GSG CONSULTANTS, INC.

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GEOTECHNICAL DESIGN MEMORANDUM

To: Mr. Kurt Naus, P.E., S.E.

From: Suhaib Ibrahim
Min Zhang, Ph.D., P.E.

Date: February 24, 2022

Subject: **IDOT PTB 189/011 IL 59 Northbound over I-55**
Geotechnical Recommendations
Box Culvert Extensions at Seil Road West of IL 59 and IL 59 South of Seil Road

This design memorandum presents geotechnical recommendations for the proposed design and extension of two existing box culvert structures at the Illinois Route 59 (SN: 099-0351) and Seil Road (SN: 099-0022) in Will County, Illinois. As part of the Phase II design, GSG completed a geotechnical investigation at the proposed culvert locations. The purpose of the investigation was to verify the results of the Phase I exploration completed by Himalayan Consultants (Himalayan) in 2018, and to provide supplemental design recommendations for the proposed improvements as necessary.

1. Introduction

As part of the Phase I design, Himalayan provided a structural geotechnical report for the proposed design and extension of two existing box culverts based on the preliminary plan and profiles and cross section, provided by IDOT in October 2018. Four (4) borings were completed to depths of 10.0 to 15.0 feet, at the proposed work locations. Geotechnical evaluation and recommendations were provided for the proposed extensions. The Phase 1 design report provided by Himalayan Consultants is included as **Attachment E.**

Based on the cross sections provided by Benesch for the proposed improvements in November 2020 (**Attachment A**) and the plan view of the culverts (**Attachment B**), the project includes extending two existing culverts at Seil Road and IL 59 in Will County, IL. The proposed geometry information is summarized in **Tables 1 and 2** for Phase I and II investigations, respectively.

Table 1 Summary of Culvert information During Phase I investigation

Structure	Inlet Elevation (feet)	Outlet Elevation (feet)	Upstream Extension (feet)	Downstream Extension (feet)
IL 59 Culvert	587.5	586.43	28.0	170.0
Seil Road Culvert	586.0	585.8	20.0	30.0

Table 2 Summary of Culvert information During Phase II investigation

Structure	Inlet Elevation (feet)	Outlet Elevation (feet)	Upstream Extension (feet)	Downstream Extension (feet)
IL 59 Culvert	587.2	586.9	24.5	160.0
Seil Road Culvert	585.7	585.5	14.0	44.0

2. Field Exploration Summary

GSG completed one soil boring (GCB-01) to a depth of 40.0 feet for the proposed improvements during Phase II field exploration. GSG also completed three subgrade borings (SGB-110, SGB-116, and SGB-117), one retaining wall boring (RWB-13), and one overhead sign boring (OHS-10) in the vicinity of the two culverts. A boring location plan, including the Phase 1 borings completed by Himalayan (CB-01 through CB-04), is provided in **Attachment B.** Copies of the boring logs are provided in **Attachment C**.

The surface elevation for boring GCB-01 (drilled by GSG) is 609.6 feet and was blind drilled to elevation 589.6 feet, approximately where CB-01 through CB-04 were drilled. Silty clay fill was encountered between elevations 589.6 and 581.0 feet, followed by very stiff to hard silty clay to elevation 549.6 feet, with unconfined compressive strength ranging between 2.9 and 4.6 tsf. Medium dense silty loam was encountered between elevations 549.6 and 548.0 feet, with SPT blow count (N) values of 23 blows per foot. The SGB borings encountered silty clay fill within the full boring depths. The general soil condition observed during the Phase II investigation was consistent with borings completed by Himalayan Consultants during the Phase I investigation, with the exception of the saturated sand layer encountered in CB-04 between elevations 586.5 to 584.0 feet.

Groundwater was not encountered during drilling at boring GCB-01. Based on the color change from brown and gray to gray, it is anticipated that the long-term groundwater level could be at an approximate elevation 579 feet, which is deeper than the ground water level provided by Himalayan.

3. Foundation Analysis and Recommendations

The following recommendations for the Culvert and Wingwalls are provided in the SGR by Himalayan dated 12/26/2018:

- For both culverts, the foundation soil at the invert elevation was estimated to have a factored bearing resistance of 6000 psf for strength limit state and a bearing resistance of 3700 psf for service limit state. The differential settlement along the culvert extensions is estimated to be 0.5 inch or less under this design bearing resistance.
- For the anticipated concrete wingwalls at both culverts, a factored bearing resistance of 7000 psf for strength limit state and a bearing resistance of 4000 psf for service limit state can be used to design the footing for the T type of wingwall bearing on very stiff to hard silty clay. The differential settlement along the wall is estimated to be 0.5 inch or less under this design bearing resistance.
- For yielding wingwalls, the following lateral earth pressure parameters were recommended assuming free drain of granular backfill was used. A geometric drain and free drain granular backfill should be placed behind the wall.

Backfill/Load on top of Wingwalls	Horizontal Backfill	1V:2.5H Backfill	Adjacent to the height of barrel
Equivalent fluid pressure (psf/ft)	40	50	60

- High moisture and low strength soil encountered at the invert elevation or the bottom of the wingwall should be removed and replaced with granular backfill.

GSG concurs with the foundation analysis and recommendations regarding bearing resistance, culvert type, and wingwall recommendations as summarized above.

4. Excavation Recommendations

It is anticipated that the roadway embankment will be open cut in order to construct the culvert extensions. All excavations that extend more than 4 feet should be sloped or braced to prevent excavation instability. The excavation sloping and bracing should be designed in accordance with the Occupational Safety and Health Administration (OSHA) 29 CFR, Part 1926, regulations and requirements.

The top elevation of the embankment above the IL 59 Culvert is at approximately 609 feet and the bottom of the culvert at 587.0 feet. The total excavation depth will be approximately 22 feet. For Seil Road Culvert, the top of the embankment above the culvert is at approximately

606 feet, and the bottom of the culvert at 585.5 feet. The total excavation depth will be approximately 20.5 feet. Slope stability analysis for the excavations was performed using software SLIDE 2018. SLIDE 2018 is a comprehensive slope stability analysis software used to evaluate the proposed slopes for the project based on the limit equilibrium method. A circular failure analysis was evaluated for both a short term (undrained) and long term (drained) using the simplified Bishop analyses methods.

Table 3 – Slope Stability Analyses Results

Analysis Exhibit	Soil Profile Location	Proposed Excavation Slope	Analysis Type	Factor of Safety	Minimum Required Factor of Safety
Exhibit 1a	IL 59 Culvert SGB-116, SGB-110, OHS-10	1.75H:1V	Circular – Short Term	5.2	1.7
Exhibit 1b			Circular – Long Term	1.8	1.7
Exhibit 1c	Seil Rd Culvert SGB-117, RWB-13	1.75H:1V	Circular – Short Term	4.7	1.7
Exhibit 1d			Circular – Long Term	1.8	1.7

Based on the analyses performed, a maximum slope of 1.75H:1V should be maintained to satisfy the minimum factor of safety of 1.7. Copies of the analysiss exhibits are included in the Slope Stability Analyses Exhibits (**Attachment D**).

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

Sincerely,

Suhaib Ibrahim
Project Engineer

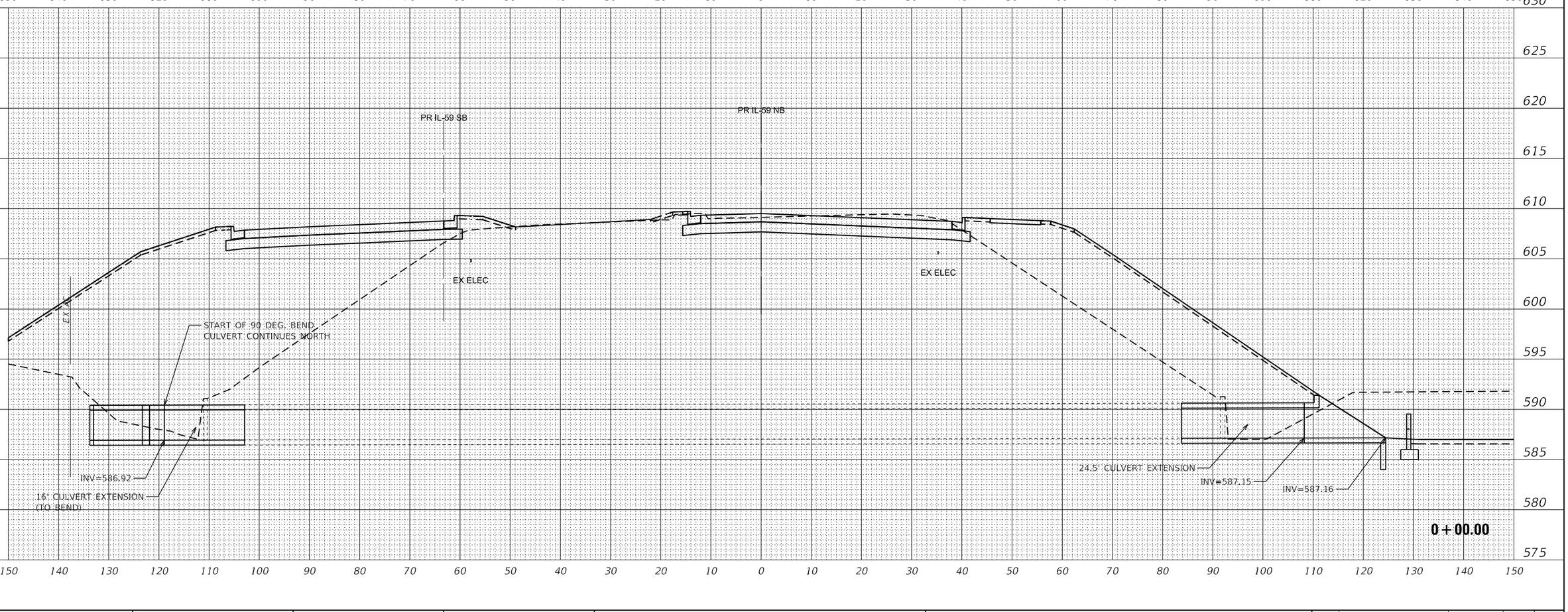
Min Zhang, Ph.D., P.E.
Project Engineer

Attachment A: IL 59 and Seil Road Culvert Cross Sections
Attachment B: Soil Boring Location Plan
Attachment C: Soil Boring Logs
Attachment D: Slope Stability Analyses Exhibits
Attachment E: I-55 at IL 59_Culvert SGR by Himalayan Consultants

Attachment A

IL 59 and Seil Road Culvert Cross Sections

NOTE: CULVERT IS ALINGED AT A 94.05 DEG. SKEW TO PROPOSED IL 59 NB ALIGNMENT



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	DRAWN -	REVISED -	**DEPARTMENT OF TRANSPORTATION**
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PLOT DATE = $DATE$	DATE -	REVISED -	

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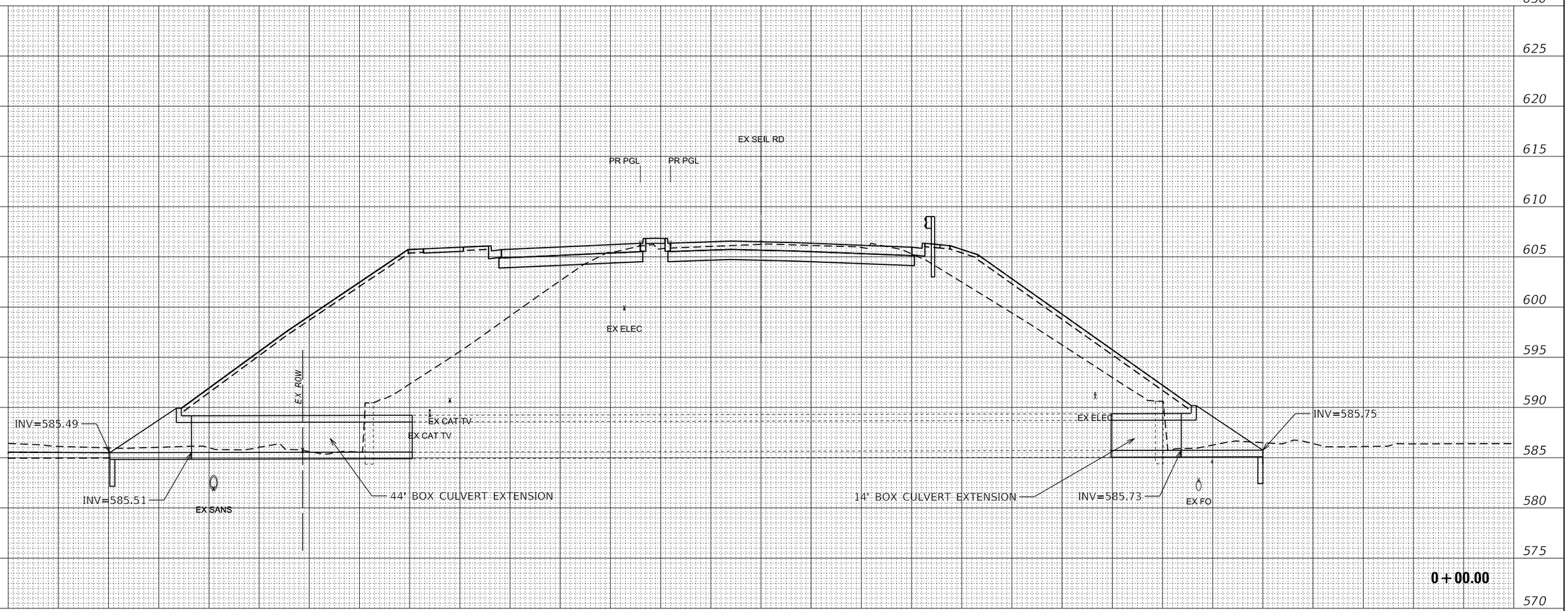
F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
		CONTRACT NO.		
	ILLINOIS	FED. AID PROJECT		

MODEL: $MODELNAME$
FILE NAME: $FILEL$

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

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

NOTE: CULVERT IS ALIGNED AT A 94.03 DEG. SKEW TO EXISTING SEIL ROAD ALIGNMENT



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ORIGINAL SURVEY
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STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

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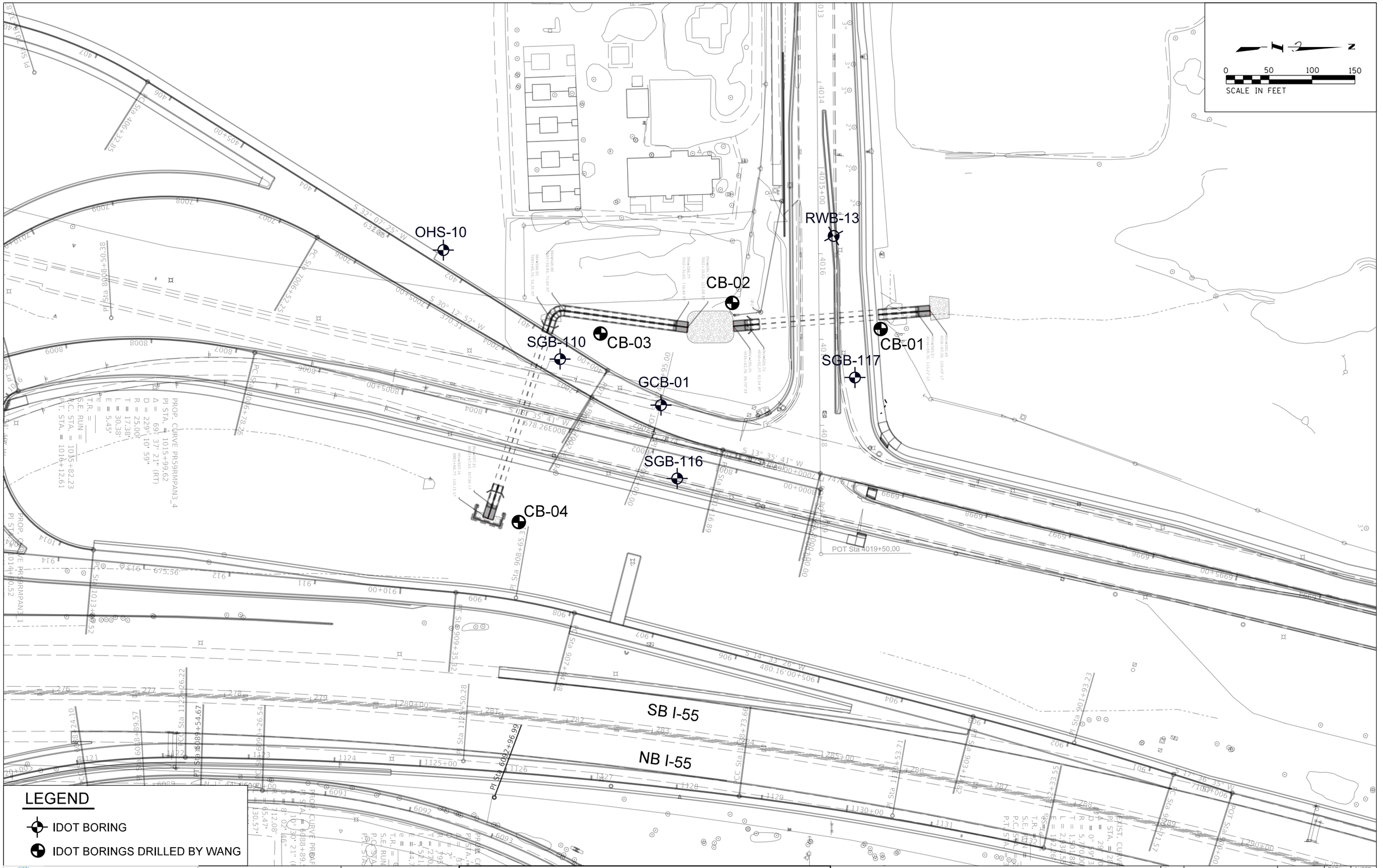
ILLINOIS | FED. AID PROJECT

Attachment B

Soil Boring Location Plan



LEGEND

- IDOT BORING
- IDOT BORINGS DRILLED BY WANG

GSG CONSULTANTS, INC.
Engineers, Scientists & Construction Managers
623 Cooper Court Schaumburg, IL 60173
Tel: 630.994.2600
"Integrity| Quality| Reliability"

USER NAME = nnano	DESIGNED -	SI	
SHEET SIZE = 1.41667x0.916667 (ft.)	DRAWN -	NN	
PLOT SCALE = 1200.0000 ' / ft.	CHECKED -	MIN	
PLOT DATE = 2/15/2021	DATE -	08/26/2020	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

CONTRACT NO. 189-011
I-55/ROUTE 59 WILL COUNTY
BORING LOCATION PLAN CULVERT

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

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

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PEN TABLE = X:\Clients\Tollway\Work Space\tables pen\gng mono.tbl
PLOT DATE = 2/15/2021
TIME = 1:01:03 PM
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PLOT SCALE = 1200.0000 ' / ft.
USER NAME = nnano

Attachment C

Soil Boring Logs

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

SOIL BORING LOG

Date 4/30/20

ROUTE I-55 and IL 59 **DESCRIPTION** Culvert **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** West of IL-59 SB

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

STRUCT. NO. Culvert Boring
Station

BORING NO. GCB-01
Station 7002+3.6
Offset 28.00ft RT
Ground Surface Elev. 609.62 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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Blind drill to 20 feet
-5				
-10				
-15				
589.62 -20				
	6			Brown, Gray, and Black, Moist FILL: SILTY CLAY, trace sand and gravel
	4 5		NR	
	2			
-25	5 6	4.8 B	16	
	6			
	9 10	5.8 B	15	
580.62	5			
-30	7 13	4.6 B	22	Hard Brown and Gray, Moist SILTY CLAY LOAM, trace sand (ML/CL)
578.62	4			Very Stiff Gray, Moist SILTY CLAY LOAM, trace sand (ML/CL)
	6 9	2.9 B	17	
	9			
-35	10 11	3.5 P	18	
571.12	9			Medium Dense Gray, Moist SILTY LOAM, with sand and
569.62 -40	11 12		13	

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)

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Division of Highways
GSG Consultants, Inc.

SOIL BORING LOG

Date 4/30/20

ROUTE I-55 and IL 59 **DESCRIPTION** Culvert **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** West of IL-59 SB

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

STRUCT. NO. Culvert Boring
Station

BORING NO. GCB-01
Station 7002+3.6
Offset 28.00ft RT
Ground Surface Elev. 609.62 **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**

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	
				limestone fragments (ML)
				End of Boring
-45				
-50				
-55				
-60				

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)

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GSG Consultants, Inc.

SOIL BORING LOG

Date 4/30/20

ROUTE I-55 and IL 59 **DESCRIPTION** Roadway Boring **LOGGED BY** MH

SECTION 2018-075-R **LOCATION** Ramp D

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

STRUCT. NO. _____
Station _____

BORING NO. SGB-110
Station 400+53.7904
Offset 18.06ft LT
Ground Surface Elev. 603.23 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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
10 inches of Asphalt 5 inches of Aggregate Base Course 601.98	5		
Brown, Black, and Gray, Moist FILL: SILTY CLAY, with sand and gravel	4 8	4.8 B	22
	4		
-5	5 9	4.6 B	13
Cobbles at 6-7.5 feet	9		
	11 12	4.5 P	16
Cobbles at 8.5-10 feet	12		
-10	8 14	5.4 B	12
	32		
	15 7		10
	4		
-15	8 8	5.0 P	20
587.23	5		
Brown, Black, and Gray, Moist FILL: SILTY CLAY, trace gravel	5 7	2.5 B	25
	4		
583.23 -20	5 10	5.0 P	22

End of Boring

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)

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GSG Consultants, Inc.

SOIL BORING LOG

Date 5/6/20

ROUTE I-55 and IL 59 **DESCRIPTION** Roadway Boring **LOGGED BY** EH

SECTION 2018-075-R **LOCATION** IL-59 DDI NB

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

STRUCT. NO. _____
Station _____

BORING NO. SGB-116
Station 8001+65.2413
Offset 26.90ft LT
Ground Surface Elev. 611.53 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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
3 inches of Topsoil 611.28			
Brown and Gray, Moist FILL: SILTY CLAY, trace gravel	1		
	3 3	0.8 B	19
	3		
	6 7	4.2 B	15
-5	2		
	5 10	2.5 B	17
	2		
	6 7	2.5 B	12
-10	3		
	6 6	3.3 B	14
	4		
	9 12	1.3 B	18
596.53 -15			
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
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GSG Consultants, Inc.

SOIL BORING LOG

Date 3/2/20

ROUTE I-55 and IL 59 **DESCRIPTION** Roadway Boring **LOGGED BY** AB

SECTION 2018-075-R **LOCATION** Seil Rd

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

STRUCT. NO. _____
Station _____

BORING NO. SGB-117
Station 4017+44.6859
Offset 41.31ft LT
Ground Surface Elev. 605.50 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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil 605.00			
Brown and Gray, Moist FILL: SILTY CLAY, trace organics	3		
	3 3	0.5 P	17
	2		
-5	2 2	0.3 P	20
	4		
	3 4	1.5 P	13
	2		
595.50 -10	3 5	0.5 P	17
End of Boring			
-15			
-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 3/24/20

ROUTE I-55 and IL 59 **DESCRIPTION** Ramp D from IL-59 SB to SW Frontage Rd **LOGGED BY** AB

SECTION 2018-075-R **LOCATION** West of IL 59

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

STRUCT. NO. _____
Station _____

BORING NO. OHS-10
Station 402+36.60
Offset 17.21ft LT
Ground Surface Elev. 592.15 ft

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

Groundwater Elev.:
First Encounter 573.7 ft ▼
Upon Completion N/A ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
6 inches of Topsoil 591.65				
Brown, Black and Gray, Moist FILL: SILTY CLAY, trace gravel and organics		2		
		3 4	1.5 B	20
		4		
		7 9	6.0 B	19
	-5			
586.15				
Gray and Brown, Moist FILL: SILTY CLAY, trace gravel		5		
		6 8	4.0 B	20
		3		
		4 6	3.1 B	22
	-10			
581.15				
Very Stiff Gray, Moist SILTY CLAY (CL/ML)		5		
		8 10	3.5 P	19
		4		
		6 8	3.0 P	19
	-15			
576.15				
LIMESTONE, highly weathered		8		
		13 13		7
	▼	32		
		50/2"		6
Auger and split spoon refusal at 572.15	-20			

20.0 feet
End of Boring

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-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)

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GSG Consultants, Inc.

SOIL BORING LOG

Date 2/28/20

ROUTE I-55 and IL 59 **DESCRIPTION** Retaining Wall 1 **LOGGED BY** AB

SECTION 2018-075-R **LOCATION** Seil Rd WB off road

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

STRUCT. NO. W099-1001
Station

BORING NO. RWB-13
Station 4015+79.5151
Offset 17.86ft LT
Ground Surface Elev. 602.30 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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				6 inches of Topsoil 601.80
				Brown, Gray, and Black, Moist FILL: SILTY CLAY, with gravel
	5			
	6 6	0.6 B	22	
	3			
-5	7 11	2.3 B	16	
	4			
	7 16	4.4 B	14	
	7			
-10	6 7	2.5 B	17	Cobbles at 9.0 feet
	6			
	7 10	4.2 B	16	
	2			
-15	5 5	2.9 B	21	
	10			
	10 10	NR	22	
	5			
-20	9 12	6.9 B	21	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				Brown, Gray, and Black, Moist FILL: SILTY CLAY, with gravel *(continued)*
	5			
	8 10	4.2 B	23	
	4			
-25	7 7	4.2 B	20	Stiff to Hard Gray, Moist to Very Moist SILTY CLAY, trace gravel (CL/ML) 578.80
	10			
	14 13	NR	19	
	3			
-30	4 5	1.7 B	32	572.30
-35				End of Boring
-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)

Himalayan Consultants, LLC
Engineers and Hydrogeologists
8770 W. Bryn Mawr Avenue, Suite 1300
Chicago, IL 60631
Phone: (773) 867-2956
Fax: (773) 867-2910

SOIL BORING LOG

Date 9/25/2018

ROUTE Interstate Route 55 **DESCRIPTION** Culvert Crossing at IL 59 and Seil Road **LOGGED BY** SSA

SECTION N/A **LOCATION** SE 1/4, SEC. S16 TWP. T35N, RNG. R10E 3rd PM

COUNTY WILL **DRILLING METHOD** 3.25" HSA: backfilled upon completion **HAMMER TYPE** ATV D-25 (93%)

STRUCT. NO. Culvert SN 099-0022
Station N/A

BORING NO. CB-01
Station 4016+90
Offset 70' LT
Ground Surface Elev. 592.71 ft

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

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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
592.29 TOPSOIL: 5" thick, black SILTY CLAY LOAM			
FILL: Very stiff, brown and gray, SILTY CLAY, trace gravel, moist	3	2.1B	15
Sample at 3.5' to 5.0'	5 6		
--L_L(%)=40--			
--P_L(%)=20---	4	2.5B	22
--%Gravel=2.6--	5 6		
-5			
--%Sand=7.2--			
--%Silt=53.2--	4	2.7B	17
--%Clay=36.9--	5 7		
584.71 Hard, brown and gray, SILTY CLAY, trace gravel, moist	5	4.9B	18
	8 10		
582.71 -10			
End of Boring			
-15			
-20			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-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)

Himalayan Consultants, LLC
Engineers and Hydrogeologists
8770 W. Bryn Mawr Avenue, Suite 1300
Chicago, IL 60631
Phone: (773) 867-2956
Fax: (773) 867-2910

SOIL BORING LOG

Date 8/25/2018

ROUTE Interstate Route 55 **DESCRIPTION** Culvert Crossing at IL 59 and Seil Road **LOGGED BY** SSA

SECTION N/A **LOCATION** NE 1/4, SEC. S21 TWP. T35N, RNG. R9E 3rd PM

COUNTY WILL **DRILLING METHOD** 3.25" HSA: backfilled upon completion **HAMMER TYPE** ATV D-25 (93%)

STRUCT. NO. Culvert SN 099-0022
Station N/A

BORING NO. CB-02
Station 4016+57
Offset 103' RT
Ground Surface Elev. 590.57 ft

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

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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				TOPSOIL: 8" thick, black SILTY CLAY LOAM
				589.90
	5	6.2S	19	Hard, brown and gray, SILTY CLAY, trace gravel, moist
	5 6			Sample at 3.5' to 5.0'
				--L_L(%)=39--
	3	5.5B	21	--P_L(%)=20--
	4 5			--%Gravel=1.1--
-5				--%Sand=7.6--
	4	8.0S	20	--%Silt=52.1--
	9 11			--%Clay=39.2--
	5	6.6B	20	
	7 10			
580.57				
-10				End of Boring
-15				
-20				
-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)

Himalayan Consultants, LLC
Engineers and Hydrogeologists
8770 W. Bryn Mawr Avenue, Suite 1300
Chicago, IL 60631
Phone: (773) 867-2956
Fax: (773) 867-2910

SOIL BORING LOG

Date 8/26/2018

ROUTE Interstate Route 55 **DESCRIPTION** Culvert Crossing at IL 59 and Seil Road **LOGGED BY** SSA

SECTION _____ **LOCATION** NE 1/4, SEC. S21 TWP. T35N, RNG. R9E 3rd PM

COUNTY WILL **DRILLING METHOD** 3.25" HSA: backfilled upon completion **HAMMER TYPE** GEOPROBE

STRUCT. NO. _____
Station _____

BORING NO. CB-03
Station 7002+84
Offset 80' RT
Ground Surface Elev. 591.12 ft

Surface Water Elev. _____ ft
Stream Bed Elev. _____ ft

Groundwater Elev.:
First Encounter 4 ft
Upon Completion N.E. ft
After _____ **Hrs.** _____ ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
TOPSOIL: 8" thick, black SILTY CLAY LOAM 590.45			2.5p	19
FILL: Very stiff, brown and gray, SILTY CLAY, trace gravel, moist 589.12				
Hard, brown and gray, SILTY CLAY, trace gravel, moist			4.5+p	19
Sample at 2.0 to 4.0'				
--L_L(%)=39--			4.3p	17
--P_L(%)=21--	-5			
--%Gravel=1.1--			4.5+p	17
--%Sand=7.0--				
--%Silt=52.5--				
--%Clay=39.5--			4.5+p	21
581.12	-10			
End of Boring				
	-15			
	-20			
	-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)

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SOIL BORING LOG

Date 8/28/2018

ROUTE Interstate Route 55 **DESCRIPTION** Culvert Crossing at IL 59 and Seil Road **LOGGED BY** SSA

SECTION N/A **LOCATION** NE 1/4, SEC. S21 TWP. T35N, RNG. R9E 3rd PM

COUNTY WILL **DRILLING METHOD** 3.25" HSA: backfilled upon completion **HAMMER TYPE** ATV D-25 (93%)

STRUCT. NO. Culvert SN 099-0351
Station N/A

BORING NO. CB-04
Station 8033+42
Offset 104' RT
Ground Surface Elev. 591.97 ft

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

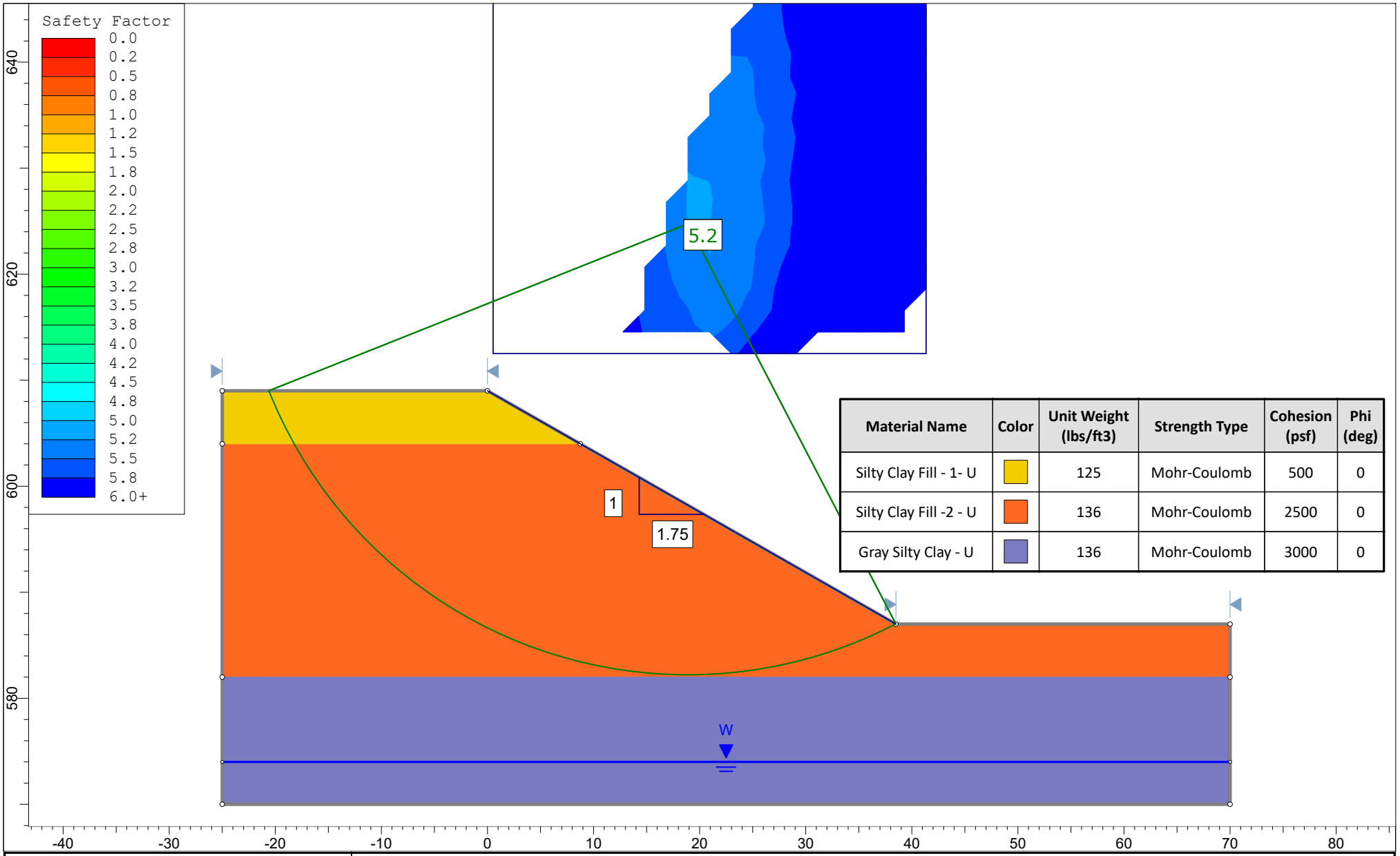
Groundwater Elev.:
First Encounter 5.5 ft
Upon Completion 11 ft
After N/A **Hrs.** N/A ft

		DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
TOPSOIL: 8" thick, black SILTY CLAY LOAM	591.30				
FILL: Hard, brown and gray, SILTY CLAY, trace gravel, moist			7	4.5+p	16
			9		
			10		
	588.97				
Hard, brown and gray, SILTY CLAY, trace gravel, moist			7	5.7S	21
Sample at 3.5' to 5.0'			11		
		-5	14		
--LL(%)=40, --PL(%)=20	586.47 ▼				
--%Gravel=0.3--			5	NP	22
--%Sand=4.7--			5		
			4		
--%Silt=51.7--	583.97				
--%Clay=43.3--			4	2.1S	15
Loose, brown and gray, coarse grained SAND, satutated			3		
		-10	5		
Very stiff to hard, gray, SILTY CLAY, trace gravel, moist					
			9	4.9S	22
			11		
			16		
			5	2.9S	21
			10		
	576.97	-15	16		
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)

Attachment D

Slope Stability Analyses Exhibits



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Silty Clay Fill - 1- U		125	Mohr-Coulomb	500	0
Silty Clay Fill -2 - U		136	Mohr-Coulomb	2500	0
Gray Silty Clay - U		136	Mohr-Coulomb	3000	0

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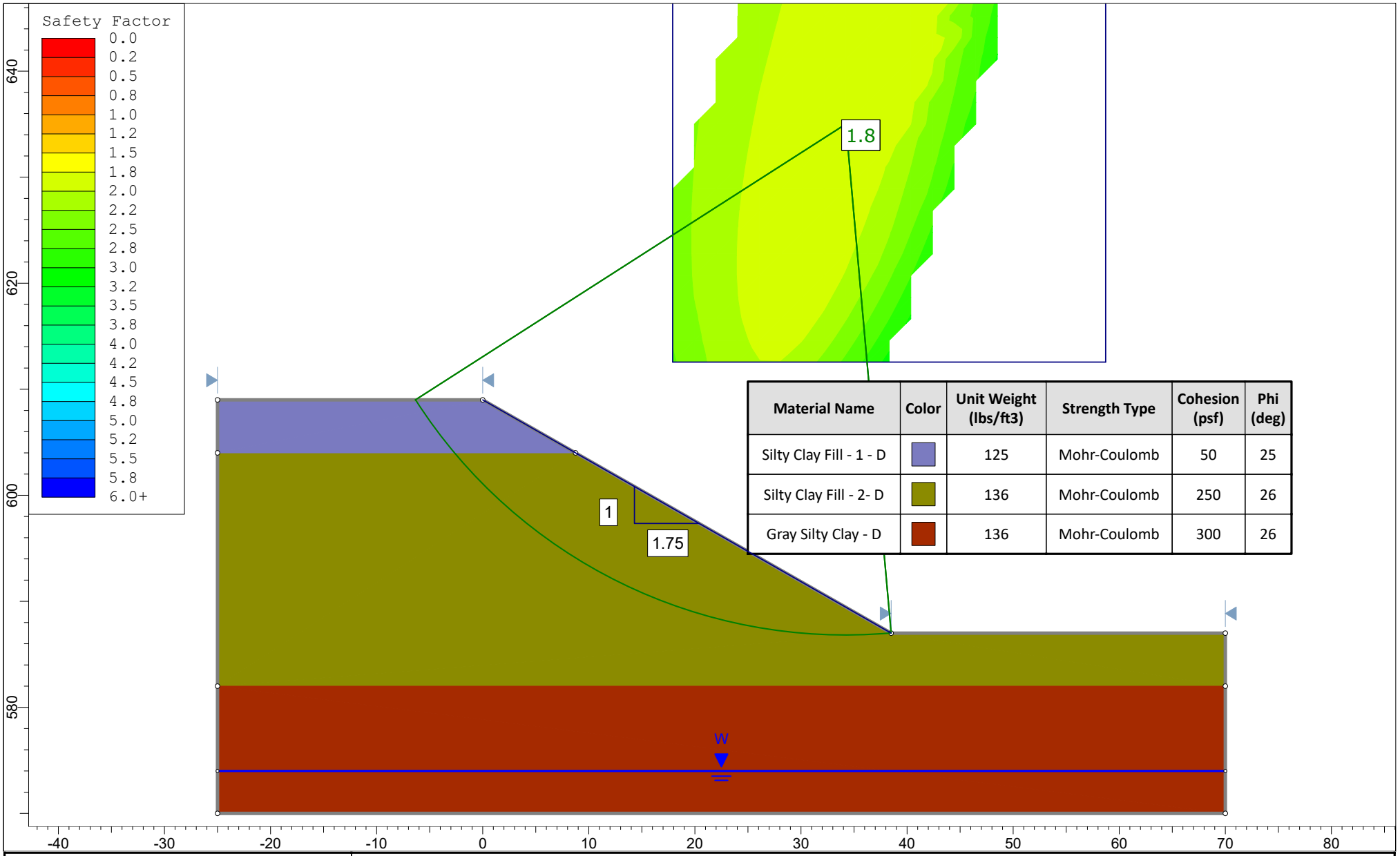
SLIDEINTERPRET 8.026

Project	IL 59 Culvert Excavation		
Analysis Description	Exhibit 1a - Circular Failure Short Term - Undrained		
Drawn By	MZ	Scale	1:150
Company	GSG Consultants, Inc.		
Date	11/24/2020	File Name	IL59 Culvert.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Silty Clay Fill - 1 - D		125	Mohr-Coulomb	50	25
Silty Clay Fill - 2- D		136	Mohr-Coulomb	250	26
Gray Silty Clay - D		136	Mohr-Coulomb	300	26

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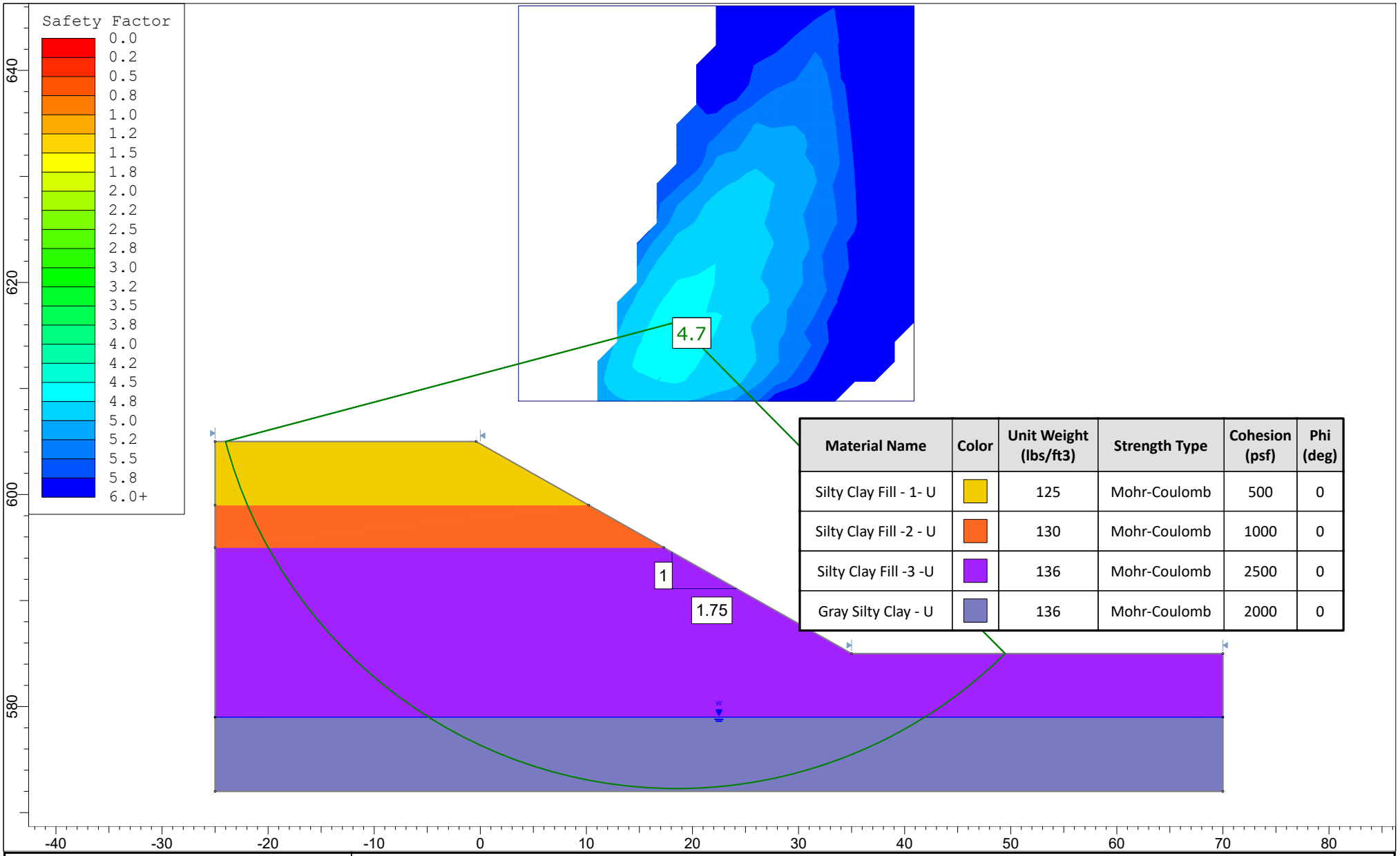
SLIDEINTERPRET 8.026

Project	IL 59 Culvert Excavation		
Analysis Description	Exhibit 1b - Circular Failure Long Term - Drained		
Drawn By	MZ	Scale	1:150
Company	GSG Consultants, Inc.		
Date	11/24/2020	File Name	IL59 Culvert.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Silty Clay Fill - 1- U		125	Mohr-Coulomb	500	0
Silty Clay Fill -2 - U		130	Mohr-Coulomb	1000	0
Silty Clay Fill -3 -U		136	Mohr-Coulomb	2500	0
Gray Silty Clay - U		136	Mohr-Coulomb	2000	0

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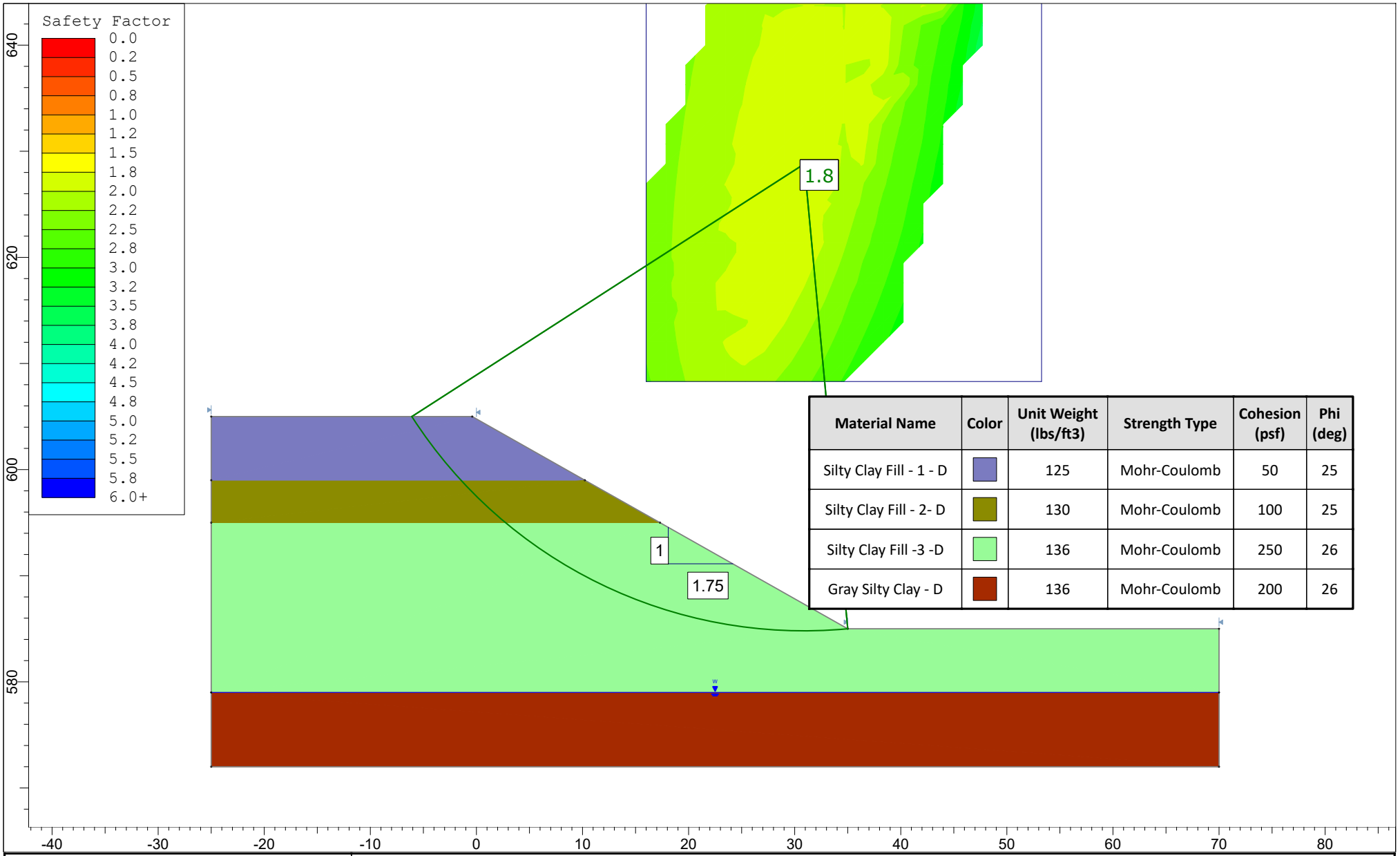
SLIDEINTERPRET 8.026

Project	Seil Road Culvert Excavation		
Analysis Description	Exhibit 1c - Circular Failure Short Term - Undrained		
Drawn By	MZ	Scale	1:150
Company	GSG Consultants, Inc.		
Date	11/24/2020	File Name	Seil Rd Culvert.slmd



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Silty Clay Fill - 1 - D		125	Mohr-Coulomb	50	25
Silty Clay Fill - 2- D		130	Mohr-Coulomb	100	25
Silty Clay Fill -3 -D		136	Mohr-Coulomb	250	26
Gray Silty Clay - D		136	Mohr-Coulomb	200	26

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SLIDEINTERPRET 8.026

Project	Seil Road Culvert Excavation		
Analysis Description	Exhibit 1d - Circular Failure Long Term - Drained		
Drawn By	MZ	Scale	1:150
Company	GSG Consultants, Inc.		
Date	11/24/2020	File Name	Seil Rd Culvert.slmd

Attachment E

I-55 at IL 59_Culvert SGR by Himalayan Consultants

STRUCTURE GEOTECHNICAL REPORT

Box Culvert Extensions
at
Seil Road-West of IL 59
and
IL 59-South of Seil Road
I-55 and IL 59 Interchange Improvements
Will County, Illinois

Prepared For:

Illinois Department of Transportation District One
201 West Center Court
Schaumburg, IL 60196

Prepared By:

Himalayan Consultants, LLC
8770 W. Bryn Mawr Ave, Suite 1300
Chicago, IL 60631
Phone: 773-867-2956

Original Date: 11/28/2018
Revised Date: 12/26/2018

TABLE OF CONTENTS

APPENDICES

ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AASHTO	American Association of State Highway Transportation Officials
ASTM	American Society of Testing Materials
bgs	Below ground surface
bpf	Blows per foot
c_u	Undrained Cohesion
IDOT	Illinois Department of Transportation
IDH	Illinois Division of Highways
ksi	Kips per square inch
N_{60}	Blow counts corrected for hammer efficiency
$N1_{60}$	Blow counts corrected for hammer efficiency and overburden effects
NCDC	National Climatic Data Center
PVC	Polyvinyl Chloride
psi	Pounds per square inch
pci	Pounds per cubic inch
psf	Pounds per square foot
tsf	Tons per square foot
Q_u	Unconfined compressive strength
RCBC	Reinforced Concrete Box Culvert
RCP	Reinforced Concrete Pipe
SPT	Standard Penetration Test
φ	Angle of internal friction
γ	Moist soil unit weight
μ	Coefficient of friction
ε_{50}	Strain at one half the maximum principal stress difference
k_s	Soil modulus of elastic loading
k_c	Soil modulus of cyclic loading
K_a	Active earth pressure coefficient
K_p	Passive earth pressure coefficient
K_o	At-rest earth pressure coefficient
LRFD	Load and Resistance Factor design

1.0 EXECUTIVE SUMMARRY

This report presents the findings and recommendations of a geotechnical investigation conducted in connection with the design and extension of two existing box culvert structures proposed at the existing Illinois Route 59 and Seil Road, in Will County, Illinois.

The existing culvert at Seil Road (Culvert SN 099-0022) is a 5 feet x 3 feet double barrel reinforced concrete box culvert (RCBC) structure which will be extended by approximately 20 and 30 feet in the upstream and downstream sections, respectively. The existing culvert at IL 59 (Culvert SN 099-0351) consists of a 5 feet x 3 feet double barrel RCBC which will be extended by approximately 28 and 170 feet in the upstream and downstream sections, respectively.

The soils encountered in borings CB-01 and CB-02 advanced for the proposed box culvert extension at Seil Road are fill materials consisting of very stiff to hard, brown and gray silty clay with trace gravel (Q_u = 2.1 to 6.2 tsf) and are underlain by hard silty clay (Q_u = 4.9 to 8.0 tsf.) to the boring completion depths (approximate elevations 583 to 581 feet). The soils encountered in borings CB-03 and CB-04 advanced for the box culvert extension at IL 59 Road are fill materials consisting of very stiff to hard, brown and gray silty clay with trace gravel (Q_u = 2.5 to > 4.5 tsf). The fill materials are underlain by very stiff to hard silty clay (Q_u = 2.1 to 5.7 tsf.) to the boring completion depths (approximate elevations 581 to 577 feet). In CB-04 a saturated layer of loose, brown and gray sand (N value = 9) was encountered at 5.5 to 8 feet below existing grades between elevations 586.5 to 584 feet.

For culvert extension at IL 59, the contractor should expect up to 2.5 feet thick layer of saturated loose sand at approximately 1 foot below the inlet invert elevation. The loose sand should be removed and replaced with coarse aggregates as indicated in Section 6.2 of this report. After removal and replacement of unsuitable soils encountered in culvert extension at IL 59, the foundation soils at or near invert elevations for both culvert extensions are estimated to have a factored bearing resistance of 6,000 psf for strength limit state (value based on a geotechnical resistance factor of 0.45 per AASHTO LRFD Table 10.5.5.2.2-1) and a bearing resistance of 3,700 psf for service limit state (value based on 1-inch settlement). The actual extent of removal should be verified during construction.

Groundwater seepage should be anticipated during construction. In view of the foundation soils that generally consist of very stiff to hard silty clay along the major part of the culvert extension and the anticipated removal/replacement of unsuitable soils, the differential settlement of the foundation soils along the proposed culvert alignment is estimated to be 0.5 inches or less.

A factored bearing resistance of 7,000 psf for strength limit state (value based on a geotechnical resistance factor of 0.55 per AASHTO LRFD Table 11.5.7.1)) and a bearing resistance of 4,000 psf for service limit state (value based on 1-inch settlement) can be used for design of spread footings for T-type wingwalls bearing on very stiff to hard clays located approximately 4 feet below the proposed culvert invert elevations.

2.0 INTRODUCTION

This report provides the results of a subsurface investigation, field and laboratory testing, geotechnical analyses and recommendations conducted in connection with the design and extension of two box culvert structures proposed at the existing Illinois Route 59 and Seil Road, in Will County, Illinois (hereafter referred to as Project Site). The Project Site is located in the Village of Shorewood, northwestern portion of Will County. See Exhibit 1 in Appendix A for general location of the Project Site.

The purpose of this investigation was to characterize the site soil and groundwater conditions, perform geotechnical analyses, and provide recommendations for the design and extension of the proposed culvert structures. It is understood that the project is currently still in Phase I and the proposed structure information is preliminary. The TSL plans will be prepared as part of the Phase II design.

3.0 PROJECT DESCRIPTION

3.1 Culvert Extension at Seil Road

Based on the preliminary design drawings provided by IDOT dated November 10 2018, the existing structure (Culvert SN 099-0022) consists of a 5 feet x 3 feet double barrel RCBC. The existing RCBC will be extended by approximately 20 feet and 30 feet in the upstream and downstream sections, respectively. The culvert will also have concrete wingwalls that are anticipated to sit at a 45-degree angle (Wingwall Length: To be determined).

The inlet and outlet invert elevations of the proposed RCBC extension are approximately 586.0 feet and 585.8 feet, respectively.

3.2 Culvert Extension at IL 59

The existing culvert (Culvert SN 099-0351) consists of a 5 feet x 3 feet double barrel RCBC. The existing RCBC will be extended by approximately 28 feet in the upstream section and by approximately 170 feet in the downstream section. The extended portion will connect to the existing culvert at an 90 degree angle. The culvert will also have concrete wingwalls that are anticipated to sit at a 45-degree angle (Wingwall Length: To be determined).

The inlet and outlet invert elevations of the proposed RCBC extension are approximately 587.5 feet and 586.43, respectively. The invert elevation at the intermediate location just past the IL 59 SB ramp is 587.50 feet.

4.0 SUBSURFACE INVESTIGATION AND TESTING

4.1 Field Investigation

From September 25 to 28, 2018, Wang Engineering, Inc. (Wang), advanced 4 borings designated as CB-01 to CB-04 at the Project Site. The borings were drilled by Wang at the location provided by IDOT and the Phase I designer.

Borings CB-01 and CB-02 were located near the downstream and upstream locations of the proposed culvert extension at Seil Road west of IL 59, respectively. Similarly, borings CB-03 and CB-04 were located near the downstream and upstream locations of the proposed culvert structure at IL 59 South of Seil Road, respectively. The borings were advanced from existing ground to boring termination depths which ranged from about 10 to 15 feet below existing grades (approximate elevations 583 to 577 feet). The borings were advanced from elevations of approximately 593 feet to 591 feet.

Borings CB-01, CB-02 and CB-04 were advanced with a rotary drilling rig in accordance with the specifications for the Standard Penetration Test (SPT) AASHTO T206. Soil sampling was performed at 2.5-foot interval from ground surface to the termination depths of the borings. Blow counts were recorded at 6-inch intervals and are shown on the boring logs. The number of blows required to advance the sampler the last 12 inches is termed the Standard Penetration Resistance (N). The N value is an indication of the consistency and relative density of soils.

Boring CB-03 was advanced using hand auger. The soil was continuously sampled with an LB-sized Geoprobe in 2-foot intervals. Soil samples collected from each sampling interval were placed in sealed jars and transported to the Wang laboratory for further examination and laboratory testing.

Himalayan supervised the drilling and sampling activities, conducted field-testing of soil samples and prepared field logs describing the soils. The split-spoon samples obtained from the drilling operation were visually classified in the field. Cohesive samples were tested for unconfined compressive strength (Q_u) using an IDOT modified RIMAC test device and/or calibrated hand penetrometer in the field.

Wang provided the as-drilled northing and easting coordinates and boring elevations including the stationing and offsets for borings. The as-drilled boring locations are shown in the Boring Location Plan (Exhibit 3, Appendix A) and boring location data are presented in the Boring Logs (Appendix B).

Groundwater levels were measured while drilling and at completion of each boring. Upon completion of sampling and water level observations, all boreholes were properly backfilled with soil cuttings

and/or bentonite chips for safety considerations. The ground surface was restored to its original condition.

4.2 Laboratory Testing

Soil samples were tested in accordance with IDOT procedures outlined in the IDOT Geotechnical Manual [Ref. 1]. The split-spoon samples obtained from the drilling operation were visually classified in the field. The acquired soil samples were then tested in the Wang laboratory for determination of natural water content (AASHTO T265). The Atterberg Limits (AASHTO T89 and T90) and Particle Size Analyses (AASHTO T88) were performed on selected samples.

Each sample was examined and classified by Himalayan in accordance with the Illinois Division of Highways (IDH) Textural Classification System. See Appendices B and C for laboratory test results.

5.0 INVESTIGATION RESULTS

A more detailed description of soil and groundwater conditions encountered at each boring location is included within the Boring Logs (Appendix B). See Exhibit 4 (Appendix B) for soil profile. It should be noted that the soil stratification lines shown in the boring logs represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in horizontal and vertical directions.

5.1 Soil Conditions

5.1.1 Culvert Extension at Seil Road

The borings CB-01 and CB-02 drilled west of IL 59 near the downstream and upstream of proposed culvert extension encountered grass, bushes and weeds at the surface. Topsoil (5-8 inches) was encountered in borings. The general soils encountered beneath the topsoil include 1) Fill Materials (Man-made ground) and 2) Native Materials consisting of silty clay

Fill Materials

Beneath the ground, fill materials were present to depths ranging from 5.5 to 7.5 feet. Fill soils generally consisted of very stiff to hard, brown and gray silty clay with trace gravel. The unconfined compressive strength ($Q_{u)}$ for the soil samples raged from 2.1 to 6.2 tsf and the natural water contents of these soils ranged from 15 to 22 %. Laboratory testing on samples from this layer shows liquid limit (LL) ranging from 39 to 40% and plastic limit (PL) of 20% for both samples, with Plasticity Index (PI) values ranging from of 19 to 20%. The IDH Classification for these soils is Silty Clay.

Silty Clay

Beneath the fill, the soils transition to native materials and consist of hard silty clay to the boring completion depths (approximate elevations 583 to 581feet). The Q_u values for soil samples ranged between 4.9 to 8.0 tsf. The natural water contents for the samples ranged from 18 to 20%.

5.1.2 Culvert Extension at IL 59

The borings CB-03 and CB-04 drilled south of Seil Road near the downstream and upstream of proposed culvert encountered grass, bushes and weeds at the surface. Topsoil (8 inches) was encountered in borings. The general soils encountered beneath the topsoil include 1) Fill Materials (Man-made ground) and Native Materials consisting of 1) Silty clay and 2) Sand.

Fill Materials

Beneath the ground, fill materials were encountered to depths ranging from 2 to 3 feet. Fill soils generally consisted of very stiff to hard, brown and gray silty clay with trace gravel. The Q_u values for the soils raged from 2.5 to >4.5 tsf. The natural water contents of these soils ranged from 16 to 19%. Laboratory testing on samples from this layer shows a LL value of 39% and PL value of 21% (PI = 18%). The IDH Classification for these soils is Silty Clay.

Silty Clay

Beneath the fill, the soils transition to native materials and consist of hard silty clay to the boring completion depths (approximate elevations 577 to 581 feet). The Q_u values for soil samples ranged between 2.1 to 5.7 tsf. The natural water contents for the samples ranged from 15 to 22%. Laboratory testing on samples from this layer shows a LL value of 40% and PL value of 20% (PI = 20%). The IDH Classification for these soils is Silty Clay.

Sand

An exception was found in boring CB-04 where a saturated layer of loose, brown and gray sand (N value = 9) was encountered at 5.5 to 8 feet below existing grades between elevations of approximately 586.5 to 584 feet. The natural water content for the sample was 22%.

5.2 Groundwater Conditions

Groundwater was encountered in boring CB-04 at an elevation of approximately 586 feet. at the time of this investigation. Based on change in soil coloration from brown to gray, we estimate the design high water elevation to be at an approximate elevation of 587 feet.

Note that fluctuation in the groundwater levels should be anticipated due to the seasonal variation in precipitation, surface runoff and water levels in the drainage ditch.

6.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS

Himalayan has performed bearing resistance, settlement, and global stability analysis for the new culvert extensions. The results of our geotechnical analysis and recommendations are provided in the following sections:

6.1 Erosion Considerations

Based on the boring logs, the soils encountered at streambed elevation (approximately 587 feet), consist of very stiff to hard silty clays. Although these soils are relatively resistant to erosion, we recommend placing stone riprap or a concrete apron at the ends of the culvert to prevent local erosion on a long term basis, This will also prevent sediments from entering and accumulating in the culvert, minimize long term maintenance, and provide protection to the stream bed at the interface.

6.2 Bearing Resistance

6.2.1 Culvert Extension at Seil Road

The subsurface investigation indicates the subsurface soils at and within 3 to 5 feet of the inlet and outlet invert elevations (586.05 and 585.82 feet) are primarily very stiff to hard silty clays. Based on these soil conditions, the foundation soils at invert elevations are estimated to have a factored bearing resistance of 6,000 psf for strength limit state (value based on a geotechnical resistance factor of 0.45 per AASHTO LRFD Table 10.5.5.2.2-1) and a bearing resistance of 3,700 psf for service limit state (value based on 1-inch settlement).

The foundation soils are anticipated to provide a stable working platform for the placement of the culvert extensions.

6.2.2 Culvert Extension at IL 59

Based on the investigation results, the subsurface soils at and within 4 feet of the new culvert invert elevations (586.43 to 587.5 feet) are primarily very stiff to hard silty clays. However, it should be noted that a saturated layer of loose sand, approximately 2.5 feet thick was encountered at about 1 foot below the inlet invert elevation in boring CB-04. If these soils are encountered during construction, they should be undercut/removed to reach suitable bearing soils below (very stiff silty clays) and replaced with coarse aggregates meeting the gradation requirements of CA-1, CA-7, CA-11 as defined in Section 1004 of IDOT Standard Specifications for Road and Bridge Construction (Standard

Specifications) [Ref. 5]. Replacement material should extend a minimum of 2.0 feet beyond each side of the box. The actual extent of removal and replacement should be verified during construction.

After the recommended removal and replacement, the foundation soils will provide a stable working platform and sufficient bearing resistance for the placement of the culvert extension.

6.3 Settlement

Considering the foundation soils that consist of very stiff to hard silty clays and the anticipated removal/replacement of unsuitable soils as described in Section 6.2.2, the differential settlement of the foundation soils along the new culvert extensions is anticipated to be 0.5 inches or less. We estimate the settlement is suitable for the construction of the proposed culvert structure.

We estimate 1 to 2 feet of new fill on top of the culvert extensions and 4 to 5 feet of new fill around the culvert extensions.

6.4 Downstream Retaining Wall

A retaining wall is proposed near the downstream end of the box culvert extension at Seil Road to retain a portion of the south side of the roadway embankment. The global stability analysis of the retaining wall should be performed as part of the retaining wall design analysis.

6.5 Wingwalls

Horizontal cantilever wingwalls should be used if the wingwalls are less than or equal to 16 feet in length and the wingwall locations can be adequately dewatered [Ref. 3]. Horizontal cantilever wingwalls should be designed based on the structural guideline provided in Section 4.2 of the IDOT Culvert Manual {Ref. 3].

The L-type cantilever wingwalls may be used for longer wall lengths ranging 14 to 30 feet. The wingwalls for these walls should be founded at a minimum depth of 3.0 feet below the culvert invert elevations.

It is anticipated that T-type cantilever concrete retaining walls may be considered for the proposed culvert extensions. These walls will be bearing on soils. The bottom of the footing for these walls is set below the frost penetration depth, which is generally 4 feet below the top of finished grade. The following sections provide recommendation for design of these wingwalls:

6.5.1 Bearing Resistance

A factored bearing resistance of 7,000 psf for strength limit state (value based on a geotechnical resistance factor of 0.55 per AASHTO LRFD Table 11.5.7.1)) and a bearing resistance of 4,000 psf for service limit state (value based on 1-inch settlement) can be used for design of spread footings for T-type wingwalls bearing on very stiff to hard clays.

6.5.2 Settlement

Considering the very stiff to hard clays present below the anticipated footing bases for the wingwalls, the total post-construction settlement and total differential settlement are not expected to exceed 1 inch and 0.5 inch, respectively. We estimate the settlement is suitable for construction of the anticipated T-type wingwalls.

6.5.3 Lateral Earth Pressure

For yielding wingwalls with horizontal backfill, it is recommended that a lateral active earth pressure of 40 psf per foot of depth (equivalent fluid pressure) be used (assuming a free-draining granular backfill is utilized). For yielding walls with a sloping surface (1V:2.5H) and free-draining granular backfill, an equivalent fluid pressure 50 psf per foot of depth may be used. An equivalent fluid pressure of 60 psf per foot should be used for soils located adjacent to the height of barrel.

In order to prevent/alleviate the buildup of potential excessive hydrostatic pressures and frost pressures, drainage behind the wall should consist of a geocomposite wall drain and porous granular backfill, consistent with Section 3.11.2.3 of the IDOT Bridge Manual. The geocomposite wall drain on the back face should be continuous [Ref. 2].

A value of 0.40 may be used for the coefficient of friction (μ) between the concrete base and drained cohesive soils (assuming a concrete base on the very stiff to hard cohesive soils) per NAVFAC Design Manual 7.2 [Ref. 6]. A value of 0.53 may be used for the coefficient of friction between the concrete base and granular materials CA-1, CA-7, CA-11 indicated in Section 6.2.

The final site grades should be sloped to permanently direct any collected rain water, or surface run off away from the front and back of the wall.

6.5.4 Cast-In-Place or Precast Considerations

After removal and replacement of unsuitable soils encountered in culvert extension at IL 59, the differential settlements are anticipated to be about 0.5 inches for the proposed culvert extensions which should not cause excessive separation of the precast sections. Therefore, both the cast-in-place and precast culvert extension options are feasible.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Site Preparation

Vegetation, surface topsoil, existing pavement and debris should be cleared and stripped where the new culvert barrels and wingwalls will be constructed. The site should be prepared in accordance with the requirements of the IDOT Standard Specifications. Any unstable or unsuitable materials should be removed and replaced with compacted fill as described in Section 7.3.

7.2 Excavation, Dewatering, and Utilities

The foundation excavations should be performed in accordance with local, state and federal regulations. If excavations are ≥ 4 feet, the slopes should be graded, benched and shielded in accordance with the latest Occupational Safety and Health Administration (OSHA) safety standards and requirements for temporary side slopes. Allowances should be made for any surcharge loads adjacent to the excavation areas. Movement of adjacent soils near the edge of and into excavation areas should be prevented and the potential effects of ground movements upon nearby utilities should be considered during construction.

Based on the upstream boring CB-04 advanced as part of culvert extension at IL 59 South of Seil Road, the contractor should expect a 2.5 feet thick saturated layer of loose sand sandwiched between very stiff and hard silty clays (approximate elevations 586.5 to 584 feet). Groundwater seepage should be anticipated during construction.

In general, we expect that groundwater seepage into the excavations within mostly cohesive soils could be controlled with sump pump and pit procedures. However, where excavations penetrate to water bearing granular soils and adjacent to lower lying wetland areas more extensive dewatering should be anticipated.

7.3 Filling and Backfilling

The fill material should be free of organic matter and debris and should be compacted in accordance with the requirements of Section 205 of the IDOT Standard Specifications. The structural fill utilized to attain the final design elevations should satisfy the requirements of the IDOT Standard Specifications. The backfill materials must be as per the IDOT Standard Specifications.

7.4 Earthwork Operations

The required earthwork can be accomplished with conventional equipment. Moisture and traffic will cause deterioration of exposed subgrade soils. The construction contractor should take measures to

prevent erosion of the exposed subgrade due to water or surface runoff. A compacted subgrade will minimize water runoff erosion.

Earth moving operations should be scheduled to not coincide with excessive cold or wet weather (early spring, late fall or winter). Any soil allowed to freeze or soften due to standing water should be removed. Wet weather can cause problems with subgrade compaction. It is recommended that an experienced geotechnical engineer or representative be retained to inspect the exposed subgrade, verify soils in the field, monitor earthwork operations, and provide material inspection services during construction phase of the project.

8.0 LIMITATIONS

Our analysis and recommendations are based upon the data obtained from the borings drilled at locations shown on the boring logs and boring location plan included in this report. Because the evaluation is based upon subsurface physical data obtained from soil borings only at specific locations and time and only to the depths sampled, the report does not reflect potential variations in the subsurface conditions 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.

The conclusions or recommendations contained represent our professional opinions. No warranty or guarantee is expressed or implied. If variations are encountered and/or the project scope is altered, we should be timely informed so that our recommendations can be adjusted accordingly.

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

Respectfully Submitted,

Himalayan Consultants, LLC

Shardul Sharma
Geotechnical Engineer

Gopal K. Adhikary
Senior Geotechnical Engineer

Mark A. Babich, P.E.
QA/QC Reviewer

9.0 REFERENCES

1. Illinois Department of Transportation (2015). Geotechnical Manual.

2. Illinois Department of Transportation (2012). Bridge Manual.

3. Illinois Department of Transportation (2017). Culvert Manual.

4. AASHTO LRFD Bridge Design Specifications (2016). Section 11-Walls, Abutments and Piers.

5. Illinois Department of Transportation (2016). Standard Specifications for Road and Bridge Construction.

6. United States Navy Naval Facilities Engineering Command (1986). Foundations and Structures.

APPENDICES

Appendix A Exhibits

- Exhibit 1: Site Location Map
- Exhibit 2: Boring Location Plan

Appendix B Boring Logs and Soil Profile

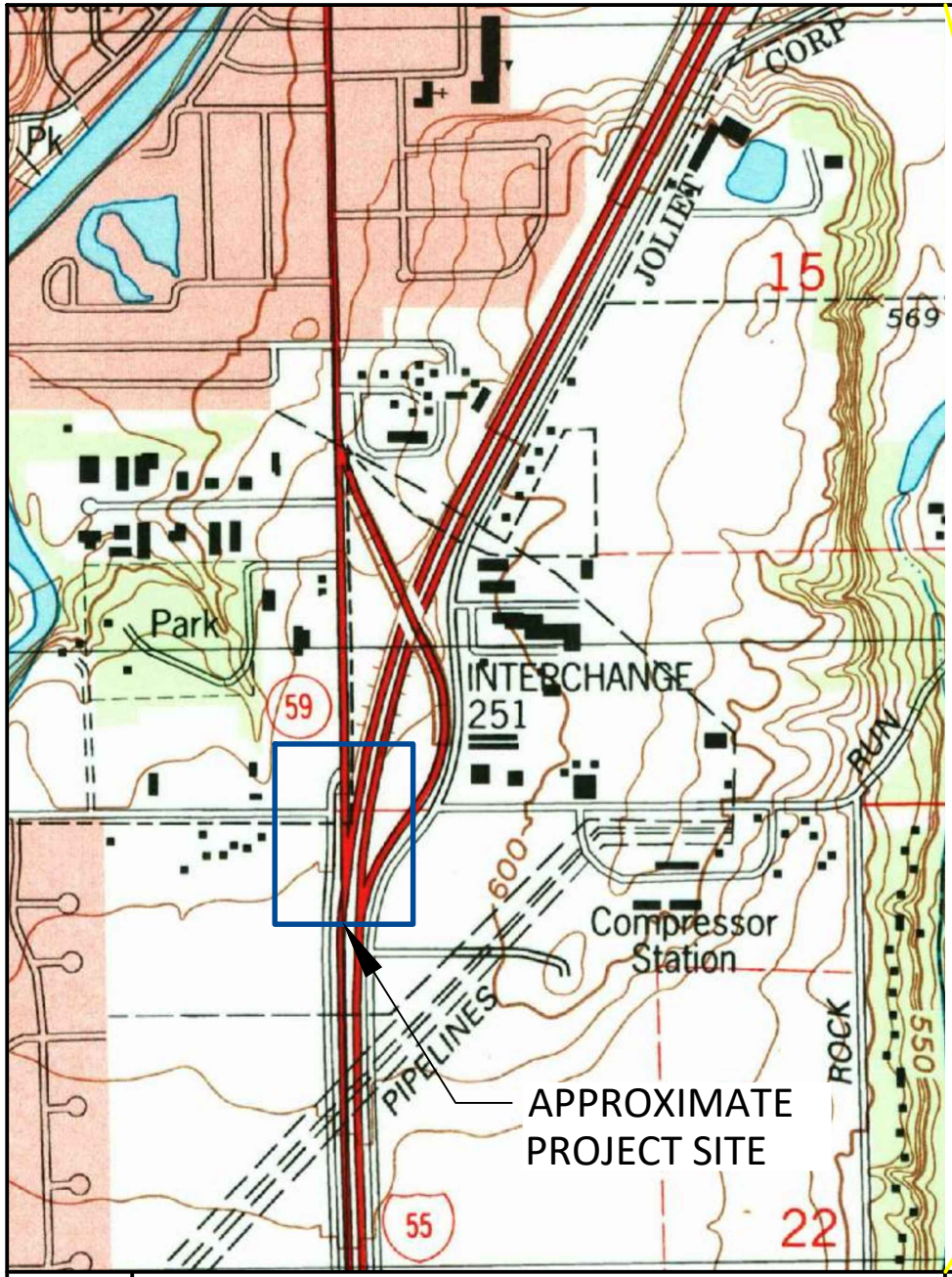
- Exhibit 4: Soil Profile

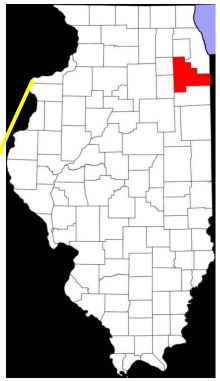
Appendix C Laboratory Test Results

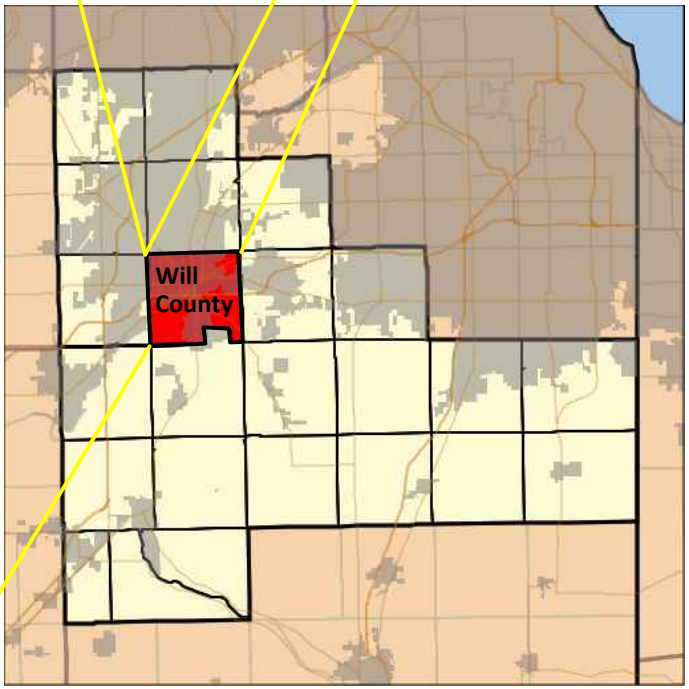
Appendix D Preliminary Design Drawings

APPENDIX A

EXHIBITS







N

Exhibit
1

Project Location Map

Box Culvert at Seil Road West of IL 59 and IL 59 South of Seil Road
I-55 at IL 59 Access Project
Will County, Illinois

Graphic Scale

1 inch = 1000 feet

Topographic Map Retrieved from USGS

Himalayan Consultants, LLC
Engineers and Hydrogeologists
8770 W. Bryn Mawr Avenue. Suite 1300
Chicago, Illinois 60631
Phone: (773) 867-2956

Exhibit
2

Boring Location Map

Box Culvert at Seil Road West of IL 59 and IL 59 South of Seil Road
I-55 at IL 59 Access Project
Will County, Illinois

LEGEND

Boring (B-X)

Map Retrieved from Will County GIS

Graphic Scale

1 inch = 100 feet

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APPENDIX B

BORING LOGS AND SOIL PROFILE

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Phone: (773) 867-2956
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SOIL BORING LOG

Date 9/25/2018

ROUTE Interstate Route 55 **DESCRIPTION** Culvert Crossing at IL 59 and Seil Road **LOGGED BY** SSA

SECTION N/A **LOCATION** SE 1/4, SEC. S16 TWP. T35N, RNG. R10E 3rd PM

COUNTY WILL **DRILLING METHOD** 3.25" HSA: backfilled upon completion **HAMMER TYPE** ATV D-25 (93%)

STRUCT. NO. Culvert SN 099-0022
Station N/A

BORING NO. CB-01
Station 4016+90
Offset 70' LT
Ground Surface Elev. 592.71 ft

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

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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
592.29 TOPSOIL: 5" thick, black SILTY CLAY LOAM			
FILL: Very stiff, brown and gray, SILTY CLAY, trace gravel, moist	3	2.1B	15
Sample at 3.5' to 5.0'	5 6		
--L_L(%)=40--			
--P_L(%)=20---	4	2.5B	22
--%Gravel=2.6--	5 6		
-5			
--%Sand=7.2--			
--%Silt=53.2--	4	2.7B	17
--%Clay=36.9--	5 7		
584.71 Hard, brown and gray, SILTY CLAY, trace gravel, moist	5	4.9B	18
	8 10		
582.71 -10 End of Boring			
-15			
-20			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
-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)

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SOIL BORING LOG

Date 8/25/2018

ROUTE Interstate Route 55 **DESCRIPTION** Culvert Crossing at IL 59 and Seil Road **LOGGED BY** SSA

SECTION N/A **LOCATION** NE 1/4, SEC. S21 TWP. T35N, RNG. R9E 3rd PM

COUNTY WILL **DRILLING METHOD** 3.25" HSA: backfilled upon completion **HAMMER TYPE** ATV D-25 (93%)

STRUCT. NO. Culvert SN 099-0022
Station N/A

BORING NO. CB-02
Station 4016+57
Offset 103' RT
Ground Surface Elev. 590.57 ft

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

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

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
TOPSOIL: 8" thick, black SILTY CLAY LOAM 589.90			
Hard, brown and gray, SILTY CLAY, trace gravel, moist	5	6.2S	19
Sample at 3.5' to 5.0'	5 6		
--L_L(%)=39--			
--P_L(%)=20--	3	5.5B	21
--%Gravel=1.1--	4 5		
--%Sand=7.6--			
--%Silt=52.1--	4	8.0S	20
--%Clay=39.2--	9 11		
	5	6.6B	20
580.57	7 10		
End of Boring			

-5 -10 -15 -20 -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)

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SOIL BORING LOG

Date 8/26/2018

ROUTE Interstate Route 55 **DESCRIPTION** Culvert Crossing at IL 59 and Seil Road **LOGGED BY** SSA

SECTION N/A **LOCATION** NE 1/4, SEC. S21 TWP. T35N, RNG. R9E 3rd PM

COUNTY WILL **DRILLING METHOD** 3.25" HSA: backfilled upon completion **HAMMER TYPE** GEOPROBE

STRUCT. NO. Culvert SN 099-0351
Station N/A

BORING NO. CB-03
Station 7002+84
Offset 80' RT
Ground Surface Elev. 591.12 ft

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

Groundwater Elev.:
First Encounter 4 ft
Upon Completion N.E. ft
After N/A **Hrs.** N/A ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
TOPSOIL: 8" thick, black SILTY CLAY LOAM 590.45			2.5p	19
FILL: Very stiff, brown and gray, SILTY CLAY, trace gravel, moist 589.12				
Hard, brown and gray, SILTY CLAY, trace gravel, moist			4.5+p	19
Sample at 2.0 to 4.0'				
--L_L(%)=39--			4.3p	17
--P_L(%)=21--	-5			
--%Gravel=1.1--			4.5+p	17
--%Sand=7.0--				
--%Silt=52.5--				
--%Clay=39.5--			4.5+p	21
581.12	-10			
End of Boring				
	-15			
	-20			
	-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)

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SOIL BORING LOG

Date 8/28/2018

ROUTE Interstate Route 55 **DESCRIPTION** Culvert Crossing at IL 59 and Seil Road **LOGGED BY** SSA

SECTION N/A **LOCATION** NE 1/4, SEC. S21 TWP. T35N, RNG. R9E 3rd PM

COUNTY WILL **DRILLING METHOD** 3.25" HSA: backfilled upon completion **HAMMER TYPE** ATV D-25 (93%)

STRUCT. NO. Culvert SN 099-0351
Station N/A

BORING NO. CB-04
Station 8033+42
Offset 104' RT
Ground Surface Elev. 591.97 ft

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

Groundwater Elev.:
First Encounter 5.5 ft
Upon Completion 11 ft
After N/A **Hrs.** N/A ft

		DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
TOPSOIL: 8" thick, black SILTY CLAY LOAM	591.30				
FILL: Hard, brown and gray, SILTY CLAY, trace gravel, moist			7	4.5+p	16
			9		
			10		
	588.97				
Hard, brown and gray, SILTY CLAY, trace gravel, moist			7	5.7S	21
Sample at 3.5' to 5.0'			11		
		-5	14		
--LL(%)=40, --PL(%)=20	586.47 ▼				
--%Gravel=0.3--			5	NP	22
--%Sand=4.7--			5		
			4		
--%Silt=51.7--	583.97				
--%Clay=43.3--			4	2.1S	15
Loose, brown and gray, coarse grained SAND, satutated			3		
		-10	5		
Very stiff to hard, gray, SILTY CLAY, trace gravel, moist					
			9	4.9S	22
			11		
			16		
			5	2.9S	21
			10		
	576.97	-15	16		
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)

Himalayan Consultants, LLC
Engineers and Hydrogeologists

LEGEND FOR BORING LOG

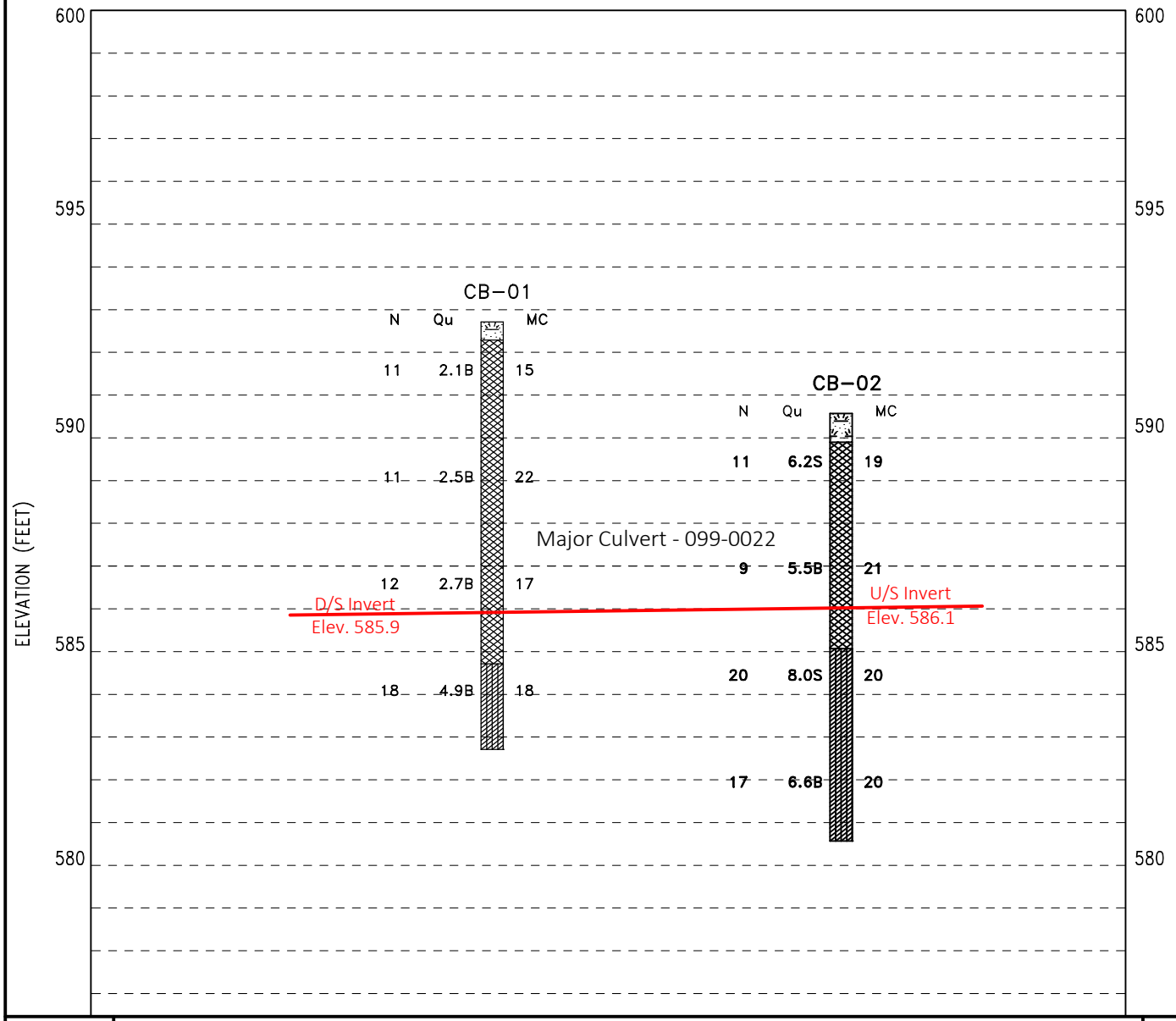
Relative Density of Non - Cohesive Soils	
N-Blows/ 12 inches	**Relative Density Term**
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80+	Very Dense

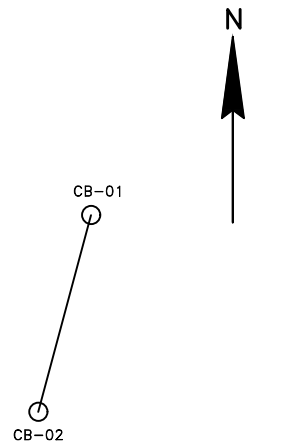
Consistency of Cohesive Soils	
Unconfined Compressive Strenght Qu, tsf	**Consistency Term**
<0.25	Very Soft
0.25-0.49	Soft
0.50-0.99	Medium Stiff
1.00-1.99	Stiff
2.00-3.99	Very Stiff
>4.00	Hard

Relative Drilling Resistace	
RDR	**Drilling Resistance Term**
1	Very Easy
2	Easy
3	Moderate
4	Hard
5	Very Hard

Proportional Terms		
Trace	1-9	**Percent of Dry Weight**
Little	10-19	
Some	20-34	
And	35-50	
Gradation Terminology		
Boulders	>200mm	
Cobbles	200mm to 75mm	
Gravel	75mm to 2mm	
Sand	2-0mm to 0.074mm	
Silt	0.074mm to 0.002mm	
Clay	<0.002mm	

Drilling and Sampling Terms	
SS=	Split Spoon
ST=	Shelby Tube
SPT*=	Standard Penetration Test (N-Value)
Q_u=	Unconfined Compresive Strength
P=	Pocket Penetrometer
S=	Shear failur of sample, Rimac test
B=	Bulge Failure of sample, Rimac Test
TMR =	Truck Mounted Rig
ATV =	All Terrain Vehicle Rig
[-%] =	SPT Hammer Efficiency
*SPT N-Value is the sum of the second and third numbers	





Explanation:

CB–04
1061+64.81
Borehole Number
Station

Borehole Lithology
N--N-value, (blow/12in)
Qu--UC Strength, (tsf)
MC--Moisture Content (%)

Lithology Graphics

- Topsoil
- IDH Sand, Sandy Loam
- Fill
- IDH Silty Clay, Silty Clay Loam

Vertical Scale
1in = 4 ft

Exhibit
3-1

Soil Profile

Box Culvert at Seil Road West of IL 59 and IL 59 South of Seil Road
I-55 at IL 59 Access Project
Will County, Illinois

Himalayan Consultants, LLC
Engineers and Hydrogeologists
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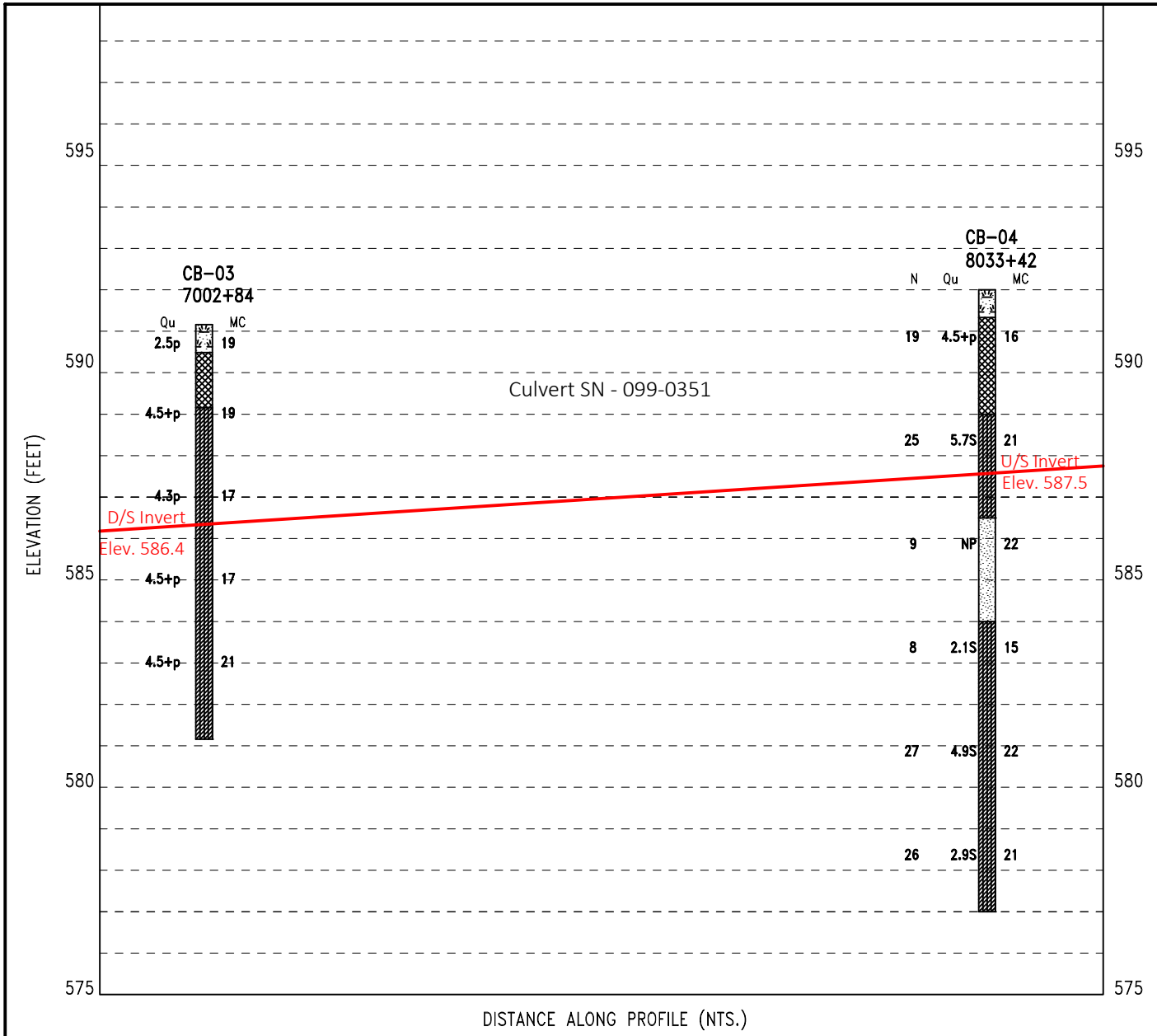

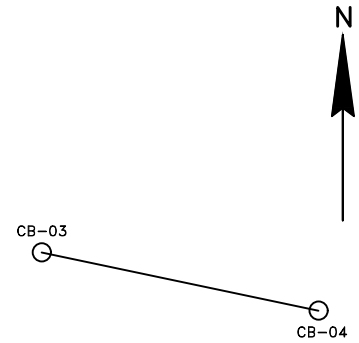

Explanation:

CB-04
1061+64.81
Borehole Number
Station

Borehole Lithology
N--N-value, (blow/12in)
Qu--UC Strength, (tsf)
MC--Moisture Content (%)

Lithology Graphics

Topsoil
IDH Sand, Sandy Loam
Fill
IDH Silty Clay, Silty Clay Loam

Vertical Scale
1in = 4 ft

Exhibit
3-2

Soil Profile

Box Culvert at Seil Road West of IL 59 and IL 59 South of Seil Road
I-55 at IL 59 Access Project
Will County, Illinois

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APPENDIX C

LABORATORY TEST RESULTS

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

LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX of SOILS

AASHTO T 89, T 90 / ASTM D 4318

Client: IDOT
Project: I-55 at IL-59
WEI Job No: 555-16-04
Prep Method: air dried

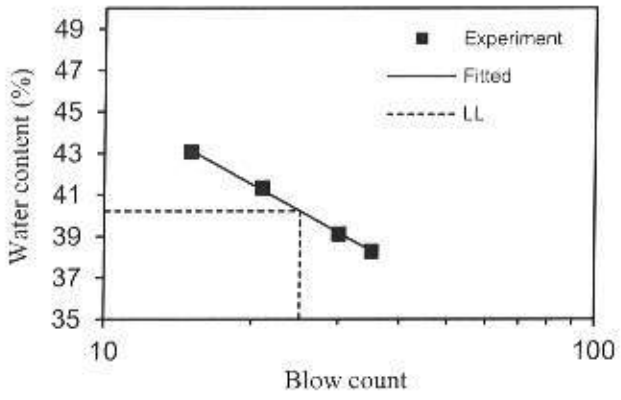
Analyst name: M. Ciapas
Test date: October 10, 2018
Soil Sample ID: CB-01, No. 2 (3.5-5.0 ft.)
Sample description: Brown Silty Clay
% retained on #40 sieve: 5%

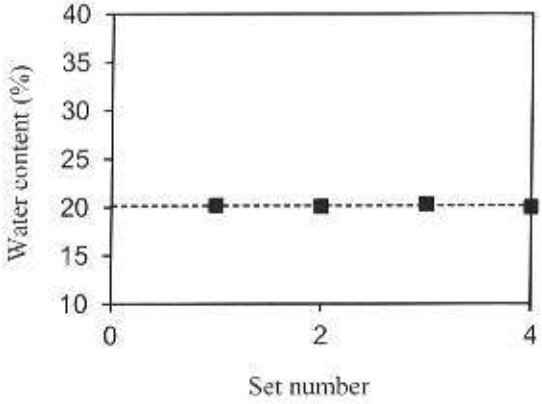
Set #	Tare mass (g) Wc	Tare with wet soil (g) Ww	Tare with dry soil (g) Wd	Blow count N	Water content (%) w	Water content fitted (%)
1	11.31	24.64	20.95	35	38.28	38.28
2	11.23	24.00	20.41	30	39.11	39.16
3	11.32	25.27	21.19	21	41.34	41.21
4	11.11	25.36	21.07	15	43.07	43.14

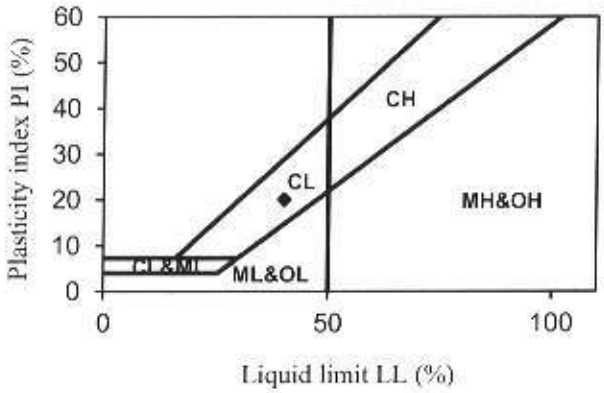
Liquid limit (%) = 40.21
Slope of flow line = 0.141

Set #	Tare mass (g) Mc	Tare with wet soil (g) Mw	Tare with dry soil (g) Md	Water content (%) w
1	11.20	23.76	21.65	20.19
2	11.70	23.48	21.51	20.08
3	11.37	23.09	21.11	20.33
4	11.09	23.21	21.19	20.00

Plastic limit (%) = 20.15







Liquid limit (%) = *40*
Plastic limit (%) = *20*
Plasticity index (%) = *20*

Prepared by: Tony Date: 10-12-18

Checked by: AH Date: 10/19/18

AASHTO ACCREDITATION PROGRAM

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

LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX of SOILS

AASHTO T 89, T 90 / ASTM D 4318

Client: IDOT
Project: I-55 at IL-59
WEI Job No: 555-16-04
Prep Method: air dried

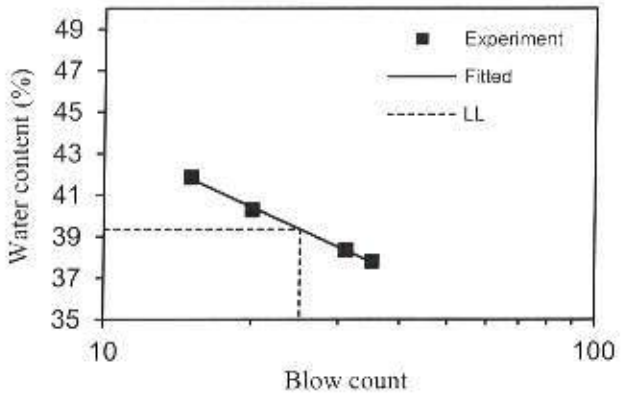
Analyst name: M. Ciapas
Test date: October 10, 2018
Soil Sample ID: CB-02, No. 2 (3.5-5.0 ft.)
Sample description: Brown Silty Clay
% retained on #40 sieve: 3%

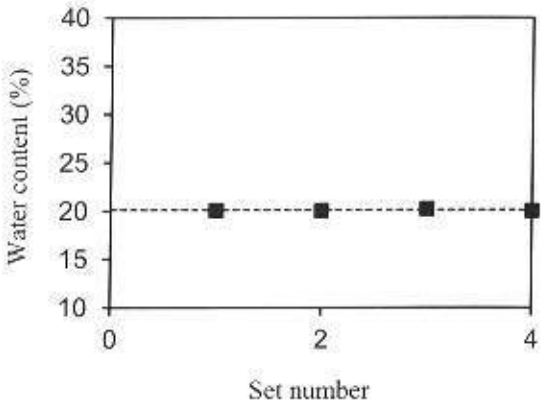
Set #	Tare mass (g) Wc	Tare with wet soil (g) Ww	Tare with dry soil (g) Wd	Blow count N	Water content (%) w	Water content fitted (%)
1	11.40	26.71	22.51	35	37.80	37.76
2	11.74	24.91	21.26	31	38.34	38.34
3	11.28	25.35	21.31	20	40.28	40.41
4	11.02	25.22	21.03	15	41.86	41.77

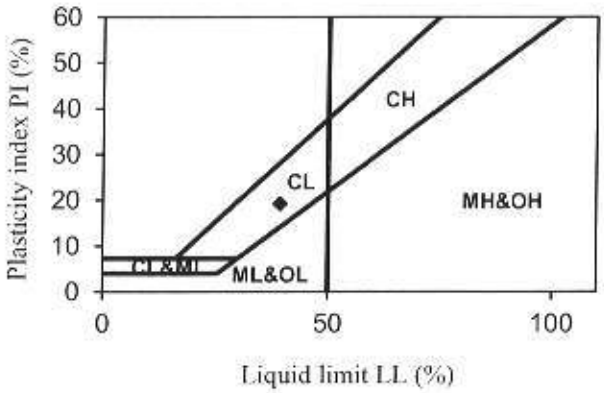
Liquid limit (%) = 39.35
Slope of flow line = 0.119

Set #	Tare mass (g) Mc	Tare with wet soil (g) Mw	Tare with dry soil (g) Md	Water content (%) w
1	11.15	23.35	21.31	20.08
2	11.17	22.84	20.89	20.06
3	11.20	23.38	21.33	20.24
4	11.21	22.65	20.74	20.04

Plastic limit (%) = 20.10







Liquid limit (%) = *39*
Plastic limit (%) = *20*
Plasticity index (%) = *19*

Prepared by: _____ Date: 10-12-18

Checked by: _____ Date: 10/19/18

AASHTO ACCREDITATION PROGRAM

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

LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX of SOILS

AASHTO T 89, T 90 / ASTM D 4318

Client: IDOT
Project: I-55 at IL-59
WEI Job No: 555-16-04
Prep Method: air dried

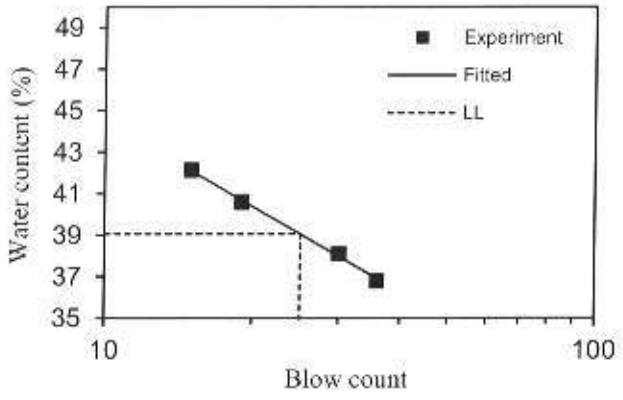
Analyst name: M. Ciapas
Test date: October 10, 2018
Soil Sample ID: CB-03, No. 2 (2.0-4.0 ft.)
Sample description: Brown Silty Clay
% retained on #40 sieve: 4%

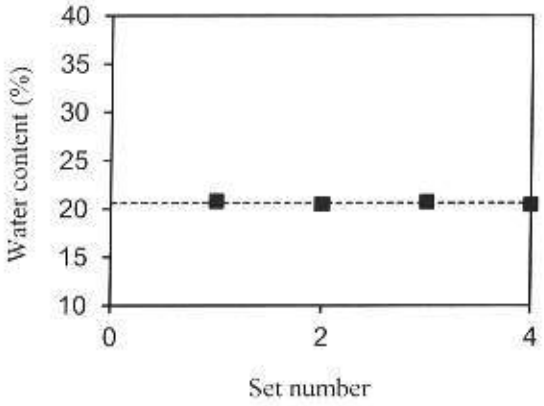
Set #	Tare mass (g) Wc	Tare with wet soil (g) Ww	Tare with dry soil (g) Wd	Blow count N	Water content (%) w	Water content fitted (%)
1	11.18	24.08	20.61	36	36.80	36.89
2	11.15	24.34	20.70	30	38.12	37.97
3	11.09	25.57	21.39	19	40.58	40.68
4	11.16	24.89	20.82	15	42.13	42.09

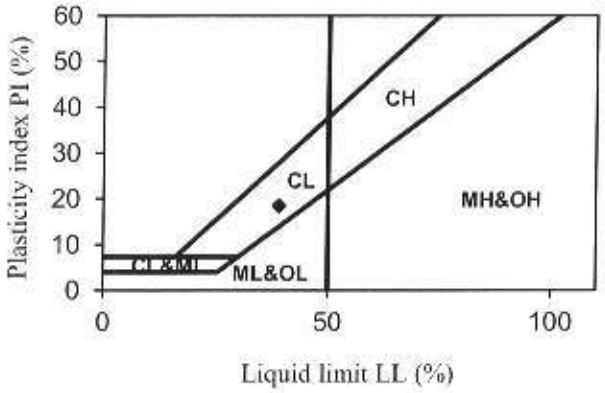
Liquid limit (%) = 39.05
Slope of flow line = 0.151

Set #	Tare mass (g) Mc	Tare with wet soil (g) Mw	Tare with dry soil (g) Md	Water content (%) w
1	11.17	22.85	20.84	20.79
2	11.16	22.45	20.53	20.49
3	11.33	22.63	20.69	20.73
4	11.32	23.64	21.55	20.43

Plastic limit (%) = 20.61







Liquid limit (%) = *39*
Plastic limit (%) = *21*
Plasticity index (%) = *18*

Prepared by: _____ Date: 10-12-18

Checked by: _____ Date: 10/19/18

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LIQUID LIMIT, PLASTIC LIMIT, and PLASTICITY INDEX of SOILS

AASHTO T 89, T 90 / ASTM D 4318

Client: IDOT
Project: I-55 at IL-59
WEI Job No: 555-16-04
Prep Method: air dried

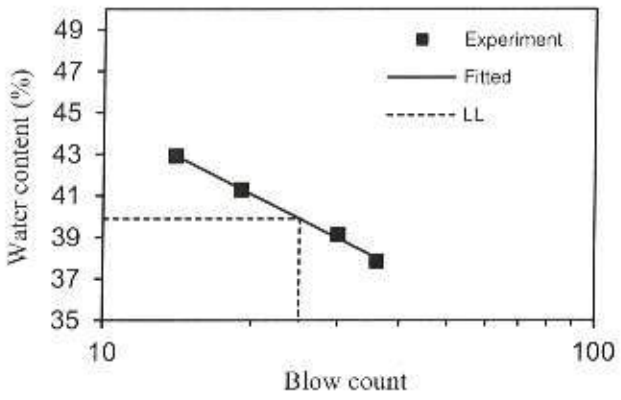
Analyst name: M. Ciapas
Test date: October 10, 2018
Soil Sample ID: CB-04, No. 2 (3.5-5.0 ft.)
Sample description: Brown Silty Clay
% retained on #40 sieve: 2%

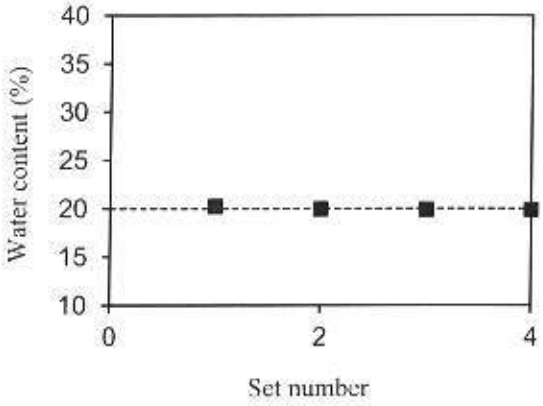
Set #	Tare mass (g) Wc	Tare with wet soil (g) Ww	Tare with dry soil (g) Wd	Blow count N	Water content (%) w	Water content fitted (%)
1	11.17	23.99	20.47	36	37.85	37.99
2	10.97	23.06	19.66	30	39.13	38.94
3	11.23	24.30	20.48	19	41.30	41.33
4	11.15	24.77	20.68	14	42.92	42.93

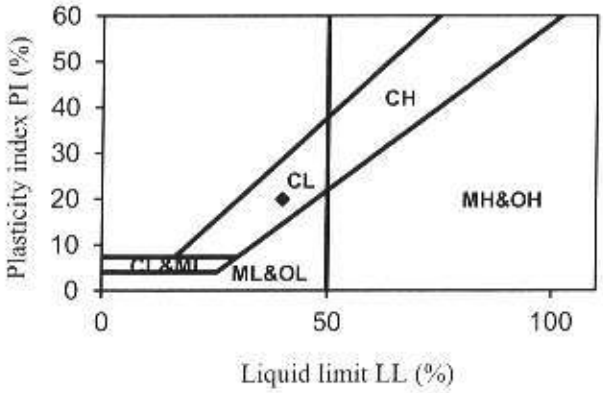
Liquid limit (%) = 39.90
Slope of flow line = 0.130

Set #	Tare mass (g) Mc	Tare with wet soil (g) Mw	Tare with dry soil (g) Md	Water content (%) w
1	11.15	22.50	20.59	20.23
2	11.18	22.65	20.74	19.98
3	11.20	24.03	21.90	19.91
4	11.19	23.14	21.16	19.86

Plastic limit (%) = 19.99





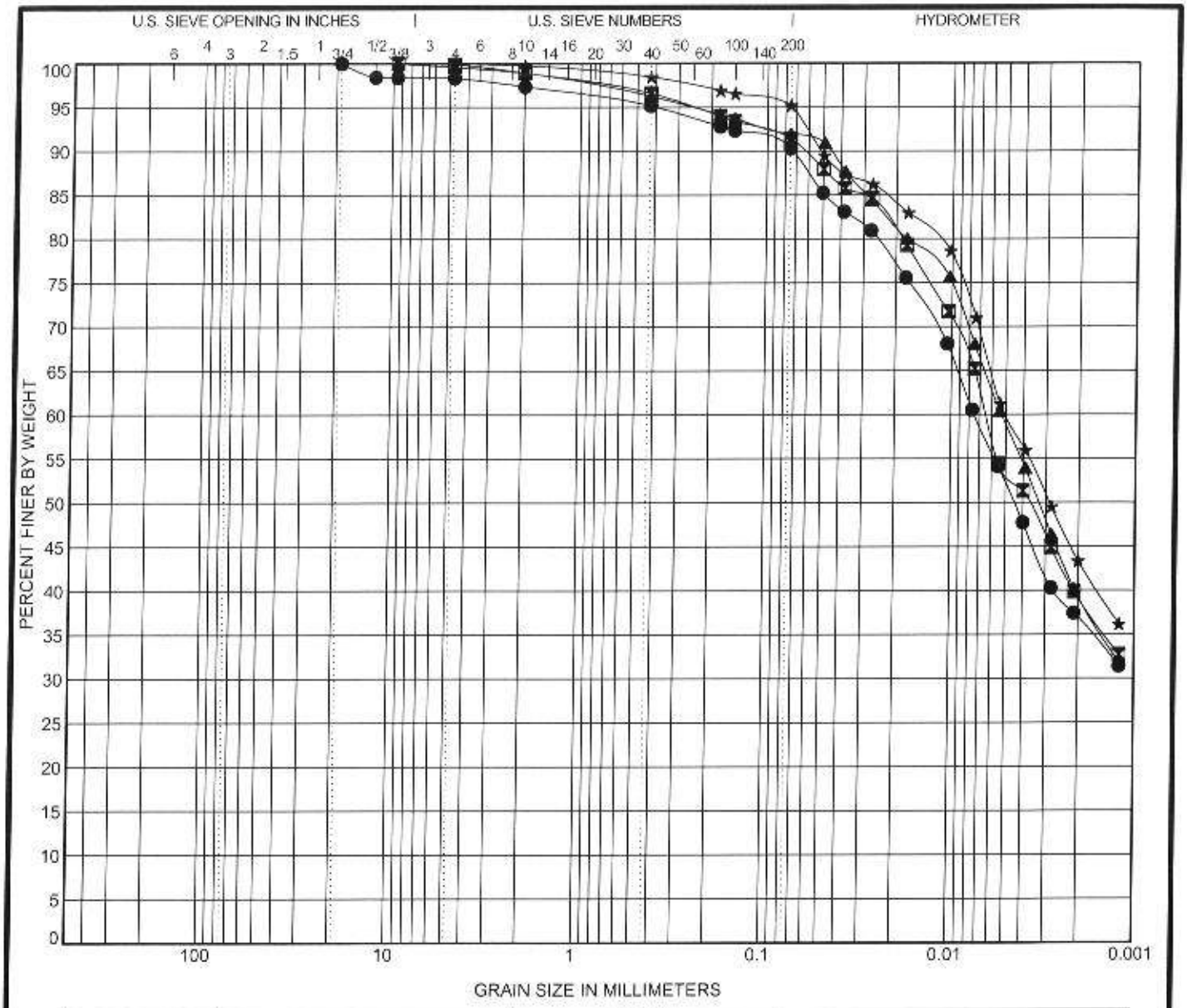


Liquid limit (%) = *40*
Plastic limit (%) = *20*
Plasticity index (%) = *20*

Prepared by: _____ Date: 10.12.18

Checked by: _____ Date: 10/19/18

AASHTO ACCREDITATION PROGRAM



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification			IDH Classification	LL	PL	PI	Cc	Cu
●	CB-01#2	3.5 ft	Silty Clay	40	20	20		
⧗	CB-02#2	3.5 ft	Silty Clay	39	20	19		
▲	CB-03#2	2.0 ft	Silty Clay	39	21	18		
★	CB-04#2	3.5 ft	Silty Clay	40	20	20		

Specimen Identification			D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	CB-01#2	3.5 ft	19	0.007			2.6	7.2	53.2	36.9
⧗	CB-02#2	3.5 ft	9.5	0.006			1.1	7.6	52.1	39.2
▲	CB-03#2	2.0 ft	9.5	0.005			1.1	7.0	52.5	39.5
★	CB-04#2	3.5 ft	4.75	0.005			0.3	4.7	51.7	43.3

WEI SINCE 1982
Wang Engineering, Inc.
1145 North Main Street
Lombard, Illinois 60148
Telephone: 630-953-9928
Fax:

GRAIN SIZE DISTRIBUTION

Project: I-55 at IL 59

Location: Will County, IL

Number: 555-16-04

WEI GRAIN SIZE IDH 5551604.GPJ US_LAB.GDT 10/12/18

APPENDIX D

Preliminary Design Drawings

MATCH LINE STA 7000+00 = 7476+00, IL 59 SHEET 4 OF 40

MATCH LINE STA. 7014+50 SHEET 6 OF 40

TO OUTLET 59-1

INV (587.50)

2-5' X 3' RCBC

CULVERT TO BE ANALYZED IN PHASE II, MINIMUM SIZE 24"

REMOVE STORM SEWER

IL 59 (DDI NB)

MAJOR CULVERT 099-0351

INV (587.30)

INV 601.00

COMB CC&G TB6.24

SEIL RD

INV 590.50

FILL 24" RCP

INV 596.00

INV 599.00

COMB CC&G TB9.24

E IL 59 (DDI SB)

IL 59 (DDI SB)

RAMP D SOUTH

E RAMP D NORTH

HMA SHOULDER

CC&G TB-6.24

PROP 2-5'x3' RCBC EXTENSION INV 586.43

PROP 10' WIDE DITCH

INV 587.50

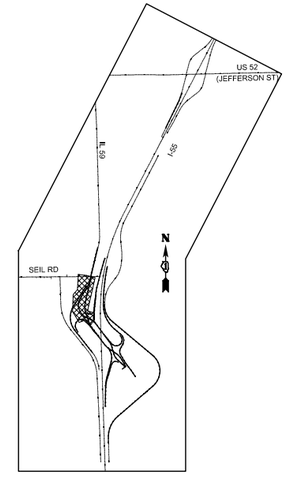
PROP 2-5'x3' RCBC EXTENSION INV 586.08

2-5'X3' RCBC INV 586.05

EX. 2 - 5'X3' RCBC

FOR DITCH LAYOUT AND PROFILE SEE RAMP D SOUTH, SHT 21 OF 40

REGRADE EXISTING GROUND TO PROVIDE POSITIVE DRAINAGE TO PROP DITCH



FOR LEGEND SEE SHEET 1 OF 40

SCALE: 1"=50'-0"

PROFILE

PR PGL

EX GROUND AT PGL

LEFT DITCH PROFILE

RIGHT DITCH PROFILE

PROP 2-5'X3' RCBC, 7001+46, RT INV 586.08

PROP 2-5'X3' RCBC 7002+13, RT INV 586.43

-0.16% -1.03% -1.88% +0.41% -1.03% +2.00% +1.50% +2.97% +2.00% +2.00% +2.64% +2.64%

+00, LT EL 601.00

+15, LT EL 590.50

+00, LT EL 596.00

+00, LT EL 599.00

HORIZONTAL SCALE: 1" = 50'-0"

VERTICAL SCALE: 1" = 5'-0"

EX PGL / PR PGL	7000+00	7001+00	7002+00	7003+00	7004+00	7005+00	7006+00	7007+00	7008+00	7009+00	7010+00	7011+00	7012+00	7013+00	7014+00
EX PGL	611.42	611.68 / 611.33	611.50 / 611.20	611.26 / 610.87	610.52 / 610.37	609.67 / 609.86	609.02 / 609.35	607.16 / 608.83	601.98 / 608.32	595.12 / 607.81	590.37 / 607.30	592.85 / 606.78	592.74 / 606.27	592.77 / 605.76	592.88 / 605.33	592.89 / 605.44	592.84 / 606.19	592.93 / 607.19	593.00 / 608.19	593.26 / 609.19	594.56 / 610.19	601.46 / 611.19	598.42 / 612.19	594.36 / 613.19	595.11 / 614.19	595.17 / 615.19	601.05 / 616.19	609.78 / 617.29	618.13 / 618.61	619.79 / 619.93

EXHIBIT 2-00a

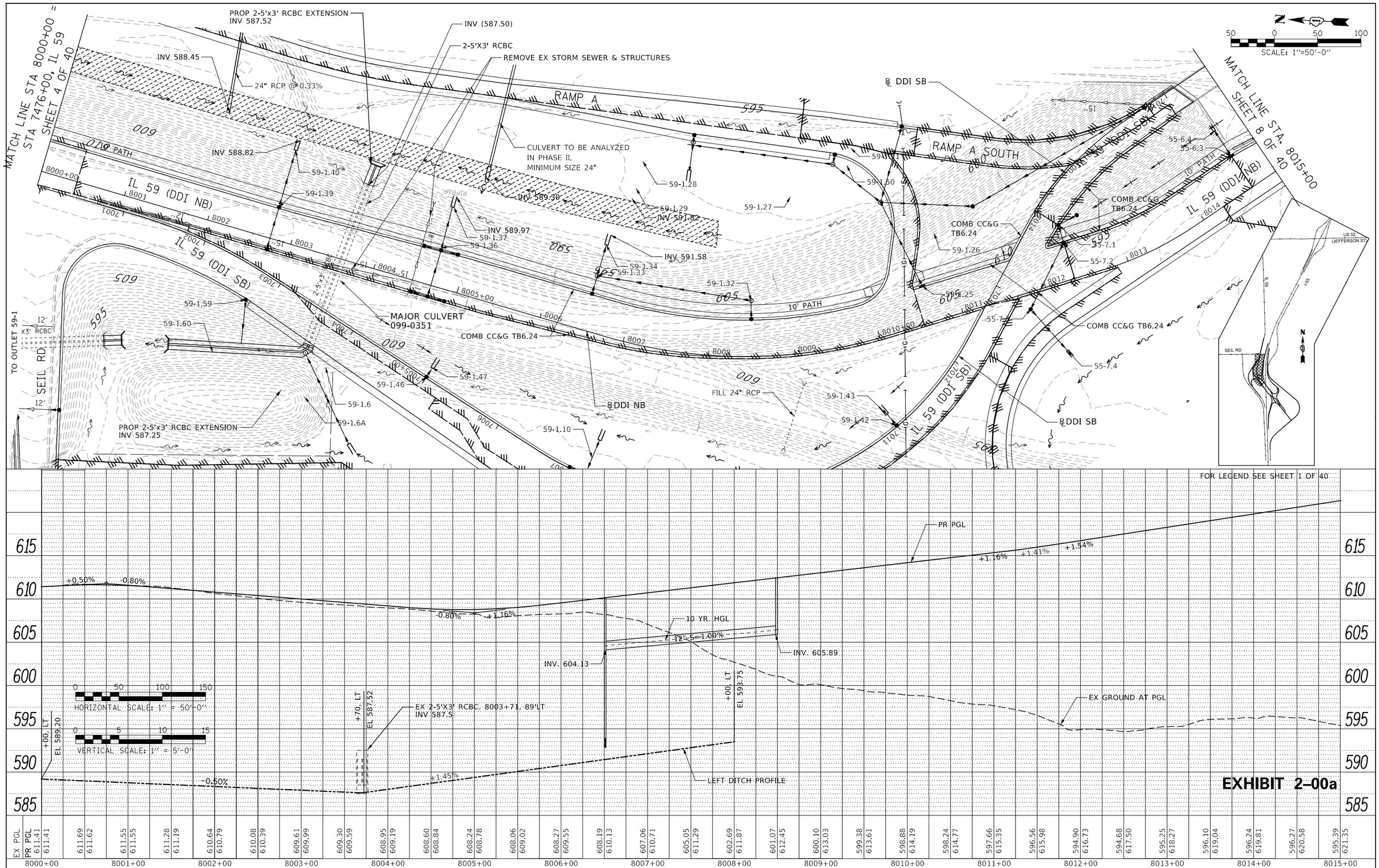
FILE NAME =	USER NAME = rmchugh	DESIGNED - RM	REVISED -
D1155ATIL59-sht-drain-02-DDI-South.dgn		DRAWN - SP	REVISED -
	PLOT SCALE = 1:100	CHECKED -	REVISED -
	PLOT DATE = 11/1/2018	DATE - 10/5/2018	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 59 DDI SOUTHBOUND
PROPOSED DRAINAGE PLAN

SCALE: 1"=50' | SHEET OF SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
55		WILL	40	7
		CONTRACT NO.		
		ILLINOIS FED. AID PROJECT	P-91-015-19	



PLAN — SURVEYED; PLOTTED; CROSS CHECKED; ALIGNMENT CHECKED; RT. OF WAY CHECKED; CADD FILE NAME; NOTE BOOK; NO.; BY; DATE

PROFILE — SURVEYED; PLOTTED; CROSS CHECKED; BM. NOTED; STRUCTURE NOTATNS CHKD; NOTE BOOK; NO.; BY; DATE

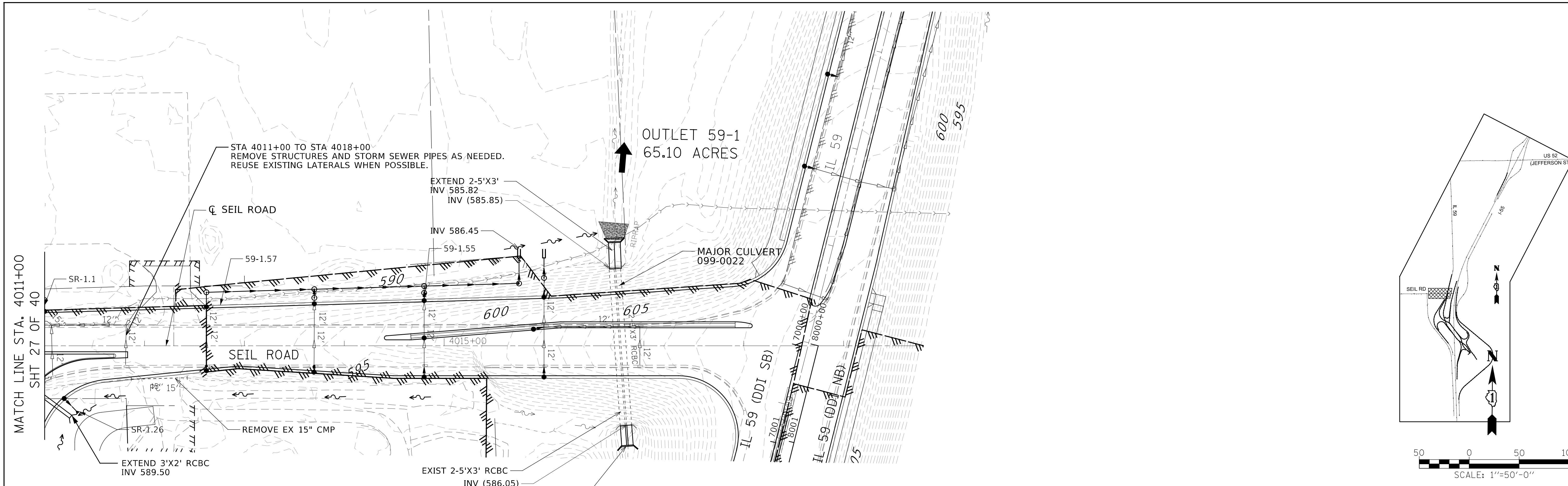
FILE NAME = D1155ATIL59-sht-drain-04-DDI-North.dgn	USER NAME = rmchugh	DESIGNED - RM	REVISED -
		DRAWN - SP	REVISED -
	PLOT SCALE = 1:100	CHECKED -	REVISED -
	PLOT DATE = 11/1/2018	DATE - 10/5/2018	REVISED -

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

IL 59 DDI NORTHBOUND
PROPOSED DRAINAGE PLAN

SCALE: 1"=50' | SHEET OF SHEETS | STA. | TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
55		WILL	40	9
		CONTRACT NO.		
	ILLINOIS FED. AID PROJECT	P-91-015-19		



FILE NAME = D1155ATIL59-sht-drain-24-SEILRD2.dgn	USER NAME = rmchugh	DESIGNED - RM	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	SEIL ROAD PROPOSED DRAINAGE PLAN
		DRAWN - SP	REVISED -		
	PLOT SCALE = 1:100	CHECKED -	REVISED -		
	PLOT DATE = 11/1/2018	DATE - 10/5/2018	REVISED -		SCALE: 1"=50' SHEET OF SHEETS STA. TO STA.

F.A. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
55		WILL	40	30
		CONTRACT NO.		
	ILLINOIS	FED. AID PROJECT	P-91-015-19	