Structural Geotechnical Report

Retaining Wall #5
SN: 099-1003
I-55 at IL 59 Diverging Diamond Interchange
Station 272+24.35 to 279+35
IDOT PTB 189-011
Will County, Illinois

Prepared for

Illinois Department of Transportation (IDOT)
Contract Number: D-91-368-18

Project Design Engineer Team
Alfred Benesch & Company

Geotechnical Consultant:
GSG Consultants, Inc.

April 28, 2021

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April 28, 2021

Mr. Kurt Naus, P.E., S.E.
Alfred Benesch & Company
1230 East Diehl Rd. Suite 109
Naperville, IL 60563

Structural Geotechnical Report
IL 59 northbound over IL-55
Retaining Wall #5, SN: 099-1003
Contract Number: 189-011

Dear Mr. Naus:

Attached is a copy of the Structural Geotechnical Report for the above referenced project. This report provides a brief description of the site investigation, site conditions and foundation recommendations. The site investigation included advancing ten (10) soil borings to depths between 16.1 and 23.6 feet.

Should you have any questions or require additional information, please call us at 630-994-2600.

Sincerely,

Suhaib Ibrahim
Project Engineer

Ala E Sassila, Ph.D., P.E.
Principal

TABLE OF CONTENTS

Exhibits

Tables

Appendices

1.0 INTRODUCTION

GSG Consultants, Inc. (GSG) completed a geotechnical investigation for the Phase II design of Retaining Wall #5 (SN: 099-1003) between Station 272+24.35 and 279+35, along the west side of I-55 southbound, north of the existing bridge carrying IL-59 over I-55 in Tory Township, Will County, Illinois. The purpose of this Phase II site investigation was to explore the subsurface conditions along the entire proposed structure location, to determine engineering properties of the subsurface soil, and to develop final design and construction recommendations for Retaining Wall #5 (SN: 099-1003).

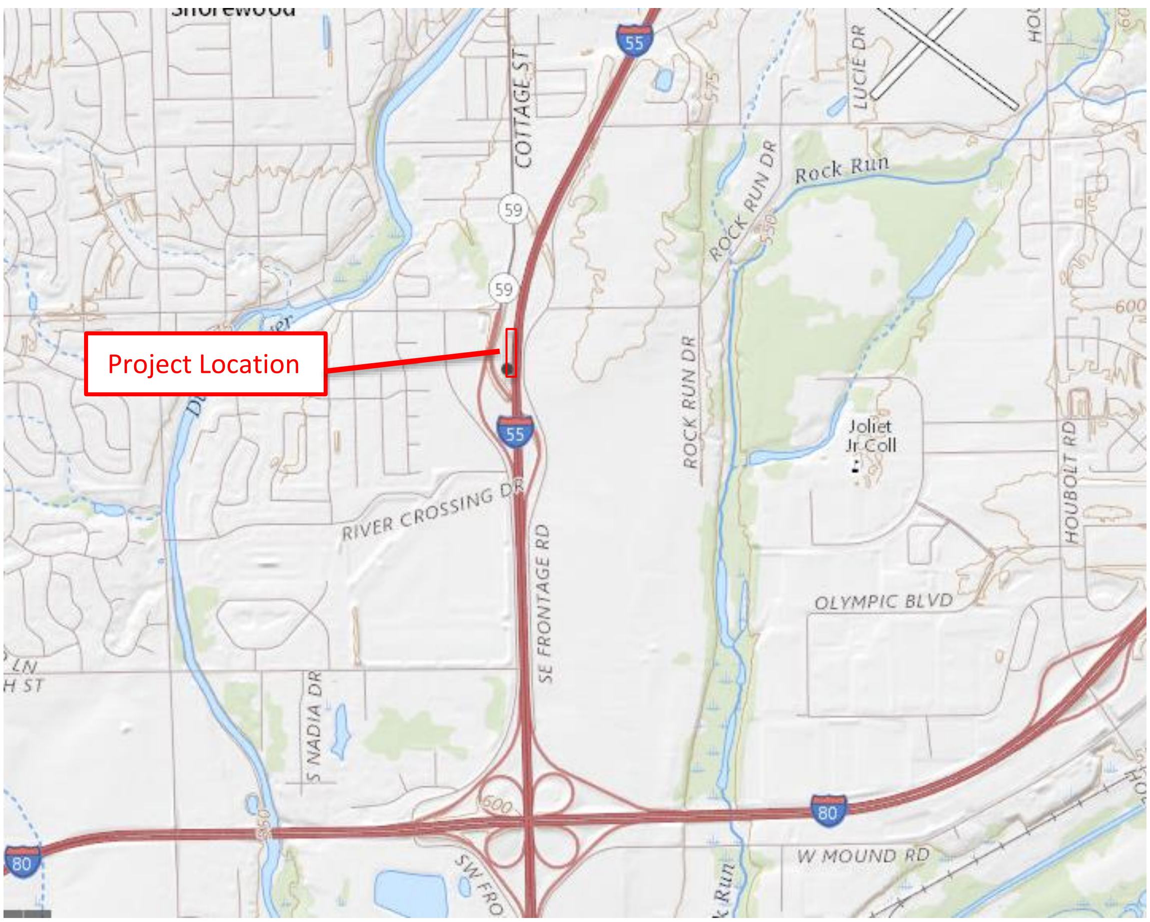


Exhibit 1 – Project Location Map

(Source: USGS Topographic Maps, usgs.gov)

The general scope of the overall project is the conversion of a partial access interchange to a full access interchange at I-55 and IL 59. This will include the construction a Diverging Diamond Interchange (DDI) and associated auxiliary lanes at the intersection of I-55 and IL 59. Two new ramps are proposed for the new interchange; Ramp D to provide access from I-59 to I-55 southbound, and Ramp C to provide access from I-55 to IL-59. An auxiliary lane between IL 59 and US 52 along I-55 is also proposed in each direction along the mainline. In proximity to the DDI, the existing I-55 East Frontage Road will be realigned further east. This report pertains to Wall #5 (SN: 099-1003), which will be located along I-55 SB, north of the existing bridge carrying IL-59 over I-55.

1.1 Existing Site Conditions

The proposed Retaining Wall #5 will be located along I-55 Southbound, north of the existing bridge (SN: 099-4642) carrying IL-59 over I-55. It is anticipated that the proposed wall will tie into the existing wingwall of the bridge. The area where the proposed improvements are to be built will be on existing IDOT right-of-way (ROW) and consists of an unoccupied ditch. **Exhibit 2** generally shows the existing conditions where the proposed retaining wall will be constructed.

Exhibit 2 – Existing Site Conditions at Proposed Wall Location, Looking south along I-55 SB

1.2 Proposed Retaining Wall Information

Based on the design information and drawings provided by Benesch (**Appendix A**, dated February 8, 2021), the proposed retaining wall will be carrying the proposed IL-59 Ramp A South Bound. According to the cross sections provided, the proposed retaining wall will be a "fill" section; a MSE wall is proposed for this location. **Table 1** presents a summary of the proposed wall.

Table 1 –Retaining Wall Summary

Wall Name	Wall Stations	Proposed Wall Type	Approximate Length (ft)	Maximum Anticipated Retained Wall Height* (ft)
SN: 099-1003	Sta. 272+24.35 to Sta. 279+35	MSE	710.75	24.5

*Retained wall height is calculated from the top of coping to the top of levelling pad

The front face of the proposed retaining wall is located approximately 26 feet (at Station 279+20) to 61 feet (at Station 273+40) away from the proposed edge of pavement for Ramp A. It is anticipated that a new embankment will be built for Ramp A in the same stage as the construction of Wall # 5; the design and recommendations for Ramp A embankment will be presented in a separate roadway geotechnical report.

2.0 SITE SUBSURFACE EXPLORATION PROGRAM

This section describes the subsurface exploration program and laboratory testing program completed as part of this project. The proposed locations and depths of the soil borings were selected in accordance with IDOT requirements and review with Benesch for available design information at the time of the field activities. The borings were completed in the field based on field conditions and accessibility.

2.1 Subsurface Exploration Program

Soil borings were completed between October 28, 2019 through April 2, 2020. The exploration program included advancing ten (10) standard penetration test (SPT) borings at locations along the length of the proposed wall. The as-drilled locations of the soil borings are shown on the Soil Boring Location Map and Subsurface Profile (**Appendix B**). **Table 2** presents a list of the borings used for the proposed retaining wall analysis.

Table 2 – Summary of Subsurface Exploration Borings

Boring ID	Station *	Offset (ft)/ Direction	Depth (ft)	Surface Elevation (ft)
RWB-30	272+58.5	84.8 LT	23.0	593.3
RWB-15	273+19.8	85.3 LT	21.0	593.9
RWB-16	273+70.7	90.3 LT	23.0	595.4
RWB-17	274+43.9	89.3 LT	21.5	595.3
RWB-04	275+32.7	112.3 LT	16.1	595.8
RWB-05	276+6.5	107.5 LT	24.1	595.6
RWB-06	276+79.5	102.6LT	23.0	595.4
RWB-07	277+54.1	99.7 LT	23.6	595.3
RWB-08	278+69.3	100.6 LT	21.6	594.6
RWB-09	279+42.5	101.8 LT	20.5	594.4

* Based on existing I-55 Stationing

The soil borings were drilled using ATV mounted Diedrich D-50 drill rig using 3¼-inch I.D. hollow stem augers and an automatic hammer. Soil sampling was performed according to AASHTO T 206, "Penetration Test and Split Barrel Sampling of Soils." Soil samples were obtained at 2.5-foot intervals to the boring termination depths. Water level measurements were made in each boring when evidence of free groundwater was detected on the drill rods or in the samples. The boreholes were also checked for free water immediately after auger removal, and before filling the open boreholes with soil cuttings.

GSG's field representative inspected, visually classified and logged the soil samples during the subsurface exploration activities and performed unconfined compressive strength tests on cohesive soil samples using a calibrated Rimac compression tester and a calibrated hand penetrometer in accordance with IDOT procedures and requirements. Representative soil samples collected from each sample interval, were placed in jars and were returned to the laboratory for further testing and evaluation.

2.2 Laboratory Testing Program

All samples were inspected in the laboratory to verify the field classifications. A laboratory testing program was undertaken to characterize and determine engineering properties of the subsurface soils encountered in the area of the proposed retaining wall. The following laboratory tests were performed on representative soil samples:

- Moisture content ASTM D2216 / AASHTO T-265
- Atterberg Limits ASTM D4318 / AASHTO T-89 / AASHTO T-90
- Dry Unit Weight ASTM D7263
- Organic Content ASTM D7348 / AASHTO T-267

The laboratory tests were performed in accordance with test procedures outlined in the IDOT Geotechnical Manual (2015), and per ASTM and AASHTO requirements. Based on the laboratory test results, the soils encountered were classified according to the AASHTO and the Illinois Division of Highways (IDH) classification systems. The results of the laboratory testing program are included in the **Appendix D Laboratory Test Results** and are also shown along with the field test results in **Appendix C Soil Boring Logs**.

2.3 Subsurface Soil Conditions

This section provides a brief description of the soils encountered in the borings performed in the vicinity of the proposed retaining wall. Variations in the general subsurface soil profile were noted during the drilling activities. Detailed descriptions of the subsurface soils are provided in the Soil Boring Logs (**Appendix C**). The soil boring logs provide specific conditions encountered at each boring location, including soil descriptions, stratifications, penetration resistance, elevations, location of the samples, water levels (when encountered), and laboratory test data. Variations in the general subsurface soil profile were noted during the drilling activities. The stratifications shown on the boring logs represent the conditions only at the actual boring locations and represent the approximate boundary between subsurface materials; however, the actual transition may be gradual.

The surface elevations of these borings ranged between 593.9 and 595.8 feet. The borings noted 4 to 6 inches of topsoil followed by silty clay fill to depths between 3.0 and 8.5 feet. Below the fill, soft to hard silty clay was encountered at depths between 3.5 and 21.0 feet with unconfined compressive strength values ranging from 0.4 and 7.1 tsf, with most values between 2.5 and 5.5 tsf. The soil color changed from brown and gray to gray at depths between 10.0 and 13.5 feet. The unconfined compressive strength values of the upper brown and gray clay ranged from 0.8 and 6.7 tsf, with most values between 2.5 and 5.5 tsf. The unconfined compressive strength of the gray silty clay ranged from 0.4 to 6.25 tsf, with most values between 2.0 and 5.0 tsf. Medium dense to extremely dense silty loam or gravel were encountered at depths between 16.0 and 21.0 feet with SPT blow count (N) values ranging from 12 to 100 blows per foot. Borings RWB-04, RWB-05, and RWB-06 encountered highly weathered limestone at depths between 21.0 and 24.0 feet, where the borings were terminated upon encountering auger refusal. The remaining borings were also terminated upon auger refusal on apparent bedrock.

2.4 Groundwater Conditions

Water levels were checked in each boring to determine the general groundwater conditions present at the site and were measured while drilling and after each boring was completed. Ground water was encountered in borings RWB-06, RWB-07, and RWB-15 to RWB-17 at depths between 11.0 to 20.0 feet while drilling. No groundwater was observed after drilling at these locations or within the remaining borings at these times. No delayed groundwater readings were obtained as the borings were backfilled immediately upon completion.

Based on the color change from brown and gray to gray, it is anticipated that the long-term groundwater level could range between elevations 582.0 to 585.0 feet. Water level readings were made in the boreholes at times and under conditions shown on the boring logs and stated in the text of this report. However, it should be noted that fluctuations in groundwater level may occur due to variations in rainfall, other climatic conditions, or other factors not evident at the time measurements were made and reported herein.

3.0 GEOTECHNICAL ANALYSES

This section provides GSG's geotechnical analysis and recommendations for the design of the proposed retaining wall based on the results of the field exploration, laboratory testing, and geotechnical analysis. Subsurface conditions in unexplored locations may vary from those encountered at the boring locations. If structure locations, loadings, or elevations are changed, we request that GSG be contacted so that we may re-evaluate our recommendations.

3.1 Derivation of Soil Parameters for Design

GSG determined the geotechnical parameters to be used for the project design based on the results of field and laboratory test data on individual boring logs as well as our experience. Unit weights, friction angles and shear strength parameters were estimated using corrected standard penetration test (SPT) using published correlations for N values results for the fill and cohesionless soils and in-situ and laboratory test results for cohesive soils. The SPT N values were corrected for hammer efficiency. The hammer efficiency correction factor considers the use of a safety hammer/rope/cat-head system, generally estimated to be 60% efficient. Thus, correlations should be based upon what is currently termed as N_{60} data. The efficiencies of the automatic hammers used for this exploration were estimated to be approximately 98% for the ATV mounted Diedrich D-50 and based on recent efficiency testing of the drill rigs. The correction for hammer efficiency is a direct ratio of relative efficiencies as follows:

$$N_{60} = N_{Field} * (98/60)\text{: Diedrich D-50 ATV}$$

* Where the N_{Field} value is the blow counts recorded during the subsurface investigation.

Based on the field investigation data collected, generalized soil parameters for the soils in the project area for use in design are presented in **Appendix E**.

3.2 Settlement

Based on the GPE and provided construction sequence, Wall # 5 will be constructed at the same stage as the Ramp A embankment. Total settlement is anticipated to be approximately 1 to 3 inches depending on the height of the wall and embankment. It is anticipated that the Ramp A paving operations will be delayed to allow settlement to occur for a period of preloading under the self-weight of the embankment and wall. Wall #5 settlement will be discussed in *Section 4.2.5* of this report. Settlement of the Ramp A embankment will be discussed in a separate roadway report.

4.0 GEOTECHNICAL RECOMMENDATIONS

This section provides GSG's geotechnical recommendations for the design of the proposed retaining wall based on the results of the field exploration, laboratory testing, and geotechnical analyses, and information provided by the designer. If there are any significant changes to the project characteristics or if significantly different subsurface conditions are encountered during construction, GSG should be consulted so that the recommendations of this report can be reviewed

4.1 Retaining Wall Type Recommendations

There are several types of retaining walls that could be utilized for retaining earth embankments in fill areas or excavation slopes in cut areas. Based on the proposed grading, it appears that the proposed wall is located within a fill area, adjacent to the roadway possible wall types may include cast-in-place concrete cantilever, Mechanically Stabilized Earth (MSE), prefabricated modular gravity, steel sheet piles, and soldier-pile and lagging.

The wall type should be selected based on soil conditions, construction schedule, and cost. The following provides a brief description of each type of wall that could be considered at this location.

A. CIP Concrete Cantilever Walls

CIP concrete cantilever retaining walls are typically used in fill areas. They are constructed with a footing that extends laterally both in front of and behind the wall. They can be designed to resist horizontal loading with or without tie-backs by changing the geometry of the foundation. This type of wall typically requires that the area behind the wall be excavated to facilitate construction or are constructed where new fill embankments are necessary.

The advantages of a CIP wall include that it is a conventional system with well-established design procedures and performance characteristics; it is durable; and it has the ability to easily be formed, textured, or colored to meet aesthetic requirements. Disadvantages include a relatively long construction period due to undercutting, excavation, form work, steel placement, and curing of the concrete. This wall system is also sensitive to total and differential settlements.

B. Mechanically Stabilized Earth Walls

An MSE wall is typically associated with fill wall construction and consists of facing such as segmental precast units, dry block concrete or CIP concrete facing units connected to horizontal steel strips, bars or geosynthetic to create a reinforced soil mass. The reinforcement is typically placed in horizontal layers between successive layers of granular backfill. A free draining backfill is required to provide adequate performance of the wall. MSE walls can be used in cut situations as well. The additional cost of the excavations for an MSE wall is usually offset by the savings in construction costs and schedule as compared to a CIP wall on spread footings.

Advantages of the MSE wall include a relatively rapid construction schedule that does not require specialized labor or equipment, provided excavation for the reinforcement is not extensive. This type of retaining wall can accommodate relatively large total and differential settlements without distress, and the reinforcement materials are light and easy to handle. Facing panels can be designed for various architectural finishes.

The design of MSE walls for internal stability is the Contractor's responsibility and will need to be designed by a licensed Structural Engineer in the State of Illinois. The length of the reinforced soil mass from the outside face should be a minimum of 8 feet, but not less than 70% of the wall height. The length should be determined to satisfy eccentricity and sliding criteria and provide adequate length to prevent structural failure with respect to pullout and rupture of reinforcement. The MSE wall could be designed using a unit weight of 120 pcf and a friction angle of 34 degrees for the reinforced backfill soil.

C. Prefabricated Modular Gravity Walls

This type of wall typically consists of interlocking soil or rock-filled concrete, steel, or wire modules or bins (such as gabions). The combined weight of the wall materials resists the lateral loads from the soil embankment being retained. This type of wall may be used where conventional reinforced concrete walls are also being considered but are typically selected when the overall wall height will be less than 25 feet.

The advantage of this type of wall is that less select fill is required for the backfill behind the wall and the construction is relatively more economical compared to other wall types; however, this type of wall may require additional soil excavation for placement of the modules. The additional cost of the excavations could be offset by the savings in construction costs and schedule as compared to other walls.

D. Soldier Pile and Lagging Walls

Soldier pile and lagging walls are typically used in cut areas where the existing ground surface needs to be maintained during construction or when a near vertical excavation is needed. The wall may be constructed with driven steel piles or steel piles placed in drilled holes and backfilled with concrete. The depth of the soldier pile is normally estimated to be two times the wall exposed height. Soldier piles are typically spaced at 8 foot on center and are faced with cast-in-place or precast concrete. The cost for this type of wall is generally higher than gravity wall. However, there is fewer restriction for the installation this type of wall.

E. Recommended Wall Type

Based on the nature of the site conditions and preliminary designs provided by the design team, GSG concurs with the Benesch's design selection of a MSE wall for this section of the project. Design plans indicate that the wall location would require filling to reach the proposed roadway subgrade.

GSG evaluated the global and external stability, and settlement to determine the suitability of the retaining wall for this section of the project. The wall section should be analyzed to determine that adequate factors of safety relative to sliding and overturning failure. The contractor is responsible for providing detailed internal stability design for the wall.

4.2 Retaining Wall Design Recommendations

The engineering analyses performed for evaluation of the retaining wall options followed the current AASHTO Load and Resistance Factor Design (LRFD) Methodology. LRFD methodology incorporates the use of load factors and resistance factors to account for uncertainty in applied loads and load resistance of structure elements separately. The AASHTO LRFD Bridge Design Specifications outline load factors and combinations for various strength, extreme event, service, and fatigue limit states. Section 11, which outlines geotechnical criteria for retaining walls, of the AASHTO Specifications requires the evaluation of bearing resistance failure, lateral sliding, and overturning at the strength limit state and excessive vertical displacement, excessive lateral displacement, and overall stability at the service limit state. The selected wall should be also evaluated with respect to the collision load. **Table 4** outlines the load factors used in evaluation of the retaining wall in accordance with AASHTO Specification Tables 3.4.1-1 and 3.4.1-2.

Table 4 - LRFD Load Factors for Retaining Wall Analyses

	Type of Load	Sliding and Eccentricity Strength I	Bearing Resistance Strength I	Sliding and Eccentricity Extreme II	Bearing Resistance Extreme II	Settlement Service I
Load Factors for Vertical Loads	Dead Load of Structural Components (DC)	0.90	1.25	1.00	1.00	1.00
	Vertical Earth Pressure Load (EV)	1.00	1.35	1.00	1.00	1.00
	Earth Surcharge Load (ES)		1.50			
	Live Load Surcharge (LS)		1.75		0.50	1.00
Load Factors for Horizontal Loads	Horizontal Earth Pressure Load (EH) Active At-Rest AEP for anchored walls	1.50	 1.50 1.35 1.35	1.00	1.00	1.00
	Earth Surcharge (ES)	1.50	1.50			
	Live Load Surcharge (LS)	1.75	1.75	0.50	0.50	1.00
Load Factor for Vehicular Collision				1.00	1.00	

4.2.1 Lateral Earth Pressures and Loading

The wall should be designed to withstand earth and live lateral earth pressures. The lateral earth pressures on MSE walls should be determined in accordance with AASHTO 3.11.5.8. Earth loads of retained soils behind the MSE wall may be calculated using an active earth pressure coefficient, K_a, calculated using the Coulomb Theory with a back slope angle of 9.5° (1V:6H) shown in the GPE. **Table 5** presents soil design properties for the retaining wall for the anticipated soil types at this site.

Table 5 – Lateral Soil Parameters

Elevation Range (feet)	Soil Description	Long-term/Drained			Soil Parameters used in L-Pile		
		Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	At-Rest Earth Pressure Coefficient (K_o)	Coefficient of Lateral Modulus of Subgrade Reaction (k_{py}, pci)	Soil Strain (ε_{50})	Soil Type
	New Engineered Clay Fill	0.42	4.95	0.58	500	0.01	Stiff Clay w/o free water (Reese)
	New Engineered Granular Fill	0.34	7.56	0.50	90	N/A	Sand (Reese)
595-591	Brown and Gray FILL Silty Clay	0.42	4.95	0.58	1,240	0.005	Stiff Clay w/o free water (Reese)
591-583	Brown and Gray Very Stiff to Hard Silty Clay	0.37	6.80	0.53	2,050	0.004	Stiff Clay w/o free water (Reese)
583-579	Gray Very Stiff to Hard Silty Clay	0.37	6.80	0.53	1,740	0.004	Stiff Clay w/o free water (Reese)
579-574	Gray Medium Dense to Dense Loam or Gravel	0.26	16.40	0.41	90	N/A	Sand (Reese)

*The initial p-y modulus, E_{py} , varies linearly with depth. To obtain E_{py} use the equation $E_{py} = k_{py} * z$, where k_{py} is the coefficient of lateral modulus of subgrade reaction given in the table and z is the distance from the surface to the center point of the layer in inches.

Traffic and other surcharge loads should be included in the retaining wall design. A live load surcharge shall be applied where vehicular load is expected to act on the surface of the backfill within a distance equal to one-half the wall height behind the back face of the wall in accordance with AASHTO 3.11.6.4. The live load surcharge may be estimated as a uniform horizontal earth pressure due to an equivalent height (H_{eq}) of two feet of soil.

The retaining walls design should include a drainage system to allow movement of any water behind the wall, and not allowing hydrostatic (seepage) pressures to develop in the active soil wedge behind the wall. This could be accomplished by placing a Geocomposite Wall Drain over the entire length of the back face of the wall connected to 6-inch diameter perforated drain pipe and backfilling a minimum of 2 feet of free draining materials, Porous Granular Embankment, as measured laterally from the back of the wall. The backfill should be placed in accordance with the IDOT SSRBC. Heavy compaction equipment should not be allowed closer than five (5) feet to the retaining wall to prevent inducing high lateral earth pressures and causing wall yielding and/or other damage. The passive lateral earth pressure coefficient (Kp) from the upper 3.5 feet of level backfill at the toe of the wall should be neglected, unless the soil is confined or protected by a concrete slab or well drained pavement. The passive lateral earth pressure coefficient from the upper 3.5 feet of soil for a descending slope at the wall toe should also be neglected, regardless of any surface protection.

4.2.2 Bearing Resistance

It is anticipated that the MSE wall will bear on existing/new fill, or native silty clay. Bearing resistance for the retaining wall founded on a granular fill leveling pad shall be evaluated at the strength limit state using load factors (See **Table 4**), and factored bearing resistance. The bearing resistance factor, ϕ_b, for an MSE wall is 0.65 per AASHTO Table 11.5.7-1. The bearing resistance shall be checked for the extreme limit state with a resistance factor of 1.0. **Table 6** presents the proposed bearing elevation and recommended bearing resistances of suitable materials to support the wall system. By preloading the bearing soils with the new embankment and wall construction for specific time periods as noted, the service limit bearing resistances can increase as the duration after construction. Bearing resistance values after one month and three months of preloading are presented in **Table 6**.

Table 6 – Recommended Bearing Resistance

Station	Bearing Elevation (feet)[1]	Maximum Retained Wall Height/Width (ft)	Nominal Resistance (ksf)[2]	Factored Bearing Resistance (ksf)	Bearing Resistance for 1-inch Settlement Service Limit (ksf)			Bearing Resistance for 2-inch Settlement Service Limit (ksf)			Anticipated Bearing Soil
					Preloading Days			Preloading Days			
					0[3]	30[4]	90[4]	0[3]	30[4]	90[4]	
272+24.35 to 273+40	589.1 to 592.8	24.5/19.0	15.8	10.3	1.3	2.7	3.5	2.0	3.6	4.4	Existing /New Fill
273+40 to 279+35	592.8 to 589.2	14.5/12.0	15.8	10.3	1.8	3.4	4.2	3.9	5.6	6.1	Existing /New Fill or Native Silty Clay

1. Elevations estimated from GP&E dated 02/08/2021
2. Includes undercut recommendations in Table 7
3. Based on the existing soil profile before any staged construction.
4. Assuming preloading with the full height of new embankment and Wall #5 and the soil strength parameters be the same as existing soil profile.

The minimum depth of the wall foundation should be 3.5 feet below the final exterior grade to alleviate the effects of frost. The subgrade soils encountered at the bearing elevation should be cleared of any unsuitable material, such as topsoil. Based on the results of the subsurface exploration, we anticipate the wall would be supported upon the soil types noted in **Table 6.**

4.2.3 Subgrade Undercut Areas

Based on the soil conditions along the wall alignment, it is anticipated that existing silty clay fill with low unconfined compressive strength and/or high moisture contents will be encountered near bearing elevation between Stations 273+00 and 274+12, and Stations 277+25 and 278+00. When encountered, these soils are not generally considered suitable for bearing and should be removed during construction. Cohesive materials exhibiting moisture contents greater than 27% and unconfined compressive strengths less than 2.0 tsf if encountered should be removed during construction.

Table 7 – Potential Remedial Treatment Summary for MSE Wall

Station		Wall Height (feet)	Soil Description	Remedial Undercut		Reason for Undercut
From	To			Top Elevation (feet)	Depth (feet)	
273+00	273+50	22.0	Existing Fill	592.0	2	Qu < 2 tsf, Moisture >27%
273+50	274+12	16.0	Existing Fill	592.5	3	Moisture >27%
277+25	278+00	14.0	Existing Fill	591.0	2	Qu < 2 tsf

Undercut areas should be replaced with granular structural fill in accordance with IDOT standard construction requirements. The lateral limit of the structural fill should extend a minimum of 1 foot beyond the edge of the MSE wall, then an additional 1 foot laterally for every 2 feet of structural fill depth as depicted in **Exhibit 3**. The granular structural fill should be placed and compacted to a minimum of 95% of the maximum dry density, as determined by AASHTO T-180: Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures (ASTM D1557) in accordance with IDOT standard construction requirements.

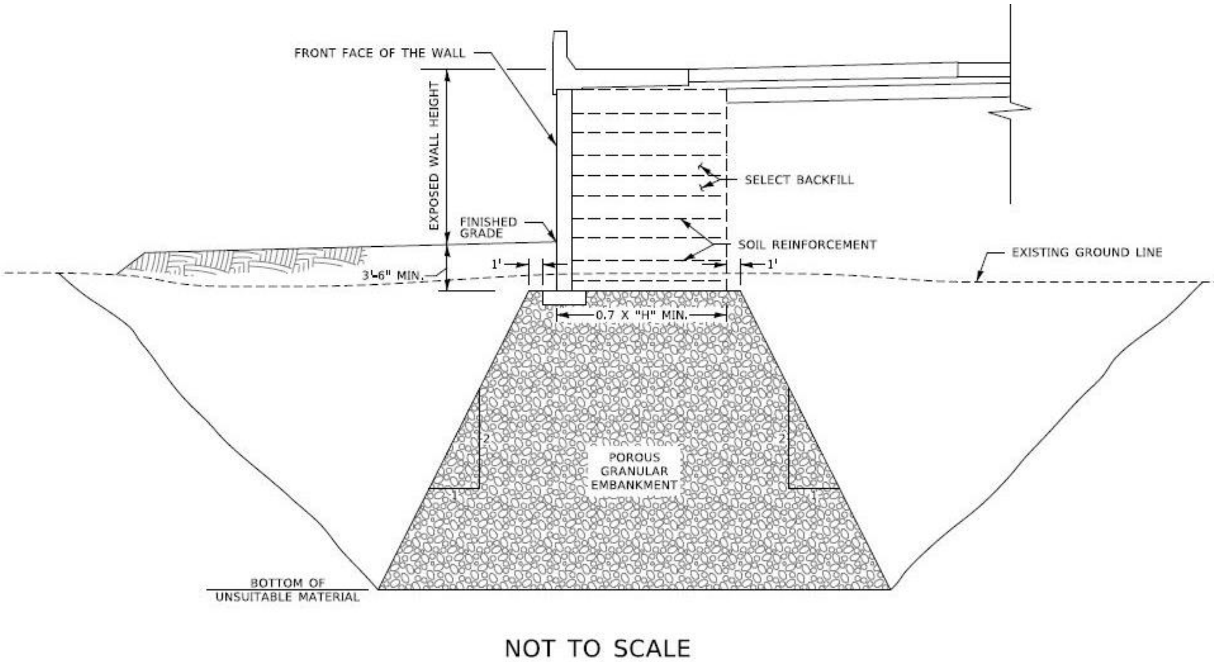


Exhibit 3 - Structural Fill Placement below MSE Wall Footing

4.2.4 Sliding and Overturning Stability

The wall base width should be sufficient to resist sliding. The frictional resistance shall include the friction between granular backfill for the wall and supportive cohesive or granular soils, and the friction between the wall foundation and bearing soils.

The factored resistance against sliding should be calculated using equation 10.6.3.4-1 in the AASHTO LRFD manual. A sliding resistance factor, ϕ, of 1.0 (Table 11.5.7-1) shall be applied to the nominal sliding resistance of soil-on-soil beneath the MSE wall. A maximum frictional coefficient of 0.53 (tan 28 degrees) could be used for determining the sliding resistance for the soil to soil interfaces. The width of the MSE wall (length of the reinforcing) must be wide enough to resist overturning forces. The location of the resultant of the forces shall be within the middle two-thirds of the MSE base width.

4.2.5 Wall Settlement

Settlement of the MSE wall depends on the foundation size and strength and compressibility characteristics of the underlying bearing soil. Assuming the foundation subgrade has been prepared as recommended above and the service bearing resistances as mentioned in **Table 6** are used, the settlement of the MSE wall will be on the order of 1 to 2 inches. Differential settlement between two points of 100 feet apart along the length of the wall will be ½ inch or less. AASHTO 11.10.4.1 provides guidelines regarding the maximum total and differential tolerable settlements for various facing of MSE walls. Settlement of the entire ramp embankment will be discussed in the roadway report.

4.2.6 Overall Stability

The MSE wall should be designed for external stability of the wall system as well as the internal stability of the reinforced soil mass behind the wall facing. The wall contractor should confirm stability requirements based on the final wall configurations. The following parameters were used to evaluate the wall.

Table 8a – Wall Description: Sta. 272+24.35 to Sta. 274+00

*Based on GPE dated 02/08/2021

Maximum total retained height of the retaining wall (H)*	24.5 feet
Minimum length of reinforcement	19.0 feet
Unit weight of the retained soil (embankment)	120 pcf
Unit weight of the reinforced soil mass	120 pcf

Table 8b – Wall Description: Sta. 274+00 to Sta. 279+35

*Based on GPE dated 02/08/2021

Maximum total retained height of the retaining wall (H)*	14.5 feet
Minimum length of reinforcement (0.7xH)	12.0 feet
Unit weight of the retained soil (embankment)	120 pcf
Unit weight of the reinforced soil mass	120 pcf

The actual wall width, and total height of the wall should be based on structural analysis performed by a Licensed Structural Engineer in the State of Illinois.

Slide 2018 is a comprehensive slope stability analysis software used to evaluate the proposed wall for the project based on the limit equilibrium method. The proposed wall was analyzed based on the preliminary grading and the soils encountered while drilling. A circular failure analyses were evaluated using the simplified Bishops analyses methods for the proposed wall geometry. The analyses were performed using the soil parameters in **Appendix C**. Based on the proposed geometry and the soil borings, global stability analyses were performed.

4.2.7 Global Slope Stability Results

A circular failure analysis was evaluated for both a short term (undrained) and long term (drained) conditions for the proposed retaining wall. The analyses were performed at Station 272+24, at the anticipated maximum wall height section, and Station 277+50 where undercuts are anticipated at bearing level. The results of the analyses are shown in **Table 11**.

Table 9 – Slope Stability Analyses Results

Analysis Exhibit	Station	Analysis Type	Factor of Safety	Minimum Factor of Safety
Exhibit 4a	272+24	Circular – Short Term	3.6	1.5
Exhibit 4b		Circular – Long Term	1.9	1.5
Exhibit 4c	277+50	Circular – Short Term	3.1	1.5
Exhibit 4d		Circular – Long Term	2.0	1.5

Based on the analyses performed, the proposed retaining wall meets the IDOT minimum factor of safety of 1.5 for a fill section. Summaries of the slope stability analyses are included in the Slope Stability Analyses Exhibits (**Appendix F**).

4.3 Drainage Recommendations

The wall should be designed to prevent the buildup of hydrostatic forces. This can be done with the construction of a base drain and back drain to collect and remove surface water away from the face of the wall. Geocomposite Wall Drain or open grade stone with a geotextile fabric system should be placed over the entire length of the back face of the wall.

5.0 CONSTRUCTION CONSIDERATIONS

All work performed for the proposed project should conform to the requirements in the IDOT Standard Specifications for Road and Bridge Construction (2016). Any deviation from the requirements in the manuals above should be approved by the design engineer.

5.1 Site Preparation

All of the borings were completed within the existing IDOT property right-of-way (ROW). Based on the existing site conditions at the proposed wall location west of the existing roadway, it is anticipated that the surface will require stripping of vegetation and surface topsoil from the vicinity of the proposed wall. It is anticipated that topsoil stripping depths could be on the order of about 6 inches, however thicker deposits may be present at the base of the drainage ditch. After stripping, areas intended to support new wall elements or new engineered fill should be carefully evaluated by a geotechnical engineer.

Where possible, the engineer may require proof-rolling of the subgrade with a 20 to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. The purpose of the proof-rolling is to locate soft, weak, or excessively wet soils present at the time of construction. Proof-rolling should be performed during a time of good weather and not while the site is wet, frozen, or severely desiccated. Any unsuitable materials observed during the evaluation and proof-rolling operations should be undercut and replaced with compacted structural fill and/or stabilized in-place. The possible need for, and extent of, undercutting and/or in-place stabilization required can best be determined by the geotechnical engineer at the time of construction. Once the site has been properly prepared, at grade construction may proceed.

5.2 Existing Utilities

Based on the existing site conditions, significant utilities may exist along the project corridor that may interfere with construction of the proposed widening of the roadway and the retaining wall construction.

Before proceeding with construction, any existing utility lines that will interfere with construction should be completely relocated from beneath the proposed construction areas. Where possible, existing utility lines that are to be abandoned in place should be removed and/or plugged with a minimum of 2 feet of cement grout. All excavations resulting from underground utility removal activities should be cleaned of loose and disturbed materials, including all previously placed backfill, and backfilled with suitable fill materials in accordance with the requirements of this section. During the clearing and stripping operations, positive surface drainage should be maintained to prevent the accumulation of water.

5.3 Site Excavation

Site excavations are expected to encounter various types of soils as described in the Subsurface Exploration section of this report. The contractor will be responsible to provide a safe excavation during the construction activities of the project. All excavations should be conducted in accordance with applicable federal, state, and local safety regulations, including, but not limited to the Occupational Safety and Health Administration (OSHA) excavation safety standards. Excavation stability and soil pressures on temporary shoring are dependent on soil conditions, depth of excavations, installation procedures, and the magnitude of any surcharge loads on the ground surface adjacent to the excavation. Excavation near existing structures and underground utilities should be performed with extreme care to avoid undermining existing structures. Excavations should not extend below the level of adjacent existing foundations or utilities unless underpinning or other support is installed. It is the responsibility of the contractor for field determinations of applicable conditions and providing adequate shoring for all excavation activities.

5.4 Borrow Material and Compaction Requirements

If borrow material is to be used for onsite construction, it should conform to Section 204 "Borrow and Furnish Excavations" of the IDOT Construction Manual (2016).

5.5 Groundwater Management

It is anticipated that the long-term water table is between elevations 582.0 to 585.0 feet. GSG does not anticipate groundwater related issues during construction activity based on the predominantly cohesive nature of the site and propose design; however, water may become perched in the fill material encountered near the surface. If rainwater run-off or perched water is accumulated at the base of excavation, the contractor should remove accumulated water using conventional sump pit and pump procedures and maintain a dry and stable excavation. The location of the sump should be determined by the contractor based on field conditions. During earthmoving activities at the site, grading should be performed to ensure that drainage is maintained throughout the construction period. Water should not be allowed to accumulate in the foundation area either during or after construction. Undercut and excavated areas should be sloped toward one corner to facilitate removal of any collected rainwater or surface run-off. Grades should be sloped away from the excavations to minimize runoff from entering.

If water seepage occurs during excavations or where wet conditions are encountered such that the water cannot be removed with conventional sumping, we recommend placing open grade stone similar to IDOT CA-7 to stabilize the bottom of the excavation below the water table. The CA-7 stone should be placed to 12 inches above the water table, in 12-inch lifts, and should be compacted with the use of a heavy smooth drum roller or heavy vibratory plate compactor until stable. The remaining portion of the excavation beneath the footings should be backfilled using approved structural fill.

6.0 LIMITATIONS

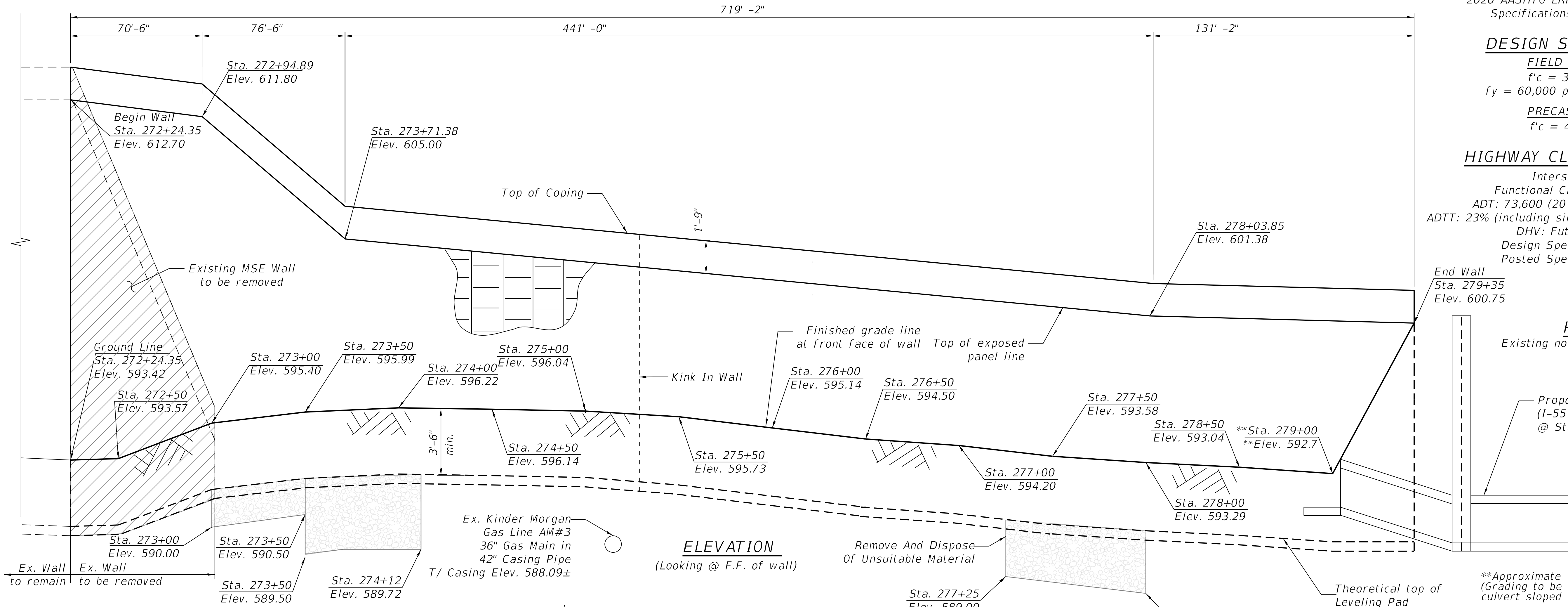
This report has been prepared for the exclusive use of the Illinois Department of Transportation and its Design Section Engineer consultant. The recommendations provided in the report are specific to the project described herein and are based on the information obtained at the soil boring locations within the proposed retaining wall area. The analyses have been performed, and the recommendations provided in this report, are based on subsurface conditions determined at the location of the borings. This report may not reflect all variations that may occur between boring locations or at some other time, the nature and extent of which may not become evident until during the time of construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and review the recommendations presented herein.

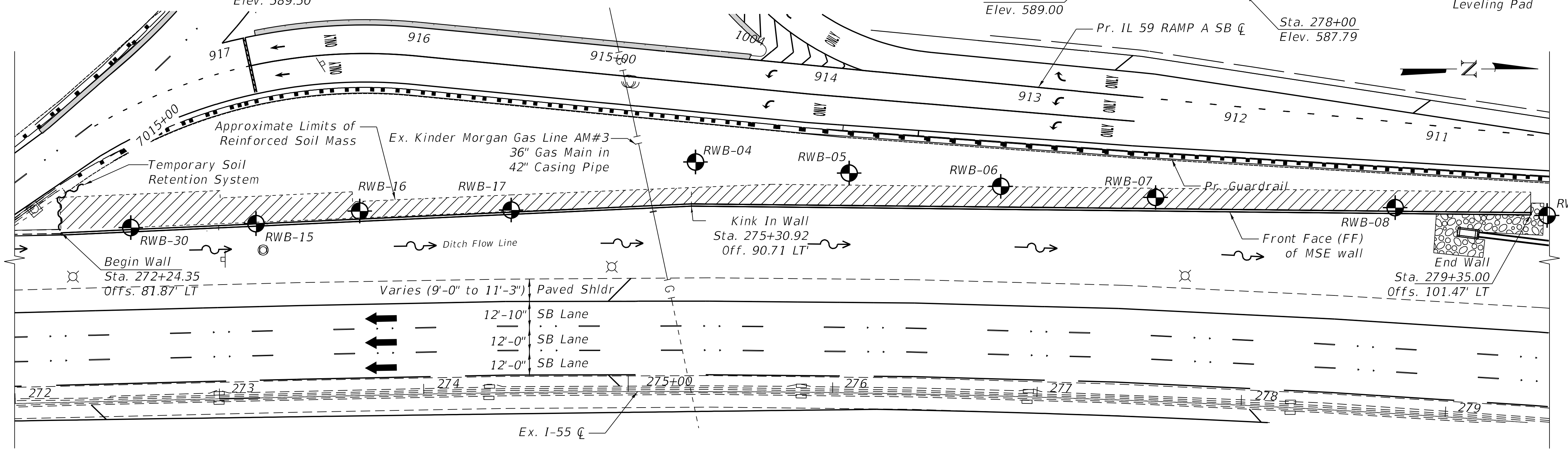
APPENDIX A

General Plans, Elevations, and Details

Bench Mark: BM-302 Set 2" diameter Aluminum Disc in brindge wall at northwest corner of existing NB IL-59 Ramp Bridge over I-55, El. 625.23.

Existing Structure: A portion of Existing MSE Wall from SN 099-4642 to be removed.





PLAN

Note:
Wall offsets are measured from the ℄ of I-55 to the front face of precast panels

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition

DESIGN STRESSES

FIELD UNITS
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

PRECAST UNITS
f'c = 4,500 psi

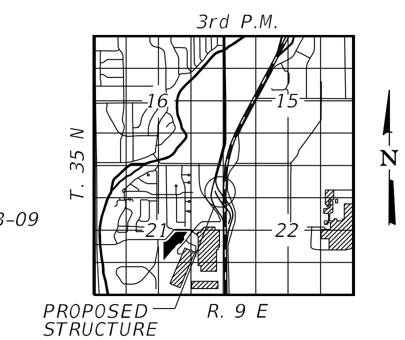
HIGHWAY CLASSIFICATION

Interstate 55
Functional Class: Highway
ADT: 73,600 (2019) 90,300 (2040)
ADTT: 23% (including single/multiple unit trucks)
DHV: Future 3,005
Design Speed: 70 m.p.h.
Posted Speed: 65 m.p.h.

PROFILE

Existing not modified and not shown

**Approximate
(Grading to be shaped around proposed culvert sloped end section)



LOCATION SKETCH

GENERAL PLAN & ELEVATION
I-55/IL 59 RETAINING WALL
F.A.I 55 INTERSTATE 55 (I-55)
SECTION 2018-075-R
WILL COUNTY
STATION 272+24.35 TO 279+35
STRUCTURE NO. 099-1003

Ardmore Roderick, 1500 West Carroll Avenue, Suite 300, Chicago, Illinois 60607, 312-795-1400	USER NAME = jeffreyehrhart	DESIGNED - JPK	REVISED -
		CHECKED - JCE	REVISED -
	PLOT SCALE =	DRAWN - JPK	REVISED -
	PLOT DATE = 2/08/2021	CHECKED - JCE	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.I/P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
*	2018-075-R	WILL		
		CONTRACT NO. 62H15		

* FAI 55, FAP 338 | ILLINOIS | FED. AID PROJECT

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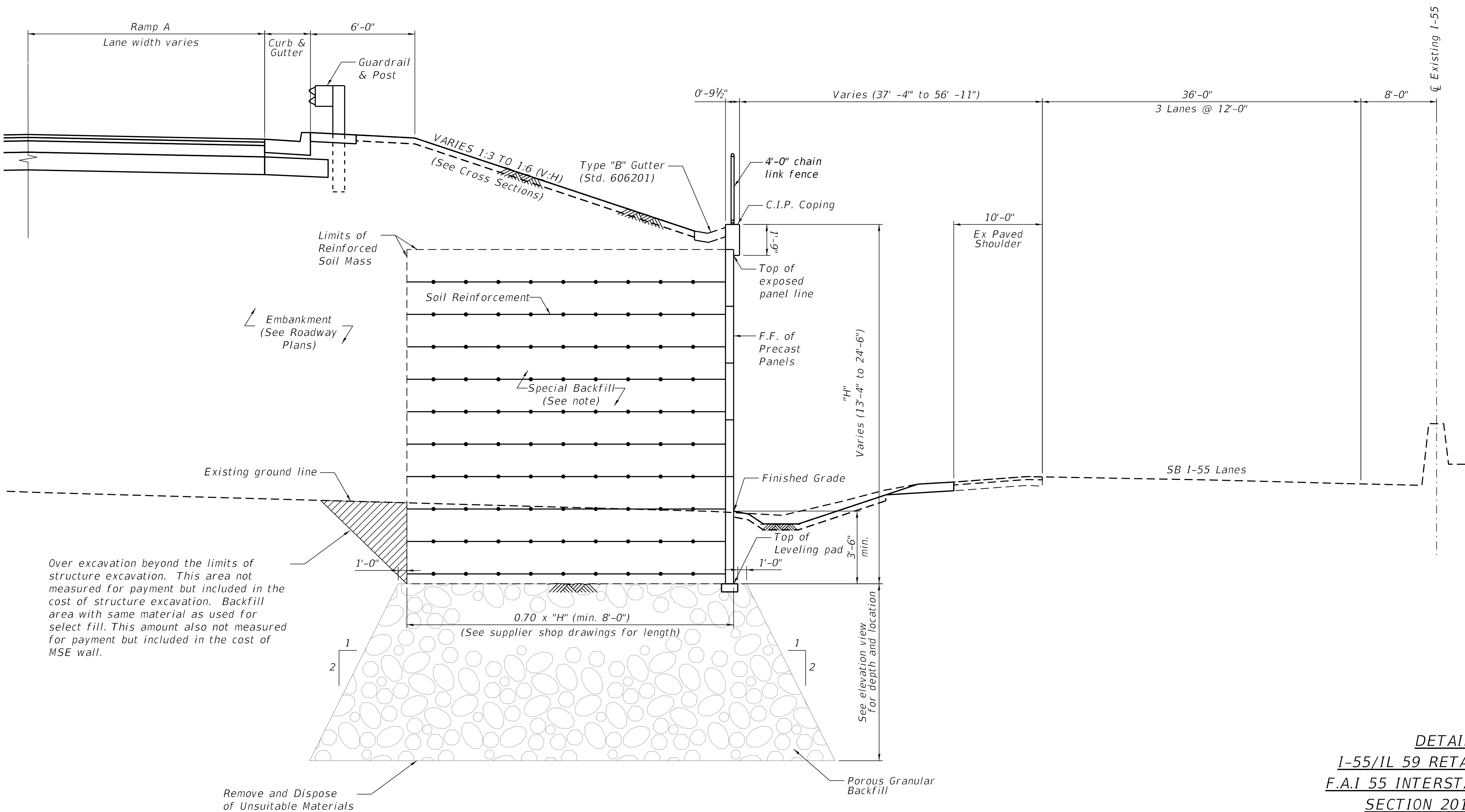

TYPICAL WALL SECTION
(Looking North)

DETAILS
I-55/IL 59 RETAINING WALL
F.A.I 55 INTERSTATE 55 (I-55)
SECTION 2018-075-R
WILL COUNTY
STATION 272+24.35 TO 279+35
STRUCTURE NO. 099-1003

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Ardmore Roderick
Ardmore Roderick, 1500 West Carroll Avenue, Suite 300, Chicago, Illinois 60607, 312-795-1400

USER NAME = jeffreyehrhart	DESIGNED - JPK	REVISED -	
	CHECKED - JCE	REVISED -	
PLOT SCALE =	DRAWN - JPK	REVISED -	
PLOT DATE = 2/08/2021	CHECKED - JCE	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

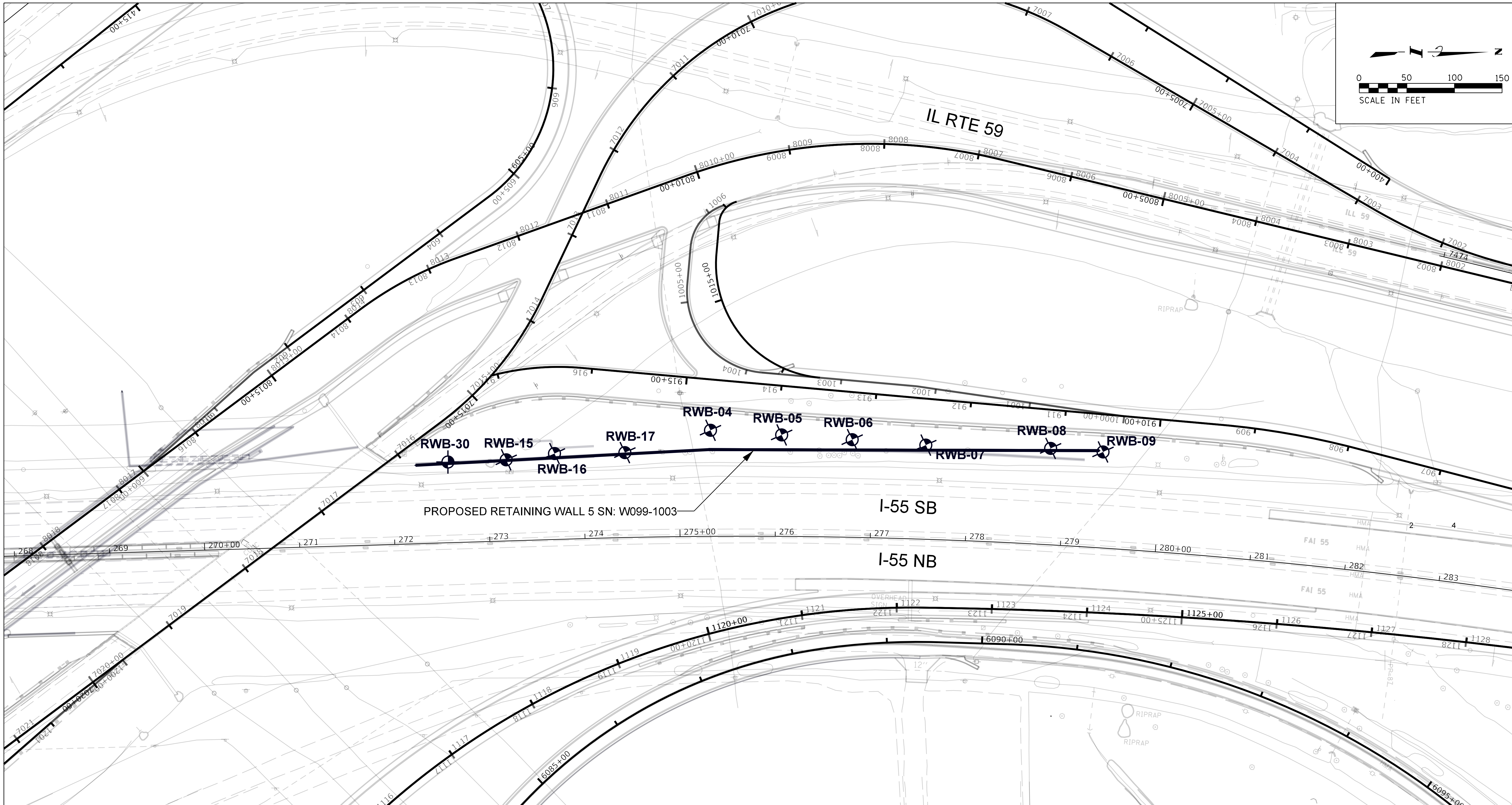
SHEET 2 OF 2 SHEETS

F.A.I/P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
*	2018-075-R	WILL		
		CONTRACT NO. 62H15		
* FAI 55, FAP 338		ILLINOIS	FED. AID PROJECT	

APPENDIX B

SOIL BORING LOCATION PLAN

AND SUBSURFACE PROFILE



LEGEND

IDOT RETAINING WALL BORINGS

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GSG CONSULTANTS, INC.

USER NAME = nnano	DESIGNED - SI		
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PLOT SCALE = 1200.0000 ' / ft.	CHECKED - DE		
PLOT DATE = 2/18/2021	DATE - 02/12/2021		

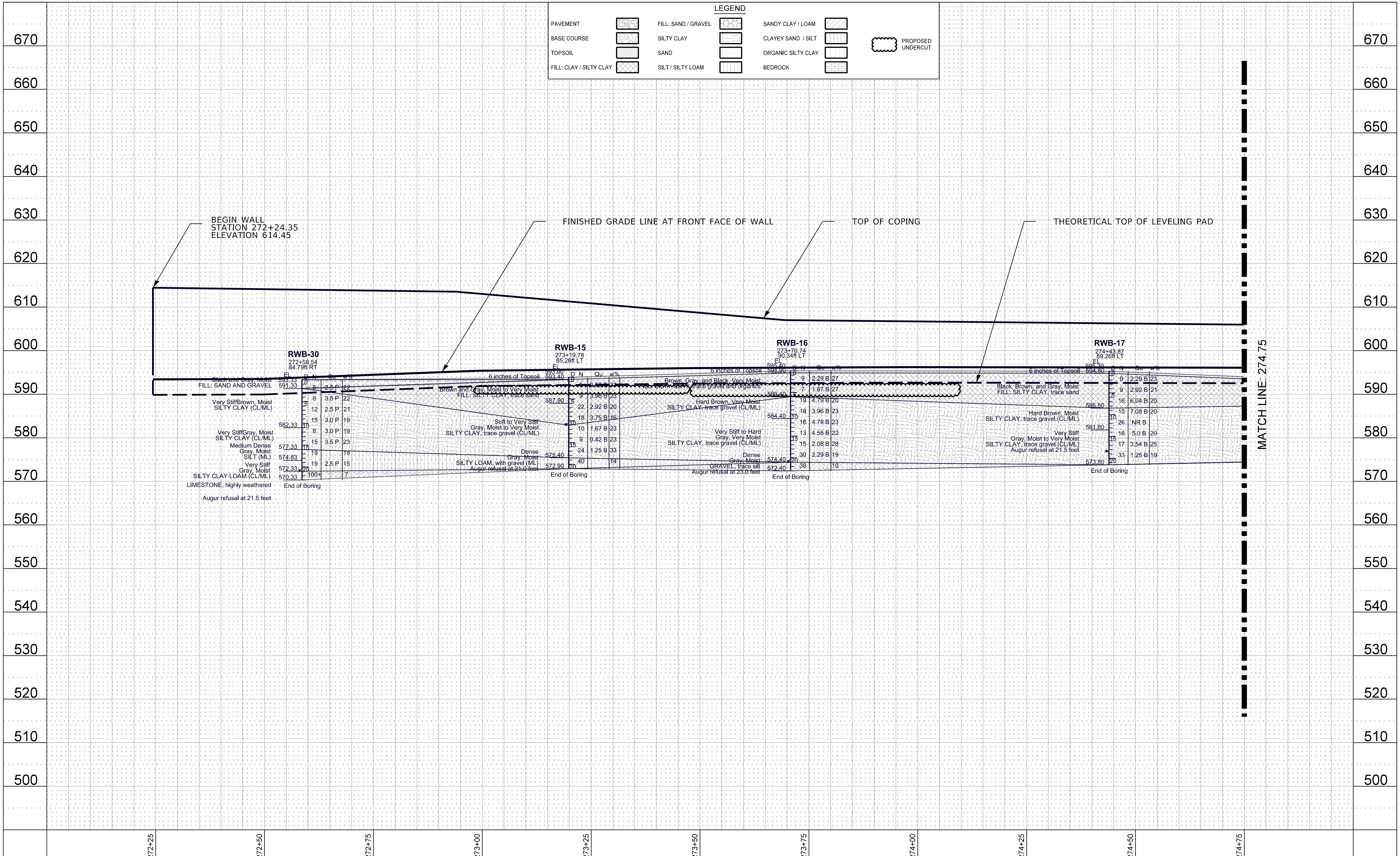
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. 189-011

I-55/ROUTE 59 WILL COUNTY
RETAINING WALL NO.5 SN:099-1003 BORING LOCATION PLAN

SCALE: AS NOTED | SHEET 1 OF 1 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
I-55		WILL	4	1
		CONTRACT NO. 189-011		
	ILLINOIS	FED. AID PROJECT		



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GSG CONSULTANTS, INC.

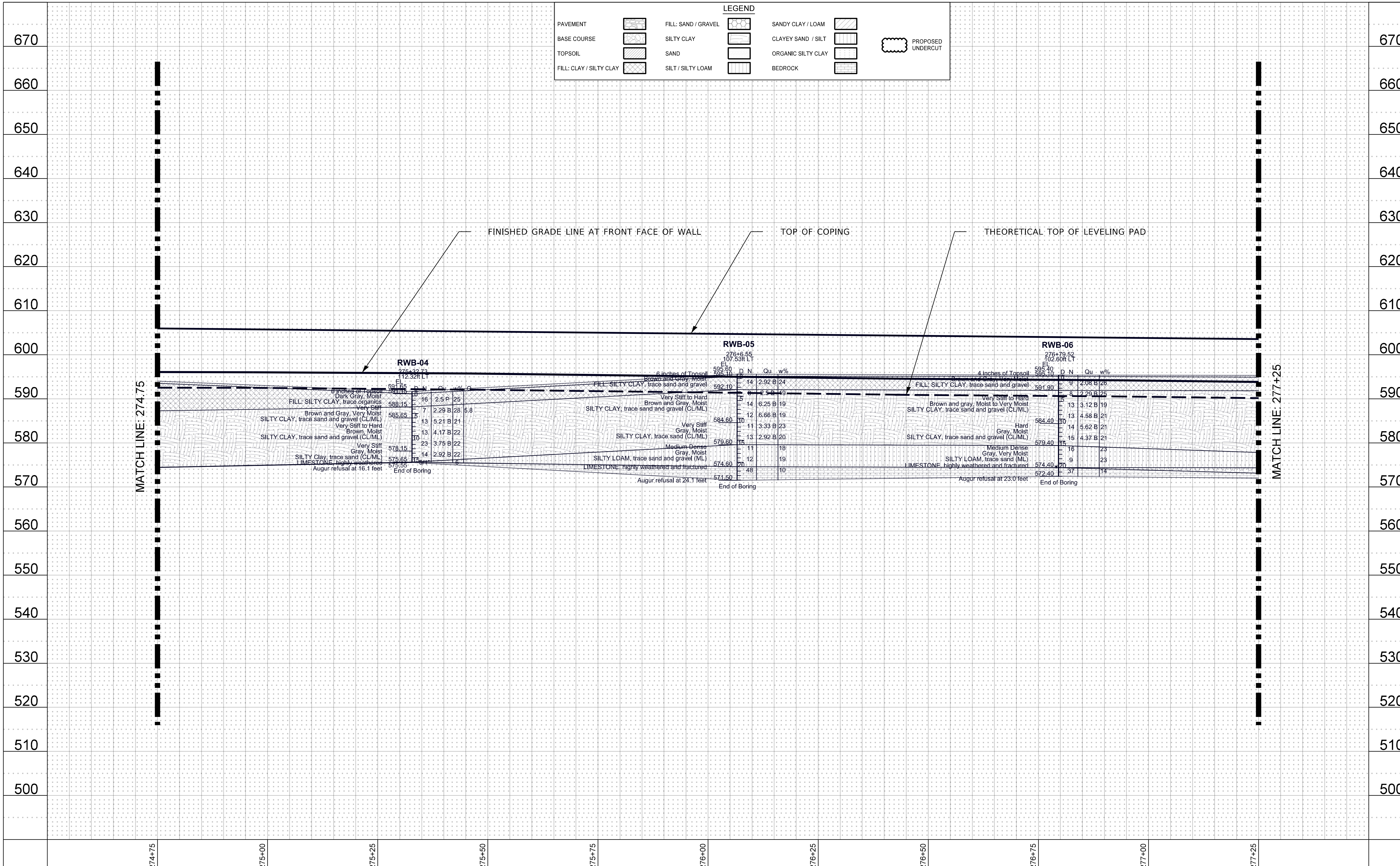
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. 189-011
I-55/ROUTE 59 WILL COUNTY
RETAINING WALL NO.5 SN:099-1003 SOIL PROFILE

SCALE: AS NOTED | SHEET 1 OF 3 SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
I-55		WILL	4	2

CONTRACT NO. 2189-011
ILLINOIS | FED. AID PROJECT



GSG CONSULTANTS, INC.

USER NAME	= nnano	DESIGNED	-	SI
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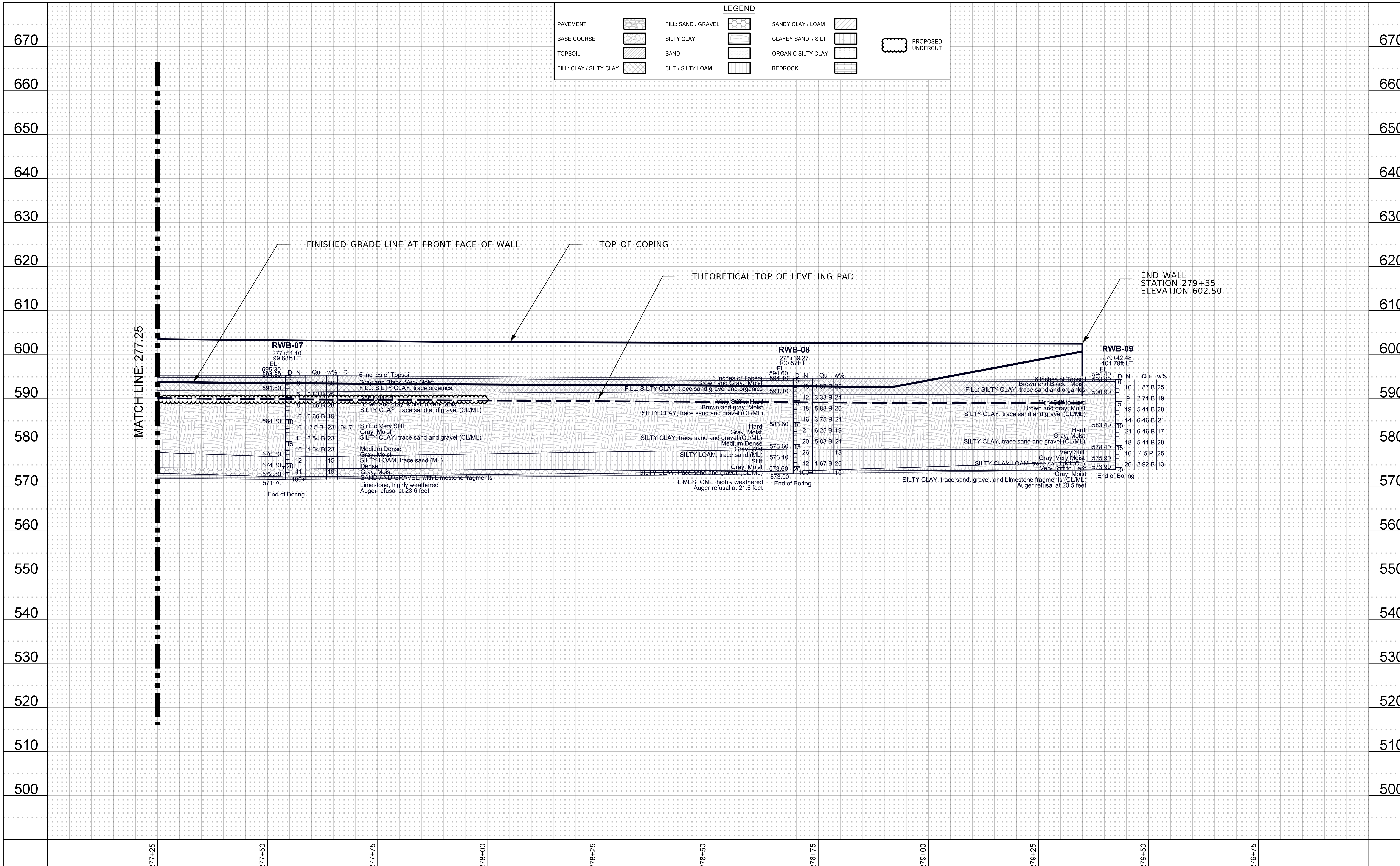
PLOT SCALE	= 240.0000 ' / ft.	CHECKED	-	DE
PLOT DATE	= 2/18/2021	DATE	-	02/12/2021

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. 189-011
I-55/ROUTE 59 WILL COUNTY
RETAINING WALL NO.5 SN:099-1003 SOIL PROFILE
SCALE: ____AS NOTED | SHEET 2 OF 3 SHEETS | STA. TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
I-55		WILL	4	3
		CONTRACT NO. 2189-011		
	ILLINOIS	FED. AID PROJECT		



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	PLOT DATE = 2/18/2021	DATE - 02/12/2020

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. 189-011
I-55/ROUTE 59 WILL COUNTY
RETAINING WALL NO.5 SN:099-1003 SOIL PROFILE

SCALE: AS NOTED | SHEET 3 OF 3 SHEETS | STA. TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
I-55		WILL	4	4
		CONTRACT NO. 2189-011		
		ILLINOIS	FED. AID PROJECT	

APPENDIX C

SOIL BORING LOGS

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/1/19

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** NP

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-04
Station 275+32.73
Offset 112.32ft LT
Ground Surface Elev. 591.65 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	591.15				
Dark Gray, Moist FILL: SILTY CLAY, trace organics			2 7 9	2.5 P	25
	588.15				
Very Stiff Brown and Gray, Very Moist SILTY CLAY, trace sand and gravel (CH)		-5	3 2 5	2.3 B	28
	585.65				
Very Stiff to Hard Brown, Moist SILTY CLAY, trace sand and gravel (CL/ML)			3 5 8	5.2 B	21
		-10	3 4 9	4.2 B	22
			5 12 11	3.8 B	22
	578.15				
Very Stiff Gray, Moist SILTY CLAY, trace sand (CL/ML)		-15	3 6 8	2.9 B	22
	575.65				
LIMESTONE, highly weathered	575.55		50/1"		6
Auger refusal at 16.1 feet End of Boring		-20			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 10/28/19

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** NP

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-05
Station 276+6.55
Offset 107.53ft LT
Ground Surface Elev. 595.60 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	595.10				
Brown and Gray, Moist FILL: SILTY CLAY, trace sand and gravel			4		
			6	2.9	24
			8	B	
	592.10				
Very Stiff to Hard Brown and Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)			1		
			2	2.5	19
		-5	6	B	
			4		
			6	6.3	19
			8	B	
			3		
			5	6.7	19
		-10	7	B	
	584.60				
Very Stiff Gray, Moist SILTY CLAY, trace sand (CL/ML)			3		
			5	3.3	23
			6	B	
			4		
			6	2.9	20
		-15	7	B	
	579.60				
Medium Dense Gray, Moist SILTY LOAM, trace sand and gravel (ML)			4		
			6		18
			5		
			2		
			4		19
		-20	8		
	574.60				
LIMESTONE, highly weathered and fractured			13		
			15		10
			33		
Auger refusal at 24.1 feet			5		
	571.50				
End of Boring			50/1"		11
		-25			
		-30			
		-35			
		-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 10/28/19

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** NP

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-06
Station 276+79.52
Offset 102.60ft LT
Ground Surface Elev. 595.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 574.4 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
4 inches of Topsoil	595.10				
Brown and Gray, Very Moist FILL: SILTY CLAY, trace sand and gravel			2 4 5	2.1 B	26
	591.90				
Very Stiff to Hard Brown and gray, Moist to Very Moist SILTY CLAY, trace sand and gravel (CL/ML)			2 3 5	2.3 B	25
		-5			
			3 6 7	3.1 B	19
			3 5 8	4.6 B	21
		-10			
	584.40				
Hard Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)			3 6 8	5.6 B	21
			2 6 9	4.4 B	21
		-15			
	579.40				
Medium Dense Gray, Very Moist SILTY LOAM, trace sand (ML)			5 7 9		23
			4 4 5		23
		-20			
	574.40 ▼				
LIMESTONE, highly weathered and fractured			4 10 27		14
Auger refusal at 23.0 feet	572.40				
End of Boring					
		-25			
		-30			
		-35			
		-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/1/19

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** NP

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-07
Station 277+54.10
Offset 99.68ft LT
Ground Surface Elev. 595.30 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 574.3 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	594.80				
Gray and Black, Very Moist FILL: SILTY CLAY, trace organics			2 3 3	1.0 P	30
	591.80				
Soft to Hard Brown and gray, Moist to Very Moist SILTY CLAY, trace sand and gravel (CL/ML)		-5	2 2 3	0.8 B	25
			3 4 4	6.7 B	28
		-10	3 7 9	6.7 B	19
	584.30				
Very Stiff Gray, Moist CLAY, trace sand and gravel (CL)			5 7 9	2.5 B	23
	581.80				
Stiff to Very Stiff Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)		-15	2 4 7	3.5 B	23
			5 4 6	1.0 B	23
	576.80				
Medium Dense Gray, Moist SILTY LOAM, trace sand (ML)		-20	2 4 8		15
	574.30 ▼				
Dense Gray, Moist SAND AND GRAVEL, with Limestone fragments			7 18 23		19
	572.30				
LIMESTONE, highly weathered	571.70		50/1"		
Auger and split spoon refusal at 23.6 feet					
End of Boring		-25			
		-30			
		-35			
		-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/6/19

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** NP

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-08
Station 278+69.27
Offset 100.57ft LT
Ground Surface Elev. 594.60 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	594.10				
Brown and Gray, Moist FILL: SILTY CLAY, trace sand gravel and organics			3 6 7	1.9 B	25
	591.10				
Very Stiff to Hard Brown and gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)		-5	2 6 6	3.3 B	24
			4 8 10	5.8 B	20
		-10	2 7 9	3.8 B	21
	583.60				
Hard Gray, Moist SILTY CLAY, trace sand and gravel (CH)			6 9 12	6.3 B	19
	581.10				
Hard Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)		-15	5 9 11	5.8 B	21
	578.60				
Medium Dense Gray, Wet SILTY LOAM, trace sand (ML)			8 11 15		18
	576.10				
		-20	5 4 8	1.7 B	26
Stiff Gray, Moist SILTY CLAY, trace sand and gravel, (CL/ML) *(continued)*	573.60		13		
	573.00				
LIMESTONE, highly weathered Auger refusal at 21.6 feet			50/1"		16
End of Boring		-25			
		-30			
		-35			
		-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 11/6/19

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** NP

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-09
Station 279+42.48
Offset 101.79ft LT
Ground Surface Elev. 594.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter None ft
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	593.90				
Brown and Black, Moist FILL: SILTY CLAY, trace sand and organics			3 5 5	1.9 B	25
	590.90				
Very Stiff to Hard Brown and gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)		-5	2 4 5	2.7 B	19
			5 8 11	5.4 B	20
		-10	2 6 8	6.5 B	21
	583.40				
Hard Gray, Moist SILTY CLAY, trace sand and gravel (CL/ML)			8 9 12	6.5 B	17
		-15	4 8 10	5.4 B	20
	578.40				
Very Stiff Gray, Very Moist SILTY CLAY LOAM, trace sand (ML/CL)			8 8 8	4.5 P	25
	575.90				
		-20	4 5 21	2.9 B	13
Very Stiff to Hard Gray, Moist SILTY CLAY, trace sand, gravel, and Limestone fragments (CL/ML) *(continued)* Auger refusal at 20.5 feet	573.90				
End of Boring		-25			
		-30			
		-35			
		-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, form 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 2/27/20

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** AB

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-15
Station 273+19.78
Offset 85.26ft LT
Ground Surface Elev. 593.90 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 582.9 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	593.40				
Brown and Gray, Moist to Very Moist FILL: SILTY CLAY, trace sand			2 / 4 / 5	0.8 B	33
			2 / 3 / 6	4.0 B	23
	587.90	-5			
Soft to Very Stiff Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML)			4 / 10 / 12	2.9 B	20
			5 / 8 / 10	3.8 B	16
		-10 ▼	3 / 4 / 6	1.7 B	23
			3 / 4 / 5	0.4 B	23
		-15	3 / 6 / 18	1.3 B	33
	575.40				
Dense Gray, Moist SILTY LOAM, with gravel (ML)			13 / 14 / 26		14
		-20			
Auger refusal at 21.0 feet	572.90				
End of Boring		-25, -30, -35, -40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 2/27/20

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** AB

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-16
Station 273+70.74
Offset 90.34ft LT
Ground Surface Elev. 595.40 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 574.4 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	594.90				
Brown, Gray, and Black, Very Moist FILL: SILTY CLAY, trace gravel and organics			3 4 5	2.3 B	27
			2 3 4	1.9 B	27
		-5			
Hard Brown, Moist SILTY CLAY, trace gravel (CL/ML)	589.40		5 8 11	4.8 B	20
			3 8 10	4.0 B	23
		-10			
Very Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML)	584.40		6 7 9	4.8 B	23
Cobbles at 12.0 and 14.0 feet			3 5 8	4.6 B	22
		-15			
			6 9 6	2.1 B	28
			3 5 25	2.3 B	19
		-20			
Dense Gray, Moist GRAVEL, trace silt	574.40 ▼		15 21 17		10
Auger refusal at 23.0 feet	572.40				
End of Boring					
		-25			
		-30			
		-35			
		-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
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SOIL BORING LOG

Date 2/27/20

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** AB

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** , **Latitude** , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-17
Station 274+43.87
Offset 89.26ft LT
Ground Surface Elev. 595.30 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 576.8 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil	594.80				
Black, Brown, and Gray, Moist FILL: SILTY CLAY, trace sand			3		
			4	2.3	23
			5	B	
			3		
			4	2.9	21
		-5	5	B	
			4		
			7	6.0	20
			9	B	
	586.80				
Hard Brown, Moist SILTY CLAY, trace gravel (CL/ML)			5		
			6	7.1	20
		-10	9	B	
Cobbles at 11.0 feet			6		
			11	NR	
			15		
	581.80				
Very Stiff Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML)			4		
			7	5.0	20
		-15	11	B	
			5		
			9	3.5	25
			8	B	
		▼	6		
			13	1.3	19
		-20	20	B	
Very Stiff Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) *(continued)* Auger refusal at 21.5 feet	573.80				
End of Boring					
		-25			
		-30			
		-35			
		-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
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SOIL BORING LOG

Date 4/2/20

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 5 **LOGGED BY** TEK

SECTION 2018-075-R **LOCATION** I-55 SB off shoulder, **SEC.** , **TWP.** , **RNG.** ,
Latitude , **Longitude**

COUNTY WILL **DRILLING METHOD** HSA **HAMMER TYPE** AUTO

STRUCT. NO. 099-1003
Station

BORING NO. RWB-30
Station 272+58.54
Offset 84.79ft LT
Ground Surface Elev. 593.33 ft

Surface Water Elev. N/A ft
Stream Bed Elev. N/A ft

Groundwater Elev.:
First Encounter 572.3 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Black and Gray, Moist FILL: SAND AND GRAVEL			4		
	591.33		2 / 4	2.5 P	22
Very Stiff Brown, Moist SILTY CLAY (CL/ML)			2		
			3 / 5	3.5 P	22
		-5			
			3		
			5 / 7	2.5 P	21
			3		
			6 / 9	3.0 P	19
		-10			
	582.33				
Very Stiff Gray, Moist SILTY CLAY (CL/ML)			3		
			3 / 5	3.0 P	19
			3		
			6 / 9	3.5 P	23
		-15			
	577.33				
Medium Dense Gray, Moist SILT (ML)			10		
			10 / 9		18
	574.83				
Very Stiff Gray, Moist SILTY CLAY LOAM (CL/ML)			3		
		-20	5 / 14	2.5 P	15

Description	Elev.	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
	572.33 ▼				
LIMESTONE, highly weathered			50/6"		
					7
	570.33				
End of Boring					
		-25			
		-30			
		-35			
		-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

APPENDIX D

Laboratory Test Results

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623 Cooper Court • Schaumburg, IL 60173
Tel: 630.994.2600 • Fax: 312.733.5612

Table D1a–Retaining Wall #5 Test Results – Atterberg Limits

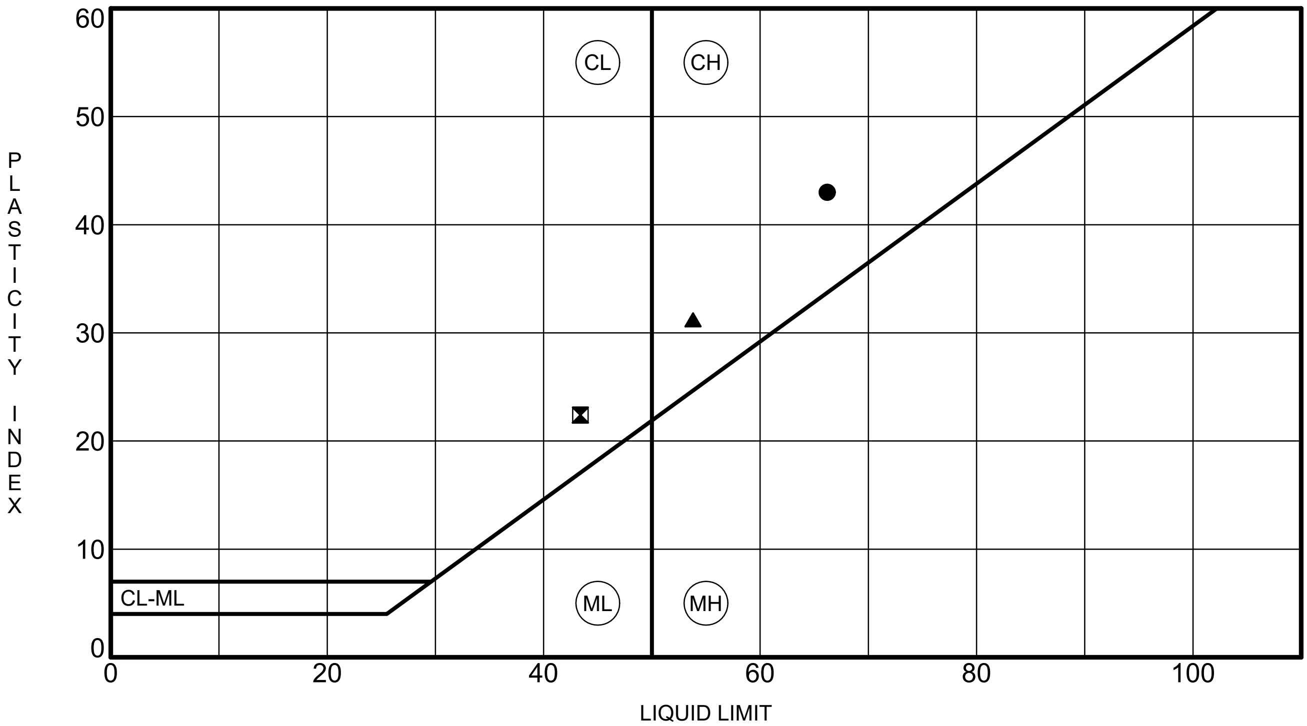
Boring ID	Sample Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Soil Classification
RWB-04	3.5-5	66.2	23.2	43.0	CH
RWB-07	11-12.5	43.4	21.0	22.4	CL
RWB-08	11-12.5	53.8	22.6	31.2	CH

Table D1b– Retaining Wall #5 Test Results – Organic Content

Boring ID	Sample Depth (ft)	Organic Content (%)	Soil Classification
RWB-04	3.5-5	5.8	CH

Table D1c– Retaining Wall #5 Test Results – Unit Weight

Boring ID	Sample Depth (ft)	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)	Soil Classification
RWB-07	11-12.5	104.7	129.0	CL



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**RWB-04**	**3.50**	**66.2**	**23.2**	**43.0**		
⧗	**RWB-07**	**11.00**	**43.4**	**21.0**	**22.4**		
▲	**RWB-08**	**11.00**	**53.8**	**22.6**	**31.2**		

Illinois Department of Transportation
Division of Highways
GSG Consultants, Inc.

ATTERBERG LIMITS' RESULTS

Route: I-55 and IL 59
Section:
County: WILL

APPENDIX E

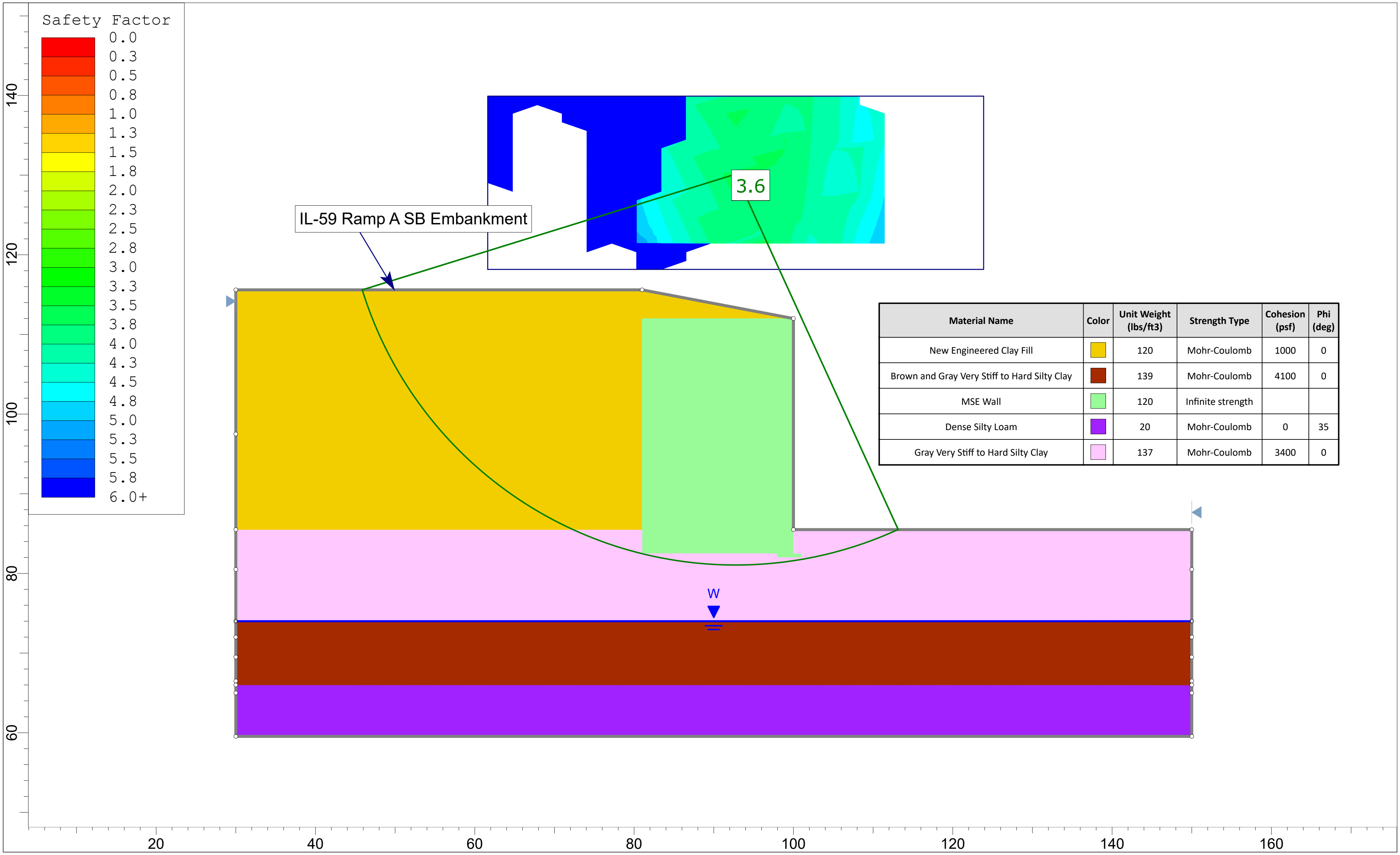
SOIL PARAMETERS TABLE

Soil Parameters Table

Elevation Range (feet)	Soil Description	In situ Unit Weight γ (pcf)	Undrained		Drained	
			Cohesion c (psf)	Friction Angle ϕ (°)	Cohesion c (psf)	Friction Angle ϕ (°)
	New Engineered Clay Fill	120	1,000	0	50	25
	New Engineered Granular Fill	125	0	30	0	30
595-591	Brown and Gray FILL Silty Clay	133	2,400	0	240	25
591-583	Brown and Gray Very Stiff to Hard Silty Clay	139	4,100	0	410	28
583-579	Gray Very Stiff to Hard Silty Clay	137	3,400	0	340	28
579-574	Gray Medium Dense to Dense Loam or Gravel	129	0	36	0	36

APPENDIX F

SLOPE STABILTY ANALYSIS



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
New Engineered Clay Fill		120	Mohr-Coulomb	1000	0
Brown and Gray Very Stiff to Hard Silty Clay		139	Mohr-Coulomb	4100	0
MSE Wall		120	Infinite strength		
Dense Silty Loam		20	Mohr-Coulomb	0	35
Gray Very Stiff to Hard Silty Clay		137	Mohr-Coulomb	3400	0

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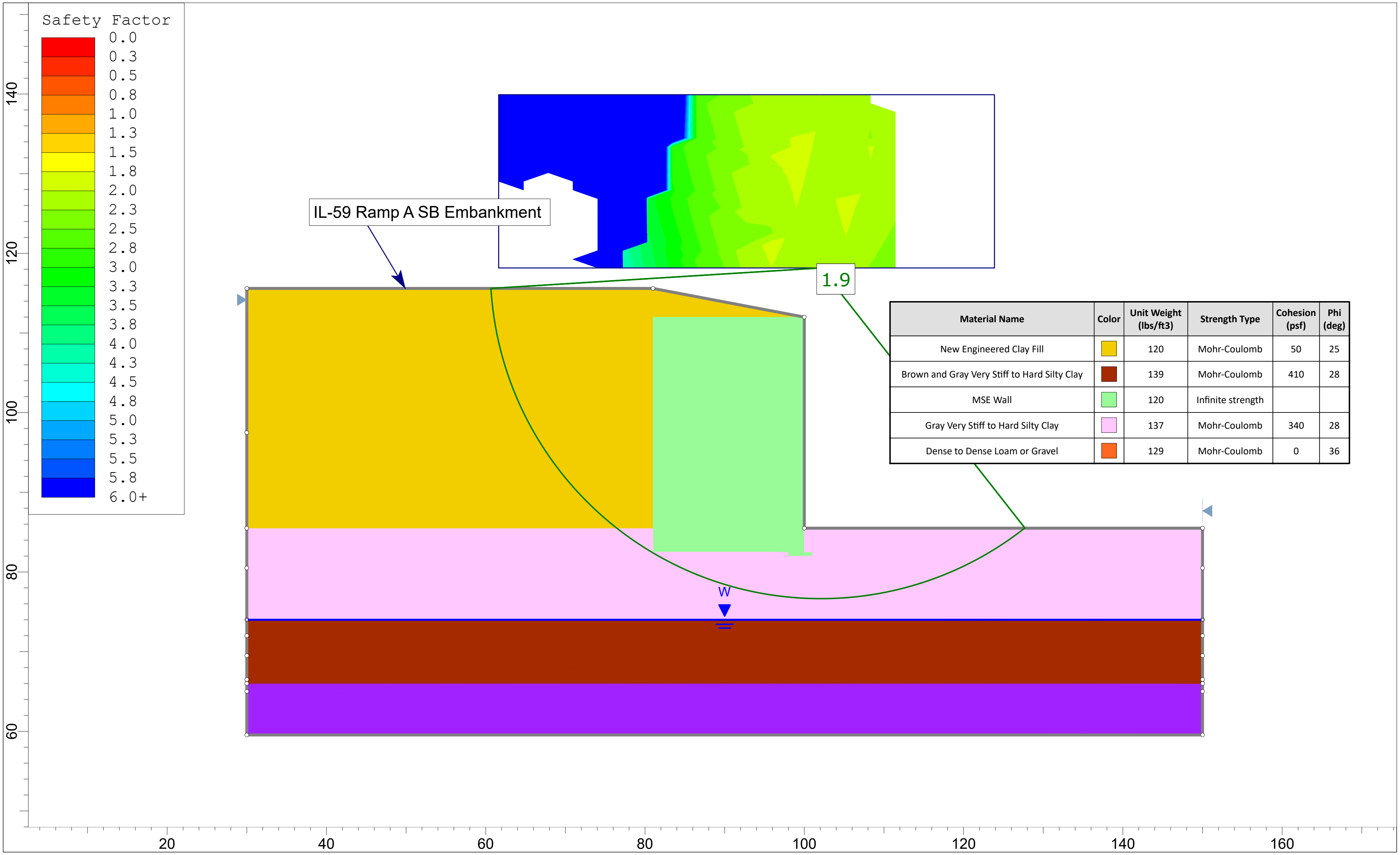
SLIDEINTERPRET 8.021

Project	Contract IDOT\189-011 Wall #5
Analysis Description	Exhibit 4a: Circular Failure Short Term - Undrained
Drawn By	SI
Scale	1:200
Company	GSG Consultants, Inc.
Date	05/27/2020
File Name	Wall 5 short term 272+56



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
New Engineered Clay Fill		120	Mohr-Coulomb	50	25
Brown and Gray Very Stiff to Hard Silty Clay		139	Mohr-Coulomb	410	28
MSE Wall		120	Infinite strength		
Gray Very Stiff to Hard Silty Clay		137	Mohr-Coulomb	340	28
Dense to Dense Loam or Gravel		129	Mohr-Coulomb	0	36

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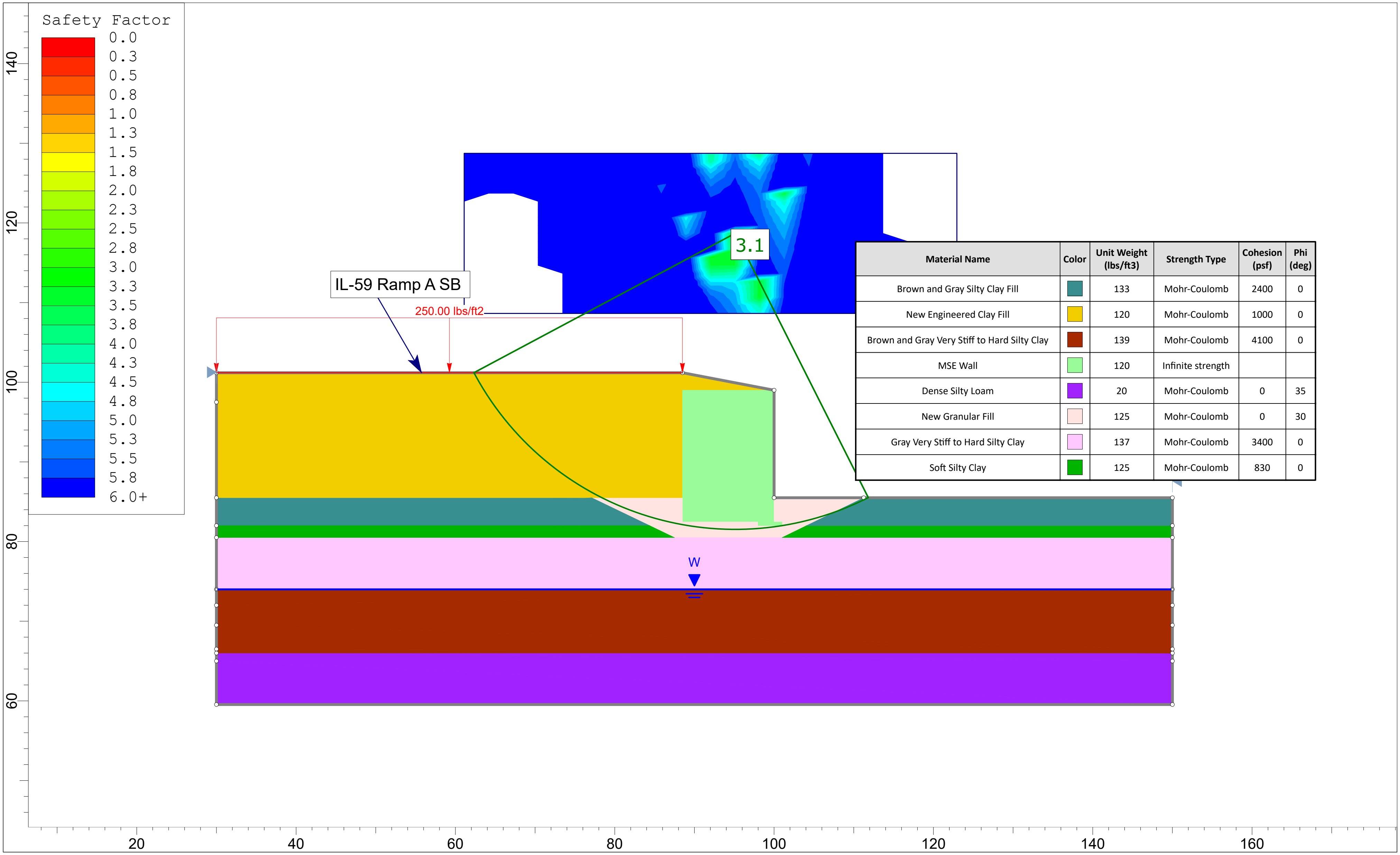
SLIDEINTERPRET 8.021

Project	Contract IDOT\189-011 Wall #5
Analysis Description	Exhibit 4b: Circular Failure Long Term - Drained
Drawn By	SI
Scale	1:200
Company	GSG Consultants, Inc.
Date	06/01/2020
File Name	Wall 5 long term 272+56



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Brown and Gray Silty Clay Fill		133	Mohr-Coulomb	2400	0
New Engineered Clay Fill		120	Mohr-Coulomb	1000	0
Brown and Gray Very Stiff to Hard Silty Clay		139	Mohr-Coulomb	4100	0
MSE Wall		120	Infinite strength		
Dense Silty Loam		20	Mohr-Coulomb	0	35
New Granular Fill		125	Mohr-Coulomb	0	30
Gray Very Stiff to Hard Silty Clay		137	Mohr-Coulomb	3400	0
Soft Silty Clay		125	Mohr-Coulomb	830	0

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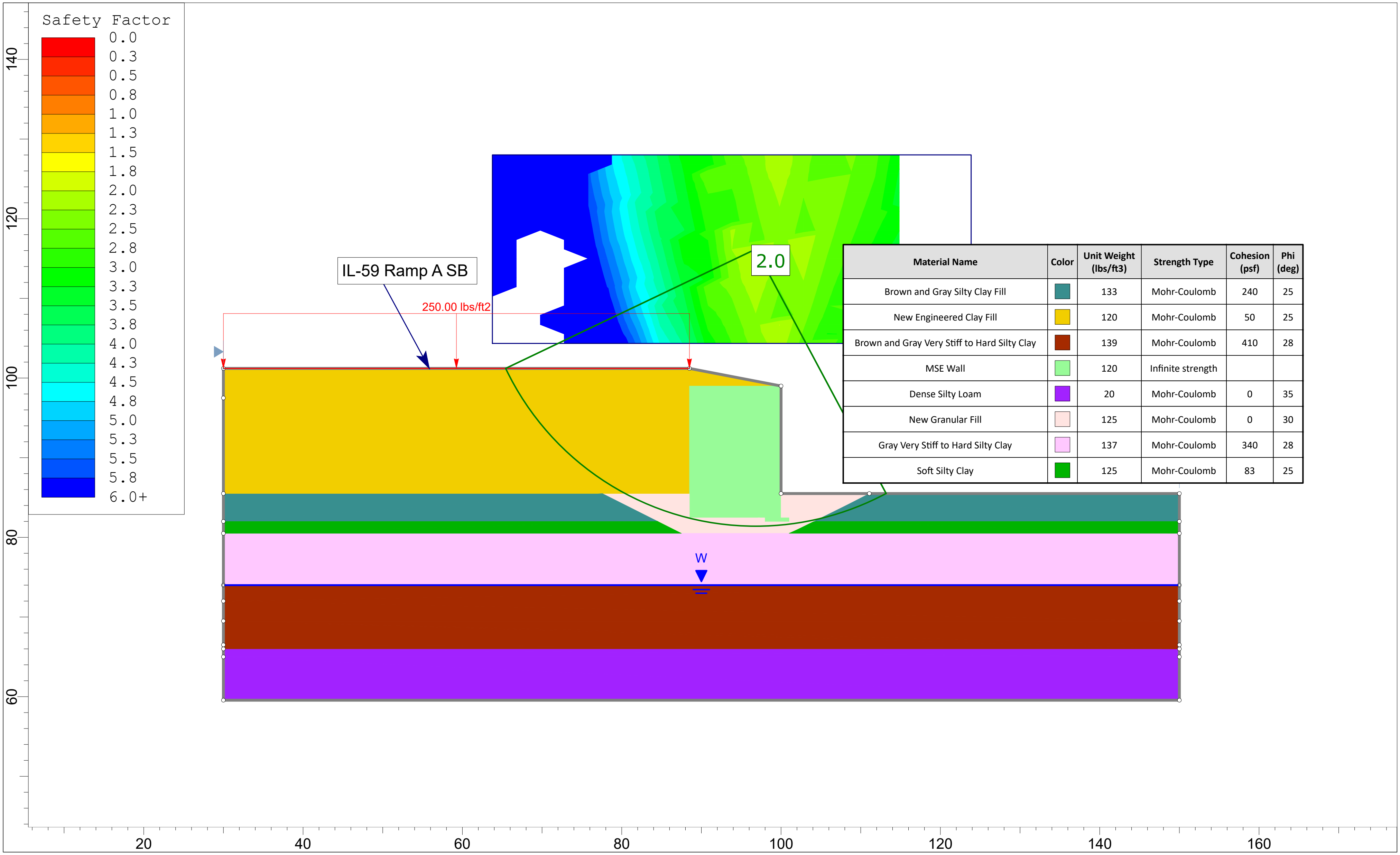
SLIDEINTERPRET 8.021

Project	Contract IDOT\189-011 Wall #5
Analysis Description	Exhibit 4c: Circular Failure Short Term - Undrained
Drawn By	SI
Scale	1:200
Company	GSG Consultants, Inc.
Date	06/01/2020
File Name	Wall 5 short term 277+50



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Brown and Gray Silty Clay Fill		133	Mohr-Coulomb	240	25
New Engineered Clay Fill		120	Mohr-Coulomb	50	25
Brown and Gray Very Stiff to Hard Silty Clay		139	Mohr-Coulomb	410	28
MSE Wall		120	Infinite strength		
Dense Silty Loam		20	Mohr-Coulomb	0	35
New Granular Fill		125	Mohr-Coulomb	0	30
Gray Very Stiff to Hard Silty Clay		137	Mohr-Coulomb	340	28
Soft Silty Clay		125	Mohr-Coulomb	83	25

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SLIDEINTERPRET 8.021

Project	Contract IDOT\189-011 Wall #5
Analysis Description	Exhibit 4d: Circular Failure Long Term - Drained
Drawn By	SI
Scale	1:200
Company	GSG Consultants, Inc.
Date	06/01/2020
File Name	Wall 5 long term 277+50