Illinois Department of Transportation

Abbreviated Structure Geotechnical Report

Original Report Date: 1/31/2024	**Proposed SN:** 101-1360	**Route:**	F.A.I. RTE. 39
Revised Date:	**Existing SN:** 101-0215	**Section:**	(201-3)K and (4-1,5)R
Geotechnical Engineer: Matt D. Masterson, PE		**County:**	Winnebago
Structural Engineer: Moshe Cohen, PE, SE		**Contract:**	64C62

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing): The proposed new structure at I-39/US Rte. 20 over Cherry Valley Path will be a single barrel pre-cast concrete box culvert with an interior cross section of 12' across by 10' high with an approximate length of 258'. See Location Map - Exhibit A, and the TS&L drawing - Exhibit C for more details.

Discuss the existing boring data, existing plans foundation information, new subsurface exploration and need for any additional exploration to be provided with SGR Technical Memo (attach all data and subsurface profile plot): Three boring logs were provided to Kaskaskia Engineering Group, LLC. by IDOT for borings B-1 through B-3. Borings B-1 through B-3 were drilled in August 2020. Locations of the borings are as shown on the attached Boring Location Plan (Exhibit B). Boring B-1 started an an elevation of 759.95' and was drilled on the interior shoulder of the southbound lane. It consisted of a small layer of rock from the shoulder followed by layers of sandy loam and sandy gravel. B-1 was terminated at a depth of 31 ft at El. 728.95. Boring B-2 started at an elevation of 749.04 and was drilled at the bottom of the exterior slope of the northbound lanes. It consisted of a layer of sandy loam followed by sandy gravel. B-2 was terminated at a depth of 26 ft at El. 723.04. Boring B-3 started at an elevation of 747.46' and was drilled in a clearing near Cherry Valley Path and Madigan Creek located at the bottom of the exterior slope of the southbound lanes. It consisted of a layer of sandy loam followed by very dense limestone. B-3 was terminated at a depth of 12.5 ft at EL. 734.96. See Boring Logs - Exhibit D and Subsurface Profile - Exhibit E for additional details.

Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary: The bearing pressure of the proposed structure is less than the bearing pressure of the existing soil, so no settlement is to be expected. The bearing capacity of the sandy gravel soil located at the base of the proposed culvert is 82.5 ksf, which is well above the 639 psf bearing pressure of the culvert and soil. See Bearing Capacity Calculations - Exhibit G for additional details.

Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis or ground improvement/treatment is necessary: The TS&L indicates new fill for the East and West ends of the culvert with a height of approximately 10 ft. The slope of the West abutment will be 2H:1V while the slope of the East Abutment will be 3H:1V. Stability analysis using SLOPE/W was performed using the proposed roadway and culvert geometry on the TS&L and soil characteristics from Boring B-1. Two conditions were modeled for each scenario: end-of-construction and long-term stability. A critical factor of safety (FOS) was calculated for each condition. According to current standard of practice, the target FOS is 1.5 for end-of-construction and long-term slope stability. The slope stability analyses indicated that the required minimum FOS for all conditions were met. To model the end-of-construction condition, full cohesion and a friction angle of 0 degrees were assumed. Nominal values for cohesion were used with full friction angle to model the long-term condition to analyze the theoretical condition where pore water pressure has dissipated. Nominal values were between 50 and 250 psf for the cohesive soils, with friction angles between 26 and 38 degrees. The Bishop Circular Method, which generates circular-shaped failure surfaces, was used to calculate the critical failure surfaces and FOS for the proposed conditions. The FOS obtained in the analysis is summarized below.

West Abutment: End of Construction= 3.9 Long Term= 2.0
East Abutment: End of Construction= 4.8 Long Term= 1.9

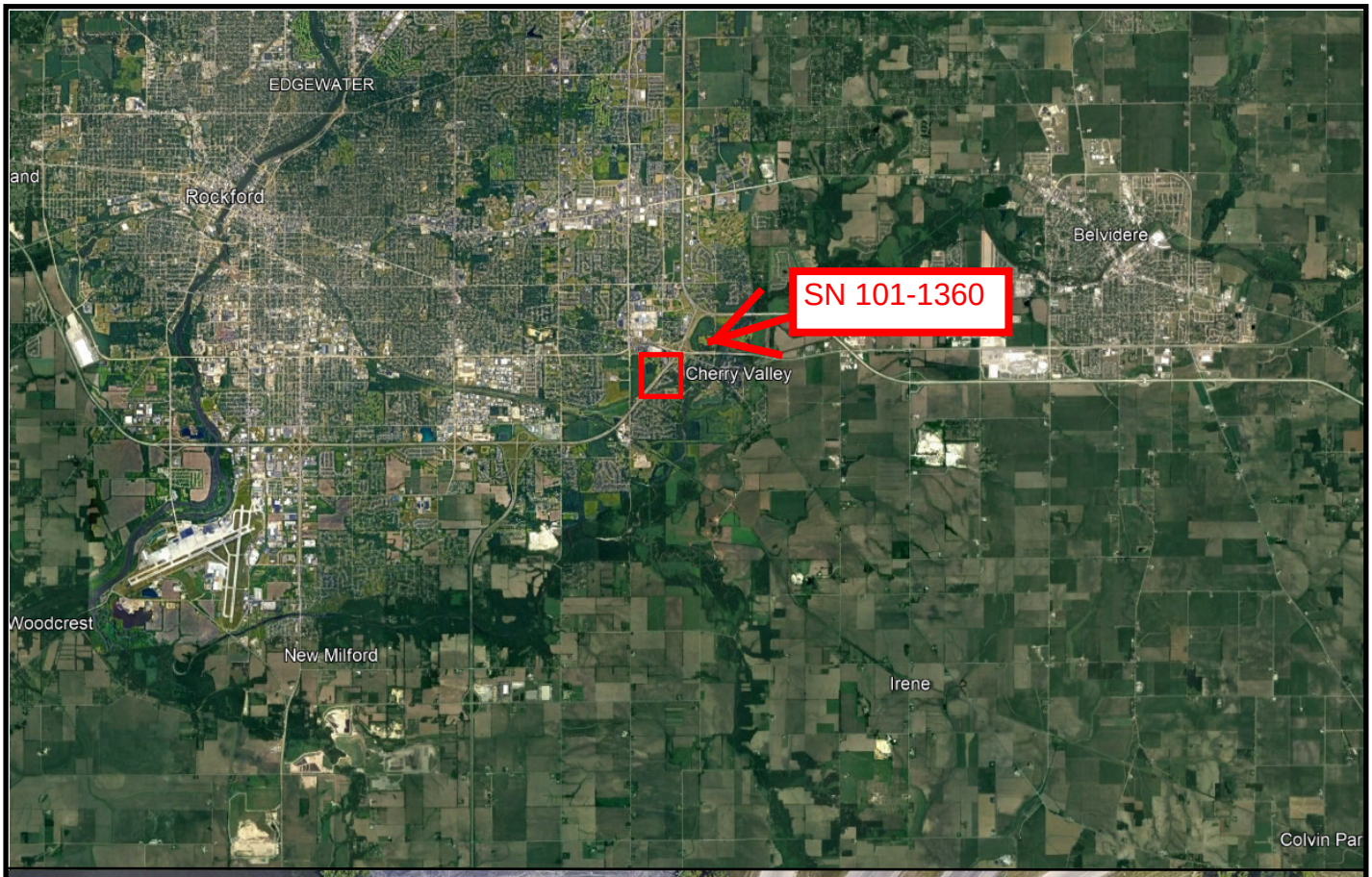
The results indicate that an acceptable FOS. will exist under undrained and drained conditions. No additional ground improvement/treatments are necessary for long term support of the proposed slopes. Results of the slope stability analysis are attached in Exhibit F - Slope Stability Analysis.

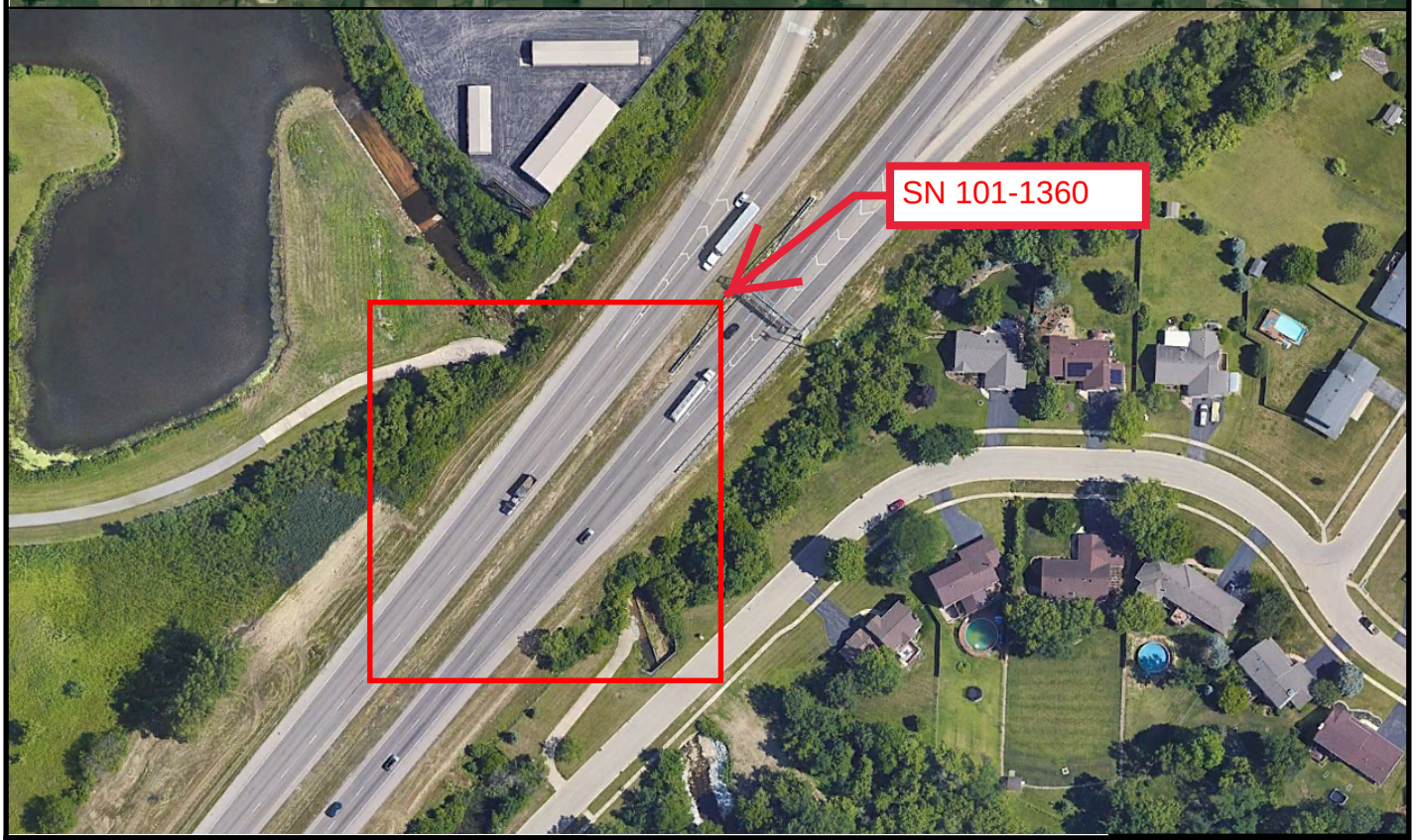
Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations: Not applicable for this structure.

Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable: As per Bridge Manual v. 2012, Section 2.3.10, seismic data is not required for buried structures.
Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored bearing resistance and unit sliding resistance at various elevations and confirm no ground improvement/treatment is necessary where spread footings are proposed. Estimated top of rock elevations as well as preliminary factored unit side and tip resistance values shall be indicated when drilled shafts are proposed: The soils are sufficient for support of the proposed box culvert according to the analysis done for bearing capacity attached as Exhibit G.
Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat: Not applicable for this structure.
Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns: Temporary Soil Retention Systems may be required for support of any required Staged construction for retained heights greater than 15 feet and should be designed in accordance with IDOT Design Guide 3.13.1 - Temporary Sheet Piling Design.

EXHIBIT A

LOCATION MAP





Kaskaskia Engineering Group, LLC

LOCATION MAP

I-39 over Cherry Valley Path
Section (201-3)K & (4-1,5)R
Winnebago County, Illinois

Exhibit No.

A

KEG JOB #19-1138.00

EXHIBIT B

BORING PLAN

Kaskaskia Engineering Group, LLC

BORING LOCATION MAP

I-39 over Cherry Valley Path
Section (201-3)K & (4-1,5)R
Winnebago County, Illinois

Exhibit No.

B

KEG JOB #19-1138.00

EXHIBIT C

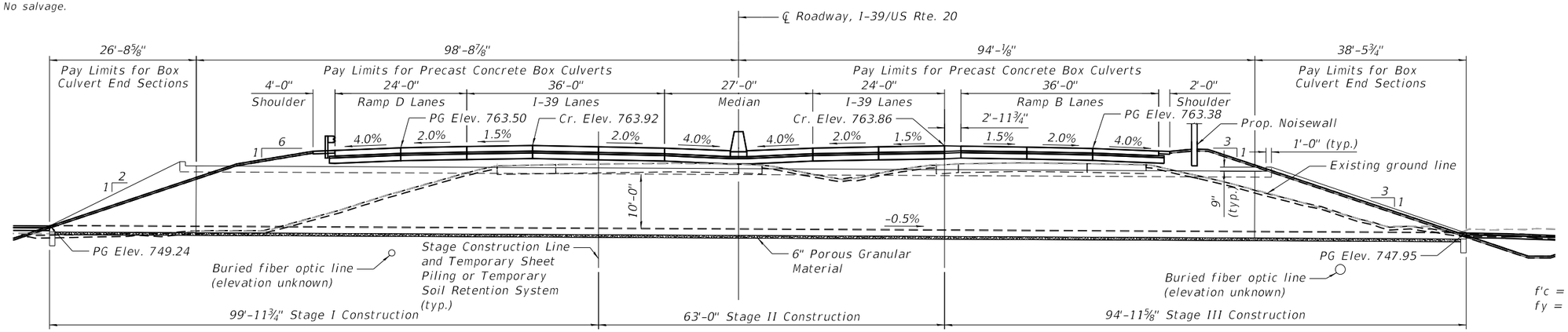
TYPE, SIZE AND LOCATION PLAN

Benchmark: BM #402 – Cut square in southeast wingwall of S.N. 101-0070. Elevation 796.69.

Existing structure: None

Structure to be constructed under stage construction. See Roadway plans for traffic staging.

No salvage.



ELEVATION

Note:
Grading details are still being finalized. The length of the culvert may change and guardrail may need to be added.

DESIGN STRESSES

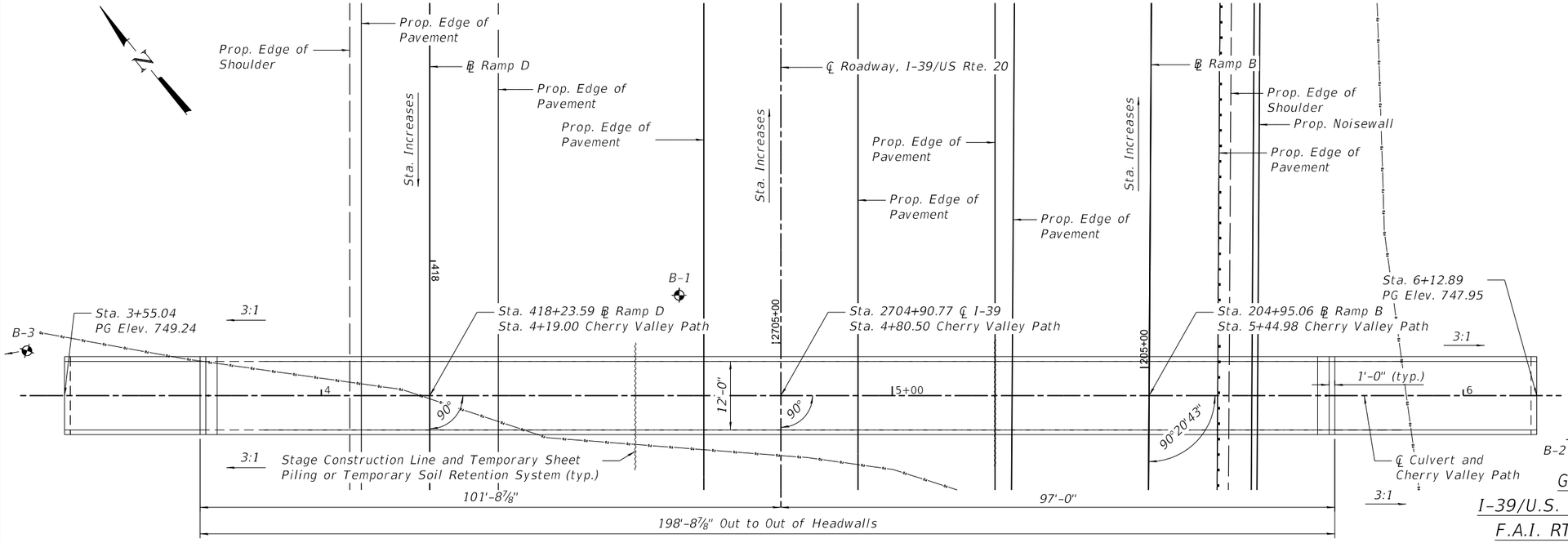
PRECAST UNITS

f'c = 5,000 psi
fy = 65,000 psi (Welded Wire Reinforcement)

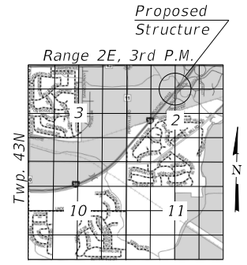
LOADING HL-93

DESIGN SPECIFICATIONS

2020 AASHTO LRFD Bridge Design Specifications, 9th Edition



PLAN



LOCATION SKETCH

HIGHWAY CLASSIFICATION

F.A.I. Rte. 39 – I-39/U.S. Rte. 20
Functional Class: Interstate
ADT: 44,600 (2013); 106,610 (2040)
ADTT: 12,950 (2013); 32,000 (2040)
DHV: 10,600 (2040)
Design Speed: 70 m.p.h.
Posted Speed: 65 m.p.h.

GENERAL PLAN AND ELEVATION
I-39/U.S. ROUTE 20 OVER CHERRY VALLEY PATH
F.A.I. RTE. 39 SECTIONS (201-3)K & (4-1,5)R
WINNEBAGO COUNTY
STATION 2704+90.77
S.N. 101-XXXX

Kaskaskia Engineering Group, LLC
200 E. Main St., Suite 100, Salem, Illinois 62220
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618.233.5977 fax
www.kaskaskiaeng.com
PROFESSIONAL REGISTRATIONS
Illinois Professional Design Firm – LICENSE NO. 184.005733
Professional Engineering Group – LICENSE NO. 20-3680586

USER NAME =	DESIGNED - MLC	REVISED -	
	CHECKED - MMC	REVISED -	
PLOT SCALE =	DRAWN - MLC	REVISED -	
PLOT DATE =	CHECKED - MMC	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 1 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
39	(201-3)K & (4-1,5)R	WINNEBAGO		
		CONTRACT NO. 64C62		
	ILLINOIS	FED. AID PROJECT		

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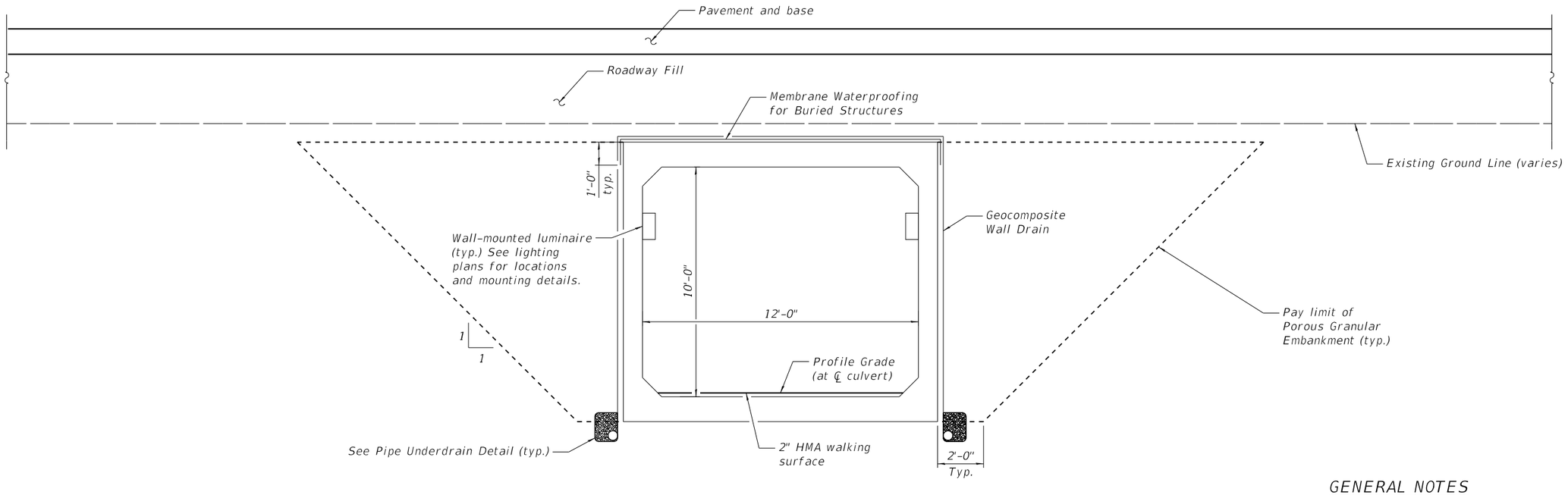
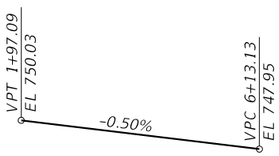
10/20/2023 8:20:36 AM

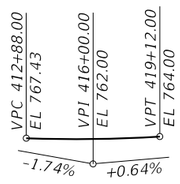


SECTION THRU BARREL



PROPOSED PROFILE

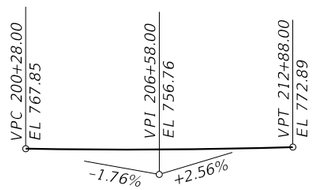
Along ℄ Cherry Valley Path



L = 624'

PROPOSED PROFILE

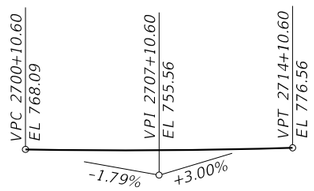
Along ℄ Ramp D



L = 1,260'

PROPOSED PROFILE

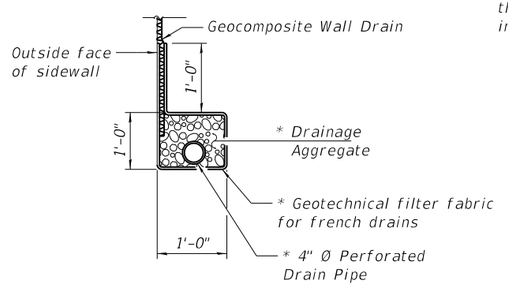
Along ℄ Ramp B



L = 1400'

PROPOSED PROFILE

Along I-39/U.S. Route 20



PIPE UNDERDRAIN DETAIL

* Cost Included with Pipe Underdrains for Structures 4". All draiange components shall extend to 2'-0" from the end of each wingwall, except an outlet pipe shall extend until interesecting with side slopes. The pipes shall drain into concrete headwalls. See Highway Standard 601101.

GENERAL NOTES

The design fill height for this box is 5 ft. The precast box culvert sections shall conform to the requirements of ASTM C 1577.

Nonwoven geotextile fabric shall conform to the requirements of Art. 1080.01 of the Standard Specifications. The minimum weight of the fabric shall be 6 ounces per square yard.

Precast concrete box culverts and box culvert end sections shall be backfilled with Porous Granular Embankment in the required excavation areas on the sides of the box culvert from the top of the box culvert to the bottom of the box culvert. This area of PGE is included in the Porous Granular Embankment pay item. The 6-inch thick layer of porous granular material required under the precast concrete box culvert, according to Section 540.06 of the standard specifications, shall also apply to the end sections. Cost of this porous granular material will not be paid for separately but shall be included in the unit price of the work for which it is required.

DETAILS

I-39/U.S. ROUTE 20 OVER CHERRY VALLEY PATH

F.A.I. RTE. 39 SECTIONS (201-3)K & (4-1,5)R

WINNEBAGO COUNTY

STATION 2704+90.77

S.N. 101-XXXX

MODEL: Default
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10/20/2023 8:20:43 AM

Kaskaskia Engineering Group, LLC
PROFESSIONAL REGISTRATIONS
Illinois Professional Design Firm 184.004773
Professional Engineering Group 20-5000186
LICENSE NO.

USER NAME =	DESIGNED -	REVISED -	
	CHECKED -	REVISED -	
PLOT SCALE =	DRAWN -	REVISED -	
PLOT DATE =	CHECKED -	REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET 2 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
39	(201-3)K & (4-1,5)R	WINNEBAGO		
		CONTRACT NO. 64C62		
	ILLINOIS	FED. AID PROJECT		

EXHIBIT D

BORING LOGS

Illinois Department of Transportation
Division of Highways
IDOT

SOIL BORING LOG

Date 8/4/20

ROUTE I-39/US Bypass 20 **DESCRIPTION** P92-111-06 - Proposed bike path under US 20, W of Madigan Creek **LOGGED BY** W. Garza

SECTION (201-3)K & (4-1,5)R **LOCATION** Cherry Valley, NW2, **SEC.** , **TWP.** 43N, **RNG.** 2E

COUNTY Winnebago **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME-45 Automatic

STRUCT. NO. 101-0215
Station

Latitude 42° 14' 06.40" **Longitude** -88° 58' 13.03"
Northing 2,030,472.4837 **Easting** 2,620,567.0446

BORING NO. B-1
Station 2705+10
Offset 14.00ft Lt of CL
Ground Surface Elev. 759.95 ft

Surface Water Elev. ft
Stream Bed Elev. 86.00 ft

Groundwater Elev.:
First Encounter 743.0 ft ▼
Upon Completion 737.5 ft ▽
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
Shoulder Rock				
758.95				
MEDIUM tan SANDY LOAM		2 3 6	0.5 P	
756.45				
STIFF tan SANDY LOAM	-5	6 8 6	1.7 B	13.0
753.95				
STIFF gray SILTY CLAY LOAM		3 4 8	1.1 P	17.0
750.45				
VERY DENSE tan BIG GRAVEL Auger Refusal at 10' Moved 2705+07	-10	4 50 for 2"		
748.95				
MEDIUM tan/brown DIRTY SANDY GRAVEL		6 9 8		
746.45				
MEDIUM tan moist MEDIUM COARSE SAND	-15	3 8 10		
743.95				
▼				
DENSE tan SANDY GRAVEL		10 14 25		
741.45				
	-20	6		

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
DENSE tan SANDY GRAVEL		15 21		
738.95				
5' Run *(continued)*				
▽				
DENSE tan SANDY GRAVEL	-25	18 24 25		
5' Run				
733.95				
VERY DENSE tan SANDY GRAVEL	-30	34 36 29		
728.95				
End of Boring				
	-35			
	-40			

Northing and Easting were calculated using the ILHP-WF coordinate system

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
IDOT

SOIL BORING LOG

Date 8/13/20

ROUTE I-39/US Bypass 20 **DESCRIPTION** P92-111-06 - Proposed bike path under US 20, W of Madigan Creek **LOGGED BY** W. Garza

SECTION (201-3)K & (4-1,5)R **LOCATION** Cherry Valley, NW2, **SEC.** , **TWP.** 43N, **RNG.** 2E

COUNTY Winnebago **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME-45 Automatic

STRUCT. NO. 101-0215
Station

Latitude 42° 14' 05.22" **Longitude** -88° 58' 11.63"
Northing 2,030,354.7913 **Easting** 2,620,673.5201

BORING NO. B-2
Station 2704+95
Offset 110.00ft Rt of CL
Ground Surface Elev. 749.04 ft

Surface Water Elev. ft
Stream Bed Elev. ft
Groundwater Elev.:
First Encounter 739.5 ft ▼
Upon Completion ft
After Hrs. ft

	DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
HARD light brown SANDY LOAM			4.0 P	9.0
747.04				
HARD light brown SANDY LOAM		6 5 7	4.0 P	12.0
744.54				
MEDIUM tan dirty MEDIUM SAND MEDIUM GRAVEL	-5	5 5 14		
743.04				
MEDIUM tan SAND with MEDIUM GRAVEL		4 7 10		
740.54				
MEDIUM tan SANDY GRAVEL ▼	-10	7 11 12		
738.04				
MEDIUM tan SANDY GRAVEL		9 11 16		
735.54				
VERY DENSE tan SANDY GRAVEL	-15	21 21 32		
5' Run				
733.04				
	-20	18		
DENSE tan SAND with MEDIUM GRAVEL		15 16		
728.04				
5' Run *(continued)*				
MEDIUM tan SANDY GRAVEL	-25	15 14 15		
723.04				
End of Boring				
	-30			
	-35			
	-40			

Northing and Easting were calculated using the ILHP-WF coordinate system

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
IDOT

SOIL BORING LOG

Date 8/27/20

ROUTE I-39/US Bypass 20 **DESCRIPTION** P92-111-06 - Proposed bike path under US 20, W of Madigan Creek **LOGGED BY** W. Garza

SECTION (201-3)K & (4-1,5)R **LOCATION** Cherry Valley, NW2, **SEC.** , **TWP.** 43N, **RNG.** 2E

COUNTY Winnebago **DRILLING METHOD** Hollow Stem Auger **HAMMER TYPE** CME-45 Automatic

STRUCT. NO. 101-0215
Station

Latitude 42° 14' 07.13" **Longitude** -88° 58' 14.45"
Northing 2,030,544.9548 **Easting** 2,620,458.7671

BORING NO. B-3
Station 2705+10
Offset 156.00ft Lt of CL
Ground Surface Elev. 747.46 ft

Surface Water Elev. ft
Stream Bed Elev. 14.30 ft

Groundwater Elev.:
First Encounter 738.0 ft ▼
Upon Completion Wash ft
After Hrs. ft

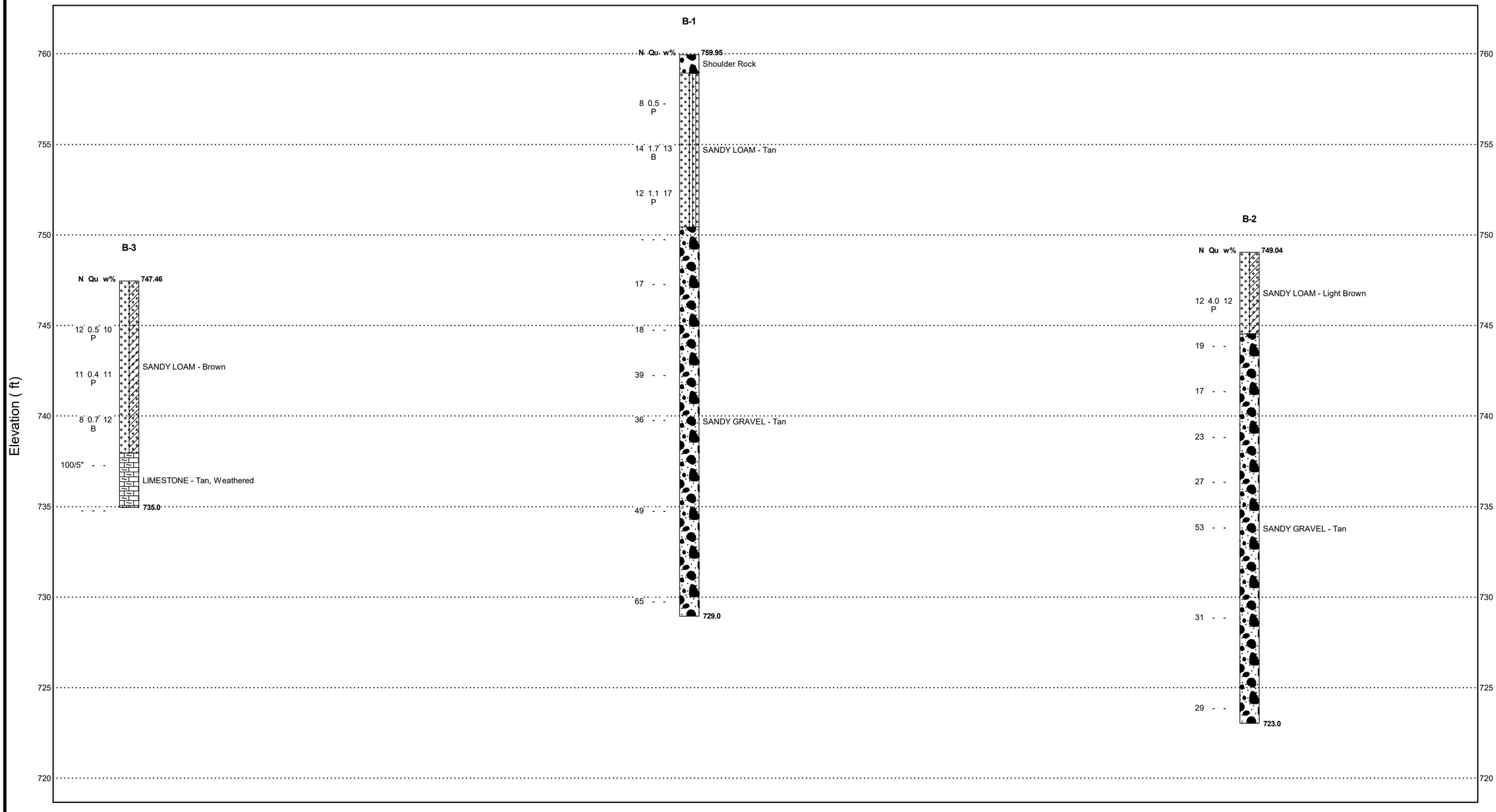
		DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)
SOFT brown SANDY LOAM				0.3 P	23.0
	745.46				
MEDIUM tan SANDY LOAM with GRAVEL			6 4 8	0.5 P	10.0
	743.96				
SOFT tan SANDY LOAM with GRAVEL		-5	4 5 6	0.4 P	11.0
	741.46				
MEDIUM tan SANDY LOAM GRAVEL with FINE SAND LENS			3 4 4	0.7 B	12.0
	737.96 ▼				
VERY DENSE tan WEATHERED LIMESTONE		-10	3 11 100 for 5"		
18" Wash	736.46				
VERY DENSE tan WEATHERED LIMESTONE	734.96		100 for 2"		
End of Boring		-15			
		-20			

Northing and Easting were calculated using the ILHP-WF coordinate system

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)

EXHIBIT E

SUBSURFACE PROFILE



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618.233.5877 phone
618.233.5977 fax
www.kaskaskiaeng.com

PROFESSIONAL REGISTRATIONS	LICENSE NO.
Illinois Professional Design Firm	184.004773
Professional Engineering Group	20-5080586

NOT TO HORIZONTAL SCALE

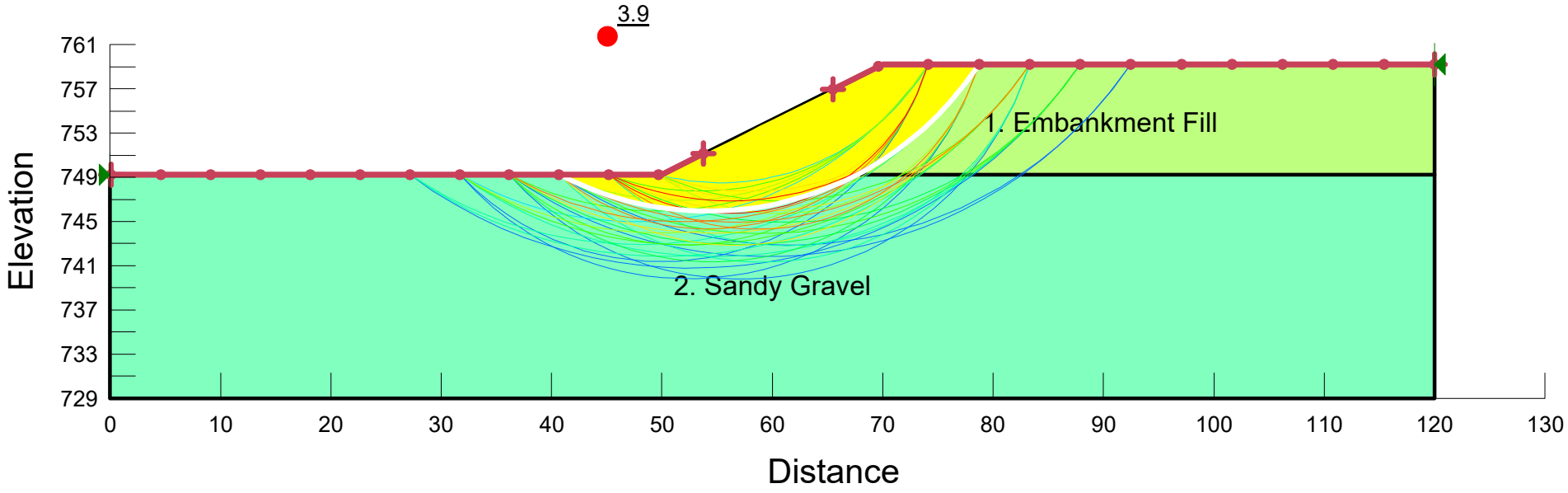
SUBSURFACE PROFILE

Route: F.A.I. RTE. 39
Section: (201-3)K and (4-1,5)R
County: Winnebago

EXHIBIT F

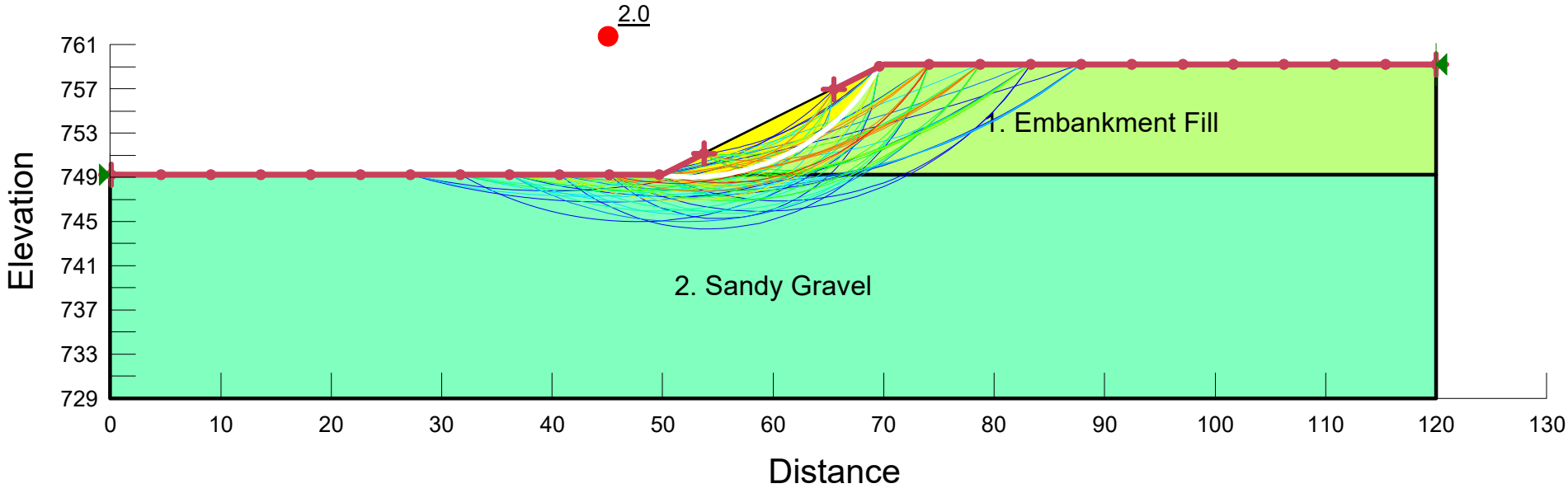
SLOPE/W SLOPE STABILITY ANALYSIS

Cherry Valley Path Culvert
Boring B-1 - West Abutment
End-of-Construction (Undrained Analysis)



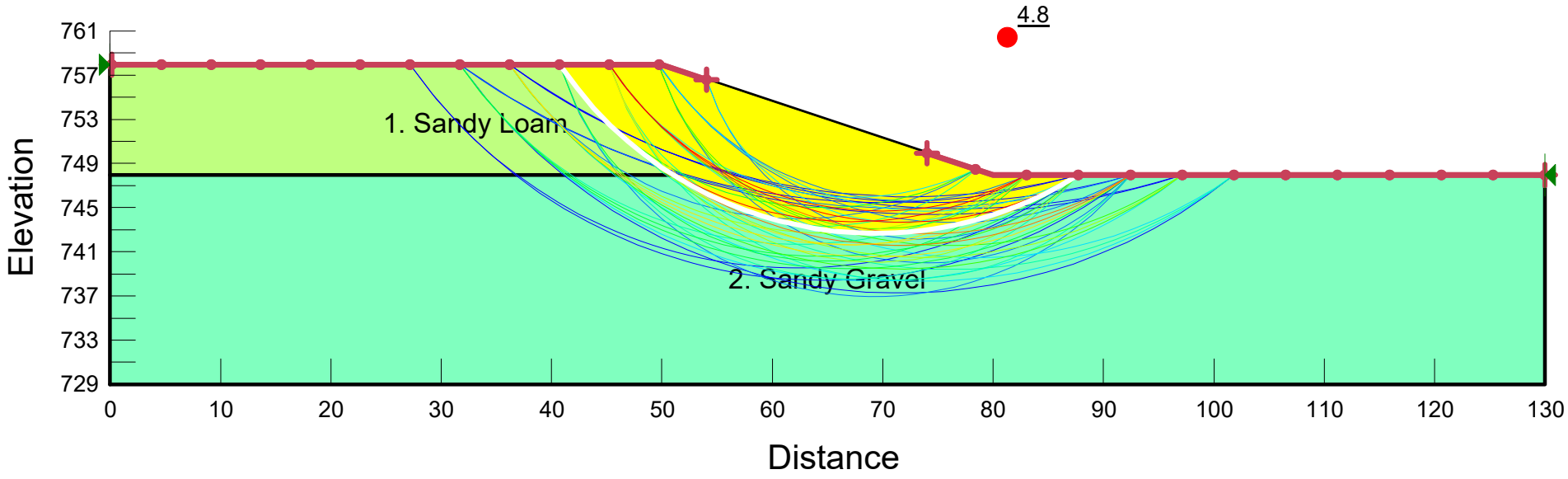
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	1. Embankment Fill	Mohr-Coulomb	125	1,000	0	0
	2. Sandy Gravel	Mohr-Coulomb	120	0	38	0

Cherry Valley Path Culvert
Boring B-1 - West Abutment
Long Term (Drained Analysis)



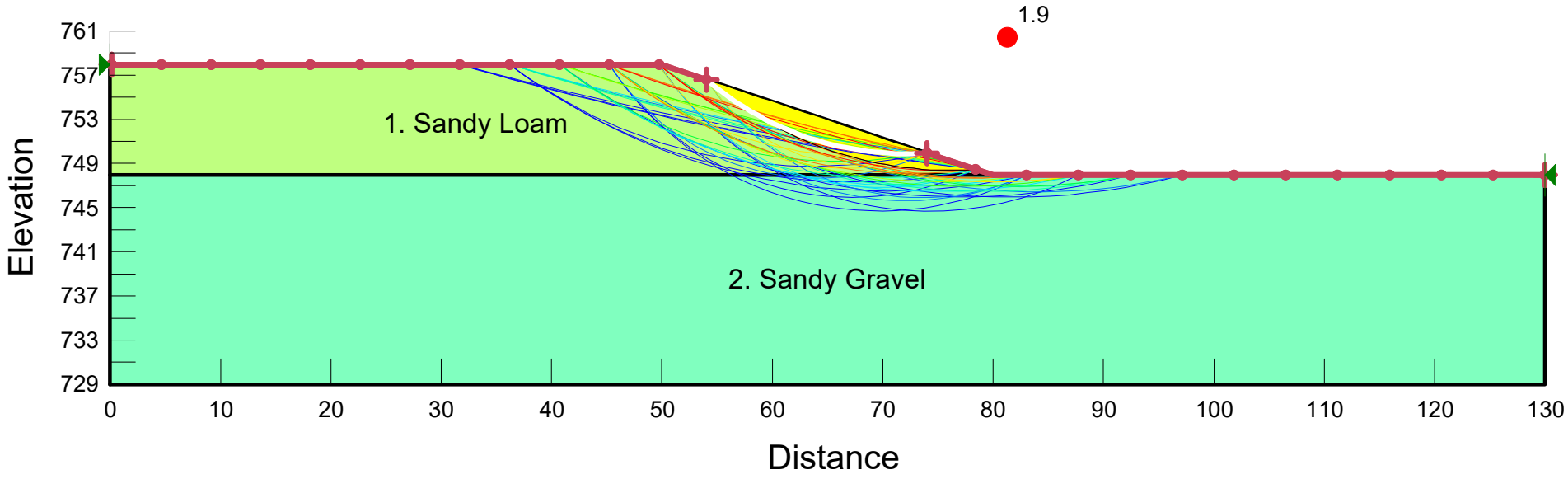
Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	1. Embankment Fill	Mohr-Coulomb	125	100	26	0
	2. Sandy Gravel	Mohr-Coulomb	120	0	38	0

Cherry Valley Path Culvert
Boring B-1 - East Abutment
End-of-Construction (Undrained Analysis)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	1. Sandy Loam	Mohr-Coulomb	120	1,100	0	0
	2. Sandy Gravel	Mohr-Coulomb	120	0	38	0

Cherry Valley Path Culvert
Boring B-1 - East Abutment
Long Term (Drained Analysis)



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Effective Cohesion (psf)	Effective Friction Angle (°)	Phi-B (°)
	1. Sandy Loam	Mohr-Coulomb	120	0	30	0
	2. Sandy Gravel	Mohr-Coulomb	120	0	38	0

EXHIBIT G

BEARING RESISTANCE CALCULATIONS

Kaskaskia
Engineering Group, LLC
208 E. Main Street
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Project Title: Cherry Valley Path culvert Sheet: 1 of 1
Project Number: 19-1138.00
Calculated By: MTH Date: 1/8/24
Checked By: MDM Date: 1/31/2024
Comments: Bearing Capacity

Culvert Bearing Resistance (Boring B-1)

Bearing on Sandy Gravel Layer $\Rightarrow \gamma = 120$ pcf
$\phi = 38°$
$C = 0$ psf
$D_f = 13'$
$N'_c = 77.50$
$N'_q = 61.55$
$N'_\gamma = 78.61$
$B = 14'$

σ_{VD} = 10' Fill material + 3' Sandy gravel
$= 10'(125\text{ pcf}) + 3'(120\text{ pcf})$
$= 1{,}610$ psf
* Bearing for Full Soil Column

Bearing capacity for continuous foundation (Terzaghi)

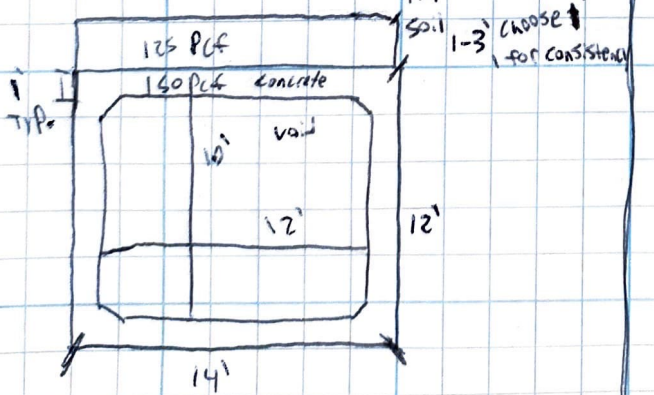
$$q_{ult} = \cancel{c' N'_c} + \sigma_{VD} N_q + \frac{1}{2}\gamma' B N_\gamma$$

$$q_{ult} = 0 + (1610)(61.55) + \frac{1}{2}(120)(14)(78.61)$$

$$q_{ult} = 165{,}125 \text{ psf}$$

$$q_{all} = \frac{q_{ult}}{FS} = \frac{165{,}125}{2.0} = 82{,}562 \text{ psf}$$

* Bearing for culvert section



$\sigma_{VD} = \frac{\text{weight soil}}{B} + \frac{\text{weight Concrete}}{B}$

$= \frac{(125 \times 1' \times 14')}{14'} + \frac{(150 \times 1' \times 48')}{14'}$

$= 639.28$ psf

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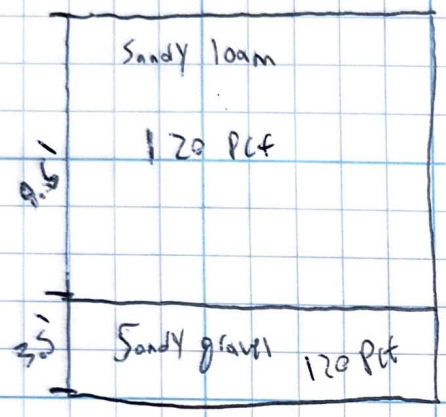
Project Title: Cherry Valley Path Culvert Sheet: 2 of 2
Project Number: 19-1139.00
Calculated By: MTH Date: 1/8/24
Checked By: MDM Date: 1/31/2024
Comments: Bearing Capacity

* Existing Soil Bearing Pressure



σ_{zp} = Sandy loam + Sandy gravel
γ h γ h
$= (120)(4.5')$ $+ (120)(3.5')$

$= 1,560$ psf