up to 23 feet of very dense silt to silty loam and sand extending to the boring termination depths or weathered bedrock. Sound bedrock was encountered at an elevation of about 477 feet. Groundwater was encountered within the fill layer at an elevation of 589 feet. Under pressure water-bearing layers are expected at deeper levels.</p> <p>Geotechnical parameters for design are presented in this report for the drilled shaft and lagging wall. Although the wall tip elevation at elevation 556 feet has a minimum undrained FOS of 1.6 and a drained FOS of 1.5, the drilled shafts should not terminate above an elevation of 538 feet due to the presence of soft to medium stiff clay to silty clay.</p> <p>Based on the TSL plan, between Stations 6331+87.58 and 6332+81.14, there will be a proposed new Junction Chamber connecting a new 78-inch Main Drain, an existing 7.2' by 8.0' Main Drain, and other drains into the IDOT Pump Station 5 located at the corner of Van Buren and Des Plaines streets. The construction of the chamber will require about 40 feet of temporary excavation to reach the chamber bearing elevation of about 553 feet. The excavation will generally consist of an open cut with 1:2 (V:H) back-slopes to about 573 feet, then a braced temporary soil retention system (TSRS) reach the chamber bearing elevation. After the installation of the Chamber, the drilled shaft wall will be constructed. The excavations will be backfilled with LCCF Class IV as per District One specifications.</p>		
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1.0 INTRODUCTION

This report presents the results of Wang Engineering, Inc. (Wang) subsurface investigation, laboratory testing, geotechnical engineering evaluations and recommendations for a new retaining wall, designated as SN 016-1839 (Retaining Wall 22B) proposed along the NB C-D Road in connection with the Circle Interchange Reconstruction project in the City of Chicago, Cook County, Illinois. A *Site Location Map* is presented as Exhibit 1.

The purpose of Wang's investigation was to characterize the site soil and groundwater conditions, perform geotechnical engineering analyses, and provide recommendations for the design and construction of the new wall structure.

1.1 Project Description

The Circle Interchange is over 50 years old and has significant congestion and safety problems. The project is aiming to improve safety and mobility as well as upgrade the mainline and interchange facilities. The project will also improve other modes of transportation such as transit, pedestrians and bicyclists within the same corridor.

The Circle Interchange Reconstruction project is along Interstate 90/94 (I-90/94) from south of Roosevelt Road to north of Lake Street, along Interstate 290 (I-290) from Loomis Street to the Circle Interchange; and along Congress Parkway from the Circle Interchange to Canal Street/Old Post Office. The routes typically have three lanes of traffic in each direction with mostly one lane ramp at interchanges. Locally, the north leg is known as the Kennedy Expressway, the south leg as the Dan

Ryan Expressway and the west leg as the Eisenhower Expressway. Within the project area, there are several cross street bridges over I-90/94 and I-290 considered for reconstruction. Along I-90/94, from south to north, the cross street overpasses include Taylor Street, Van Buren Street, Jackson Boulevard, and Adams Street. Along I-290, from west to east, the cross street overpasses include Morgan Street, Peoria Street, and Halsted Street.

The proposed improvements include additional through lanes in each direction on I-90/94. The horizontal alignment and vertical profiles throughout the interchange will be improved. A new two-lane flyover, Ramp NW (Flyover) will be constructed for I-90/94 northbound to I-290 westbound traffic. Cross street bridges, Morgan Street, Harrison Street, Halsted Street, Peoria Street, Taylor Street, Adams Street, Jackson Boulevard, and Van Buren Street will be reconstructed. Various existing ramps will be reconstructed and up to fifty one new retaining walls will be constructed.

1.2 Proposed Structure

Retaining wall 22B (SN 016-1839) is proposed along the NB C-D Road. Based on the Type, Size, and Location (TSL) plan dated April 17, 2018 provided by TranSystems Corporation (TranSystems), the 212.8-foot long wall is proposed to be a drilled shaft wall. The Wall 22B starts at Station 6330+70.68 and ends at Van Buren Street Bridge east abutment wingwall at Station 6332+81.14. The proposed drilled shaft wall will have a maximum retained height of 19.7 feet. There will be a minimum of 4.5-foot tall concrete parapet on top of the drilled shaft. The TSL plan is included in the Appendix D.

1.3 Existing Structure

There is no existing wall. There is an existing IDOT pump station and associated parking lot located behind the proposed wall. There is also a 100-foot tall CCTV Tower supported on the 5-foot drilled shaft near Station 6331+00.

2.0 SITE CONDITIONS AND GEOLOGICAL SETTING

The site is located within the City of Chicago at the I-90/94 and I-290 Circle Interchange. On the USGS *Chicago Loop 7.5 Minute Series* map, the wall is located in the NW¹/₄ of Section 16, Tier 39 N, Range 14 E of the Third Principal Meridian.

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

2.1 Physiography

The wall is situated within the Chicago Lake Plain Physiographic Subsection. The area is characterized by a flat surface that slopes gently toward the lake, largely made of groundmoraine till covered by thin and discontinuous lacustrine silt and clay. The ground elevation along the wall ranges from 590 feet at the north end to 594 feet at the south end.

2.2 Surficial Cover

The project area was shaped during the Wisconsin-age glaciation, and more than 75-foot thick drift covers the bedrock (Leetaru et al. 2004). The glacial cover is made up of clay and silt of the Equality Formation of the Mason Group and diamictons of the Wadsworth and Lemont Formations of the Wedron Group (Hansel and Johnson 1996). The Equality Formation is made up of bedded silt and clay, locally laminated, with lenses and/or thin beds of sand and gravel. The Wadsworth Formation consists of relatively homogenous, massive, gray till with clay to silty clay matrix, with dolostone and shale clasts and occasional lenses of sorted and stratified silt. The Wadsworth Formation is underlain by the pebbly silty clay loam to silty loam diamicton of the Yorkville Member of the Lemont Formation, known informally as the Chicago “hardpan.”

From a geotechnical viewpoint, the Equality Formation is characterized by low strength, medium to high plasticity, and medium to high moisture content, whereas the Wadsworth Formation is characterized by low plasticity, medium to low moisture content, medium to very stiff consistency, poor permeability, and low compressibility. The Yorkville Member (hardpan) is characterized by low plasticity, high blow counts, and low moisture content (Bauer et al. 1991; Peck and Reed 1954).

2.3 Bedrock

In the project area, the glacial deposits unconformably rest over approximately 350-foot thick Silurian-age dolostone (Leetaru et al 2004). The top of bedrock may be encountered at 475 to 500 feet elevation or 75 to 100 feet below ground surface (bgs) or more. The Silurian dolostone dips gently

eastward at a pace of 15 feet per mile. Only inactive faults are known in the area, and the seismic risk is minimal (Leetaru et al. 2004; Willman 1971). There are no records of mining activity in the area, but deep tunnel excavations are known to exist.

Our subsurface investigation results fit into the local geologic context. The borings drilled in the project area revealed the native sediments consist of clay to silty clay diamicton of the Wadsworth Formation resting on top of more competent silty clay loam diamicton (hardpan) of the Lemont Formation, which in turn is underlain by bedrock. Sound dolostone bedrock was sampled at nearby boring at a depth of 109 feet bgs, corresponding to 477.4 feet elevation, within the range predicted based on published geological data.

3.0 METHODS OF INVESTIGATION

The following sections outline the subsurface and laboratory investigations. All elevations in this report are based on NAVD 1988.

3.1 Subsurface Investigation

Wang drilled three structure borings, designated as 22-RWB-03, 22-RWB-04, and 22-RWB-05 in March and August 2014. Wang has also referenced four nearby structure borings, designated as 2055-B-02, 1712-B-03, PS-5-CCTV, and 1715-B-01 drilled between April 2013 and August 2014. The as-drilled boring locations were surveyed by Dynasty Group, Inc. and station and offset information for each boring were provided by AECOM. Boring location data are presented in the *Boring Logs* (Appendix A). The as-drilled boring locations are shown in the *Boring Location Plan* (Exhibit 3).

We also considered the Piezometer 1703-PZ-01 located about 90 feet west of Wall 22B. The piezometer was installed in accordance with ASTM D5092, “*Standard Practice for Design and Installation of Groundwater Monitoring Wells in Aquifers.*”

A truck-mounted drilling rig equipped with hollow stem augers, was used to advance and maintain an open borehole to 10 feet depths after that mud rotary was used to boring termination depths. 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 to boring termination depths. Soil samples collected from each sampling interval were placed in sealed jars and

transported to Wang Geotechnical Laboratory in Lombard, Illinois for further examination and laboratory testing.

Field boring logs, prepared and maintained by a Wang engineer or geologist, include lithological descriptions, visual-manual soil/rock classifications, results of Rimac and pocket penetrometer unconfined compressive strength tests, results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration. The SPT-N value, shown on the soil profile, is the sum of the second and third blows per 6 inches. The soils were described and classified according to Illinois Division of Highways (IDH) Textural Classification system. The field logs were finalized by an experienced engineering geologist after verifying the field visual classifications and laboratory test results.

Groundwater observations were made during drilling to depths of 10 feet before using mud rotary method. Due to safety considerations, boreholes were backfilled with grout immediately upon completion. Groundwater levels in the piezometer were recorded autonomously at defined intervals by digital pressure loggers suspended within the water column. Barometric affects were compensated by a second in-air pressure logger installed in the riser pipe. Data retrieved from loggers periodically were downloaded to a computer for analysis.

3.2 Vane Shear Tests

Wang performed vane shear tests in Boring VST-06. Boring VST-06 is located 80 feet southwest of Wall 22B. Vane shear tests were performed using calibrated RocTest vane shear equipment in undisturbed and remolded conditions. The sensitivity shown on the boring logs is the ratio of shear strength in undisturbed and remolded conditions. In general, the vane shear strength values for soft clays were significantly higher than the corresponding values from unconfined compressive strength tests using the RIMAC apparatus. Vane shear test results were used in our analyses.

3.3 Laboratory Testing

The soil samples were tested in the laboratory for moisture content (AASHTO T265). Atterberg limits (AASHTO T 89/T 90) and particle size analyses (AASHTO T 88) tests were performed on selected soil samples representing the main soil layers encountered during the investigation. Field visual descriptions of the soil samples were verified in the laboratory. Laboratory test results are shown in the *Boring Logs* (Appendix A), in the *Soil Profile* (Exhibit 4), and in the *Laboratory Test Results* (Appendix B).

4.0 RESULTS OF FIELD AND LABORATORY INVESTIGATIONS

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

4.1 Soil Conditions

Borings drilled on the I-290 Ramp and Van Buren Street encountered 3 inches of asphalt over 9 inches of concrete and 17 inches of concrete, respectively followed by crushed stone base course. Borings drilled on the grassy area along the wall encountered 3 to 14 inches of silty clay loam topsoil. In descending order, the general lithologic succession encountered beneath the pavement structure or topsoil includes: 1) man-made ground (fill); 2) medium stiff to very stiff silty clay to silty loam; 3) very soft to medium stiff clay to silty clay; 4) stiff to hard silty clay to silty clay loam; 5) medium dense to very dense silt to silty loam and sand to gravelly sand; and 6) weathered to sound dolostone.

1) Man-made ground (fill)

Underneath topsoil or pavement structure, the borings encountered 3 to 13 feet of fill materials. Granular fill consists of very loose to dense, brown loam, silty loam, and sand to gravelly sand. Cohesive fill includes stiff to hard, black to gray silty clay loam. The granular fill layer has N-values of 3 to 47 blows per foot and moisture content values of 8 to 31%. The cohesive fill layer has unconfined compressive strength (Q_u) values ranging from 1.0 to 4.1 tsf and moisture content values of 8 to 25%.

2) Medium stiff to very stiff silty clay to silty loam

Beneath the fill, at elevations of 583 to 585 feet (3 to 11 feet bgs), the borings encountered 3 to 5 feet of medium stiff to very stiff, brown to gray silty clay to silty loam. This layer has Q_u values ranging from 0.9 to 2.9 tsf and moisture content values between 18 and 25%. This layer is commonly known as the “crust.”

3) Very soft to medium stiff clay to silty clay

At elevations of 576 to 583 feet (5 to 18 feet bgs), the borings revealed up to 41 feet of very soft to medium stiff, gray clay to silty clay with Rimac Q_u values of 0.16 to 0.82 tsf and moisture content values of 20 to 29%. Laboratory index testing on samples from this layer showed liquid limit (L_L)

values of 32 to 33% and a plastic limit (P_L) value of 18%. This layer is commonly known as the “Chicago Blue Clay.”

As discussed in Section 3.2, undrained shear strength values from vane shear tests are generally higher than Rimac tests. In-situ undisturbed vane shear strengths obtained in Boring VST-06 between elevations 575 and 542 feet ranged from 580 to 980 psf.

4) Stiff to hard silty clay to silty clay loam

At elevations of 538 to 550 feet (42 to 57 feet bgs), the borings encountered up to 32 feet of stiff to hard silty clay to silty clay loam with silt and sand interbeds. The silty clay to silty clay loam and clay has Q_u values of 1.0 to 7.1 tsf and moisture content values of 12 to 22%. The borings encountered 3 feet of very dense silt to sand layers with N values of greater than 50 blows per foot.

(5) Medium dense to very dense silt to silty loam and sand

At elevations of 511 to 530 feet (57 to 77 feet bgs) the borings encountered medium dense to very dense silt to silty loam and sand. This layer has N values of 21 to over 50 blows per foot.

(6) Weathered to sound bedrock

At elevations of 485 to 499 feet (97 to 100 feet bgs) Borings 2055-B-02, 1712-B-03 and 1715-B-01 revealed about 10 feet of weathered bedrock. Based on Boring 1706-B-01 located 150 feet east of Wall 22B, strong bedrock was encountered at an elevation of 477.4 feet.

4.2 Groundwater Conditions

Groundwater was observed during drilling at an elevation of 589 feet (5.5 bgs) within the granular fill layer. The groundwater was not observed after drilling in borings due to the mud rotary drilling from 10 feet bgs.

A Piezometer 1703-PZ-01 was installed about 90 feet west of the proposed Retaining Wall 22B on November 12, 2014. The screen was placed with the top and bottom elevations at 507.2 and 487.2 feet (75 to 95 feet bgs), respectively. A summary of the monitoring data between November 2014 and March 2017 is shown in Figure 1.

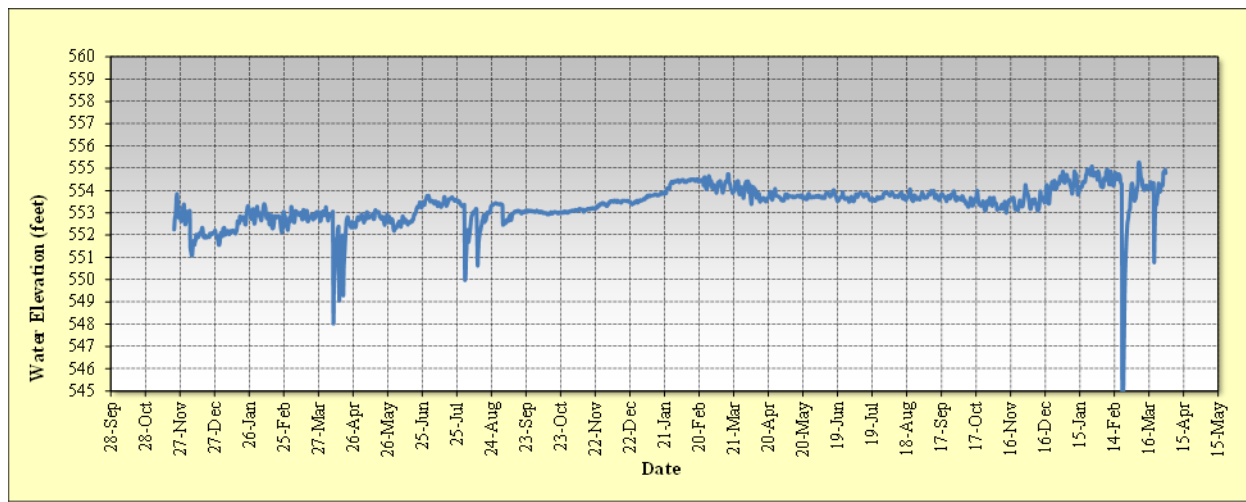


Figure 1: Summary of Groundwater Monitoring Data

The data shows groundwater that is under hydrostatic pressure head. The average hydrostatic elevation within the aquifer is about 553 feet.

The design and construction of the wall should consider the perched water between 580 and 590 feet elevations within the fill layers. The design and construction of the drilled shaft and drilled soldier pile walls should consider the granular soils (**layer 5**) as water bearing and under hydrostatic pressure.

4.3 Seismic Design Considerations

The retaining wall is located in Seismic Performance Zone (SPZ) 1 and is not required to be designed for seismic forces as per 2012 IDOT *Bridge Manual* (IDOT 2012).

5.0 ANALYSIS AND RECOMMENDATIONS

5.1 Retaining Wall Type Evaluation

Based on the TSL plan and the cross-section drawings, the proposed Retaining Wall 22B is a primarily cut wall along the NB C-D Road. The proposed 212.8-foot long Retaining Wall 22B begins north of I-290 at Station 6330+70.68 and ends at Van Buren Street east abutment wingwall at Station 6332+81.14. The wall will have a maximum retained height of 19.7 feet.

The applicable wall types for the cut section include drilled shaft and/or drilled soldier pile and lagging walls. Driven soldier pile or permanent sheet piling walls are not feasible due to noise and

vibration. The following sections present the results of our geotechnical engineering analyses and recommendations for the drilled shaft and lagging wall design and construction.

5.2 Drilled Shaft and Lagging Wall

We recommend drilled shafts should be designed for both lateral earth pressure and lateral deformation. The embedment depth in moment equilibrium for the wall section should be designed in accordance with the LRFD guidelines (AASHTO 2017). Generally, overconsolidated clayey soils, such as the stiff to very stiff clays and very dense silty loam will exhibit lower overall shear strength in the long-term condition; however, normally-consolidated clayey soils such as the very soft to medium stiff clay to silty clay (Chicago blue clay) will likely exhibit significantly lower shear strength in the short-term condition. Therefore, the lateral earth pressure analysis should be performed for walls in both the short-term (undrained) and long-term (drained) condition using the soil parameters shown in Tables 1 and 2.

The undrained shear strength properties of the soft to medium stiff silty clay were taken from the vane shear test results shown in Boring VST-06. The earth pressure coefficients were calculated based on horizontal slopes behind wall and slope of 1:3 (V:H) to horizontal slopes in front of the walls as per cross-section drawings. In addition, the results of unconfined compressive test results and undrained shear strength (cohesion) results from triaxial UU tests for the Circle Interchange project were also considered in the development of soil parameters. Moreover, the drained friction angle parameters of the soft to medium stiff clay layer were estimated from the consolidated-undrained (CU) triaxial tests performed on this stratum within the Circle Interchange project.

The design of the wall should ignore 3 feet of soil in front of the wall measured from the finished ground surface elevation in providing passive pressure due to excavation required for installation of concrete facing, drainage system and frost-heave condition. In developing the design lateral pressure, the lateral pressure due to construction equipment surcharge load should be added to the lateral earth pressure. Drainage behind the wall and underdrain should be as per 2012 IDOT *Bridge Manual* (IDOT 2012). The water pressure should be added to the earth pressure if drainage is not provided.

There is an existing CCTV Tower at Station 6331+19 that will be behind the new drilled shaft and lagging wall. The potential pressure/load from the CCTV Tower foundation on the proposed wall must be considered in final design of the wall. In addition, the design of drilled shaft wall should also consider the existing Main Drain at about Station 6332+00.

Based on the TSL plan, between Stations 6331+87.58 and 6332+81.14, there will be a proposed Junction Chamber which will connect a new 78-inch Main Drain, an existing 7.2' by 8.0' Main Drain, and other drains into the IDOT Pump Station 5 located at the corner of Van Buren and Des Plaines streets. The construction of the chamber will require about 40 feet of temporary excavation to reach the chamber bearing elevation of about 553 feet. The excavation will generally consist of an open cut with 1:2 (V:H) back-slopes to about 573 feet, then a braced temporary soil retention system (TSRS) reach the chamber bearing elevation. After the installation of the Chamber, the drilled shaft wall will be constructed. The excavations will be backfilled with LCCF Class IV as per District One specifications.

Table 1: Short-term (Undrained) Geotechnical Parameters for Design of Drilled Shaft Wall
 (Ref. Borings: 22-RWB-03, 22-RWB-04, 22-RWB-05, PS-5-CCTV, VST-06, 2055-B-02, and 1715-B-01)

Soil Description (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle ($^{\circ}$)	Active Pressure	Passive Pressure
V Loose to M Dense GRAVELLY SAND FILL Ground Surface to EL 582 feet	120	0	30	0.33	3.00 / 1.61 ⁽¹⁾
LCCF FILL Ground Surface to EL 572 feet	42	0	37	0.25	--
M Stiff to Stiff SILTY CLAY to SILTY CLAY LOAM EL 582 to 576 feet	120	1000	0	1.00	1.00
Soft to M Stiff CLAY to SILTY CLAY EL 576 to 566 feet	115	550	0	1.00	1.00
Soft to M Stiff CLAY to SILTY CLAY EL 566 to 556 feet	115	680	0	1.00	1.00
M Stiff CLAY to SILTY CLAY EL 556 to 550 feet	115	750	0	1.00	1.00
M Stiff CLAY to SILTY CLAY EL 550 to 538 feet	115	950	0	1.00	1.00
Stiff CLAY to SILTY CLAY EL 538 to 533 feet	120	1500	0	1.00	1.00

Soil Description (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle ($^{\circ}$)	Active Pressure	Passive Pressure
V Stiff to Hard SILTY CLAY to SILTY CLAY LOAM EL 533 to 524 feet	125	3000	0	1.00	1.00
V Dense SANDY LOAM EL 524 to 521 feet	125	0	35	0.27	3.69
Hard SILTY CLAY LOAM EL 521 to 511 feet	125	4500	0	1.00	1.00
V Dense SILT EL 511 to 491 feet	68 ⁽²⁾	0	35	0.27	3.69
V Dense SANDY GRAVEL EL 491 to 485 feet	63 ⁽²⁾	0	36	0.26	3.85
V Dense WEATHERED BEDROCK EL 485 to 477 feet	73 ⁽²⁾	0	37	0.25	4.02

(1) 1:3(V:H) front slope; (2) Submerged unit weight.

Table 2: Long-term (Drained) Geotechnical Parameters for Design of Drilled Shaft Wall
 (Ref. Borings: 22-RWB-03, 22-RWB-04, 22-RWB-05, PS-5-CCTV, VST-06, 2055-B-02, and 1715-B-01)

Soil Description (Layer)	Unit Weight, γ (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle ($^{\circ}$)	Active Pressure	Passive Pressure
V Loose to M Dense GRAVELLY SAND FILL Ground Surface to EL 582 feet	120	0	30	0.33	3.00 / 1.61 ⁽¹⁾
LCCF (Class IV) FILL Ground Surface to EL 572 feet	42	0	37	0.25	--
M Stiff to Stiff SILTY CLAY to SILTY CLAY LOAM El 582 to 576 feet	120	100	30	0.33	3.00 / 1.61 ⁽¹⁾
Soft to M Stiff CLAY to SILTY CLAY EL 576 to 566 feet	115	0	27	0.38	2.66

Soil Description (Layer)	Unit Weight, γ (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle ($^{\circ}$)	Active Pressure	Passive Pressure
Soft to M Stiff CLAY to SILTY CLAY EL 566 to 556 feet	115	0	27	0.38	2.66
M Stiff CLAY to SILTY CLAY EL 556 to 550 feet	115	0	27	0.38	2.66
M Stiff CLAY to SILTY CLAY EL 550 to 538 feet	115	80	29	0.35	2.88
Stiff CLAY to SILTY CLAY EL 538 to 533 feet	120	100	30	0.33	3.00
V Stiff to Hard SILTY CLAY to SILTY CLAY LOAM EL 533 to 524 feet	125	100	30	0.33	3.00
V Dense SANDY LOAM EL 524 to 521 feet	125	0	35	0.27	3.69
Hard SILTY CLAY LOAM EL 521 to 511 feet	125	100	30	0.33	3.00
V Dense SILT EL 511 to 491 feet	68 ⁽²⁾	0	35	0.27	3.69
V Dense SANDY GRAVEL EL 491 to 485 feet	63 ⁽²⁾	0	36	0.26	3.85
V Dense WEATHERED BEDROCK EL 485 to 477 feet	73 ⁽²⁾	0	37	0.25	4.02

(1) 1:3(V:H) front slope; (2) Submerged unit weight.

Design considerations should include deflection control at the top of the wall. The lateral deformation of the wall should be designed using the parameters shown in Table 3 using the p-y curve (COMP624) method.

Table 3: Recommended Parameters for Lateral Load Analysis of Drilled Shaft Wall
(Ref. Borings: 22-RWB-03, 22-RWB-04, 22-RWB-05, PS-5-CCTV, VST-06, 2055-B-02, and 1715-B-01)

Soil Type (Layer)	Unit Weight, γ (pcf)	Undrained Shear Strength, c_u (psf)	Estimated Friction Angle, Φ ($^\circ$)	Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ϵ_{50} (%)
V Loose to M Dense GRAVELLY SAND FILL Ground Surface to EL 582 feet	120	0	30	30	--
M Stiff to Stiff SILTY CLAY to SILTY CLAY LOAM El 582 to 576 feet	120	1000	0	500	0.7
Soft to M Stiff CLAY to SILTY CLAY EL 576 to 566 feet	115	550	0	60	1.0
Soft to M Stiff CLAY to SILTY CLAY EL 566 to 556 feet	115	680	0	70	1.0
M Stiff CLAY to SILTY CLAY EL 556 to 550 feet	115	750	0	80	1.0
M Stiff CLAY to SILTY CLAY EL 550 to 538 feet	115	950	0	100	1.0
Stiff CLAY to SILTY CLAY EL 538 to 533 feet	120	1500	0	500	0.7
V Stiff to Hard SILTY CLAY to SILTY CLAY LOAM EL 533 to 524 feet	125	3000	0	1000	0.5
V Dense SANDY LOAM EL 524 to 521 feet	125	0	35	110	--
Hard SILTY CLAY LOAM EL 521 to 511 feet	125	4500	0	2000	0.4
V Dense SILT EL 511 to 491 feet	68 ⁽¹⁾	0	35	120	--
V Dense SANDY GRAVEL EL 491 to 485 feet	63 ⁽¹⁾	0	36	125	--
V Dense WEATHERED BEDROCK EL 485 to 477 feet	73 ⁽¹⁾	0	37	125	--

(1) Submerged unit weight.

For the design of braced temporary soil retention system (TSRS), the parameters shown on Table 4 should be used.

Table 4: TSRS Design Soil Parameters for Junction Chamber
 Between Station 6331+87.58 and Station 6332+81.14
 (Borings 22-RWB-05, 1712-B-03, 2055-B-02, and VST-06)

Approximate Elevation Range (feet)	Soil Type (Layer)	Unit		
		Weight (pcf)	Cohesion C_u (psf)	Friction Angle \emptyset (degree)
573 ⁽¹⁾ to 571	M Stiff CLAY to SILTY CLAY	115	700	0
571 to 569	Stiff SILTY CLAY	120	1000	0
569 to 566	Soft CLAY to SILTY CLAY	110	550	0
566 to 556	M Stiff CLAY to SILTY CLAY	110	680	0
556 to 550	M Stiff CLAY to SILTY CLAY	115	750	0
550 to 538	M Stiff CLAY to SILTY CLAY	115	950	0
538 to 533	Stiff CLAY to SILTY CLAY	120	1500	0
533 to 524	V Stiff to Hard SILTY CLAY	125	3000	0
524 to 518	M Dense SILTY LOAM to SAND	120	0	30
518 to 494	V Dense SILTY LOAM	63 ⁽²⁾	0	35
494 to 485	V Dense SAND	63 ⁽²⁾	0	36
485 to 474.8	V Dense WEATHERED BEDROCK	73 ⁽²⁾	0	37

⁽¹⁾After initial open cut excavation to 573 feet elevation; ⁽²⁾Submerged unit weight.

5.2.1 Settlement Analyses

Based on the *cross-section* drawings, to reach the design finished grade at backface of the drilled shaft walls, we estimate that up to 7 feet of new fill will be required creating a surcharge load behind the wall. Since the open cut excavations will be filled with LCCF, the net service applied pressure will be less than existing pressures. Therefore, there is no settlement concern behind the wall.

There is an IDOT pump station about 65 feet away and existing electrical transformers at about 60 feet from the proposed Wall 22B. In addition, the proposed wall alignment passes through the IDOT pump station parking lot. The surface settlement induced by installation of Wall 22B is discussed in Section 5.3.

5.2.2 Global Stability Analyses

The global stability of the retaining wall at Station 6331+87.58 was analyzed based on the soil profile described in Section 4.1 and the geometry shown in cross-section drawing. The minimum required FOS for both short (undrained) and long-term (drained) conditions is 1.5 (IDOT 2015). *Slide v6.0* evaluation exhibits employing the Bishop Simplified method of analysis are shown in Appendix C. Although the wall tip elevation at elevation 556 feet has a minimum undrained FOS of 1.6 (Appendix C-1) and a drained FOS of 1.5 (Appendix C-2), the drilled shafts should not terminate above an elevation of 538 feet due to the presence of soft to medium stiff clay to silty clay.

5.3 Ground Movement Evaluations

There is an IDOT pump station about 65 feet away and existing electrical transformers at about 60 feet from the proposed Wall 22B. In addition, the Wall 22B passes through the pump station parking lot.

Wall 22B's potential impact on the pump station and transformers were determined considering IDOT wall deflection criteria. IDOT's wall deflection criteria states that the project limitations are set for a maximum allowable wall deflection of up to 1.0% of the exposed wall height of 19.7 feet (which is about 2.4 inches), if the wall is not supporting sensitive structures or facilities. For walls supporting sensitive structures, the maximum allowable wall deflection should be limited to 0.5% of the exposed wall height (which is about 1.2 inches), or less as required, to prevent detrimental effects on adjacent structures or facilities.

Using empirical data compiled from various research papers, Wang estimates the ground movement adjacent to the structures induced by the maximum lateral top of wall deflection of 1% of retained wall

height is about 0.1 inch. Ground movement estimates including method used are included in Appendix F. The existing IDOT parking lot will be partially cut from the 1:2 (V:H) back-slopes to about 573 feet for the Junction Chamber construction. The potential impact of the wall deflection inducing ground movements on other existing buried utilities must be considered on the final design to ensure specific deformation limits are not exceeded. We recommend that deflection of the wall should be limited to avoid damage to the nearby utilities and parking pavement.

6.0 CONSTRUCTION CONSIDERATIONS

6.1 Excavation

Any required excavations should be performed in accordance with local, state, and federal regulations including current OSHA regulations. The potential effect of ground movements upon nearby structures and utilities should be considered during construction.

Based on the TSL plan, the existing grade behind the Wall 22B will require a temporary open cut excavation with a side slope of 1:2 (V:H). We have performed slope stability analysis for the temporary open cut excavation and our analyses indicate a minimum undrained FOS of 1.5 (Appendix C-3).

6.2 Filling and Backfilling

All fill and backfill materials shall be as per IDOT *Standard Specification for Road and Bridge Construction* (IDOT 2016).

6.3 Drilled Shaft Encasement

Groundwater was encountered within the granular fill, about 5 feet below the ground surface, and will be encountered during drilling of the drilled shafts excavations. The installation of drilled shafts and drilled soldier piles extending into the medium dense to very dense silt to silty loam and sand (**Layer 5**) will encounter groundwater that will present challenges in maintaining an open borehole. Temporary or permanent casings should be used when the groundwater is encountered. Failure to anticipate the challenges posed by the groundwater at this location will result in caving or heaving sand and weakening of the foundation soils.

The soft soil layer with Q_u less than 0.5 tsf (500 psf cohesion) is prone to squeeze if left open for long period of time. Therefore, to minimize the squeeze potential, casing should be provided. Due to high squeeze potential, the following note should appear on the final plans:

'Due to the squeeze potential of the clay soils, the use of temporary casing will be required to properly construct the shafts. Casing may be pulled or remain in place, as determined by the Contractor at no cost to the Department.'

6.4 Wall Construction

The wall should be constructed as per IDOT *Standard Specification for Road and Bridge Construction* (IDOT 2016).

6.5 Construction Monitoring

Given the proximity of building, structures, roads, and utilities, Wang recommends special precautions should be taken during the construction not to undermine the existing foundations, pavements and utilities.

To prevent any damage to the existing IDOT pump station and electrical transformers, we recommend the following monitoring during construction of the wall:

- Establish survey points on the west side wall of the pump station to monitor the vertical and horizontal movements;
- Establish survey points at top of the wall to monitor deflection of the wall during and after construction of the wall;
- Install inclinometers before the wall construction begins between the proposed wall location and the pump station to monitor ground movement.


7.0 QUALIFICATIONS

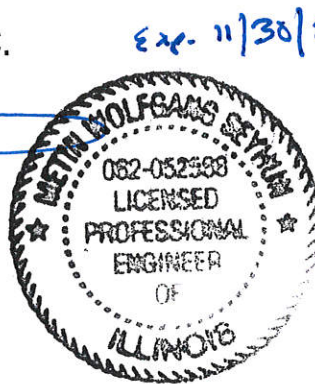
The analysis and recommendations submitted in this report are based upon the data obtained from the borings drilled at the locations shown on the boring logs and in Exhibit 3. This report does not reflect any variations that may occur between the borings or elsewhere on the site, variations whose nature and extent may not become evident until the course of construction. In the event that any changes in the design and/or location of Retaining Wall 22B (SN016-1839) are planned, we should be timely informed so that our recommendations can be adjusted accordingly.

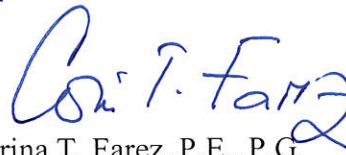
It has been a pleasure to assist AECOM and the Illinois Department of Transportation on this project. Please call if there are any questions, or if we can be of further service.


Respectfully Submitted,

WANG ENGINEERING, INC.


Metin W. Seyhun, P.E.
Senior Geotechnical Engineer



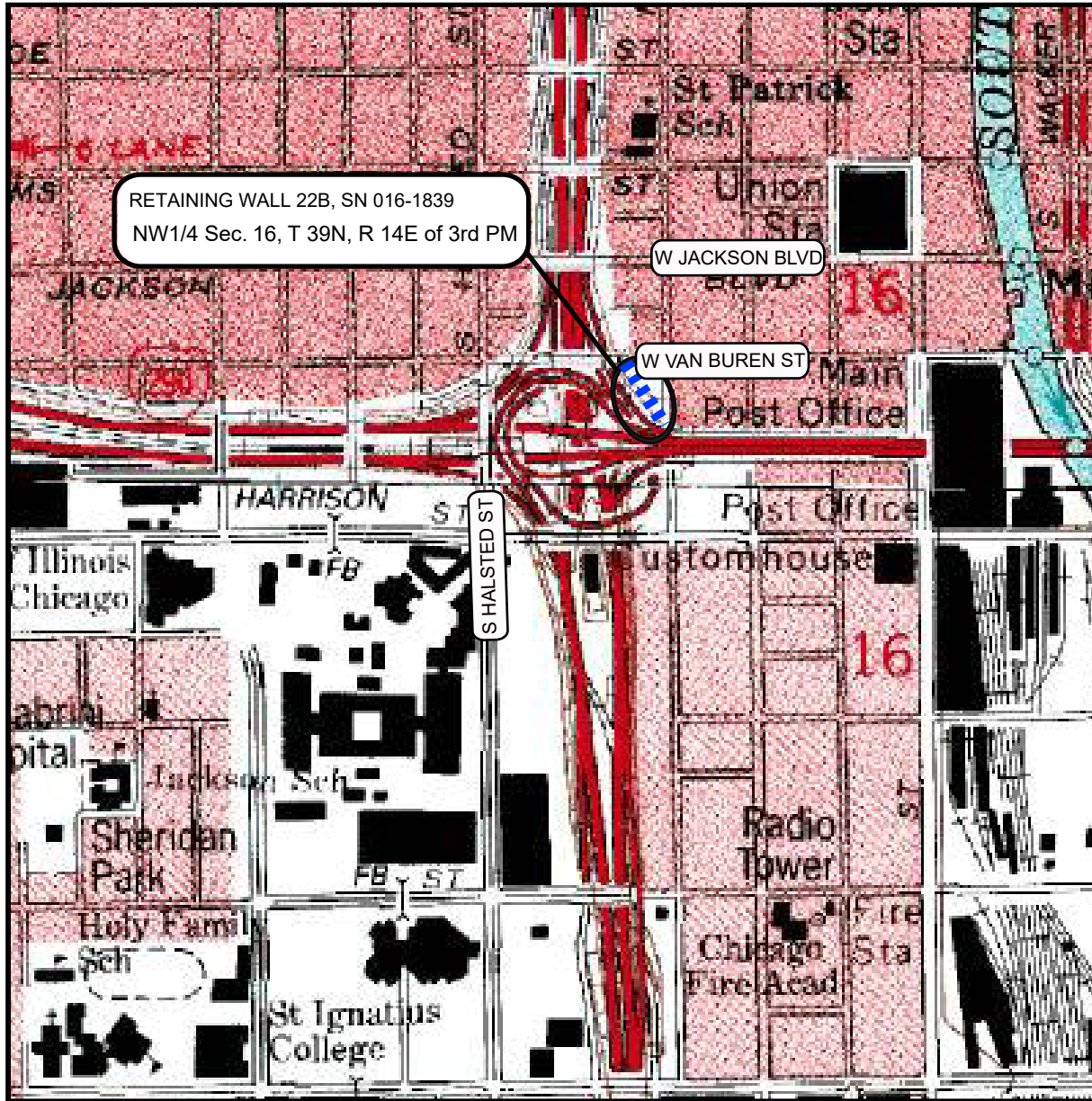

Corina T. Farez, P.E., P.G.
Vice President


Nesam S. Balakumaran
Project Geotechnical Engineer

REFERENCES

- AMERICAN ASSOCIATION OF STATE HIGHWAY TRANSPORTATION OFFICIALS (2017) *LRFD Bridge Design Specifications, 8th Edition*. United States Department of Transportation, Washington, D.C.
- BAUER, R.A., CURRY, B.B., GRAESE, A.M., VAIDEN, R.C., SU, W.J., and HASEK, M.J., 1991, *Geotechnical Properties of Selected Pleistocene, Silurian, and Ordovician Deposits of Northeastern Illinois*: Environmental Geology 139, Illinois State Geological Survey, 69 p.
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- LEETARU, H.E., SARGENT, M.L., AND KOLATA, D.R., 2004, *Geologic Atlas of Cook County for Planning Purposes*, ISGS, Champaign, IL
- ILLINOIS DEPARTMENT OF TRANSPORTATION (2015) *Geotechnical Manual*. IDOT Bureau of Materials and Physical Research, Springfield, IL.
- ILLINOIS DEPARTMENT OF TRANSPORTATION (2016) *Standard Specifications for Road and Bridge Construction*. IDOT Division of Highways, Springfield, IL.
- ILLINOIS DEPARTMENT OF TRANSPORTATION (2012) *Bridge Manual*. IDOT Bureau of Bridges and Structures, Springfield, IL.
- WILLMAN, H.B., 1971, *Summary of the Geology of the Chicago Area*, ISGS Circular C460: Urbana, Illinois State Geological Survey, p. 77.
- PECK, R.B., and REED, W.C., 1954, *Engineering Properties of Chicago Subsoils*: University of Illinois Engineering Experiment Station Bulletin No. 423: Urbana, University of Illinois, 62 p.

EXHIBITS

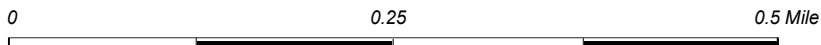
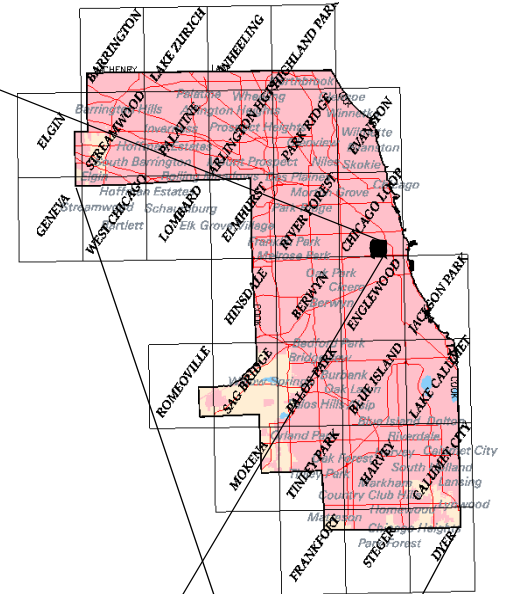


RETAINING WALL 22B, SN 016-1839
 NW1/4 Sec. 16, T 39N, R 14E of 3rd PM

W JACKSON BLVD

W VAN BUREN ST

Cook County



SITE LOCATION MAP: CIRCLE INTERCHANGE RECONSTRUCTION,
 RETAINING WALL 22B, SN 016-1839, CHICAGO, IL

SCALE: GRAPHICAL

EXHIBIT 1

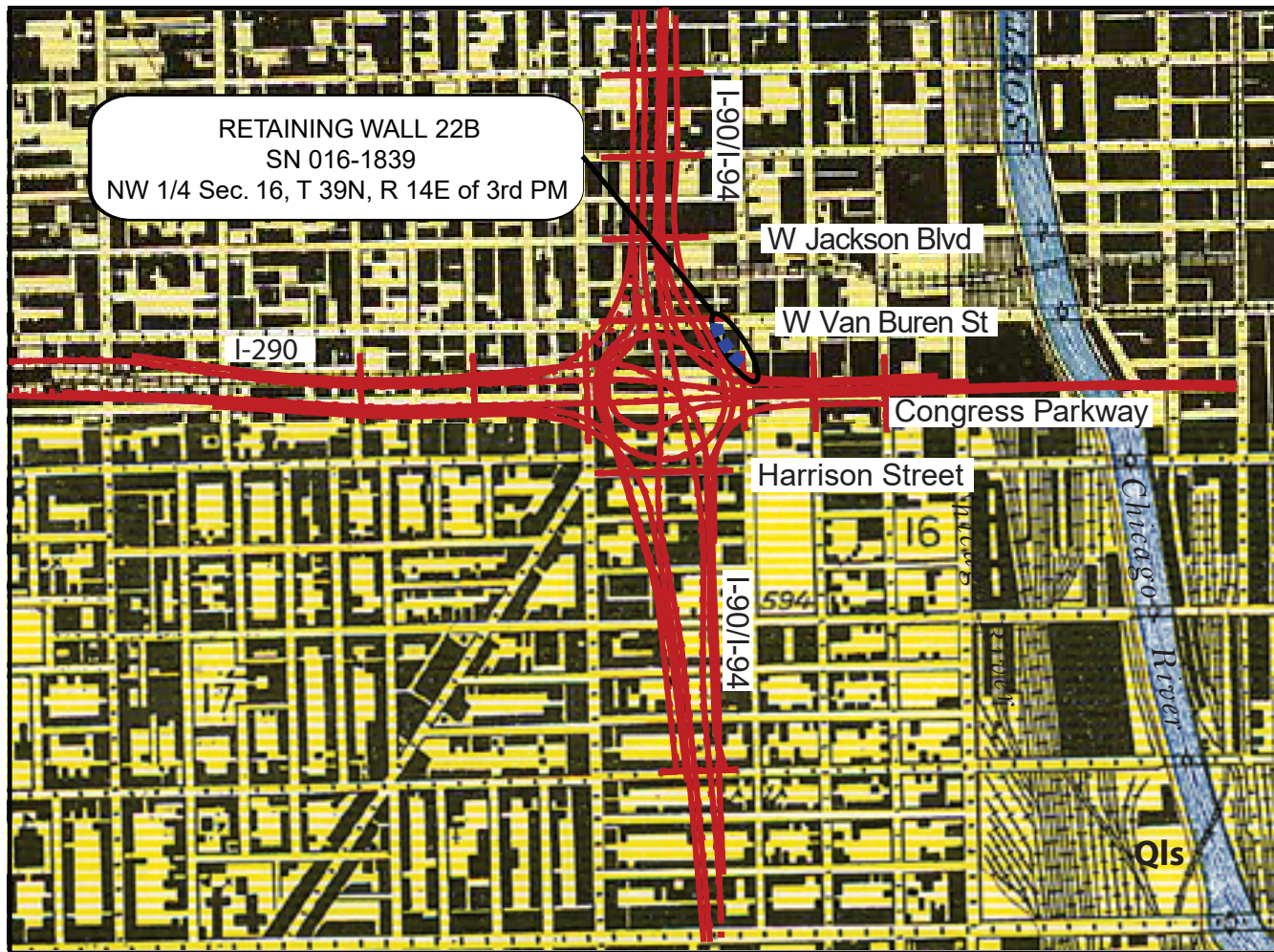
DRAWN BY: NSB
 CHECKED BY: MWS



1145 N. Main Street
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FOR AECOM

1100-04-01



REGIONAL GEOLOGY



Wedron Group

- Wadsworth Formation
- Lemont Formation
- Tiskilwa Formation

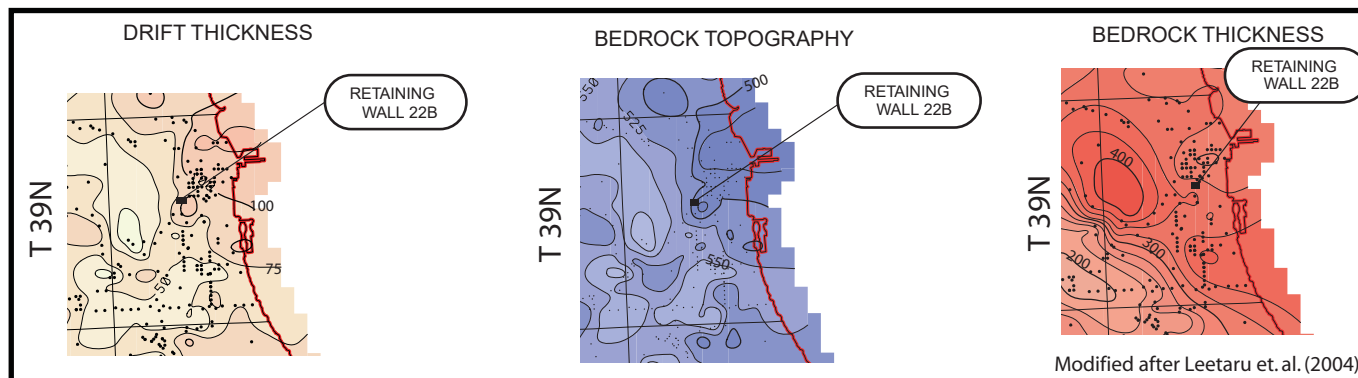
Modified after Hansel and Johnson (1996)

Legend

- Qls
Glacial lake bottom
(Covered by lacustrine deposits)

0 0.5 1.0 Miles

Modified after Bretz (1926)



0 2 4 8 miles

Modified after Leetaru et al. (2004)

SITE AND REGIONAL GEOLOGY: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22B, SN 016-1839, CHICAGO, IL

SCALE: GRAPHICAL

EXHIBIT 2

DRAWN BY: NSB
CHECKED BY: MWS



1145 N. Main Street
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FOR AECOM

1100-04-01

Bench Mark: Set "X" on east barrier wall of I-90 at \perp of Adams Street. Elev. 581.17.

Existing Structure: None.

Ramp WN and Ramp EN will be closed to traffic and detoured during construction.

No Salvage.

Notes:

- 1.) Wall offsets are measured from the \perp of Proposed NB C-D Road to the front face of cast-in-place fascia panels.
- 2.) C denotes Construction Joint.
- 3.) E denotes Expansion Joint.
- 4.) F.F. denotes Front Face.
- 5.) B.F. denotes Back Face.

- 6.) Wall to be built along straight chords between beginning station, kink points, and end station.
- 7.) Shaft diameter, spacing and tip elevation to be determined during final design.
- 8.) Proposed drainage information shown is conceptual and will be determined during final design.
- 9.) There shall be a minimum clear distance of 2' between the proposed drilled shafts and the existing main drain.

CURVE DATA

(NB C-D Road)
 Prop. Curve P-NCD-NX-4
 P.I. Sta. = 6336+57.47
 $\Delta = 35^\circ 13' 41''$ (RT)
 $D = 4^\circ 12' 24''$
 $R = 1,362.00'$
 $T = 432.42'$
 $L = 837.42'$
 $E = 67.00'$
 $e = 4.20\%$
 $T.R. = 41'$
 $S.E. Run = 87'$
 $P.C. Sta. = 6332+25.05$
 $P.T. Sta. = 6340+62.48$

HIGHWAY CLASSIFICATION

NB C-D Road
 Functional Class: Interstate
 ADT: NA (2012); 17,000 (2040)
 ADTT: NA (2012); 440 (2040)
 DHV: 1,680 (2040)
 Design Speed: 30 m.p.h.
 Posted Speed: 30 m.p.h.
 One-Way Traffic
 Directional Distribution: 100%

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge
 Design Specifications 8th Edition

DESIGN STRESSES

FIELD UNITS

$f'_c = 7,000$ psi (Drilled Shafts)**
 $f'_c = 3,500$ psi (All other concrete)
 $f_y = 60,000$ psi (Reinforcement)
 ** Final concrete strength will be determined during final design

WALL DEFLECTION CRITERIA:

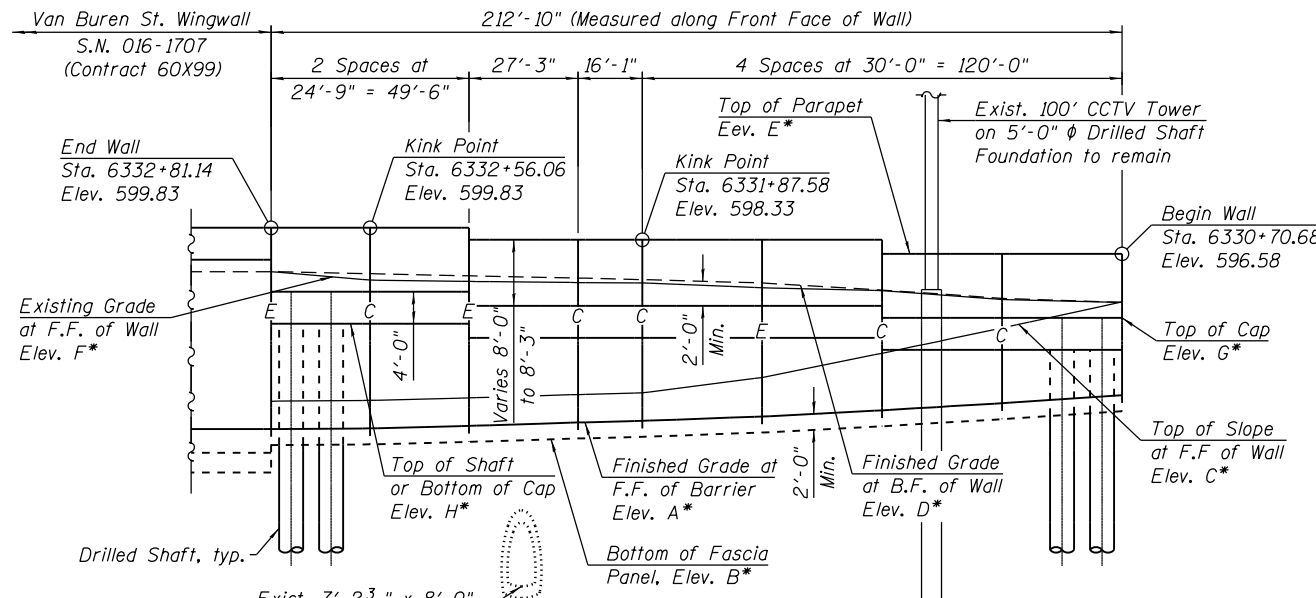
Maximum total lateral wall deflection at top of wall: 1% of retained height.

LEGEND:

- Ex. Chain Link Fence — x — x — Soil Boring
- Combined Sewer
- Electric
- Ex. Storm Sewer
- Prop. Storm Sewer
- Ex. ITS Cable
- Ex. Gas Line
- Ex. Fiber Optic
- Existing Catch Basin
- Proposed Catch Basin
- Existing Manhole
- Proposed Manhole
- Proposed Inlet
- Limits of Excavation and LCCF

SEQUENCE OF CONSTRUCTION

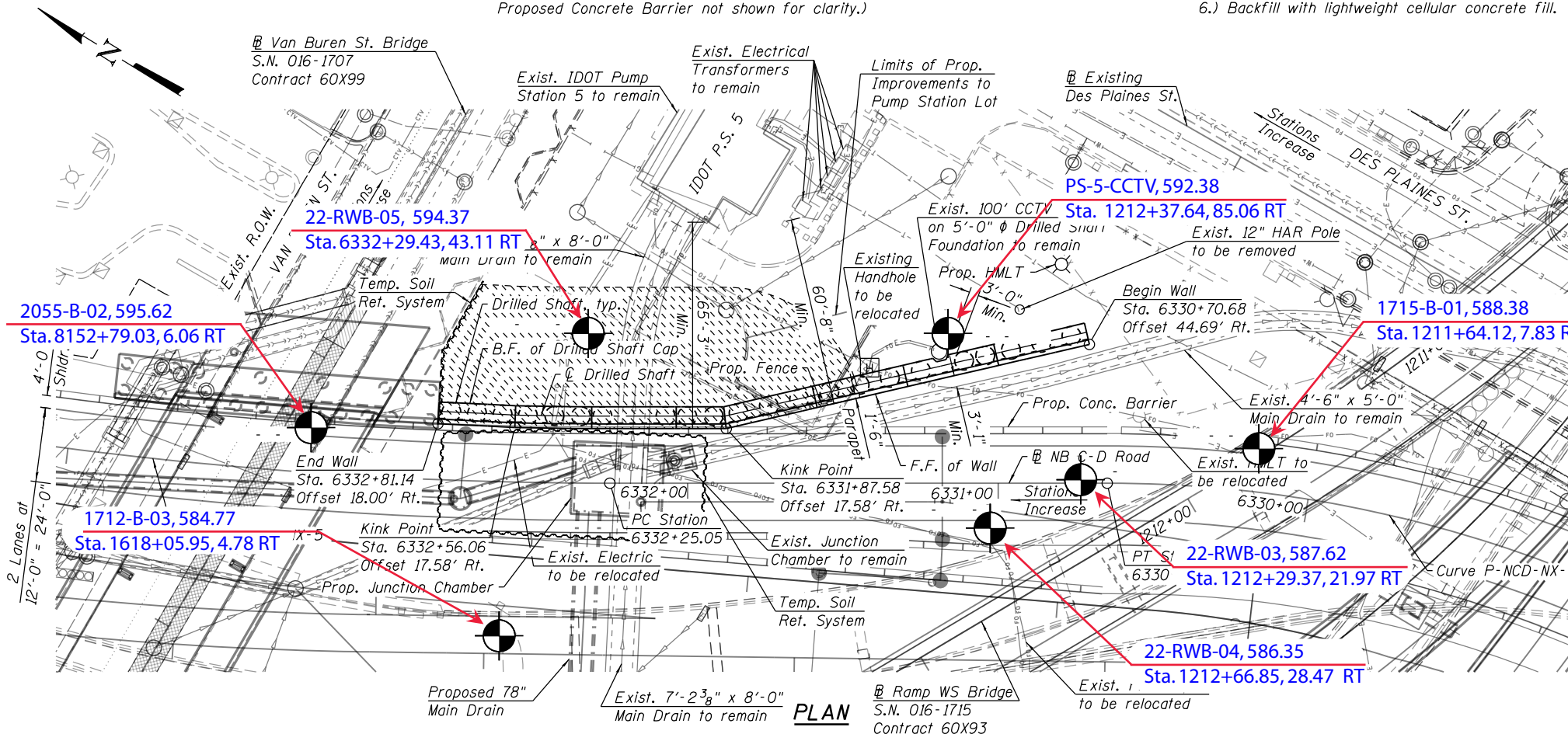
- 1.) Install TSRS along Van Buren Street.
- 2.) Excavate the area down to proposed groundline at F.F. of the wall.
- 3.) Install TSRS and excavate to install junction chamber.
- 4.) Construct junction chamber and backfill excavation.
- 5.) Drill shafts and construct retaining wall.
- 6.) Backfill with lightweight cellular concrete fill.



ELEVATION

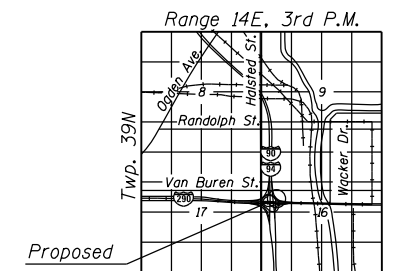
(Looking East at F.F. of Wall, Proposed Concrete Barrier not shown for clarity.)

* For elevations, see Table 1 on Sheet 2 of 3.



PLAN

Note: Boring Out of Plan
 VST-06
 N 1898109.29
 E 1171902.18



LOCATION SKETCH

GENERAL PLAN
RETAINING WALL 22B ALONG NB C-D ROAD
F.A.I. RTE. 90/94 (KENNEDY EXPRESSWAY)
SECTION 2014-005R&B
COOK COUNTY
STATION 6330+70.68 TO STATION 6332+81.14
STRUCTURE NO. 016-1839

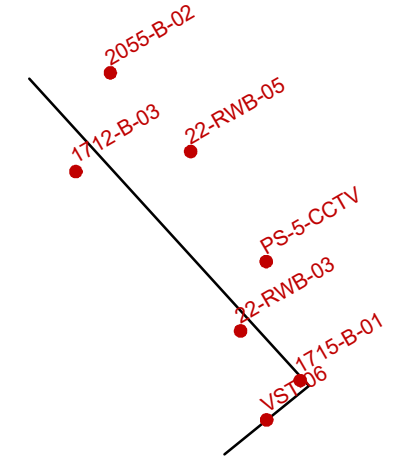
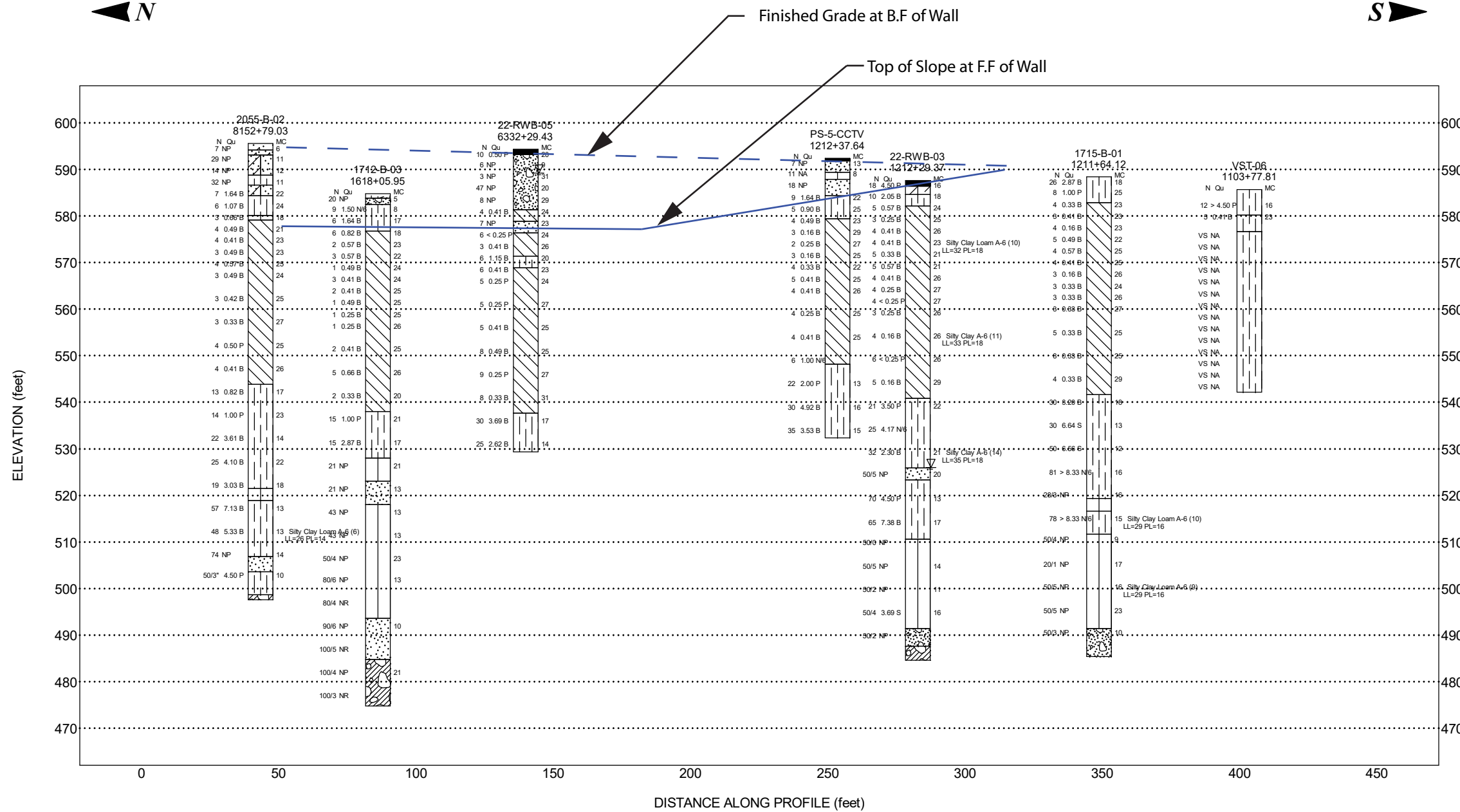
BORING LOCATION PLAN: CICRLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22B, SN. 016-1839, COOK COUNTY, ILLINOIS		
SCALE: GRAPHICAL	EXHIBIT 3	DRAWN BY: RKC CHECKED BY: NSB
		1145 N. Main Street Lombard, IL 60148 www.wangeng.com
FOR AECOM		1100-04-01



USER NAME = wjoiletta	DESIGNED - WJC	REVISED -
PLOT SCALE = 48.00' / in.	CHECKED - JM/MDS	REVISED -
PLOT DATE = 4/17/2018	DRAWN - WJC	REVISED -
	CHECKED - JM/MDS	REVISED -

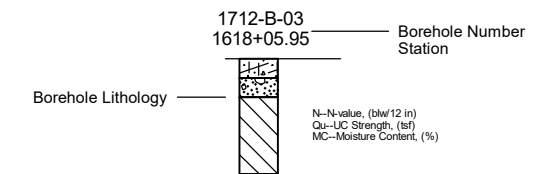
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.I. RTE. 90/94	SECTION 2014-005R&B	COUNTY COOK	TOTAL SHEETS 3	SHEET NO. 1
ILLINOIS FED. AID PROJECT			CONTRACT NO. 60X79	

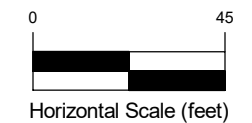


Site Map Scale 1 inch equals 165 feet

Explanation:

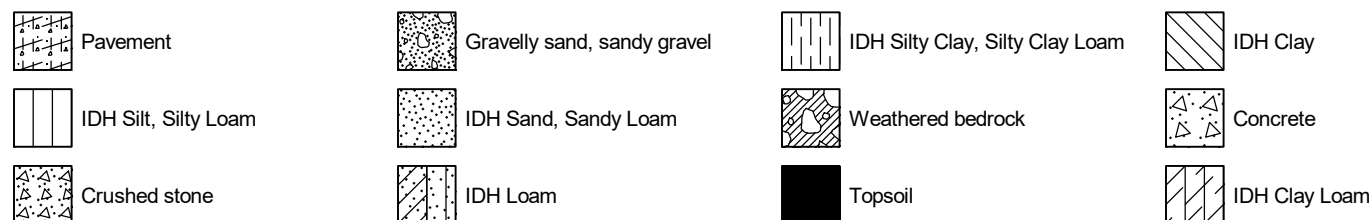


- Water Level Reading at time of drilling.
- Water Level Reading 24-hr after drilling or at end of drilling



Vertical Exaggeration: 1.5x

Lithology Graphics



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

Subsurface Data Profile Retaining Wall 22B, SN016-1839



Circle Interchange Reconstruction
Section 17, T39N, R14E of 3rd PM

JOB NUMBER	PLATE NUMBER
1100-04-01	EXHIBIT 4

APPENDIX A



BORING LOG 1712-B-03

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

WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 584.78 ft
 North: 1898322.61 ft
 East: 1171738.21 ft
 Station: 1618+05.95
 Offset: 4.7838 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	583.8	3-inch thick, ASPHALT over 9-inch thick, CONCRETE --PAVEMENT--															
	582.5	Medium dense, grayish white SANDY GRAVEL --DRY-- --BASE COURSE--			1	12 11 9	NP	5						9	0 0 2	0.41 B	25
		Stiff, brown to gray SILTY CLAY LOAM, trace gravel --FILL--			2	2 4 5	1.50 N/6	8						10	0 0 1	0.49 B	25
					3	1 3 3	1.64 B	17						11	0 0 1	0.25 B	25
	576.8	Soft to stiff, gray CLAY to SILTY CLAY, trace gravel			4	1 3 3	0.82 B	18						12	0 0 1	0.25 B	26
					5	0 0 2	0.57 B	23									
					6	0 1 2	0.57 B	22						13	0 1 1	0.41 B	25
					7	0 0 1	0.49 B	24									
					8	0 1 2	0.41 B	24						14	0 2 3	0.66 B	26

GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **07-28-2014** Complete Drilling **08-20-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR [78%]**
 Driller **R&J** Logger **S. Woods** Checked by **C. Marin**
 Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring**
 **backfilled upon completion**

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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

WANGENGINC 11000401.GPJ WANGENG.GDT 1/12/18



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 Lombard, IL 60148
 Telephone: (630) 953-9928
 Fax: (630) 953-9938

BORING LOG 1712-B-03

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 584.78 ft
 North: 1898322.61 ft
 East: 1171738.21 ft
 Station: 1618+05.95
 Offset: 4.7838 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	538.0	Stiff to very stiff, gray SILTY CLAY, trace gravel	45	X	15	0 0 2	0.33 B	20		523.0	Medium dense, gray fine SAND, trace gravel	65	X	19	10 8 13	NP	13
	518.0	Dense, gray SILTY LOAM, trace gravel	50	X	16	3 6 9	1.00 P	21		518.0	Dense, gray SILTY LOAM, trace gravel	70	X	20	13 15 28	NP	13
			55	X	17	2 5 10	2.87 B	17				75	X	21	14 17 26	NP	13
	528.0	Medium dense, gray SILTY LOAM, trace gravel	60	X	18	5 8 13	NP	21				80	X	22	18 27 50/4	NP	23

GENERAL NOTES

Begin Drilling **07-28-2014** Complete Drilling **08-20-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR [78%]**
 Driller **R&J** Logger **S. Woods** Checked by **C. Marin**
 Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring**
backfilled upon completion

WATER LEVEL DATA

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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

WANGENGINC 11000401.GPJ WANGENG.GDT 1/12/18



BORING LOG 1712-B-03

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

WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 584.78 ft
 North: 1898322.61 ft
 East: 1171738.21 ft
 Station: 1618+05.95
 Offset: 4.7838 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)			
	493.6	Very dense, gray, very fine to fine SAND --possible water bearing--		⊗	23	80/6	NP	13	[Patterned Soil Profile]	474.8	Very dense, greenish gray, shaly DOLOSTONE; moist to wet		⊗	27	100/4	NP	21			
				○	24	80/4	NR								○	28	100/3	NR		
					⊗	25	90/6	NP		10										
	484.8				○	26	100/5	NR												
											Boring terminated at 111.00 ft									

GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **07-28-2014** Complete Drilling **08-20-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-50 TMR [78%]**
 Driller **R&J** Logger **S. Woods** Checked by **C. Marin**
 Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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

WANGENGINC 11000401.GPJ WANGENG.GDT 1/12/18



BORING LOG 1715-B-01

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WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 588.39 ft
 North: 1898143.12 ft
 East: 1171931.11 ft
 Station: 12111+64.12
 Offset: 7.8377 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		Stiff to very stiff, brown SILTY CLAY LOAM															
		--FILL--															
					1	13 12 14	2.87 B	18						9	1 1 2	0.16 B	26
					2	4 3 5	1.00 P	25				25		10	1 1 2	0.33 B	24
	582.9	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			3	2 2 2	0.33 B	23						11	1 1 2	0.33 B	26
					4	1 1 2	0.41 B	23						12	2 1 2	0.33 B	27
					5	1 2 2	0.16 B	23									
					6	1 2 3	0.49 B	22						13	1 2 3	0.33 B	25
					7	1 2 2	0.57 B	25									
					8	1 1 3	0.41 B	25						14	2 3 5	0.33 B	25

GENERAL NOTES

Begin Drilling **03-04-2014** Complete Drilling **03-06-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **N&J** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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

WANGENGINC 11000401.GPJ WANGENG.GDT 1/12/18



BORING LOG 1715-B-01

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WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 588.39 ft
 North: 1898143.12 ft
 East: 1171931.11 ft
 Station: 1211+64.12
 Offset: 7.8377 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	541.6	Very stiff hard, gray SILTY CLAY LOAM to SILTY LOAM, trace gravel	45	X	15	1 2 2	0.33 B	29				65	X	19	26 33 48	8.33 N/6	16
	519.4		50	X	16	7 10 20	3.20 B	18		519.4	Very dense, gray SILTY LOAM, trace gravel --Moist--	70	X	20	26 46 28/3	NP	16
	516.6		55	X	17	12 15 15	6.64 S	13		516.6	Hard, gray SILTY CLAY LOAM, trace gravel --L _L (%)=29, P _L (%)=16-- --%Gravel=1.6-- --%Sand=10.8-- --%Silt=63.8-- --%Clay=23.7-- --A-6 (10)--	75	X	21	17 30 48	8.33 N/6	15
	511.6		60	X	18	28 26 24	6.56 S	12		511.6	Very dense, gray SILTY LOAM, trace gravel	80	X	22	50/4	NP	9

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GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **03-04-2014** Complete Drilling **03-06-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **N&J** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 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 1715-B-01

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 588.39 ft
 North: 1898143.12 ft
 East: 1171931.11 ft
 Station: 1211+64.12
 Offset: 7.8377 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
											--HARD DRILLING-- --Possible Cobbles--						
	485.4										--AUGER REFUSAL-- Boring terminated at 103.00 ft						
			85		23	35 45 20/1	NP	17									
		--L _L (%)=29, P _L (%)=16-- --%Gravel=4.7-- --%Sand=10.1-- --%Silt=57.1-- --%Clay=28.0-- --A-6 (9)--	90		24	24 50/5	NP	16									
			95		25	37 50/5	NP	23									
		--HARD DRILLING-- --Possible Cobbles--															
	491.4	Very dense, gray GRAVELLY SAND --possible water bearing--															
			100		26	50/3	NP	10									

GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **03-04-2014** Complete Drilling **03-06-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **N&J** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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

WANGENGINC 11000401.GPJ WANGENG.GDT 1/12/18



BORING LOG 2055-B-02

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WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 595.62 ft
 North: 1898407.45 ft
 East: 1171767.90 ft
 Station: 8152+79.03
 Offset: 6.0657 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	
		17-inch thick CONCRETE --PAVEMENT--																
	594.2	9-inch thick CRUSHED STONE --BASE COURSE--			1	5 4 3	NP	6						9	2 2 2	0.41 B	23	
	593.1	Medium dense, black and gray LOAM, trace gravel --FILL--			2	6 12 17	NP	11				25		10	2 2 1	0.49 B	23	
	588.8	Very stiff (2.50 - 2.75 P), brown and gray SILTY CLAY LOAM with fine sand lenses, trace gravel --FILL--			3	5 7 7	NP	12						11	1 2 2	0.57 B	25	
	586.6	Dense, black and gray LOAM to SILTY LOAM, trace gravel, brick, and wood --FILL--			4	3 4 28	NP	11				30		12	1 1 2	0.49 B	24	
	584.4	<i>boring offset 3 feet south due to obstruction</i> Stiff, gray SILTY CLAY LOAM, trace gravel			5	2 3 4	1.64 B	22										
					6	3 3 3	1.07 B	24				35		13	1 1 2	0.42 B	25	
	580.1	Gray SILTY LOAM																
	579.1	Soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			7	1 2 1	0.66 B	18										
					8	2 2 2	0.49 B	21				40		14	1 2 1	0.33 B	27	

GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **04-22-2013** Complete Drilling **04-29-2013**
 Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
 Driller **P&N** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring**
backfilled upon completion

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 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 2055-B-02

WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 595.62 ft
 North: 1898407.45 ft
 East: 1171767.90 ft
 Station: 8152+79.03
 Offset: 6.0657 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	
Profile	543.9	Medium stiff to hard, gray SILTY CLAY to CLAY, trace to little gravel	45	X	15	1 2 2	0.50 P	25	Profile	521.5	Gray SILTY LOAM	65	X	19	4 9 13	3.61 B	14	
			50	X	16	2 2 2	0.41 B	26				70	X	20	5 10 15	4.10 B	22	
			55	X	17	2 3 10	0.82 B	17				75	X	21	5 9 10	3.03 B	18	
			60	X	18	4 5 9	1.00 P	23				80	X	22	20 27 30	7.13 B	13	
	518.9	Hard, gray SILTY CLAY LOAM, trace gravel and seams of fine sand to silt								518.9	Hard, gray SILTY CLAY LOAM, trace gravel and seams of fine sand to silt							

GENERAL NOTES

Begin Drilling **04-22-2013** Complete Drilling **04-29-2013**
 Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
 Driller **P&N** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring**
 **backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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

WANGENGINC 11000401.GPJ WANGENG.GDT 1/12/18



BORING LOG 2055-B-02

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WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 595.62 ft
 North: 1898407.45 ft
 East: 1171767.90 ft
 Station: 8152+79.03
 Offset: 6.0657 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--L _L (%)=26, P _L (%)=14-- --%Gravel=6.2-- --%Sand=22.1-- --%Silt=52.6-- --%Clay=19.1-- --A-6 (6)--	85	X	23	19 21 27	5.33 B	13									
	506.9	Very dense, gray, medium SAND, trace gravel		X	24	24 37 37	NP	14									
	503.6	Hard, gray SILTY CLAY LOAM, some gravel		X	25	50/3"	4.50 P	10									
	498.6	--HARD DRILLING--															
	497.6	Possible Boulders --AUGER REFUSAL--															
		Boring terminated at 98.00 ft	95														
			100														

GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **04-22-2013** Complete Drilling **04-29-2013**
 Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
 Driller **P&N** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" SSA to 10', mud rotary thereafter, boring backfilled upon completion**

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 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 22-RWB-03

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 587.62 ft
 North: 1898185.65 ft
 East: 1171879.86 ft
 Station: 1212+29.37
 Offset: 21.9731 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	586.4	15-inch thick, black and brown SILTY LOAM --TOPSOIL--															
		Hard, brown CLAY LOAM, trace gravel --FILL--			1	7 8 10	4.50 P	16						9	1 2 2	0.41 B	26
	584.6	Very stiff, gray SILTY CLAY LOAM, trace gravel			2	3 4 6	2.05 B	18				25		10	1 2 2	0.25 B	27
	582.1	Very soft to medium stiff, gray CLAY to SILTY CLAY, trace gravel			3	2 2 3	0.57 B	24						11	2 2 2	< 0.25 P	27
					4	1 1 2	0.25 B	25				30		12	2 1 2	0.25 B	26
					5	1 2 2	0.41 B	26									
		--L _L (%)=32, P _L (%)=18-- --%Gravel=2.5-- --%Sand=15.0-- --%Silt=57.1-- --%Clay=25.4-- --A-6 (10)--			6	1 2 2	0.41 B	23						13	1 2 2	0.16 B	26
					7	2 2 3	0.33 B	21									
					8	2 2 3	0.57 B	21				40		14	2 2 4	< 0.25 P	26

GENERAL NOTES

Begin Drilling **03-07-2014** Complete Drilling **03-10-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **N&J** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 15', mud rotary thereafter, boring**
backfilled upon completion

WATER LEVEL DATA

While Drilling ∇ **62.00 ft**
 At Completion of Drilling ∇ **mud in the borehole**
 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 22-RWB-03

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 587.62 ft
 North: 1898185.65 ft
 East: 1171879.86 ft
 Station: 1212+29.37
 Offset: 21.9731 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	540.9	Very stiff to hard, gray SILTY CLAY LOAM, trace gravel	45	X	15	2 2 3	0.16 B	29		525.9	--%Silt=54.1-- --%Clay=33.9-- --A-6 (14)-- Very dense, gray, coarse SAND, little gravel --Moist--	45	X	19	35 50/5	NP	20
			50	X	16	5 9 12	3.50 P	22		523.3	Hard, gray SILTY CLAY LOAM to SILTY LOAM, trace gravel	65	X	20	25 33 37	4.50 P	13
			55	○	17	10 9 16	4.17 N/6					75	X	21	16 27 38	7.38 B	17
			60	X	18	8 10 22	2.30 B	21		510.6	--HARD DRILLING from 77 ft-- --Possible Cobbles-- Very dense, gray SILTY LOAM, trace gravel	80	X	22	50/0	NP	
		--L _L (%)=35, P _L (%)=18-- --%Gravel=1.8-- --%Sand=10.2--															

GENERAL NOTES

Begin Drilling **03-07-2014** Complete Drilling **03-10-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **N&J** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 15', mud rotary thereafter, boring**
backfilled upon completion

WATER LEVEL DATA

While Drilling ∇ **62.00 ft**
 At Completion of Drilling ∇ **mud in the borehole**
 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 22-RWB-03

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 587.62 ft
 North: 1898185.65 ft
 East: 1171879.86 ft
 Station: 1212+29.37
 Offset: 21.9731 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	484.6									484.6	--VERY HARD, STEADY DRILLING-- --WEATHERED BEDROCK-- --ROLLER BIT REFUSAL-- Boring terminated at 103.00 ft						
			85	⊗	23	50/5	NP	14									
			90	⊗	24	50/2	NP	11									
			95	⊗	25	50/4	3.69 S	16									
	491.4	Very dense, gray SANDY GRAVEL; wet --possible water bearing--															
	487.6		100	⊗	26	50/2	NP					120					

GENERAL NOTES

Begin Drilling **03-07-2014** Complete Drilling **03-10-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **N&J** Logger **A. Happel** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 15', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling ∇ **62.00 ft**
 At Completion of Drilling ∇ **mud in the borehole**
 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 22-RWB-04

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 586.36 ft
 North: 1898208.77 ft
 East: 1171849.77 ft
 Station: 1212+66.85
 Offset: 28.4715 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	586.13	13-inch thick, brown SILTY LOAM --TOPSOIL-- Hard, brown SILTY CLAY LOAM, trace gravel --FILL--			1	3 4 6	4.10 B	21						9	1 1 2	0.41 B	26
	583.4	Stiff to very stiff, gray SILTY CLAY, trace gravel	5		2	3 4 5	2.87 B	20				25		10	2 2 2	0.49 B	26
					3	2 3 3	1.56 B	22						11	2 1 2	0.41 B	27
	578.4	Soft, gray CLAY, trace gravel	10		4	1 1 2	0.33 B	25				30		12	1 2 3	0.41 B	25
					5	1 1 2	0.33 B	25									
	573.4	Medium stiff, gray SILTY CLAY LOAM, trace gravel	15		6	1 2 4	0.57 B	17				35		13	1 2 3	0.41 B	25
	570.9	Soft, gray CLAY to SILTY CLAY, trace gravel			7	1 2 3	0.41 B	25									
					8	2 2 4	0.41 B	22				40		14	1 2 3	0.25 P	26

GENERAL NOTES

Begin Drilling **08-05-2014** Complete Drilling **08-05-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **P&N** Logger **M. de los Reyes** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring**
backfilled upon completion

WATER LEVEL DATA

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 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 22-RWB-04

WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 586.36 ft
 North: 1898208.77 ft
 East: 1171849.77 ft
 Station: 1212+66.85
 Offset: 28.4715 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	543.9	--HARD DRILLING at 42.5 ft-- --Possible Cobbles--								524.6	Very dense, gray SANDY LOAM, trace gravel						
		Stiff to very stiff, gray SILTY CLAY LOAM, trace gravel	45	X	15	2 4 5	1.50 N/6	18			--Moist--	65	X	19	13 19 35	NP	11
			50	X	16	5 9 12	2.87 B	18									
			55	X	17	9 11 14	2.62 B	14									
	529.6	Very stiff, gray SILTY LOAM to SILTY CLAY LOAM, trace gravel and sand seams	60	X	18	13 19 35	3.69 S	13			Boring terminated at 65.00 ft	80					

GENERAL NOTES

Begin Drilling **08-05-2014** Complete Drilling **08-05-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **P&N** Logger **M. de los Reyes** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring**
backfilled upon completion

WATER LEVEL DATA

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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

WANGENGINC 11000401.GPJ WANGENG.GDT 1/12/18



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BORING LOG 22-RWB-05

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 594.37 ft
 North: 1898339.83 ft
 East: 1171837.02 ft
 Station: 6332+29.43
 Offset: 43.1182 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	593.2	14-inch thick, dark brown SILTY LOAM --TOPSOIL--															
		Very loose to dense, brown GRAVELLY SAND --FILL--			1	5 7 3	0.50 P	20						9	1 1 2	0.41 B	26
					2	4 4 2	NP	9		571.4	Stiff, gray, SILTY CLAY, trace gravel			10	1 3 3	1.15 B	20
					3	8 1 2	NP	31		568.9	Soft, gray CLAY, trace gravel			11	1 2 4	0.41 B	23
					4	4 14 33	NP	20						12	1 2 3	0.25 P	24
					5	7 5 3	NP	29									
	581.4	Soft, gray CLAY, trace gravel			6	1 2 2	0.41 B	24						13	1 2 3	0.25 P	27
	578.9	Loose, brown, coarse SAND --MOIST--			7	4 4 3	NP	23									
	576.4	Very soft to soft, gray CLAY to SILTY CLAY, trace gravel			8	1 3 3	< 0.25 P	24						14	1 2 3	0.41 B	25

GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **08-06-2014** Complete Drilling **08-06-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **P&N** Logger **M. de los Reyes** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring**
backfilled upon completion

While Drilling ∇ **5.50 ft**
 At Completion of Drilling ∇ **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water ∇ **NA**

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BORING LOG 22-RWB-05

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 594.37 ft
 North: 1898339.83 ft
 East: 1171837.02 ft
 Station: 6332+29.43
 Offset: 43.1182 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	537.6	Very stiff, gray SILTY CLAY to SILTY CLAY LOAM, trace gravel	45	X	15	3 3 5	0.49 B	25		529.4	Boring terminated at 65.00 ft	65	X	19	6 10 15	2.62 B	14
	50		X	16	2 4 5	0.25 P	27		70								
	55		X	17	1 4 4	0.33 B	31		75								
	60		X	18	8 13 17	3.69 B	17		80								

GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **08-06-2014** Complete Drilling **08-06-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **P&N** Logger **M. de los Reyes** Checked by **C. Marin**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

While Drilling ∇ **5.50 ft**
 At Completion of Drilling ∇ **mud in the borehole**
 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 PS-5-CCTV

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 592.39 ft
 North: 1898245.34 ft
 East: 1171901.91 ft
 Station: 1212+37.64
 Offset: 85.0667 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	591.9	6-inch thick dark brown SILTY LOAM --TOPSOIL--															
		Loose, brown and gray, fine SAND --FILL--			1	5 4 3	NP	13						9	1 1 2	0.16 B	25
	589.4	Brown SILTY LOAM, trace gravel, glass, and cinders --FILL--			2	5 5 6		8						10	2 2 2	0.33 B	22
	587.9	Medium dense, brown SANDY LOAM, trace gravel --FILL--	5									25					
					3	11 11 7	NP							11	1 2 3	0.41 B	25
	584.4	Medium stiff to stiff, gray SILTY CLAY, trace gravel			4	3 4 5	1.64 B	22						12	1 2 2	0.41 B	26
			10														
					5	2 2 3	0.90 B	25									
	579.4	Very soft to soft, gray CLAY to SILTY CLAY, trace gravel			6	1 2 2	0.49 B	23						13	1 2 2	0.25 B	25
			15														
					7	1 1 2	0.16 B	29									
					8	1 1 1	0.25 B	27						14	2 2 2	0.41 B	25
			20														

GENERAL NOTES

Begin Drilling **11-07-2013** Complete Drilling **11-07-2013**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **P&N** Logger **D. Kolpacki** Checked by _____
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring**
backfilled upon completion

WATER LEVEL DATA

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 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 PS-5-CCTV

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 592.39 ft
 North: 1898245.34 ft
 East: 1171901.91 ft
 Station: 1212+37.64
 Offset: 85.0667 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	
	548.1																	
		Very stiff to hard, gray SILTY CLAY to SILTY CLAY LOAM, trace to little gravel	45	○	15	2 2 4	1.00 N/6											
	50		△	16	6 9 13	2.00 P	13											
	55		△	17	8 14 16	4.92 B	16											
	532.4		60	△	18	11 14 21	3.53 B	15										
Boring terminated at 60.00 ft																		

GENERAL NOTES

WATER LEVEL DATA

Begin Drilling **11-07-2013** Complete Drilling **11-07-2013**
 Drilling Contractor **Wang Testing Services** Drill Rig **D-25 ATV [93%]**
 Driller **P&N** Logger **D. Kolpacki** Checked by _____
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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BORING LOG VST-06

WEI Job No.: 1100-04-01

Client: **AECOM**
 Project: **Circle Interchange Reconstruction**
 Location: **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 585.69 ft
 North: 1898109.29 ft
 East: 1171902.18 ft
 Station: 1103+77.81
 Offset: 27.3835 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	580.2	Hard, brown SILTY CLAY LOAM, trace gravel --FILL--	5		1	7 6 6	4.50 P	16			--In-Situ Vane Shear, 20.5 feet-- --S _{u undis} = 775.4 psf-- --S _{u remold} = 360.4 psf-- --Sensitivity = 2.2--	25		5			
	576.7	Soft, gray SILTY CLAY LOAM			2	1 2 3	0.41 B	23			--In-Situ Vane Shear, 23.0 feet-- --S _{u undis} = 600.6 psf-- --S _{u remold} = 305.8 psf-- --Sensitivity = 2.0--	30		7			
			10								--In-Situ Vane Shear, 25.5 feet-- --S _{u undis} = 578.8 psf-- --S _{u remold} = 316.7 psf-- --Sensitivity = 1.8--	35		8			
			15		1						--In-Situ Vane Shear, 28.0 feet-- --S _{u undis} = 611.6 psf-- --S _{u remold} = 338.5 psf-- --Sensitivity = 1.8--	40		9			
			20		2						--In-Situ Vane Shear, 30.5 feet-- --S _{u undis} = 786.3 psf-- --S _{u remold} = 382.2 psf-- --Sensitivity = 2.1--			10			
					3						--In-Situ Vane Shear, 33.0 feet-- --S _{u undis} = 698.9 psf-- --S _{u remold} = 404.1 psf-- --Sensitivity = 1.7--			11			
					4						--In-Situ Vane Shear, 35.5 feet-- --S _{u undis} = 808.1 psf-- --S _{u remold} = 502.4 psf-- --Sensitivity = 1.6--			12			
											--In-Situ Vane Shear, 38.0 feet-- --S _{u undis} = 982.9 psf-- --S _{u remold} = 546.0 psf-- --Sensitivity = 1.8--						

GENERAL NOTES

Begin Drilling **12-09-2015** Complete Drilling **12-14-2015**
 Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
 Driller **R&N** Logger **F. Bozga** Checked by **A. Kurnia**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 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 VST-06

WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 585.69 ft
 North: 1898109.29 ft
 East: 1171902.18 ft
 Station: 1103+77.81
 Offset: 27.3835 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
		--In-Situ Vane Shear, 40.5 feet-- -- $S_{u\ undis}$ = 906.4 psf-- -- $S_{u\ remold}$ = 524.2 psf-- --Sensitivity = 1.7--			13	VS											
	542.2	--In-Situ Vane Shear, 43.0 feet-- -- $S_{u\ undis}$ = 677.1 psf-- -- $S_{u\ remold}$ = 393.1 psf-- --Sensitivity = 1.7-- Boring terminated at 43.50 ft			14	VS											
			45														
			50														
			55														
			60														

GENERAL NOTES

Begin Drilling **12-09-2015** Complete Drilling **12-14-2015**
 Drilling Contractor **Wang Testing Services** Drill Rig **CME-55 TMR [85%]**
 Driller **R&N** Logger **F. Bozga** Checked by **A. Kurnia**
 Drilling Method **2.25" HSA to 10', mud rotary thereafter, boring**
 **backfilled upon completion**

WATER LEVEL DATA

While Drilling **Rotary wash**
 At Completion of Drilling **mud in the borehole**
 Time After Drilling **NA**
 Depth to Water **NA**

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BORING LOG 1703-PZ-01

WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 582.49 ft
 North: 1898127.96 ft
 East: 1171807.47 ft
 Station: 1104+74.81
 Offset: 3.30157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	
		--Drilled without sampling--	5								Piezometer Data: --Installed in Nov. 12, 2014 --Bentonite Seal 70 to 72 feet --Top of Sand Pack at 72 feet --Top of Screen at 75.3 feet --Screen Length 20 feet --Bottom of Screen at 95.3 feet	25						
			10								--piezometer stabilized water level reading -- --reading during well development (11/20/2014) = 32.00 feet bgs-- --reading date: 12/05/2014 = 31.10 feet bgs--	30						
			15									35						
			20									40						

GENERAL NOTES

Begin Drilling **11-10-2014** Complete Drilling **11-12-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR [100%]**
 Driller **P&P** Logger **S. Woods** Checked by **C. Marin**
 Drilling Method **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling ▽ **78.00 ft**
 At Completion of Drilling ▼ **NA**
 Time After Drilling **NA**
 Depth to Water ▼ **NA**

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BORING LOG 1703-PZ-01

WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 582.49 ft
 North: 1898127.96 ft
 East: 1171807.47 ft
 Station: 1104+74.81
 Offset: 3.30157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			45									65					
			50									70					
			55									75					
			60									80					

Piezometer Data:
 --Installed in Nov. 12, 2014
 --Bentonite Seal 70 to 72 feet
 --Top of Sand Pack at 72 feet
 --Top of Screen at 75.3 feet
 --Screen Length 20 feet
 --Bottom of Screen at 95.3 feet

GENERAL NOTES

Begin Drilling **11-10-2014** Complete Drilling **11-12-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR [100%]**
 Driller **P&P** Logger **S. Woods** Checked by **C. Marin**
 Drilling Method **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling ▽ **78.00 ft**
 At Completion of Drilling ▼ **NA**
 Time After Drilling **NA**
 Depth to Water ▼ **NA**

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BORING LOG 1703-PZ-01

WEI Job No.: 1100-04-01

Client **AECOM**
 Project **Circle Interchange Reconstruction**
 Location **Section 17, T39N, R14E of 3rd PM**

Datum: NAVD 88
 Elevation: 582.49 ft
 North: 1898127.96 ft
 East: 1171807.47 ft
 Station: 1104+74.81
 Offset: 3.30157 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)	Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
			85														
		Very dense, gray SILTY LOAM, trace gravel	90	X	1	40 42 18/3	NP	13									
		--Dry--															
			95	X	2	10 23 50/3	NP	20									
		--Dolostone fragments--		X	3	15 30/2	NP	14									
	482.5		100														
Boring terminated at 100.00 ft																	

GENERAL NOTES

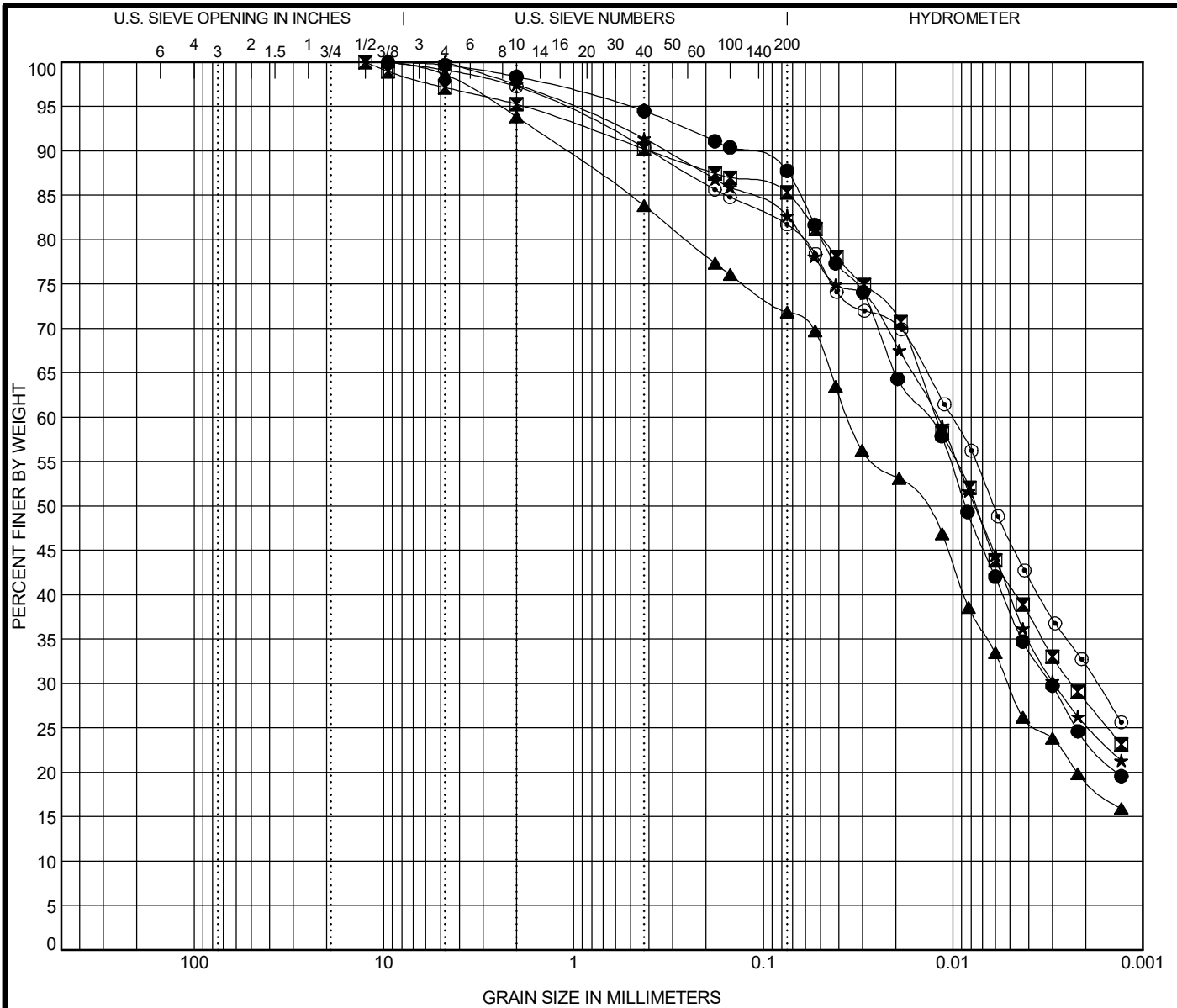
Begin Drilling **11-10-2014** Complete Drilling **11-12-2014**
 Drilling Contractor **Wang Testing Services** Drill Rig **B-57 TMR [100%]**
 Driller **P&P** Logger **S. Woods** Checked by **C. Marin**
 Drilling Method **4.25" HSA, monitoring water well**

WATER LEVEL DATA

While Drilling ▽ **78.00 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.

APPENDIX B



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification			IDH Classification					LL	PL	PI	Cc	Cu
●	1715-B-01#21	73.5 ft	Silty Clay Loam					29	16	13		
☒	1715-B-01#24	88.5 ft	Silty Clay Loam					29	16	13		
▲	2055-B-02#23	83.5 ft	Silty Clay Loam					26	14	12		
★	22-RWB-03#6	13.5 ft	Silty Clay Loam					32	18	14		
⊙	22-RWB-03#13	33.5 ft	Silty Clay					33	18	15		
Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay		
●	1715-B-01#21	73.5 ft	9.5	0.014	0.003		1.6	10.8	63.8	23.7		
☒	1715-B-01#24	88.5 ft	12.5	0.012	0.002		4.7	10.1	57.2	28.0		
▲	2055-B-02#23	83.5 ft	9.5	0.036	0.005		6.2	22.1	52.6	19.1		
★	22-RWB-03#6	13.5 ft	4.75	0.012	0.003		2.5	15.0	57.1	25.4		
⊙	22-RWB-03#13	33.5 ft	9.5	0.01	0.002		2.7	15.7	49.6	32.0		

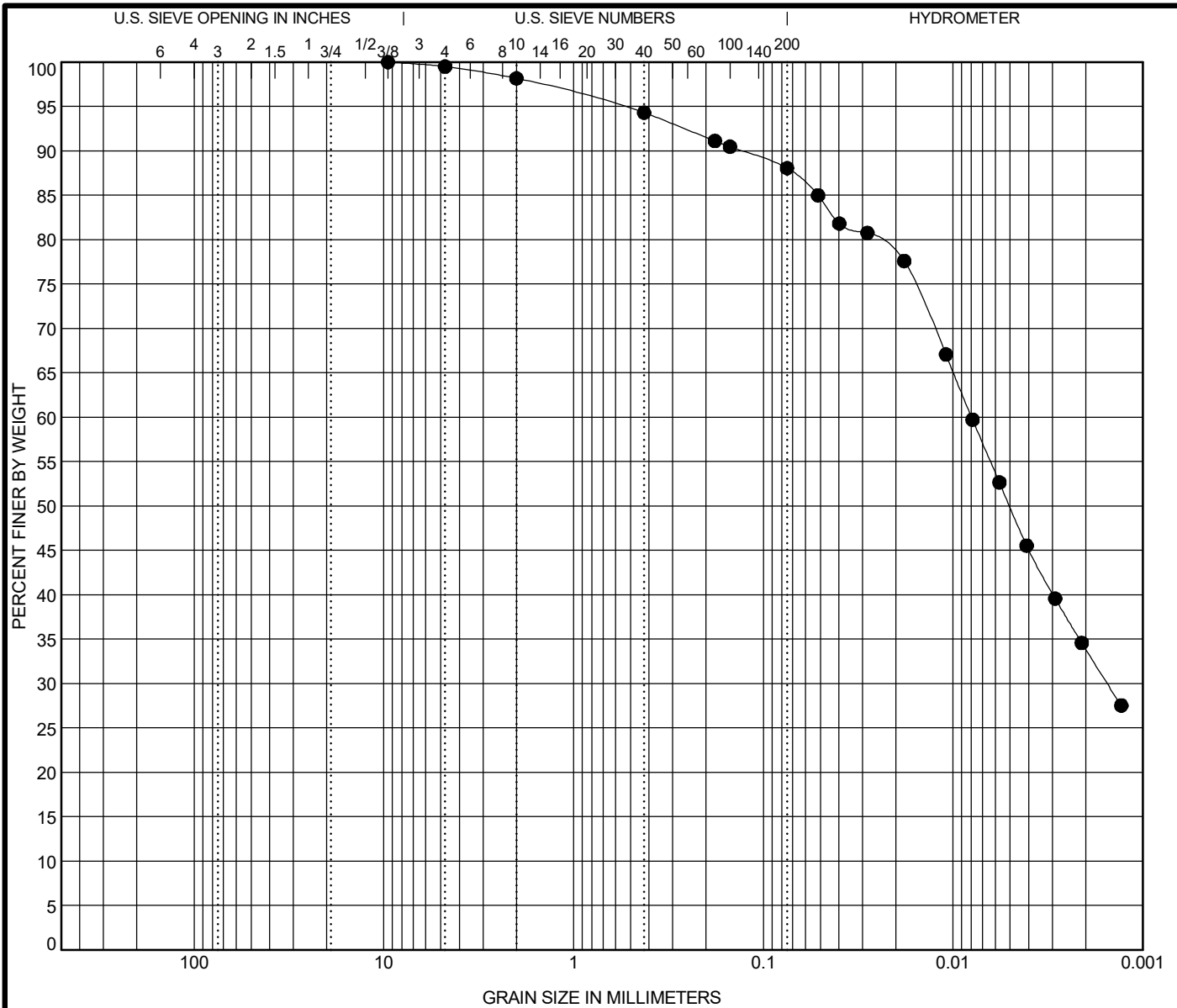
WEI GRAIN SIZE IDH 11000401.GPJ US LAB.GDT 1/5/18



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GRAIN SIZE DISTRIBUTION

Project: Circle Interchange Reconstruction
 Location: Section 17, T39N, R14E of 3rd PM
 Number: 1100-04-01



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification	IDH Classification	LL	PL	PI	Cc	Cu
● 22-RWB-03#18 58.5 ft	Silty Clay	35	18	17		

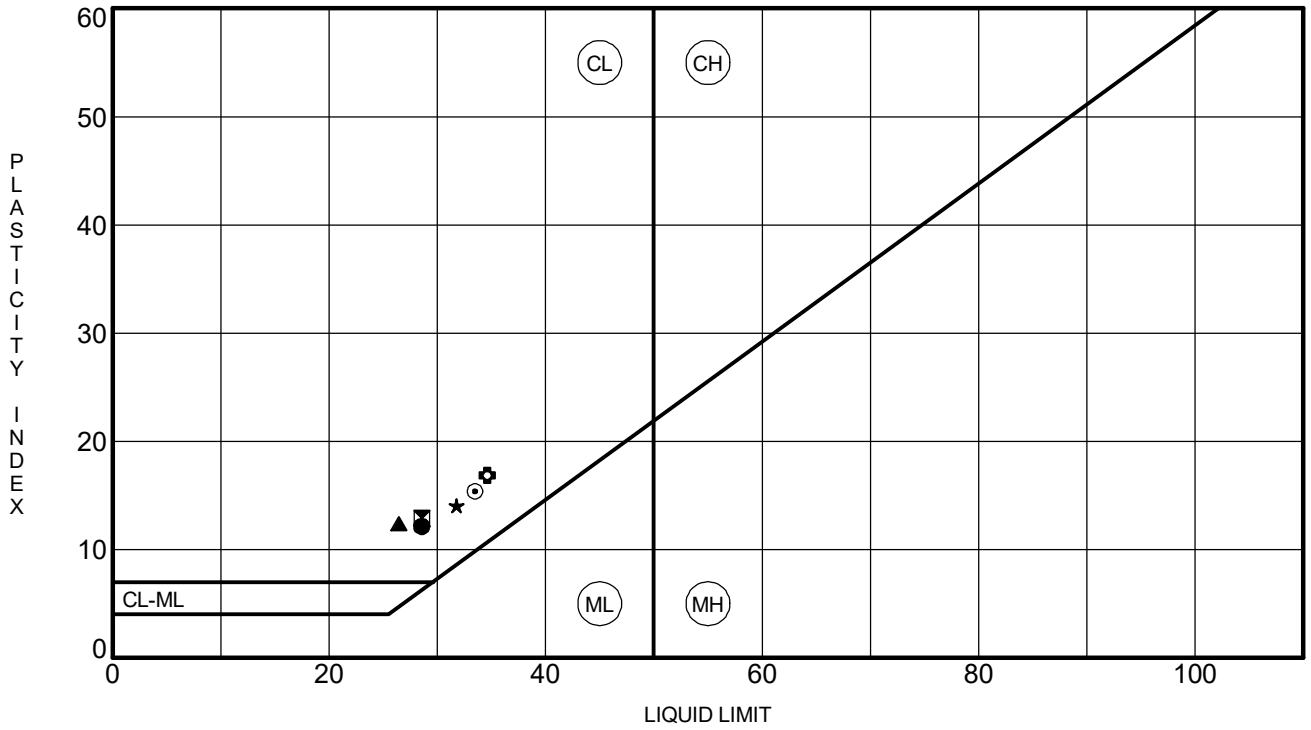
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● 22-RWB-03#18 58.5 ft	9.5	0.008	0.002		1.8	10.2	54.1	33.9



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GRAIN SIZE DISTRIBUTION
 Project: Circle Interchange Reconstruction
 Location: Section 17, T39N, R14E of 3rd PM
 Number: 1100-04-01

WEI GRAIN SIZE IDH 11000401.GPJ US LAB.GDT 1/5/18



Specimen Identification	LL	PL	PI	Fines	IDH Classification	
● 1715-B-01#21	73.5 ft	29	16	13	88	Silty Clay Loam
◻ 1715-B-01#24	88.5 ft	29	16	13	85	Silty Clay Loam
▲ 2055-B-02#23	83.5 ft	26	14	12	72	Silty Clay Loam
★ 22-RWB-03#6	13.5 ft	32	18	14	83	Silty Clay Loam
⊙ 22-RWB-03#13	33.5 ft	33	18	15	82	Silty Clay
◼ 22-RWB-03#18	58.5 ft	35	18	17	88	Silty Clay

WEI ATTERBERG LIMITS IDH 11000401.GPJ US LAB.GDT 1/5/18

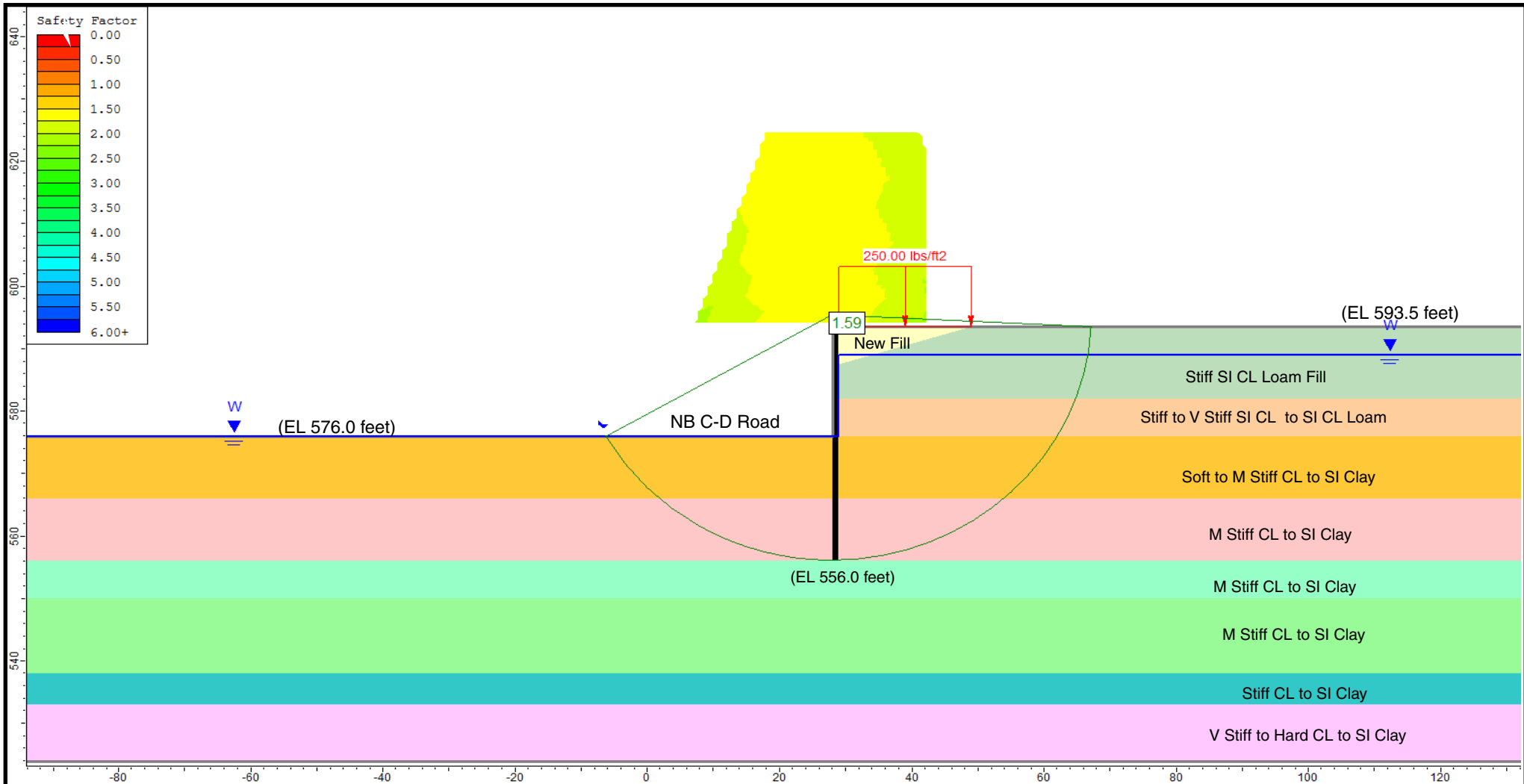


Wang Engineering, Inc.
 1145 N. Main Street
 Lombard/IL/60148
 Telephone: 6309539928
 Fax: 6309539938

ATTERBERG LIMITS' RESULTS

Project: Circle Interchange Reconstruction
 Location: Section 17, T39N, R14E of 3rd PM
 Number: 1100-04-01

APPENDIX C



Undrained Analysis at Sta. 6331+87.58, Ref Borings: 22-RWB-05, PS-5-CCTV, and VST-06

Layer ID	Description	Total Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	New Fill	120	0	30
2	Stiff GRAVELLY SAND Fill	120	0	30
3	M Stiff to Stiff SI CL to SI CL Loam	120	1000	0
4	Soft to M Stiff CL to SI Clay	115	550	0
5	M Stiff CL to SI Clay	115	680	0
6	M Stiff CL to SI Clay	115	750	0
7	Stiff CL to SI Clay	115	950	0

GLOBAL STABILITY: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22B, SN 016-1839, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL

APPENDIX C-1

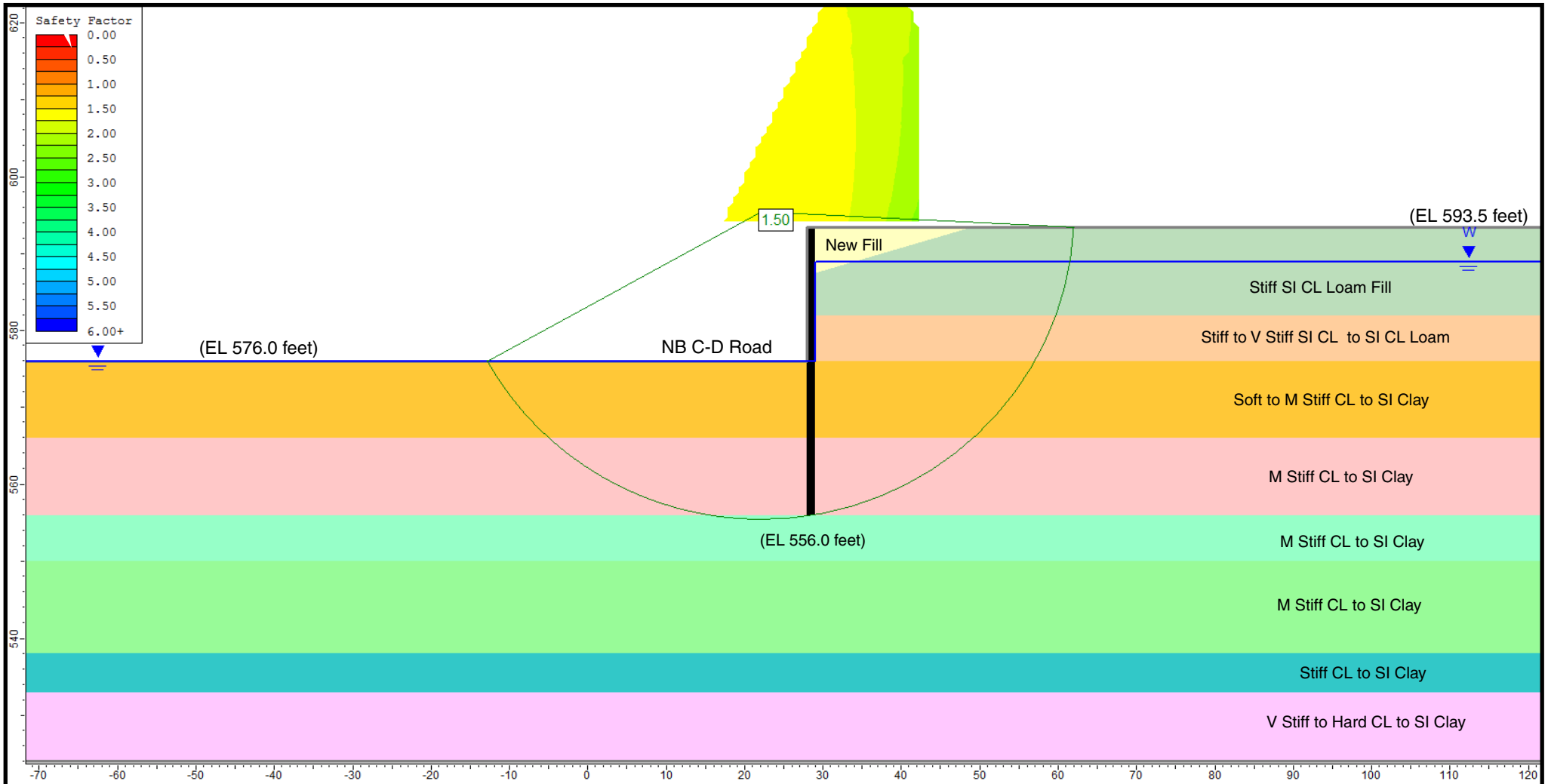
DRAWN BY: NSB
CHECKED BY: MWS



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FOR AECOM

1100-04-01



Drained Analysis at Sta. 6331+87.58, Ref Borings: 22-RWB-05, PS-5-CCTV, and VST-06

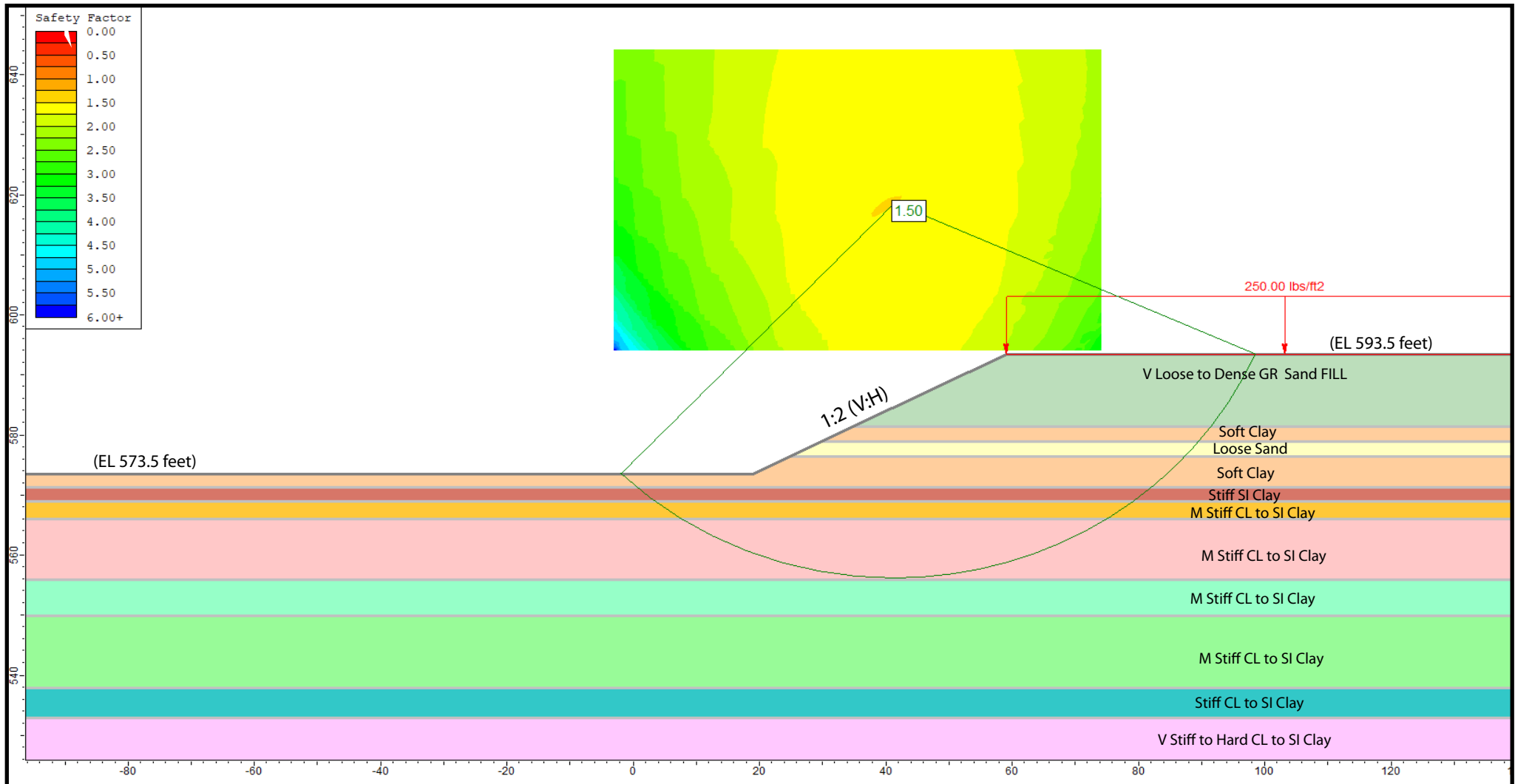
Layer ID	Description	Total Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	New Fill	120	0	30
2	Stiff GRAVELLY SAND Fill	120	0	30
3	M Stiff to Stiff SI CL to SI CL Loam	120	100	30
4	Soft to M Stiff CL to SI Clay	115	0	27
5	M Stiff CL to SI Clay	115	0	27
6	M Stiff CL to SI Clay	115	0	27
7	M Stiff CL to SI Clay	115	80	29

GLOBAL STABILITY: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22B, SN 016-1839, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL	APPENDIX C-2	DRAWN BY: NSB CHECKED BY: MWS
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FOR AECOM	1100-04-01
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Temporary Excavation, Undrained Analysis at Sta. 6332+00, Ref Borings: 22-RWB-05 and VST-06

Layer ID	Description	Total Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	V Loose to Dense GR Sand FILL	120	0	30
2	M Stiff Clay	110	700	0
3	Loose Sand	115	0	30
4	M Stiff CL to SI Clay	115	700	0
5	Stiff CL to SI Clay	120	1000	0
6	M Stiff CL to SI Clay	115	550	0
7	M Stiff CL to SI Clay	115	750	0

GLOBAL STABILITY: CIRCLE INTERCHANGE RECONSTRUCTION, RETAINING WALL 22B, SN 016-1839, COOK COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-3 | DRAWN BY: NSB
CHECKED BY: MWS

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APPENDIX D

Bench Mark: Set "X" on east barrier wall of I-90 at \mathcal{C} of Adams Street. Elev. 581.17.

Existing Structure: None.

Ramp WN and Ramp EN will be closed to traffic and detoured during construction.

No Salvage.

Notes:

- 1.) Wall offsets are measured from the \mathcal{C} of Proposed NB C-D Road to the front face of cast-in-place fascia panels.
- 2.) C denotes Construction Joint.
- 3.) E denotes Expansion Joint.
- 4.) F.F. denotes Front Face.
- 5.) B.F. denotes Back Face.
- 6.) Wall to be built along straight chords between beginning station, kink points, and end station.
- 7.) Shaft diameter, spacing and tip elevation to be determined during final design.
- 8.) Proposed drainage information shown is conceptual and will be determined during final design.
- 9.) There shall be a minimum clear distance of 2' between the proposed drilled shafts and the existing main drain.

CURVE DATA

(NB C-D Road)
 Prop. Curve P-NCD-NX-5
 P.I. Sta. = 6336+57.47
 $\Delta = 35^\circ 13' 41''$ (RT)
 $D = 4^\circ 12' 24''$
 $R = 1,362.00'$
 $T = 432.42'$
 $L = 837.42'$
 $E = 67.00'$
 $e = 4.20\%$
 $T.R. = 41'$
 $S.E. Run = 87'$
 P.C. Sta. = 6332+25.05
 P.T. Sta. = 6340+62.48

HIGHWAY CLASSIFICATION

NB C-D Road
 Functional Class: Interstate
 ADT: NA (2012); 17,000 (2040)
 ADTT: NA (2012); 440 (2040)
 DHV: 1,680 (2040)
 Design Speed: 30 m.p.h.
 Posted Speed: 30 m.p.h.
 One-Way Traffic
 Directional Distribution: 100%

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge
 Design Specifications 8th Edition

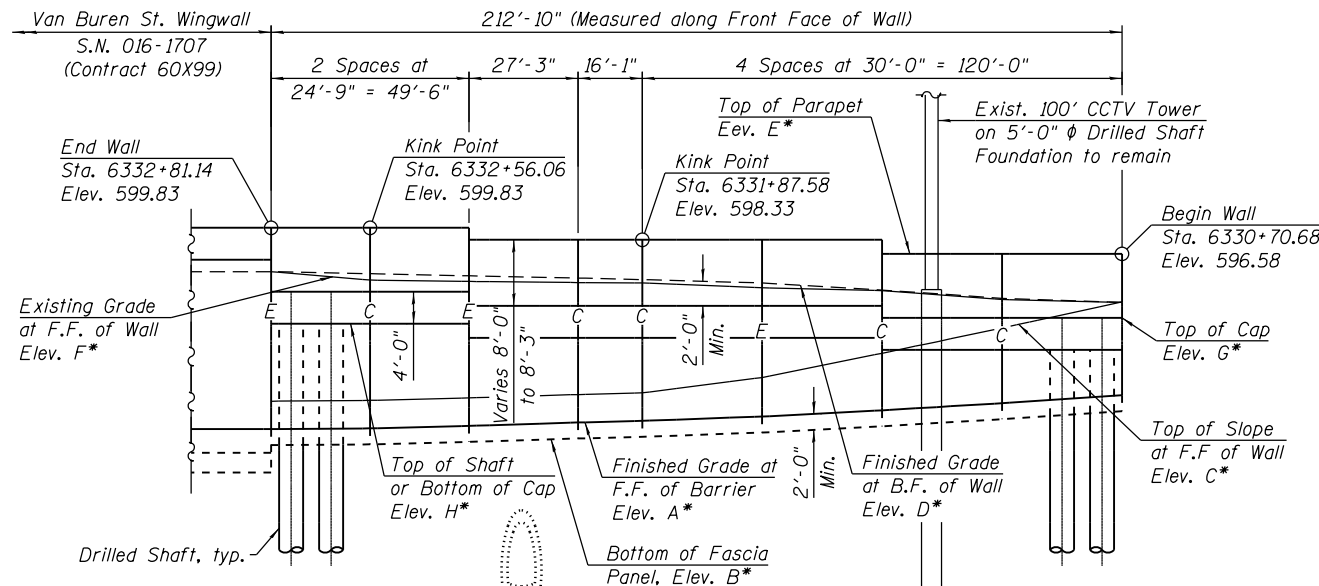
DESIGN STRESSES

FIELD UNITS

(NB C-D Road)
 Prop. Curve P-NCD-NX-4
 P.I. Sta. = 6328+76.78
 $\Delta = 59^\circ 05' 41''$ (RT)
 $D = 14^\circ 08' 50''$
 $R = 405.00'$
 $T = 229.58'$
 $L = 417.72'$
 $E = 60.54'$
 $e = 5.40\%$
 $T.R. = 36'$
 $S.E. Run = 98'$
 P.C. Sta. = 6326+47.20
 P.T. Sta. = 6330+64.91

WALL DEFLECTION CRITERIA:

Maximum total lateral wall deflection at top of wall: 1% of retained height.



ELEVATION

(Looking East at F.F. of Wall, Proposed Concrete Barrier not shown for clarity.)

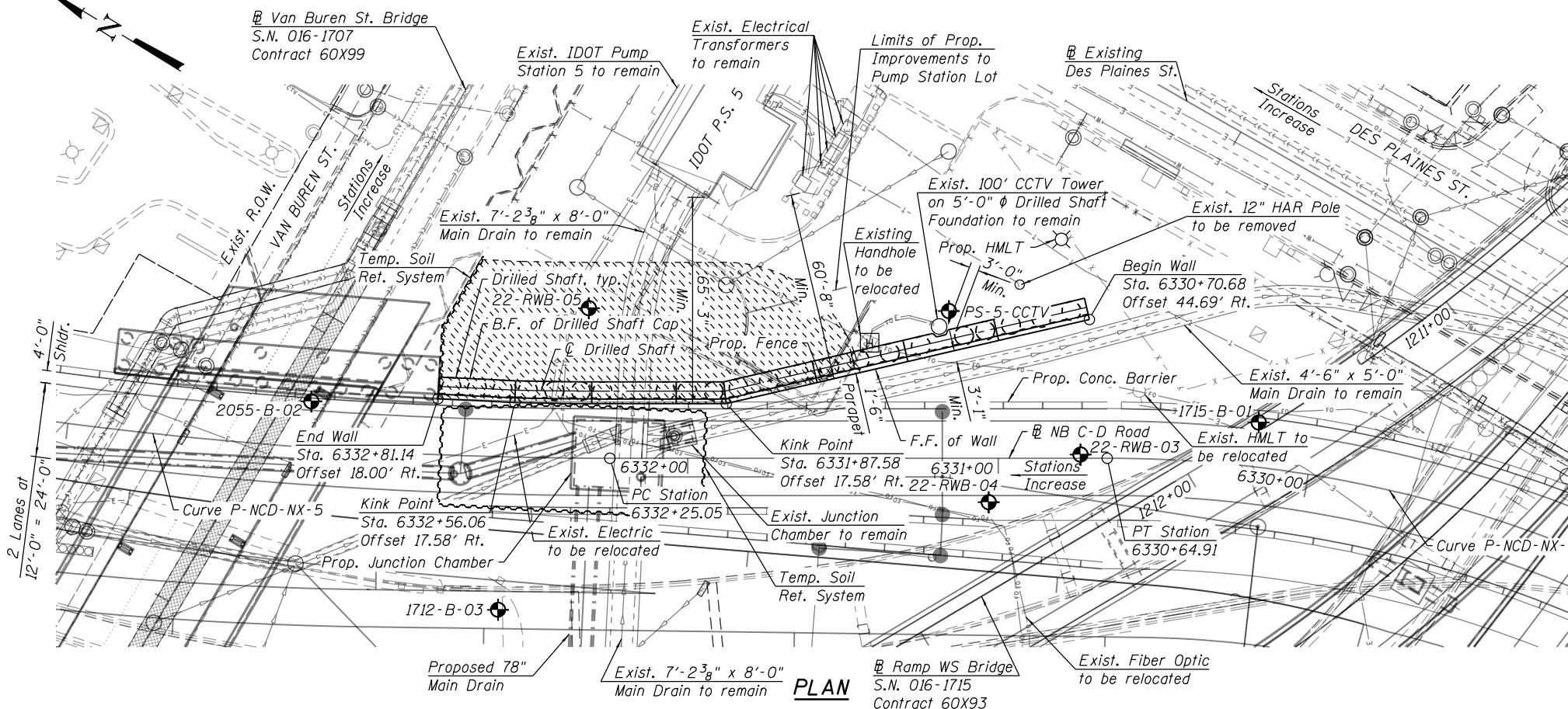
* For elevations, see Table 1 on Sheet 2 of 3.

LEGEND:

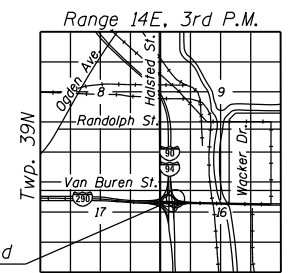
- Ex. Chain Link Fence — x — x — Soil Boring
- Combined Sewer —>>>>>> Existing Catch Basin
- Electric — E — Proposed Catch Basin
- Ex. Storm Sewer —>>>>>> Existing Manhole
- Prop. Storm Sewer —>>>>>> Proposed Manhole
- Ex. ITS Cable —>>>>>> Proposed Inlet
- Ex. Gas Line — G — Limits of Excavation and LCCF
- Ex. Fiber Optic — FO —
- Ex. Water — W —

SEQUENCE OF CONSTRUCTION

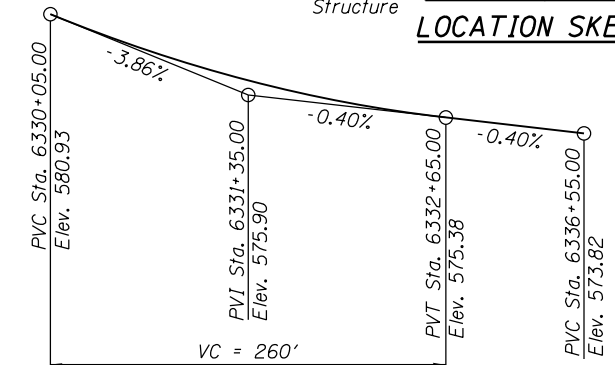
- 1.) Install TSRS along Van Buren Street.
- 2.) Excavate the area down to proposed groundline at F.F. of the wall.
- 3.) Install TSRS and excavate to install junction chamber.
- 4.) Construct junction chamber and backfill excavation.
- 5.) Drill shafts and construct retaining wall.
- 6.) Backfill with lightweight cellular concrete fill.



PLAN



LOCATION SKETCH



PROFILE GRADE

(@ NB C-D Road)

GENERAL PLAN
RETAINING WALL 22B ALONG NB C-D ROAD
F.A.I. RTE. 90/94 (KENNEDY EXPRESSWAY)
SECTION 2014-005R&B
COOK COUNTY
STATION 6330+70.68 TO STATION 6332+81.14
STRUCTURE NO. 016-1839



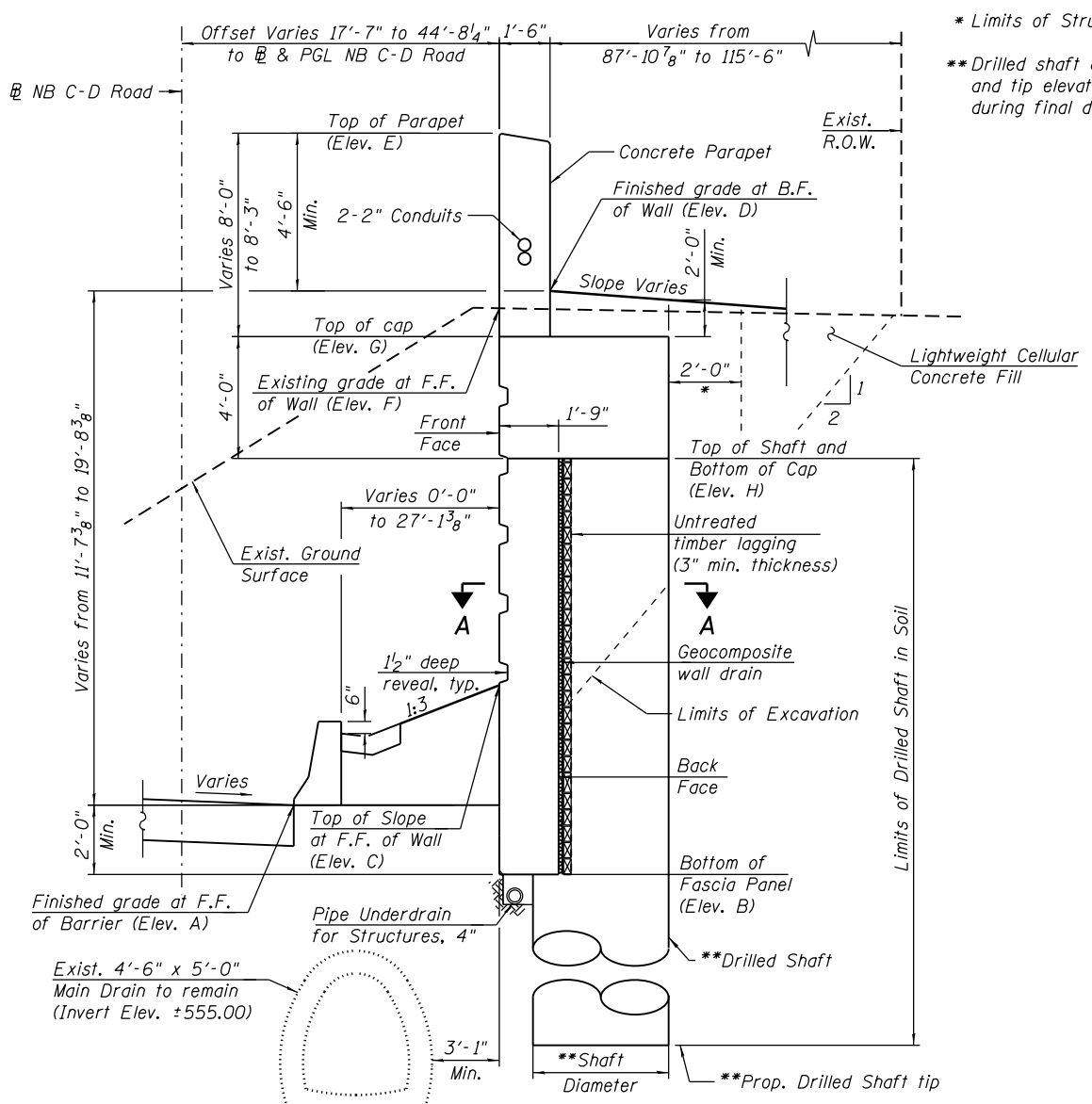
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	CHECKED - JM/MDS	REVISED -
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PLOT DATE = 4/17/2018	CHECKED - JM/MDS	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

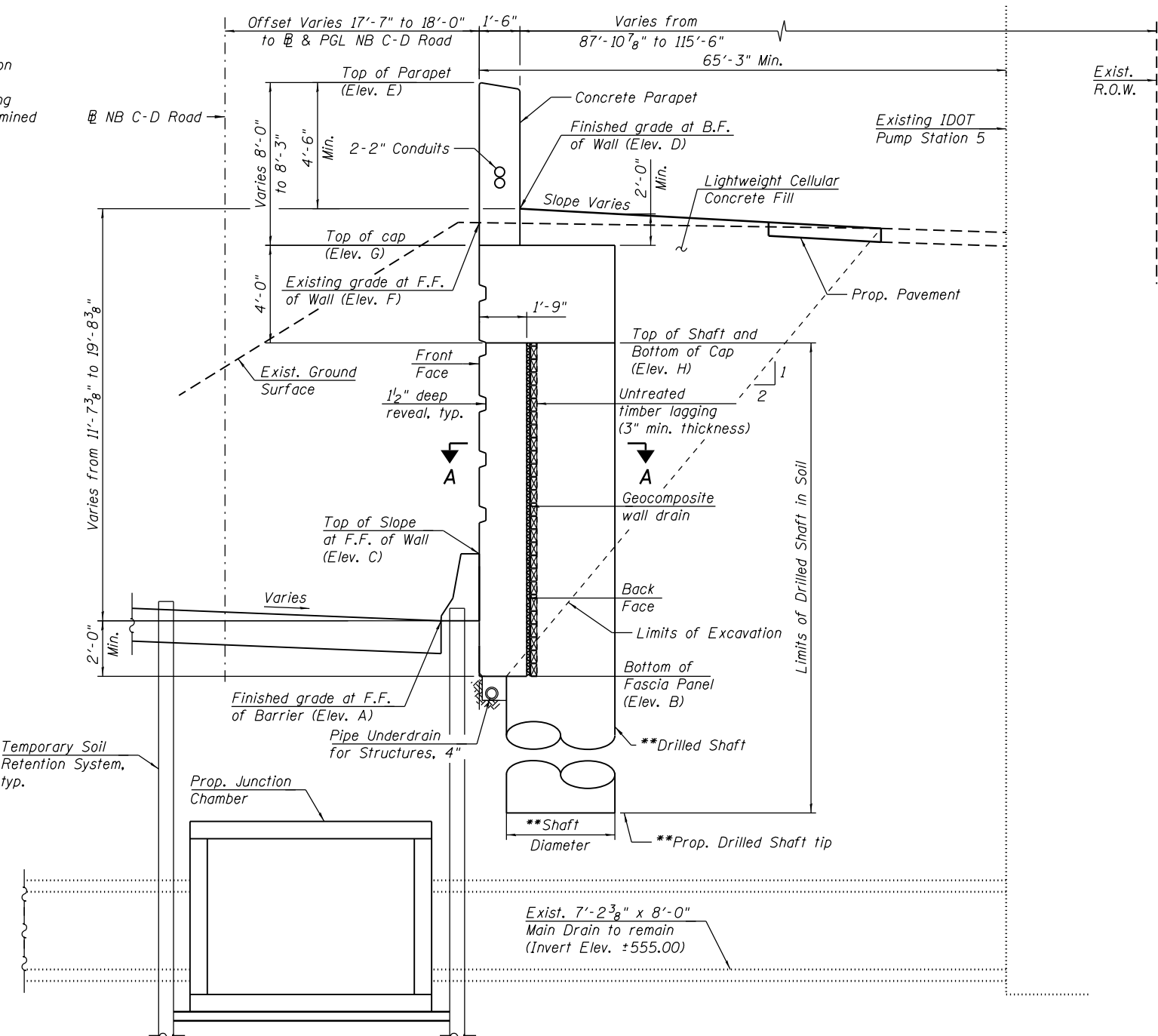
SHEET NO. 1 OF 3 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94	2014-005R&B	COOK	3	1
CONTRACT NO.			60X79	
ILLINOIS FED. AID PROJECT				

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TYPICAL CROSS SECTION
 (Sta. 6330+70.68 to Sta. 6331+87.58)
 (Looking Upstation)



TYPICAL CROSS SECTION
 (Sta. 6331+87.58 to Sta. 6332+81.14)
 (Looking Upstation)

TABLE 1 - WALL ELEVATIONS

Station	Offset	Elevation A	Elevation B	Elevation C	Elevation D	Elevation E	Elevation F	Elevation G	Elevation H
6330+70.68	44.69' Rt.	578.91	576.91	590.57	590.52	596.58	590.49	588.58	584.58
6330+99.90	37.92' Rt.	577.90	575.90	587.30	591.02	596.58	590.87	588.58	584.58
* 6331+29.13	31.14' Rt.	577.01	575.01	584.15	592.05	596.58	591.98	588.58	584.58
** 6331+29.13	31.14' Rt.	577.01	575.01	584.15	592.05	598.33	591.98	590.08	586.08
6331+58.35	24.36' Rt.	576.23	574.23	581.11	592.95	598.33	592.34	590.08	586.08
6331+87.58	17.58' Rt.	575.69	573.69	579.19	593.35	598.33	592.95	590.08	586.08
6332+03.66	17.58' Rt.	575.48	573.48	578.98	593.55	598.33	592.99	590.08	586.08
* 6332+30.99	17.58' Rt.	575.07	573.07	578.57	593.84	598.33	593.13	590.08	586.08
** 6332+30.99	17.58' Rt.	575.07	573.07	578.57	593.84	599.83	593.13	591.83	587.83
6332+56.06	17.58' Rt.	574.75	572.75	578.25	594.11	599.83	593.30	591.83	587.83
6332+81.14	18.00' Rt.	574.65	572.65	578.15	594.35	599.83	594.35	591.83	587.83

Elevation A - Finished Grade at Front Face of Barrier
 Elevation B - Bottom of Fascia Panel
 Elevation C - Top of Slope at Front Face of Wall
 Elevation D - Finished Grade at Back Face of Wall
 Elevation E - Top of Parapet
 Elevation F - Existing Grade at Front Face of Wall
 Elevation G - Top of Cap
 Elevation H - Top of Shaft / Bottom of Cap
 * Elevations just to the right of joint
 ** Elevations just to the left of joint

LEGEND:
 B.F. - denotes Back Face.
 E.F. - denotes Each Face.
 F.F. - denotes Front Face.

CROSS SECTIONS
RETAINING WALL 22B ALONG NB C-D ROAD
F.A.I. RTE. 90/94 (KENNEDY EXPRESSWAY)
SECTION 2014-005R&B
COOK COUNTY
STATION 6330+70.68 TO STATION 6332+81.14
STRUCTURE NO. 016-1839



USER NAME = wjoiletts	DESIGNED - WJC	REVISED -
PLOT SCALE = 0.17' / in.	CHECKED - JM/MDS	REVISED -
PLOT DATE = 4/17/2018	DRAWN - WJC	REVISED -
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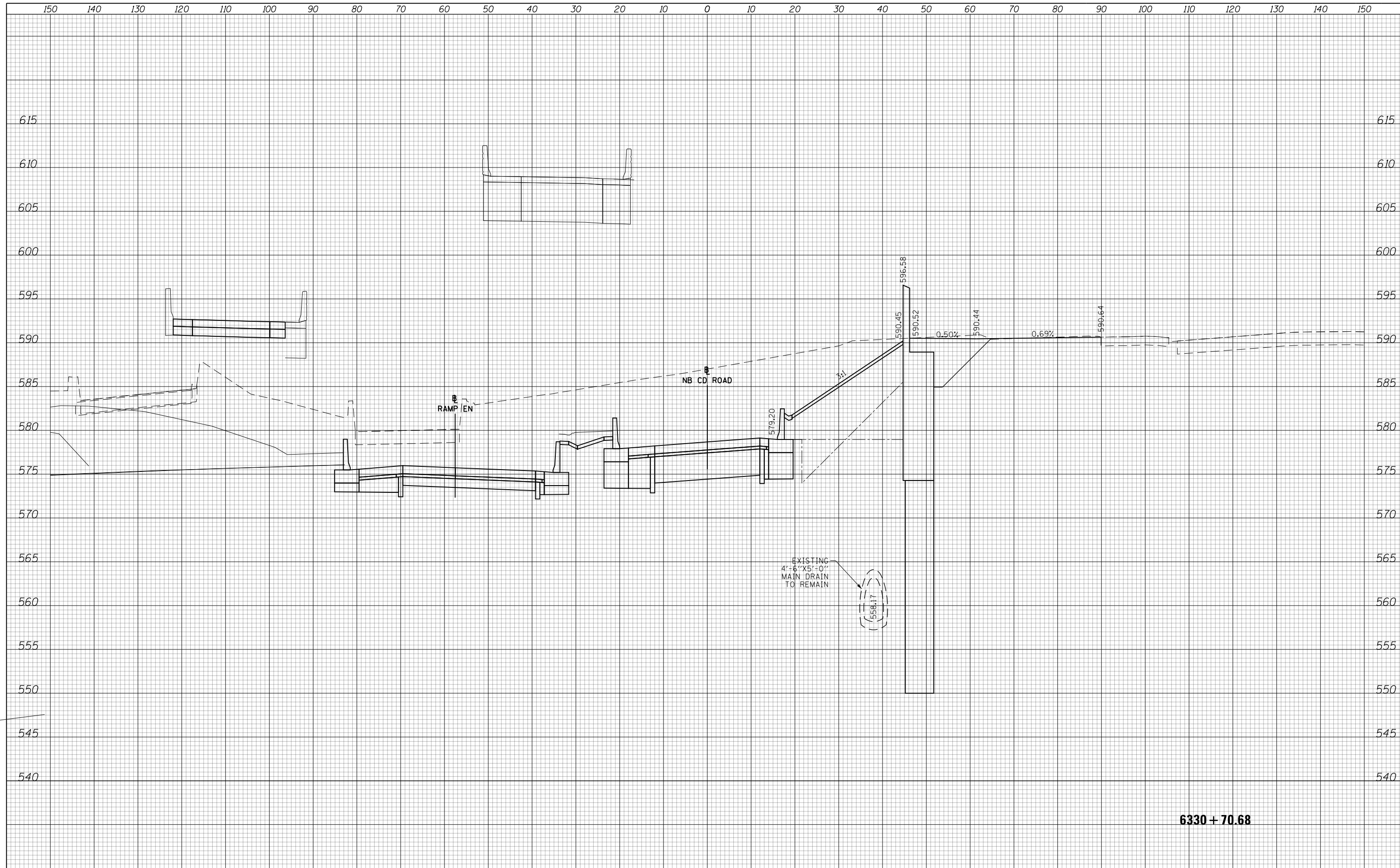
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94	2014-005R&B	COOK	3	2
CONTRACT NO.			60X79	
ILLINOIS FED. AID PROJECT				

APPENDIX E

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

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



6330 + 70.68



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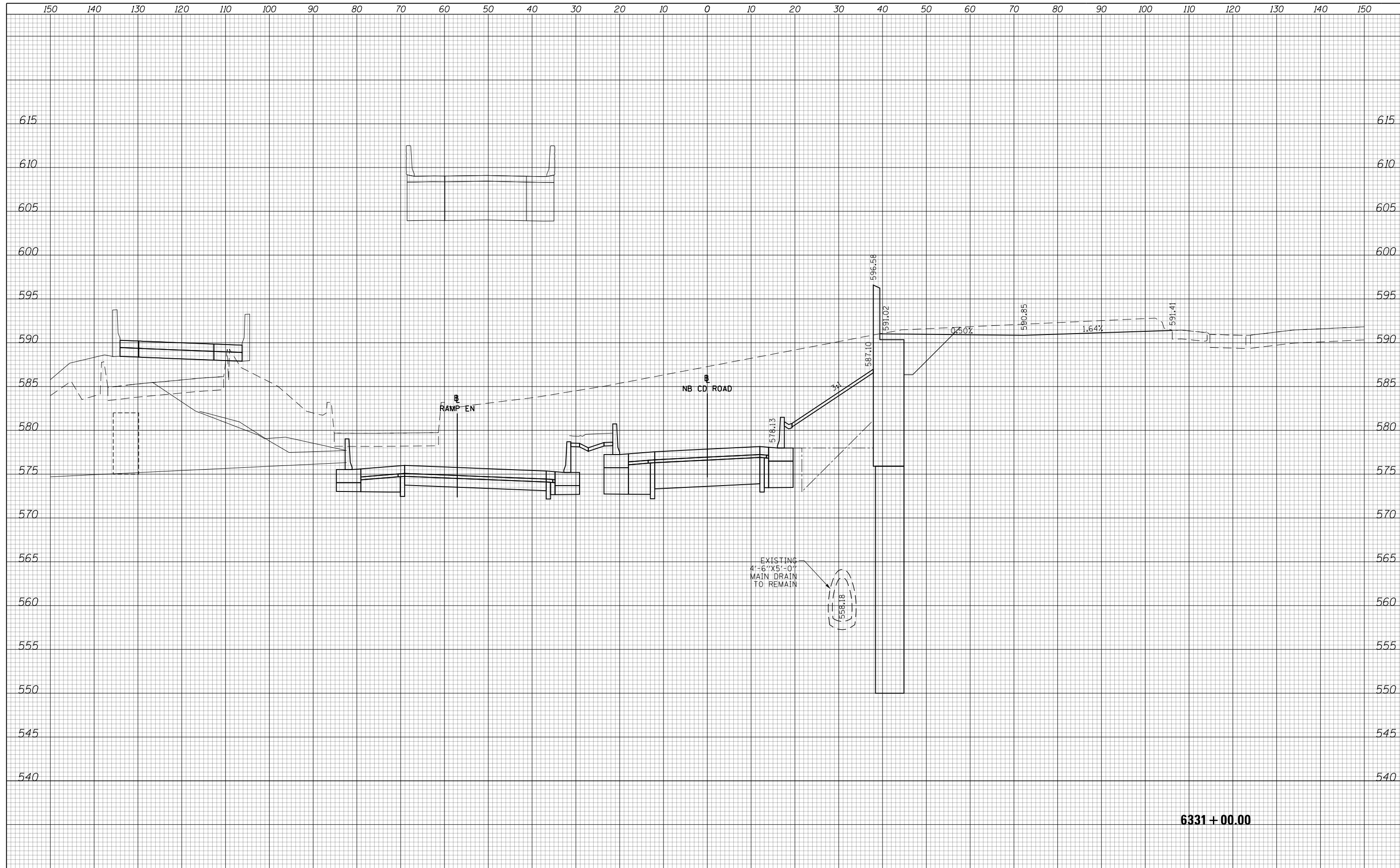
**STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION**

CROSS SECTIONS PROPOSED RETAINING WALL 22B			
SCALE: 10'H 5'V	SHEET	OF SHEETS	STA. TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	1
CONTRACT NO. 60X79				
ILLINOIS FED. AID PROJECT				

DATE	
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NOTE BOOK	PLOTTED
NO.	TEMPLATE
	AREAS CHECKED

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



6331 + 00.00



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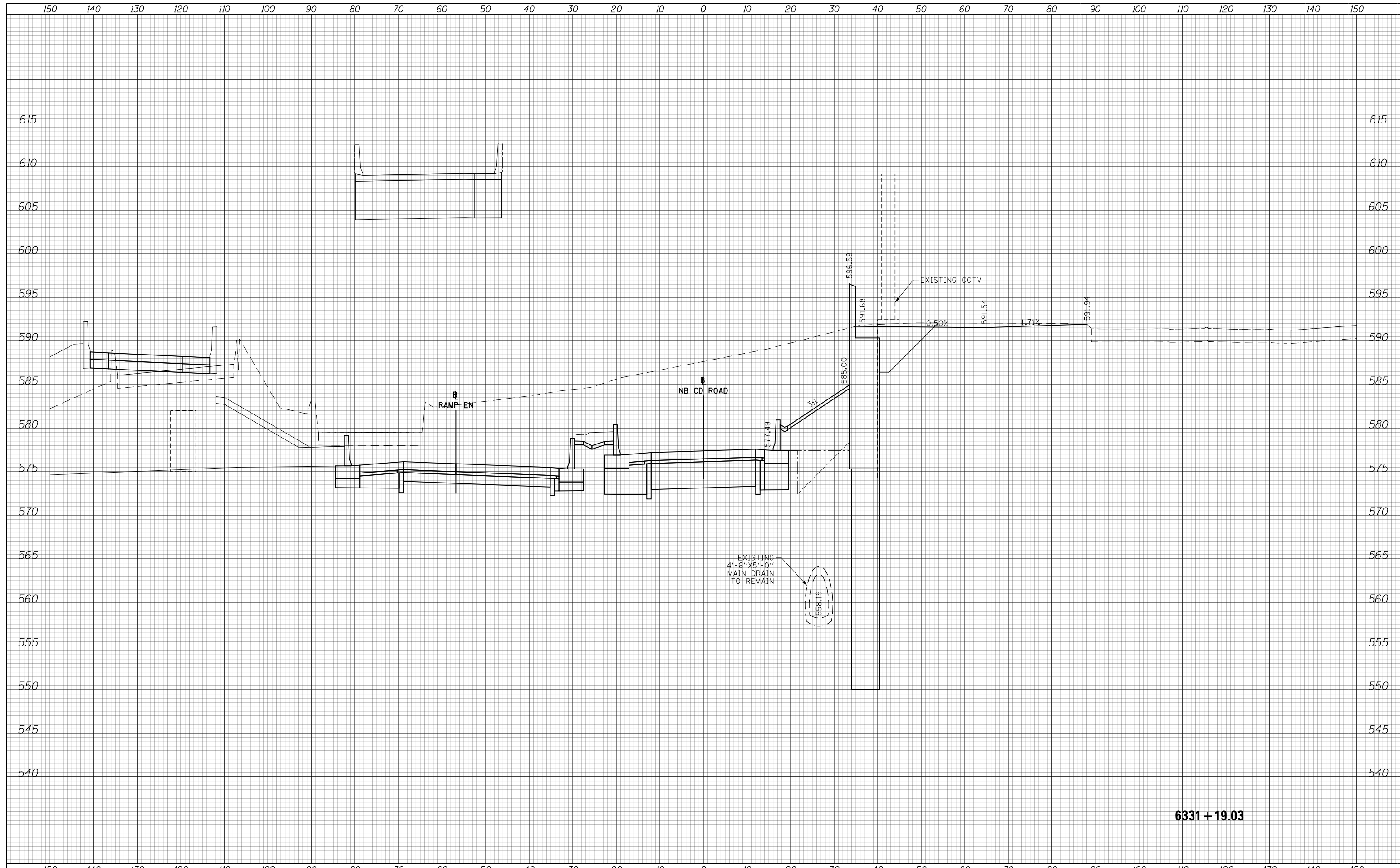
**STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION**

CROSS SECTIONS			
PROPOSED RETAINING WALL 22B			
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F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	2
CONTRACT NO. 60X79				
ILLINOIS FED. AID PROJECT				

DATE	
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TEMPLATE	
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CHECKED	
FINAL SURVEY	
NOTE BOOK	
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SURVEYED	
PLOTTED	
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AREAS	
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ORIGINAL SURVEY	
NOTE BOOK	
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6331 + 19.03



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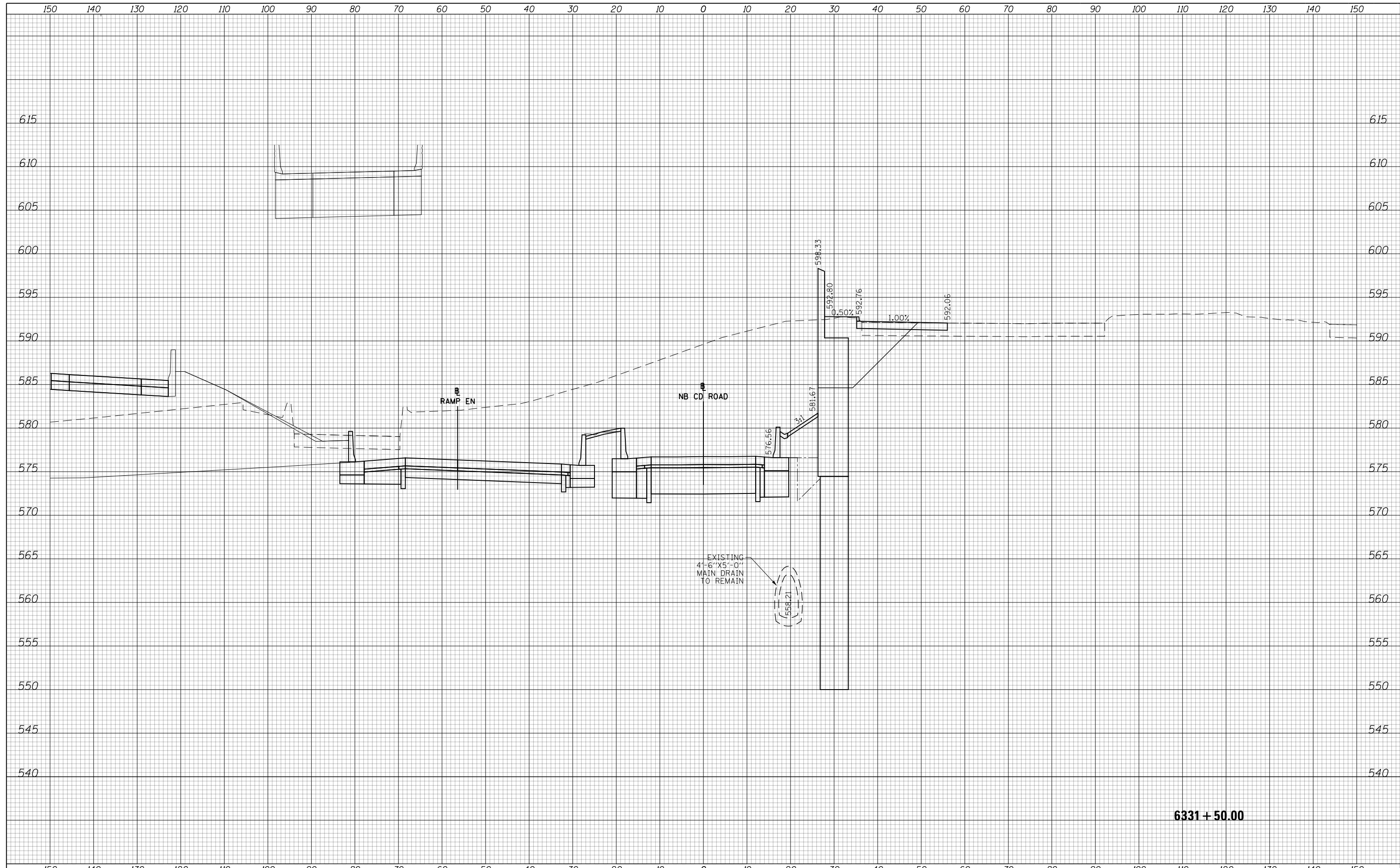
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

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PROPOSED RETAINING WALL 22B			
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F.A.I. RTE. 90/94/290	SECTION 2014-017B	COUNTY COOK	TOTAL SHEETS 11	SHEET NO. 3
ILLINOIS FED. AID PROJECT				CONTRACT NO. 60X79

DATE	
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FINAL SURVEY	
NOTE BOOK	
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DATE	
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CHECKED	
ORIGINAL SURVEY	
NOTE BOOK	
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6331 + 50.00



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PLOT DATE = 4/17/2018	DATE - 4-20-2018	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

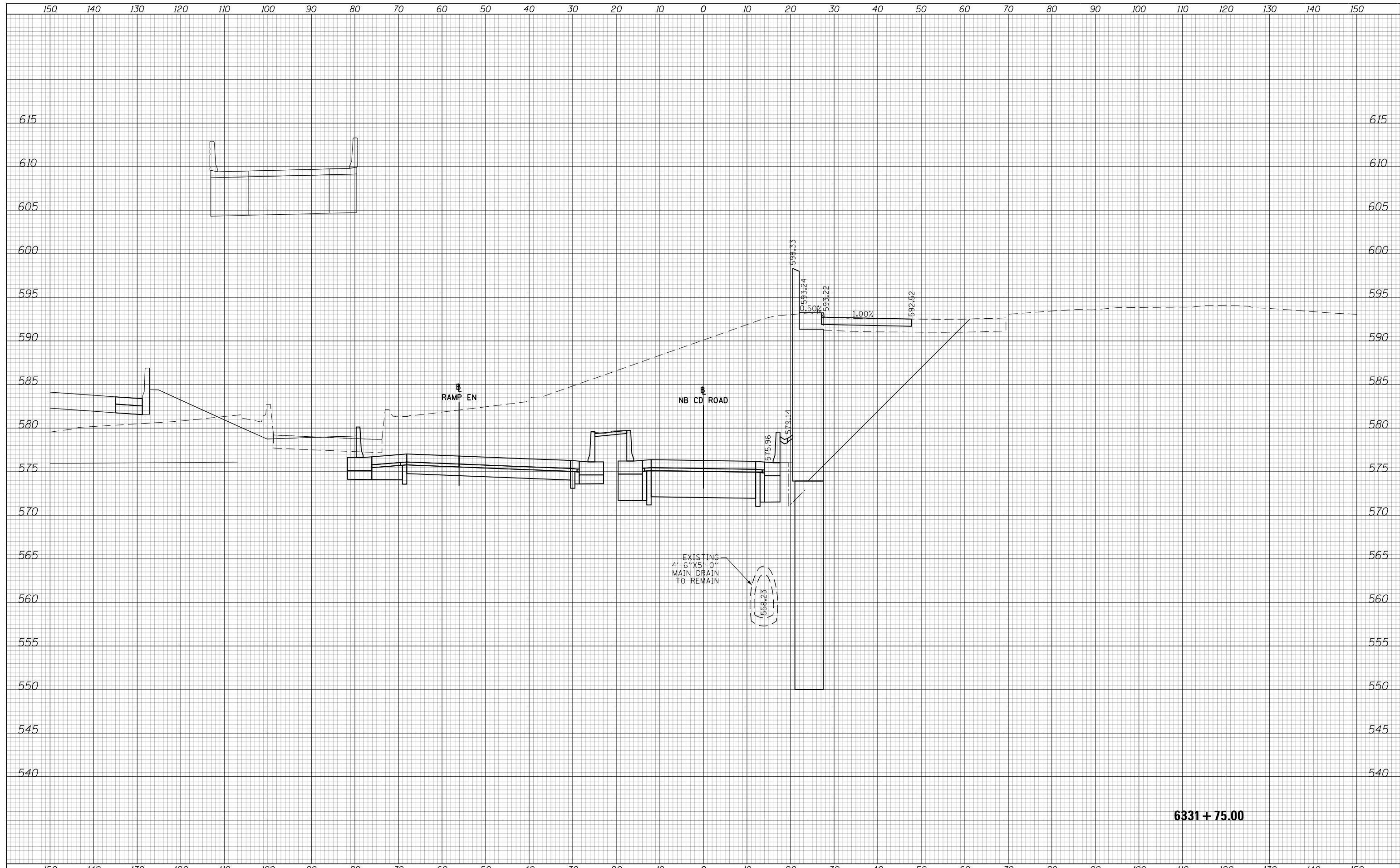
CROSS SECTIONS
PROPOSED RETAINING WALL 22B

SCALE: 10:H 5:V SHEET OF SHEETS STA. TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	4
CONTRACT NO. 60X79				
ILLINOIS FED. AID PROJECT				

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

DATE	
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NOTE BOOK	
NO.	



6331 + 75.00



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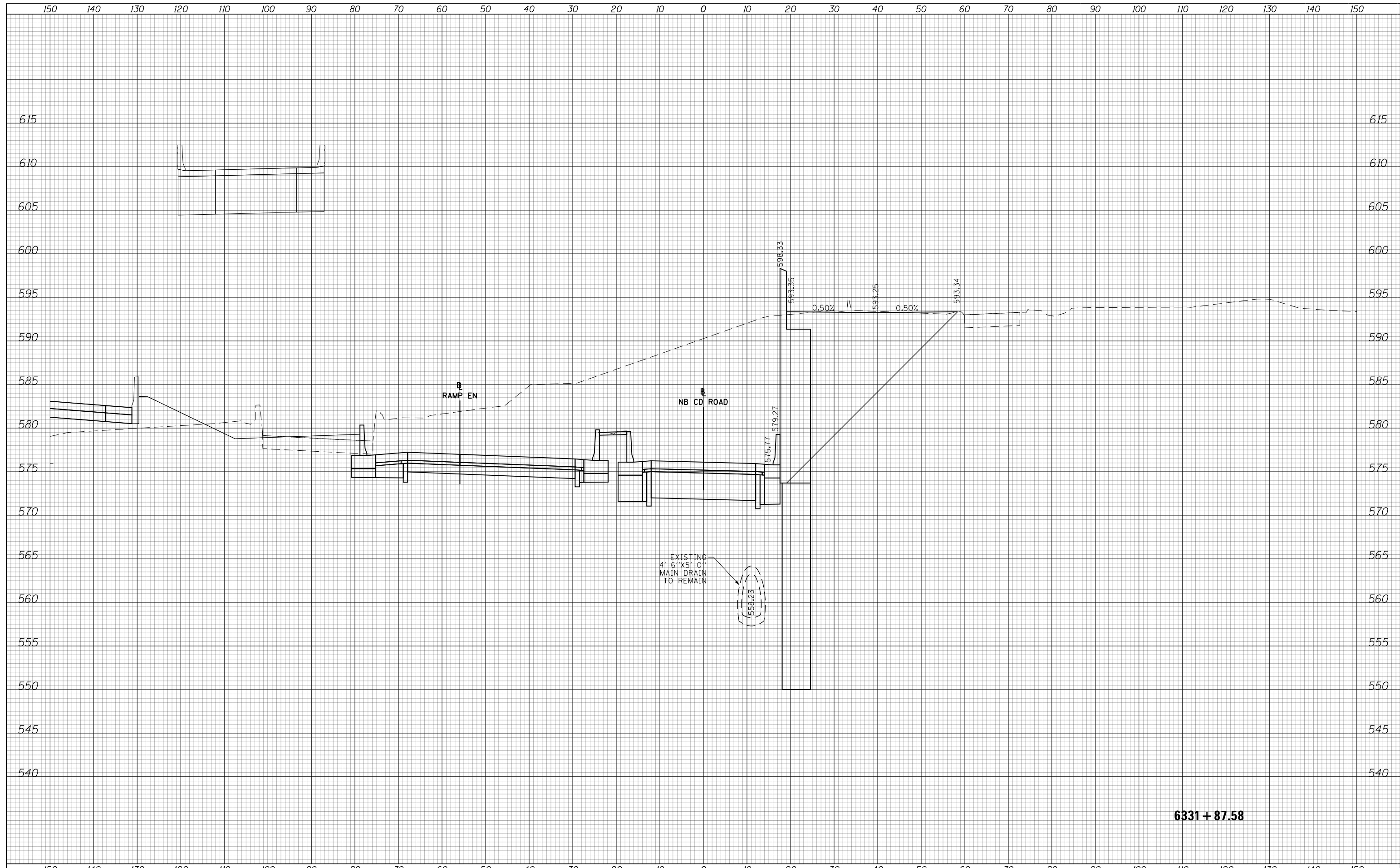
**STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION**

CROSS SECTIONS			
PROPOSED RETAINING WALL 22B			
SCALE: 10:H 5:V	SHEET	OF SHEETS	STA. TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	5
CONTRACT NO. 60X79				
ILLINOIS FED. AID PROJECT				

DATE	
BY	
SURVEYED	
PLOTTED	
TEMPLATE	
AREAS	
CHECKED	
FINAL SURVEY	
NOTE BOOK	
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DATE	
BY	
SURVEYED	
PLOTTED	
TEMPLATE	
AREAS	
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ORIGINAL SURVEY	
NOTE BOOK	
NO.	



6331 + 87.58



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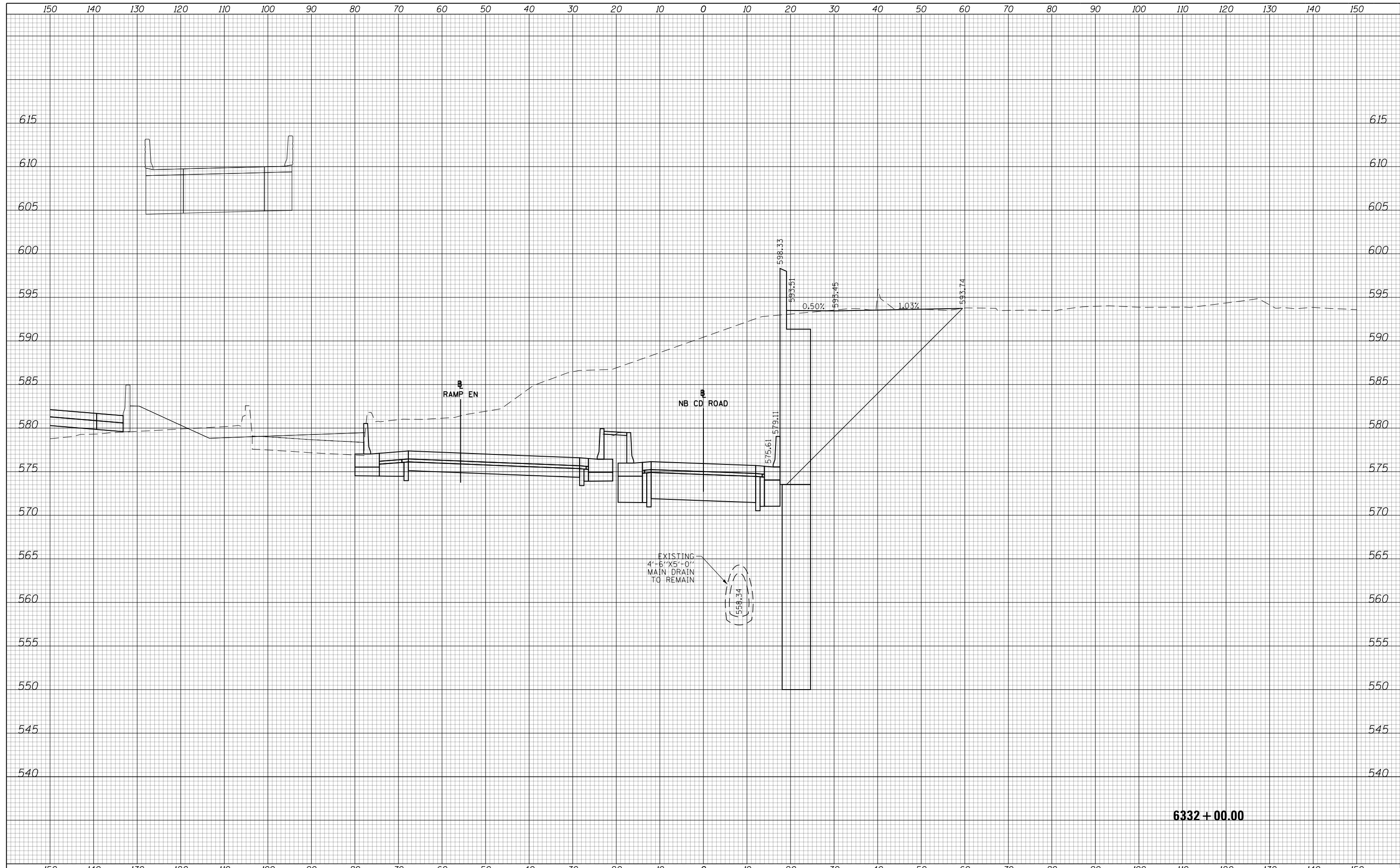
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS SECTIONS			
PROPOSED RETAINING WALL 22B			
SCALE: 10'H 5'V	SHEET	OF SHEETS	STA. TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	6
CONTRACT NO. 60X79				
ILLINOIS FED. AID PROJECT				

DATE	
BY	
SURVEYED	
PLOTTED	
TEMPLATE	
AREAS	
CHECKED	
FINAL SURVEY	
NOTE BOOK	
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DATE	
BY	
SURVEYED	
PLOTTED	
TEMPLATE	
AREAS	
CHECKED	
ORIGINAL SURVEY	
NOTE BOOK	
NO.	



6332 + 00.00



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PLOT DATE = 4/17/2018	DATE - 4-20-2018	REVISED -

**STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION**

**CROSS SECTIONS
PROPOSED RETAINING WALL 22B**

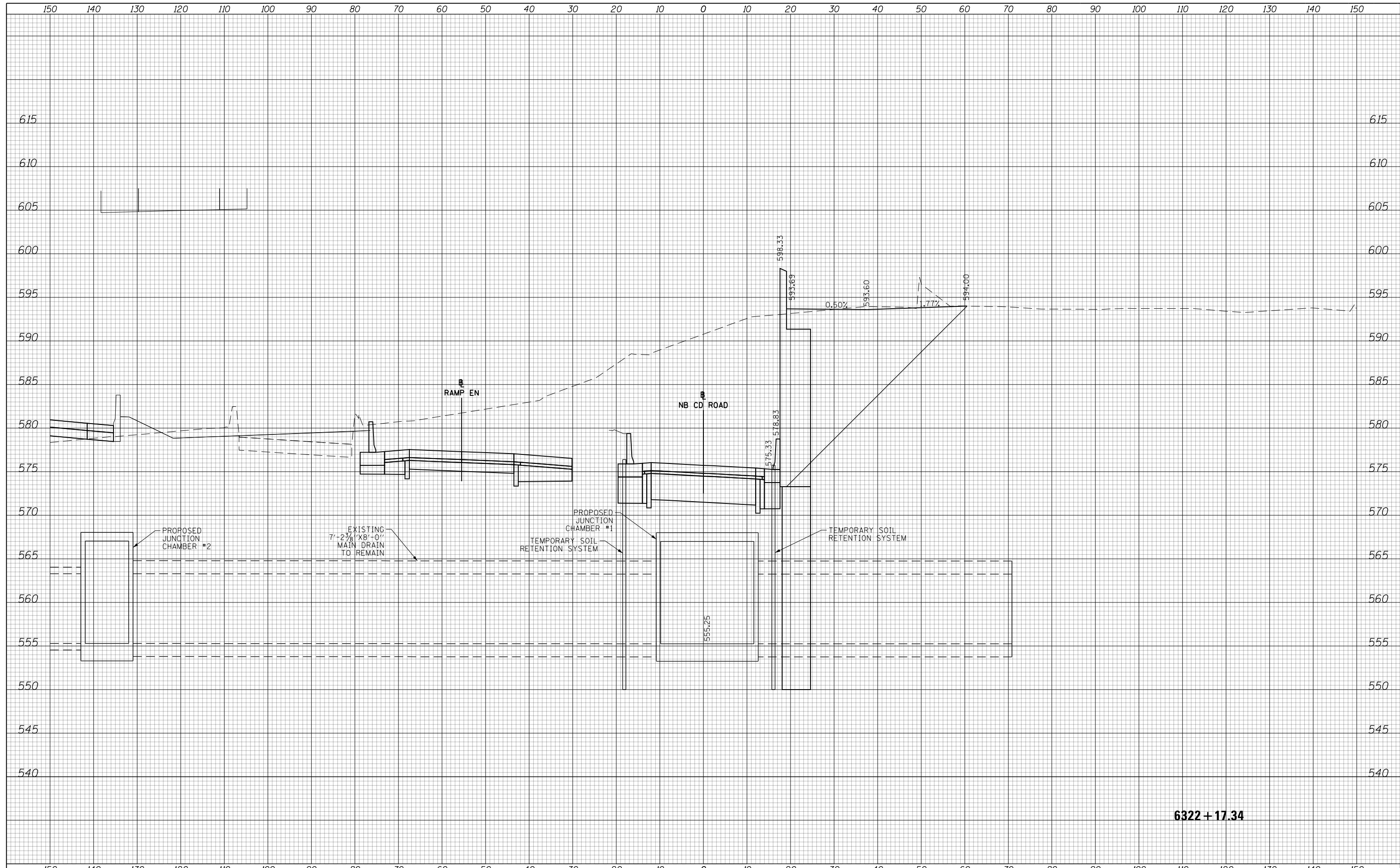
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F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	7
				CONTRACT NO. 60X79

ILLINOIS FED. AID PROJECT

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

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



6322 + 17.34



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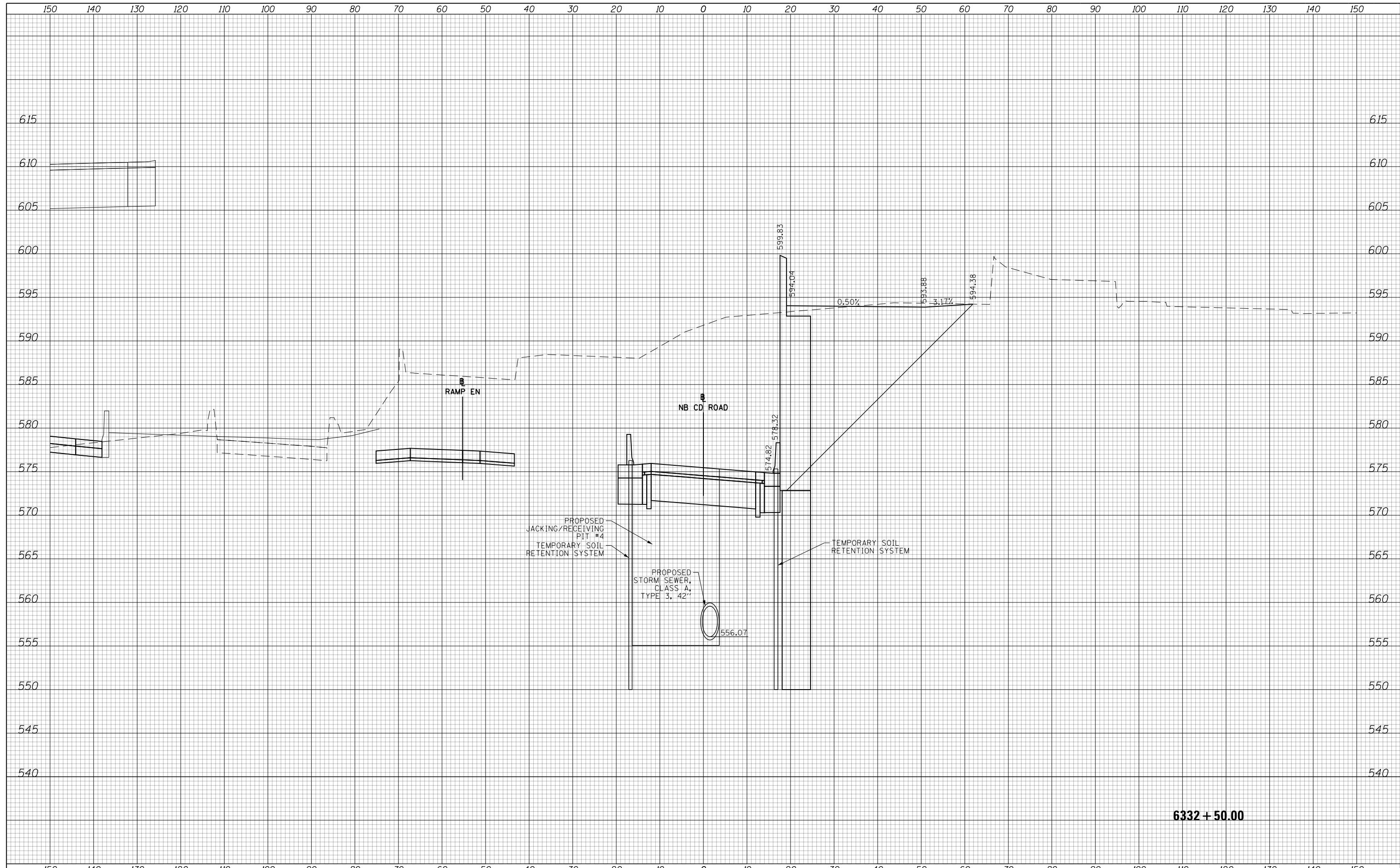
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS SECTIONS			
PROPOSED RETAINING WALL 22B			
SCALE: 10'H 5'V	SHEET	OF SHEETS	STA. TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	8
CONTRACT NO. 60X79				
ILLINOIS FED. AID PROJECT				

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

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



6332 + 50.00



D160X79-XS-WALL22B.dgn	DESIGNED - MKW	REVISED -
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PLOT DATE = 4/17/2018	DATE - 4-20-2018	REVISED -

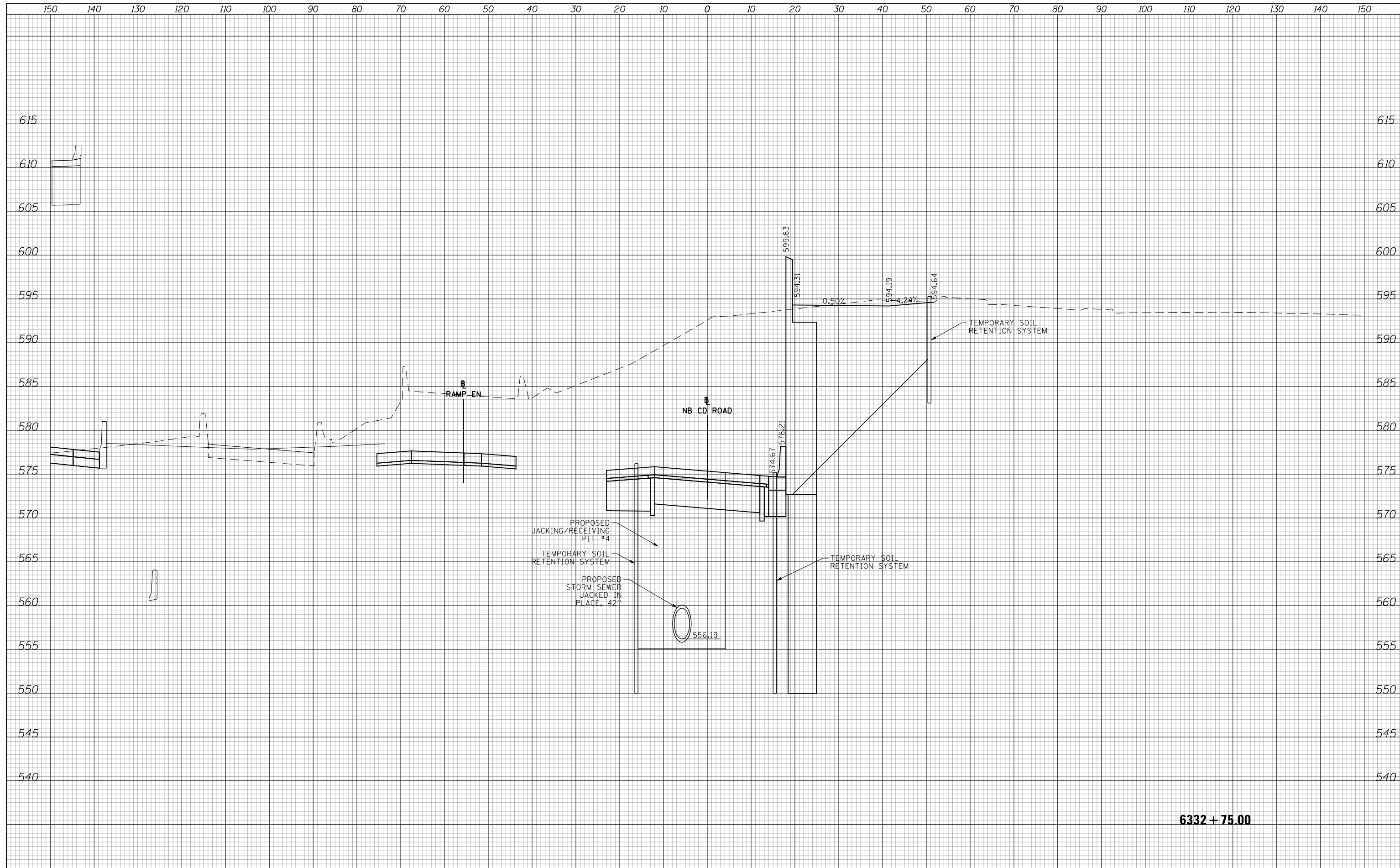
**STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION**

CROSS SECTIONS			
PROPOSED RETAINING WALL 22B			
SCALE: 10'H 5'V	SHEET	OF SHEETS	STA. TO STA.

F.A.I. RTE. 90/94/290	SECTION 2014-017B	COUNTY COOK	TOTAL SHEETS 11	SHEET NO. 9
CONTRACT NO. 60X79				
ILLINOIS FED. AID PROJECT				

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

DATE	
BY	
SURVEYED	
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NO.	



6332 + 75.00



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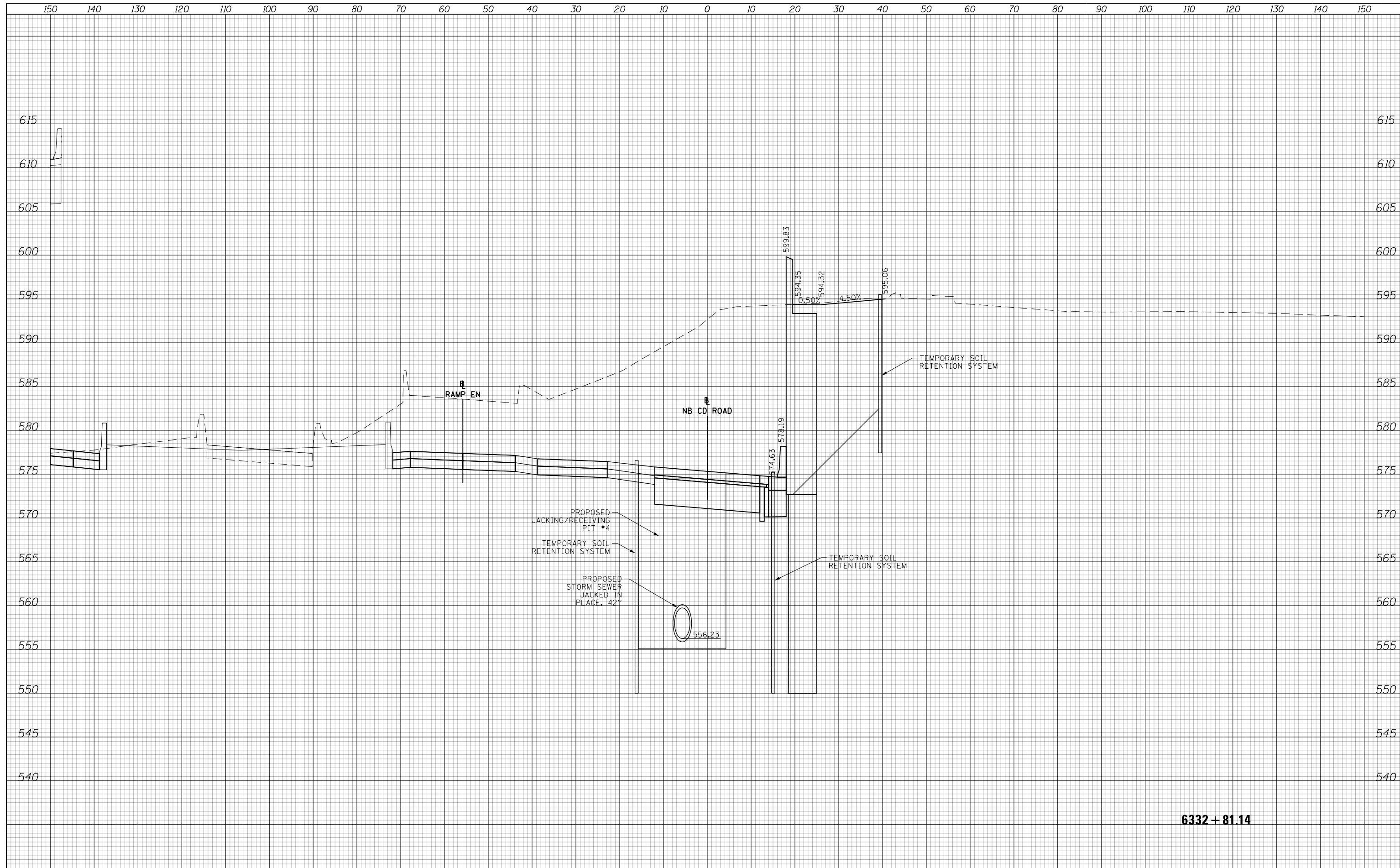
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS SECTIONS			
PROPOSED RETAINING WALL 22B			
SCALE: 10'H 5'V	SHEET	OF SHEETS	STA. TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	10
				CONTRACT NO. 60X79
ILLINOIS FED. AID PROJECT				

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

DATE	
BY	
SURVEYED	
PLOTTED	
TEMPLATE	
AREAS	
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ORIGINAL SURVEY	
NOTE BOOK	
NO.	



6332 + 81.14



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PLOT DATE = 4/17/2018	DATE - 4-20-2018	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CROSS SECTIONS
PROPOSED RETAINING WALL 22B

SCALE: 10:H 5:V SHEET OF SHEETS STA. TO STA.

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
90/94/290	2014-017B	COOK	11	11
				CONTRACT NO. 60X79

ILLINOIS FED. AID PROJECT

APPENDIX F

Ground Movement Estimates

Purpose: To estimate the surface ground movement, at the IDOT Pump Station induced by the movement of the proposed Wall 22B Construction.

- Reference:**
- 1) Clough, W and O'Rourke T (1990) Construction induced movement of in-situ soils walls
 - 2) Ou, C-y, H. Sieh, P.T, and Chew D (1993) "Characteristics of ground surface settlements during excavation" Canadian Geotechnical Journal V. 30, P 758-767
 - 3) Wang J-H, XU Z-H, and Wang W-P (2010) Wall and Ground movements due to Deep excavations in Shanghai soft soils" Journal of Geotech & Geoenvironmental Engineering, P 985-994

- Assumptions:**
- (1) IDOT Pump Station is about 60' away from Wall.
 - (2) Maximum height of wall is about 17 feet
 - (3) There is no existing wall behind the wall 22B.

Notations: S_{hm} = Max lateral displacement of wall
 S_v = ground surface settlement
 S_{vm} = Max. ground surface settlement

Design Criteria: Max S_{hm} is 1% of the wall height = (2.04 inches)
 Max S_{hm} is 0.5 of the wall height = 1.02 inches.
 Max S_{hm} is 1 inch

Evaluations: From Figure 6.14, using a ratio $\frac{S_{vm}}{S_{hm}} = 1.0$
 Obtain $S_{vm} = 2.04$ (1% design)
 $S_{vm} = 1.02$ (0.5 design)
 $S_{vm} = 1$ inch (1 inch)

Then from Figure 11
 for $d_r/H = \frac{60}{17} = 3.5$

Method 1 (Clough and O'Rourke (1990))
 Obtain $\frac{S_v}{S_{hm}} = 0.05$

$S_v = 0.10$ inch (1% deflection)
 $S_v = 0.05$ inch (0.5% deflection)
 $S_v = 0.05$ inch (1 inch deflection)

Method 2: [Kong et al. (2007)]

$$\text{Obtain } \frac{\delta_u}{S_{lim}} = \text{negligible} \quad \checkmark$$

Conclusions: Based on our evaluations the maximum ground settlement of the IDOT pump station building is about 0.1 inch for 1 inch deflection criteria. We do not anticipate any detrimental effects however the parking lot may experience up to 2 inches of settlement. Therefore, the buried utilities should be considered to ensure specific deformations limits are not exceeded.

[Signature]

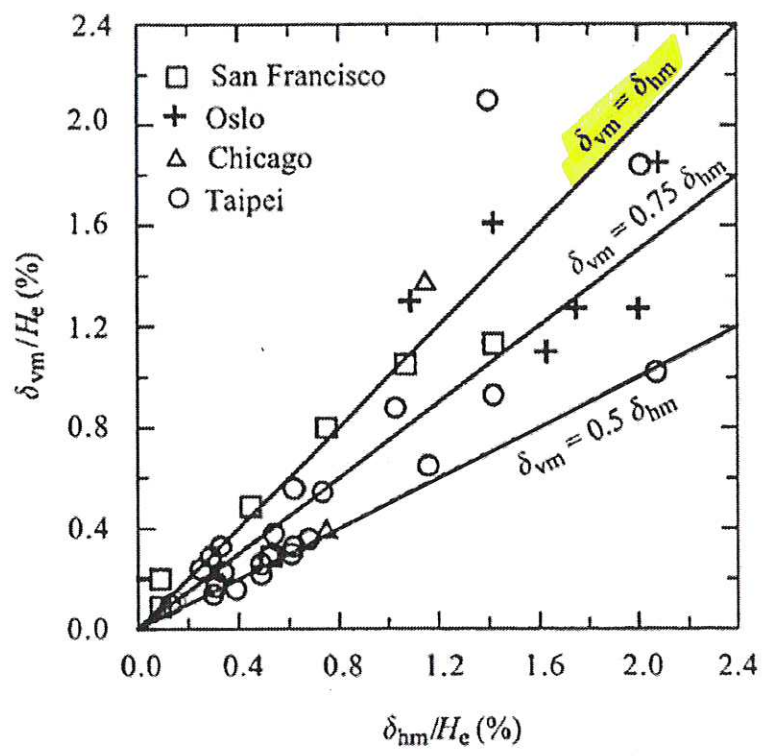


Figure 6.14 Maximum ground surface settlement and lateral wall deflection (Ou et al., 1993).

OU, C.-Y., HSIEH, P.-G., AND CHIOU, D.-C., 1993, Characteristics of ground surface settlement during excavation: Canadian Geotechnical Journal, v. 30, p. 758-767.

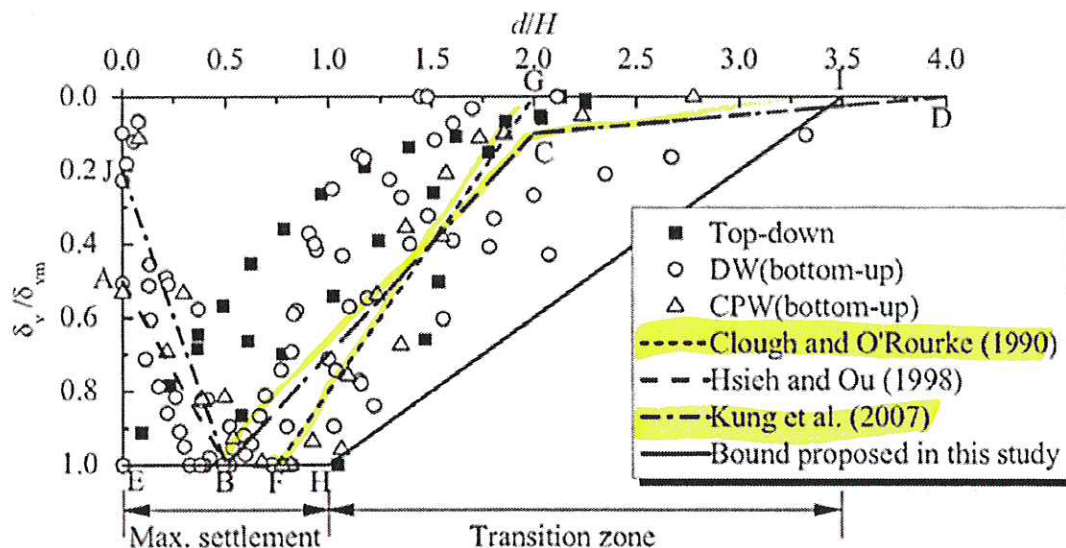
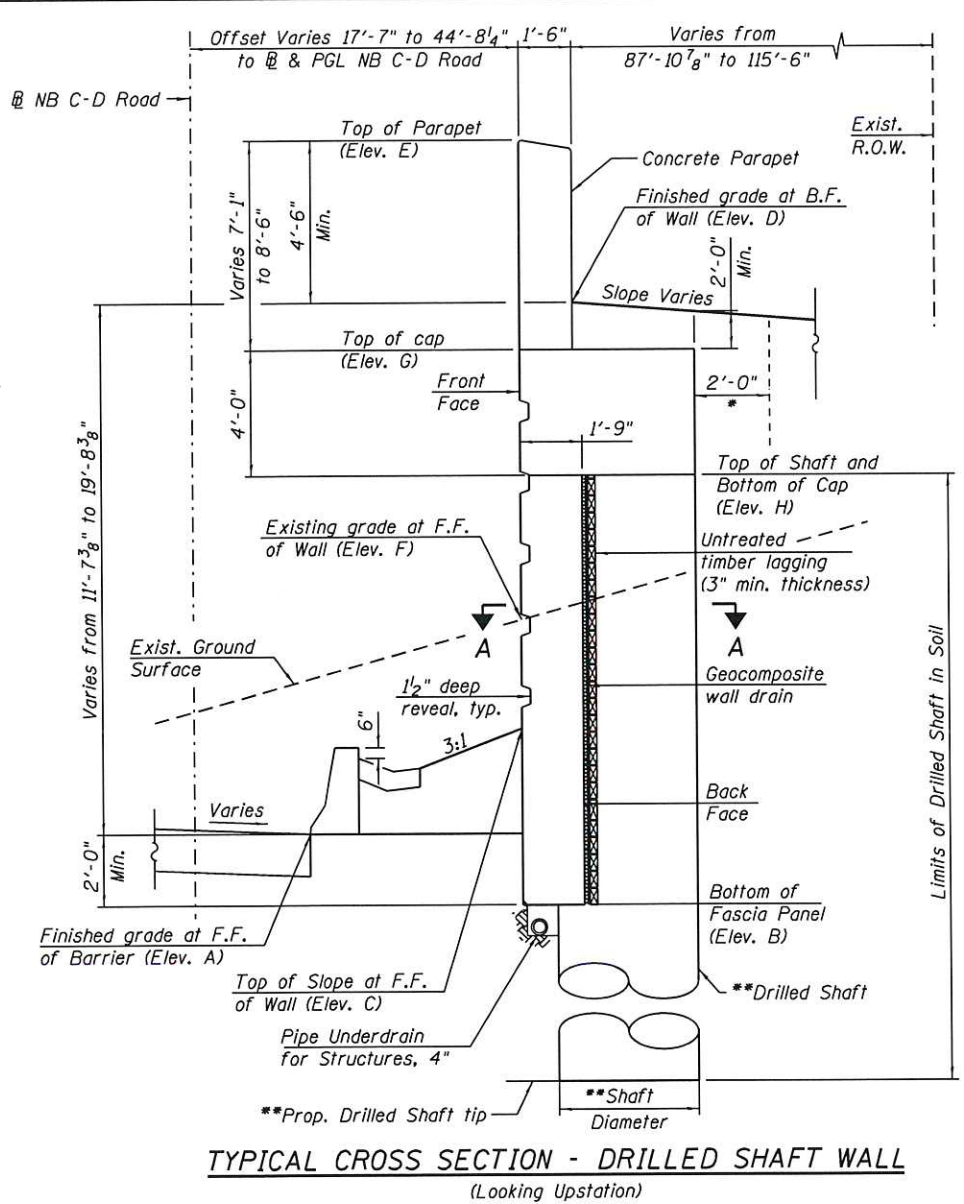


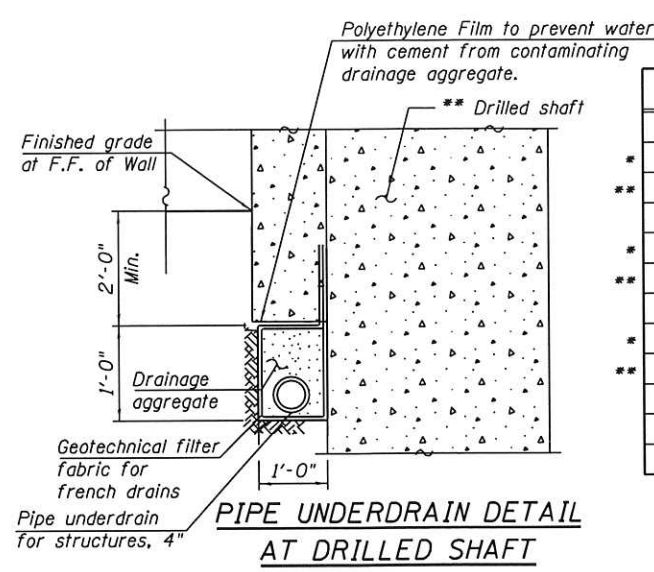
Fig. 11. Relationship between ground settlement normalized by maximum settlement and normalized distance from wall

WANG, J., XU, Z., AND WANG, W., 2009, Wall and ground movements due to deep excavations in Shanghai soft soils Journal of Geotechnical and Geoenvironmental Engineering, v. 136, p. 985-994.

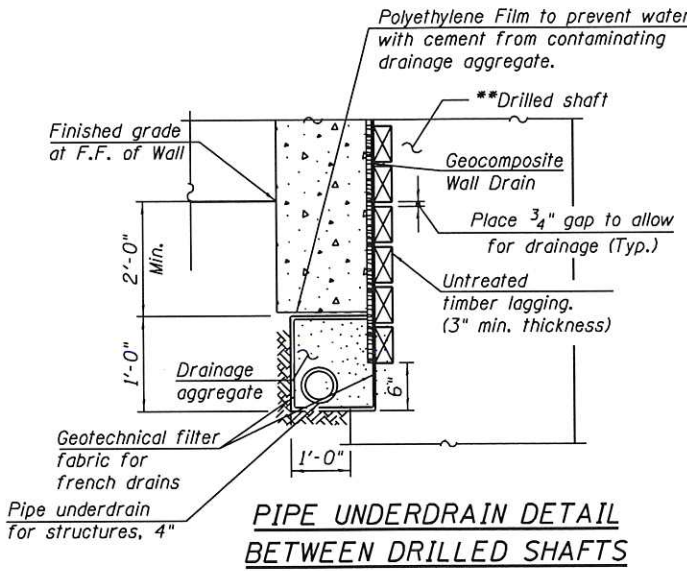
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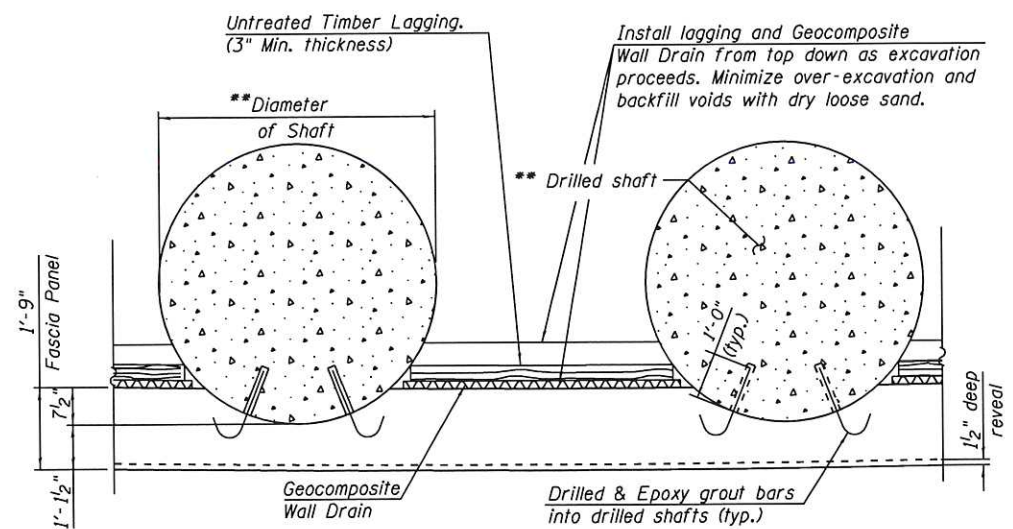
TYPICAL CROSS SECTION - DRILLED SHAFT WALL
(Looking Upstation)



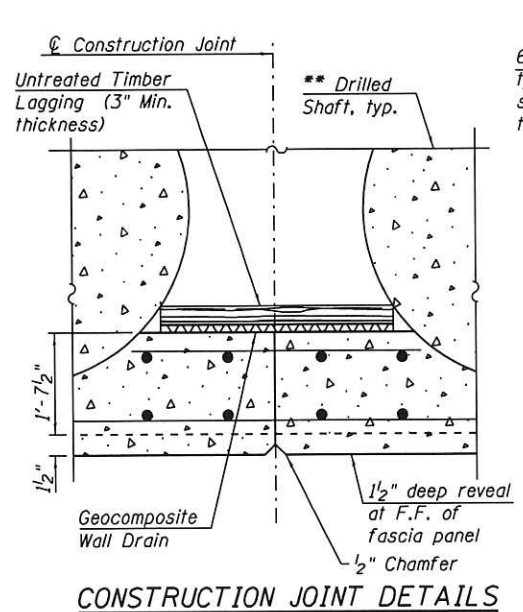
PIPE UNDERDRAIN DETAIL AT DRILLED SHAFT



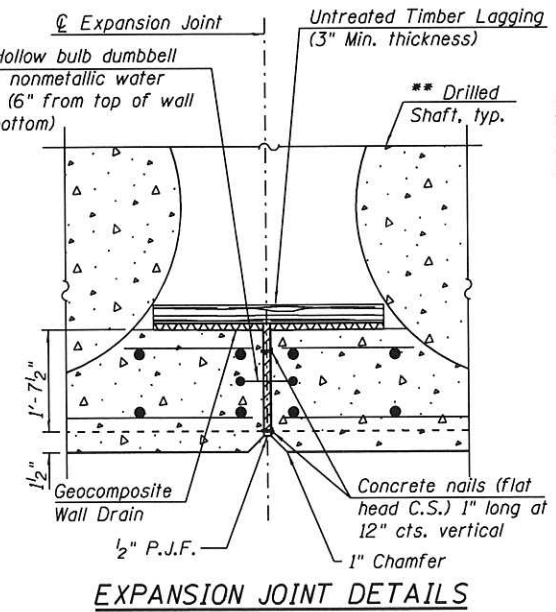
PIPE UNDERDRAIN DETAIL BETWEEN DRILLED SHAFTS



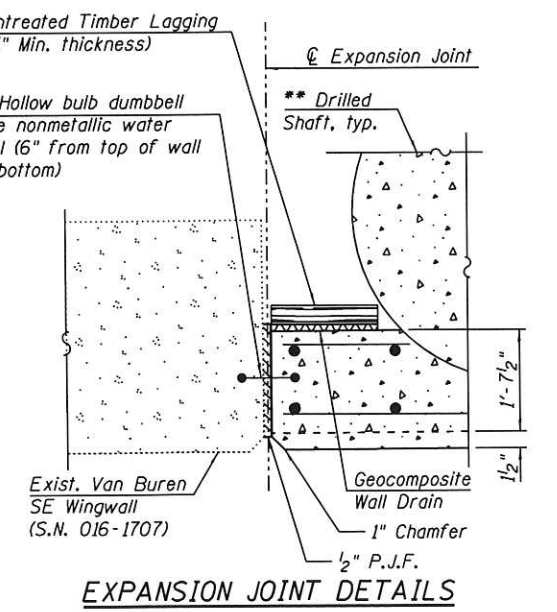
SECTION A-A
(Shaft Reinforcement not shown for clarity)



CONSTRUCTION JOINT DETAILS



EXPANSION JOINT DETAILS



EXPANSION JOINT DETAILS

- * Limits of Structure Excavation
- ** Drilled shaft diameter, spacing and tip elevation to be determined during final design.

LEGEND:
B.F. - denotes Back Face.
E.F. - denotes Each Face.
F.F. - denotes Front Face.

FF BF 7/7

TABLE 1 - WALL ELEVATIONS

Station	Offset	Elevation A	Elevation B	Elevation C	Elevation D	Elevation E	Elevation F	Elevation G	Elevation H
6330+70.68	44.69' Rt.	578.91	576.91	590.57	590.52	595.60	590.49	588.52	584.52
* 6330+99.90	37.92' Rt.	577.90	575.90	587.30	591.02	595.60	590.87	588.52	584.52
** 6330+99.90	37.92' Rt.	577.90	575.90	587.30	591.02	597.52	590.87	589.02	585.02
* 6331+29.13	31.14' Rt.	577.01	575.01	584.15	592.05	597.52	591.98	589.02	585.02
* 6331+58.35	24.36' Rt.	576.23	574.23	581.11	592.95	597.52	592.34	589.02	585.02
** 6331+58.35	24.36' Rt.	576.23	574.23	581.11	592.95	598.10	592.34	590.93	586.93
* 6331+87.58	17.58' Rt.	575.69	573.69	579.19	593.35	598.10	592.95	590.93	586.93
* 6332+03.66	17.58' Rt.	575.48	573.48	578.98	593.55	598.10	592.99	590.93	586.93
** 6332+03.66	17.58' Rt.	575.48	573.48	578.98	593.55	598.85	592.99	591.52	587.52
* 6332+30.99	17.58' Rt.	575.07	573.07	578.57	593.84	598.85	593.13	591.52	587.52
* 6332+56.06	17.58' Rt.	574.75	572.75	578.25	594.11	598.85	593.30	591.52	587.52
* 6332+81.14	18.00' Rt.	574.65	572.65	578.15	594.35	598.85	594.35	591.52	587.52

Elevation A - Finished Grade at Front Face of Wall
Elevation B - Bottom of Fascia Panel
Elevation C - Existing Grade at Front Face of Wall
Elevation D - Finished Grade at Back Face of Wall
Elevation E - Top of Parapet
Elevation F - Top of Cap
Elevation G - Top of Shaft / Bottom of Cap
Elevation H - Top of Pile
* Elevations just to the right of joint
** Elevations just to the left of joint

DRILLED SHAFT WALL DETAILS
RETAINING WALL 22B ALONG NB C-D ROAD
F.A.I. RTE. 90/94 (KENNEDY EXPRESSWAY)
SECTION 201-005R&B
COOK COUNTY
STATION 6330+70.68 TO STATION 6332+81.14
STRUCTURE NO. 016-1839