

STRUCTURE GEOTECHNICAL REPORT

068-0509

Existing SN: 068-0017

IL 16 over Sangamon Creek
FAP 325
Section 18(B-2,B-3)
Montgomery County

D-96-522-05
Contract 72984

Prepared By: Brian Laningham
IDOT Region 4 District 6
Geotechnical Unit
217-782-6709

Checked By: JKL

Approved By: B L C

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D-6 Geotechnical Engr.
Lic. #062-053757

Date: August 14, 2019

Date: 8-14-19

Prepared For: Fehr-Graham
Consultans

Attachments: Preliminary TSL
Subsurface Profile
Boring Logs
Special Provisions

This Report has been prepared based on a 'Approved' preliminary General Plan Sheet dated April 2012. Contact the author if there are any questions regarding this Report or if there are modifications to structure location, size, geometry, or vertical alignment.

Electronic copies of boring logs are available upon request for inclusion in the plans. Calculations are also available upon request.

This Report has been prepared according to AASHTO Standard Specifications for Highway Bridges 7th Edition 2014 and the 2009 IDOT BBS Bridge Manual

Project Description and Proposed Structure Information

This project consists of the removal of the existing single span, closed abutment bridge and replacing it with a triple barrel box culvert. Work will be performed under stage construction.

The proposed structure consists of a triple 10' x 10' cast in place box culvert. Wingwalls are 16± ft long with a retained height from bottom of footing of 15.5± ft. There is approximately 3 ft of fill above the culvert.

Existing Structure and Site Investigation

The existing structure is a 32± ft span, 32± ft wide closed abutment bridge built in 1923. The abutments are founded on spread footings.

The existing structure is in level terrain. The existing approaches are at or near grade. Land use is a mix of pasture and rural residential. The creek has rip rap lined banks. Existing slopes are approximately 1.5H:1V or flatter. No slope stability or settlement problems have been observed. The channel banks are steeply sloped and are approximately 5 ft high.

New borings were advanced on the existing roadway at the northwest and southeast corners. Borings were advanced to a minimum of 27± ft below streambed by the District 6 drill crew according to AASHTO T 206 and the IDOT Geotechnical Manual.

Boring data indicates approximately 10 ft of silty clay and clay loam over clay loam till. Borings on roadways are filled to prevent a hazard immediately after drilling. As a result, no 24-hour water elevation observations were made. The boring data indicates groundwater was encountered at 670.2 ft.

Geotechnical Evaluation

Settlement. The proposed box culvert produces a net increase in loading. Empirical settlement calculations indicate less than 1.5 in of settlement at the upstream end of the box. At the downstream end the box culvert is founded on clay loam till with a high unconfined compressive strength. Settlement problems are not anticipated.

Slope Stability. The stability of a 1:1 temporary construction slope has been analyzed including excavation to elevation 662.5 ft. The resulting factor-of-safety is 2.3. No problems are anticipated.

Seismic Considerations. Seismic events are not a significant design consideration for culverts. No analysis is required.

Scour. A 100 year scour estimate has not been calculated for the proposed culvert. The design scour elevation should correspond to the bottom of wingwall footing elevation. Based on available information, the upstream design scour elevation is 662.7 ft, and the downstream design scour elevation is 662.5 ft. These elevations may be adjusted during final design.

Mining Activity. ISGS records indicate no mining beneath the proposed structure.

Foundation Evaluation

Culvert Barrel. A pre-cast culvert is feasible at this site. If the pre-cast alternative is selected, cast-in-place headwalls should be included. No ground improvement is required.

Wingwalls. Proposed wingwalls are approximately 16 ft long and have a design height of 15.5 ft. Based on the wingwall geometry and soil conditions a T-Type vertical cantilever design is recommended. Soil conditions provide adequate bearing capacity with less than one inch of settlement. A preliminary has been evaluated to assess spread footing feasibility. The details of the preliminary design are summarized in the following table. It is assumed the structure designer will perform a more detailed footing design. The T-type wall should be designed with no soil above the bottom of footing in the front to accommodate the design scour elevation. Contact the author if a new analysis is needed during final design.

Bottom of Footing Elev.	662.5 ft
Design Height	15.5 ft
Fill Above Stem	3.0ft
Equivalent Fluid Pressure	45 pcf
Footing Width	9.5 ft
Soil Cohesion Below Footing	1.6 ksf
Soil Unit Weight	120 pcf

Equivalent Uniform Bearing Pressure	2.3 ksf
q_{max}	2.9 ksf
$Q_{allowable}$	37 ksf

Footing sliding resistance may be determined using undrained conditions in cohesive soil because it is unlikely drained conditions will occur. The preliminary footing width of 9.5 ft has adequate resistance to sliding. Factor of safety against sliding is 1.2, factor of safety against overturning is 2.3.

The following note should be included on the plans, "Contact the District Geotechnical Engineer to verify foundation conditions meet plan requirements."

Construction Considerations

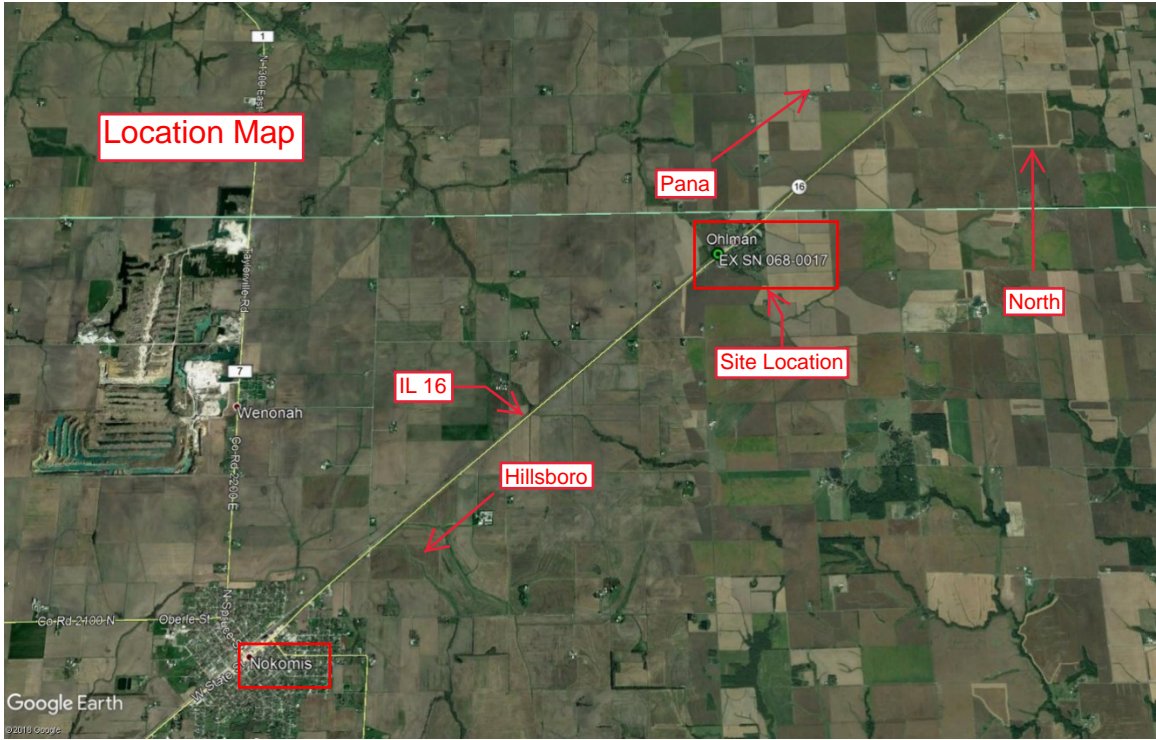
Stage Construction. This project will be constructed under stage construction.

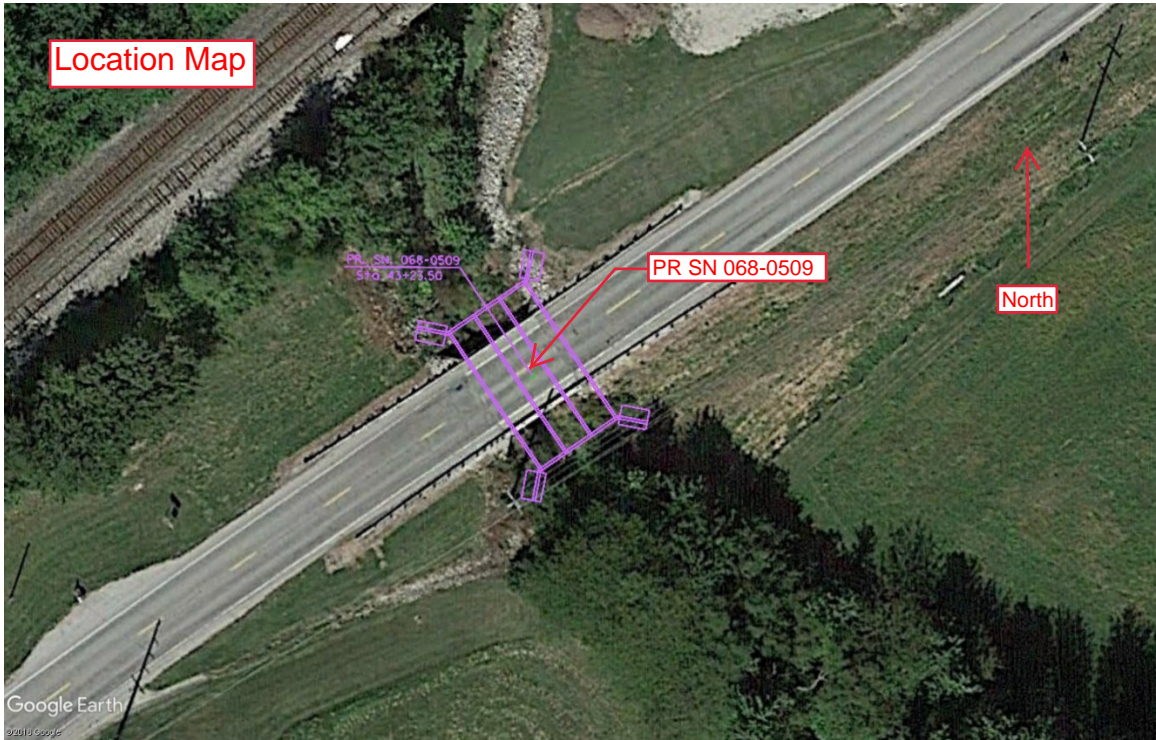
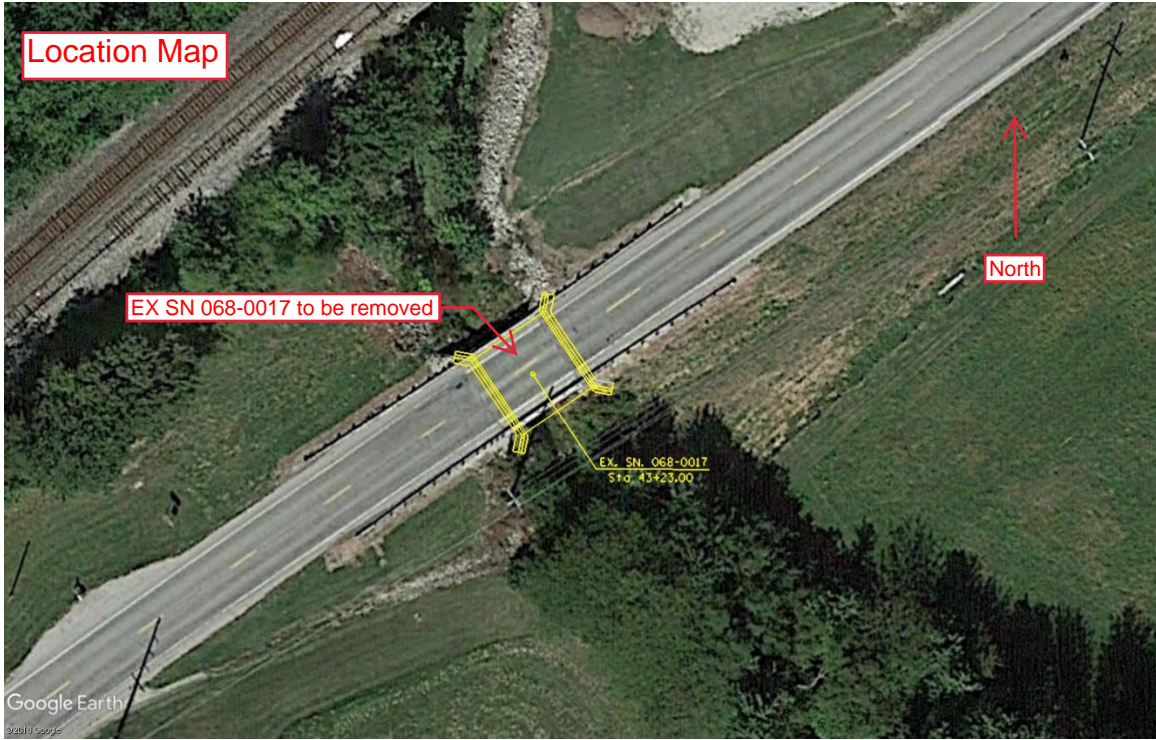
Temporary Soil Retention. Hard Till has been identified directly below the bottom of the proposed box culvert which does not permit adequate sheet pile embedment. Therefore, a Temporary Soil Retention System is required. A 1:1 temporary excavation slope is adequate. For Stage II if there is insufficient room for a 1:1 slope above Stage I construction, the area above the box should be included in the temporary retention system.

Excavation. Existing abutments should be removed to 2 ft below the proposed culvert barrel and should be backfilled with Rockfill - Foundation. The special provision is attached.

Backfill. Backfill should consist of Granular Culvert Backfill. The special provision is attached. A detail showing pay limits should be included. Pay limits include the temporary excavation limits in a section along the roadway and from edge of shoulder to edge of shoulder in a section along the culvert.

Ground Improvement. Minor ground improvement may be required beneath a portion of the culvert barrel. If required, additional Rockfill – Foundation may be used.





Benchmark: Chiseled '□' on Northwest wingwall SH 068-0017, Elev. 679.01 at Sta. 43+38.9, 16.39' Rt.

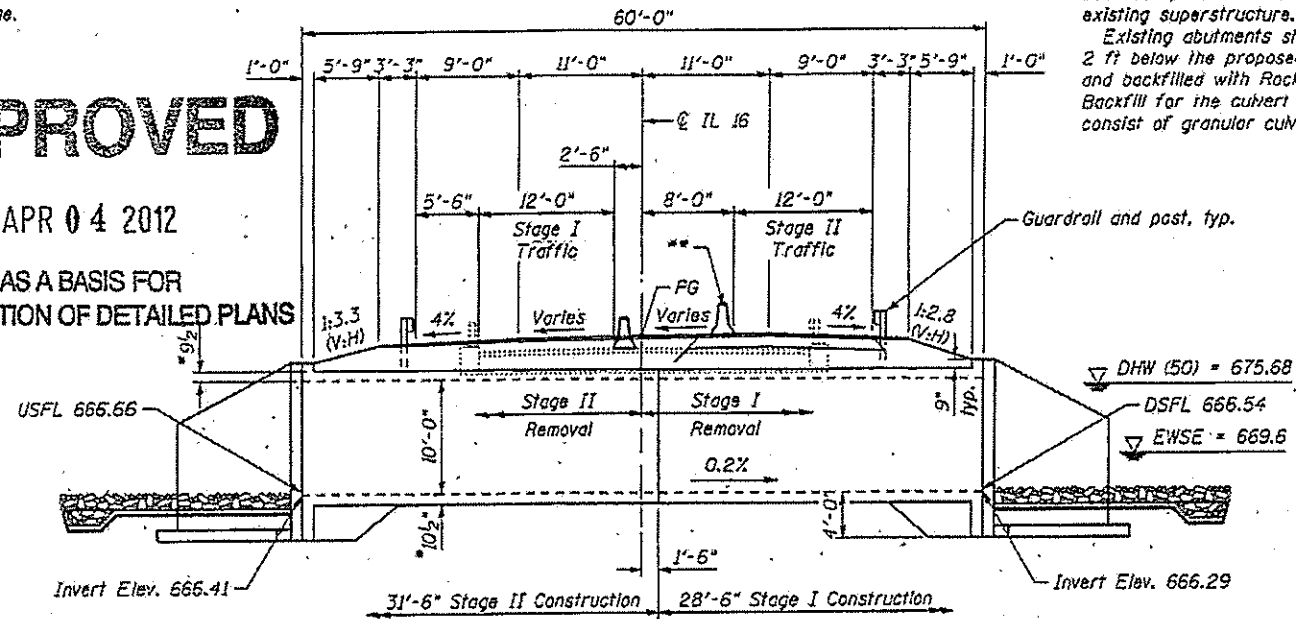
Existing Structure: SH 068-0017 at Sta. 43+23 was built in 1923 as SBI 16, Section 18. The structure is a single span concrete slab on closed abutments and has a length of 32'-0" back to back abutments and a width of 32'-2" out to out, no skew. Stage construction will be utilized to maintain one lane of traffic at all times.

No Salvage.

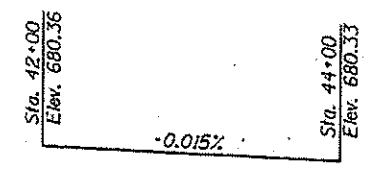
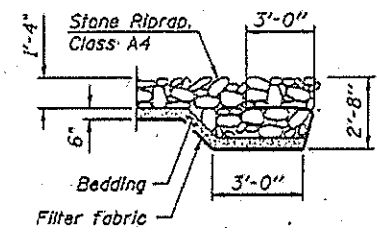
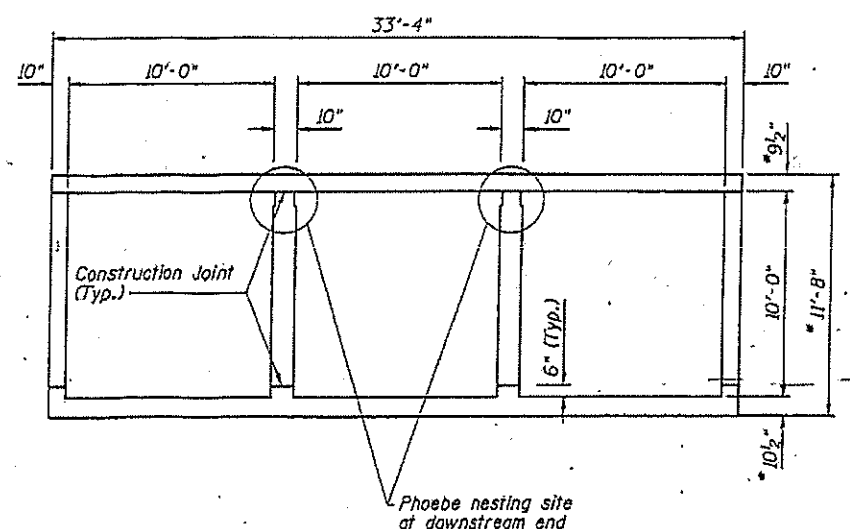
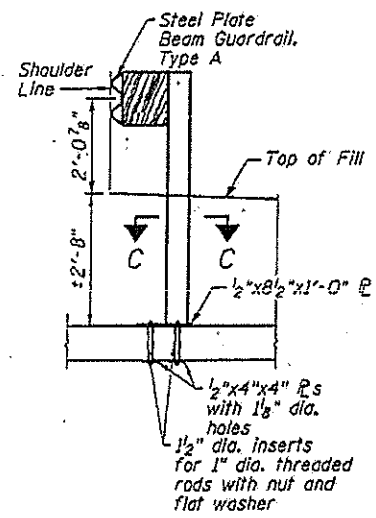
APPROVED

APR 04 2012

AS A BASIS FOR
PREPARATION OF DETAILED PLANS



Notes:
Excavation behind the existing abutments shall be completed to balance front and back soil pressure before removing the existing superstructure.
Existing abutments shall be removed to 2 ft below the proposed culvert barrel and backfilled with Rockfill (Special). Backfill for the culvert excavation shall consist of granular culvert backfill.



HIGHWAY CLASSIFICATION
F.A.P. Rte. 325 IL Rte. 16
Functional Class: Other Principal Arterial
ADT: 2550 (2009); 2430 (2021)
ADTT: 22X
DHW: 250
Design Speed: 55 m.p.h.
Posted Speed: 55 m.p.h.
2-Way Traffic
Directional Distribution: 50:50

DESIGN SPECIFICATIONS
2010 AASHTO LRFD Bridge Design Specifications, 5th Edition, with 2010 Interims

LOADING HL-93
Allow 50#/sq. ft. for future wearing surface.

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

DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	Upstream	Downstream
	662.4	662.3

GENERAL PLAN
IL RTE. 16 OVER SANGAMON CREEK
FAP RTE. 325 SECTION 18(B-2, B-3)
MONTGOMERY COUNTY
STATION 43+23.50
STRUCTURE NO. 068-0509

WATERWAY INFORMATION

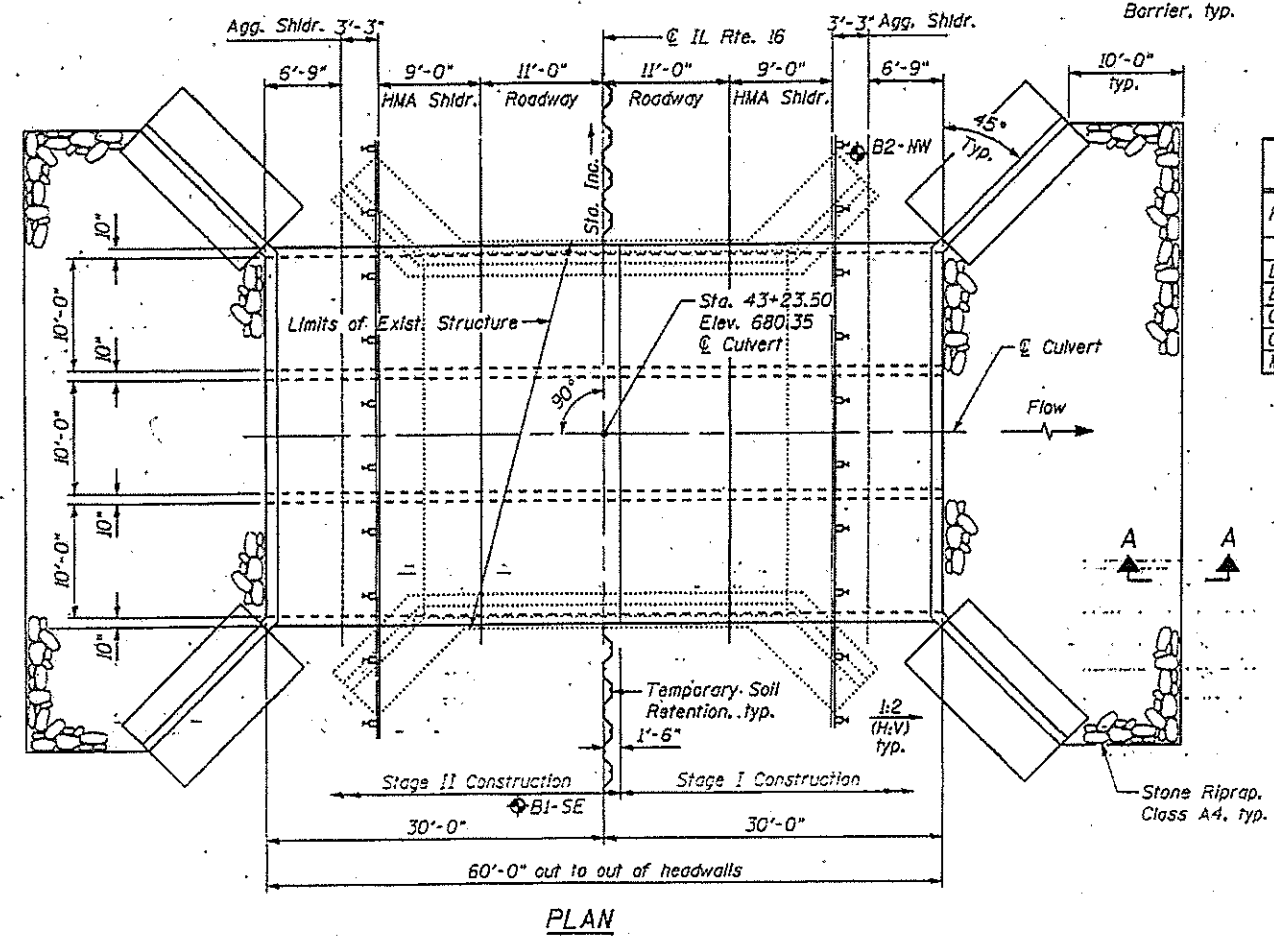
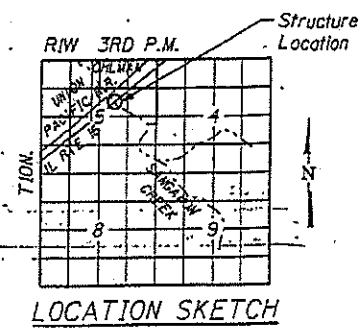
Drainage Area = 2.0 sq. mi. Exist. Overtopping Elev. 679.18 @ Sta. 43+23.00
Prop. Overtopping Elev. 680.65 @ Sta. 43+23.00

Flood	Freq. Yr.	Q C.F.S.	Waterway Opening Sq. Ft.		Head - Ft.		Headwater El.	
			Existing	Proposed	Exist.	Prop.	Exist.	Prop.
Design	10	630	130	250	675.05	0.5	0.5	675.50/675.56
Base	100	1230	170	300	675.59	0.5	0.5	677.09/677.05
Overtopping Event (E) <500 yr.	500	1690	190	300	677.29	0.8	0.5	678.05/677.74
Overtopping Event (P) <500 yr.			Bridge/Weir	Bridge/Weir				
Max. Calc.			230/260	300/20	679.71	0.9	1.0	680.59/680.67

10 yr Outlet Velocity from Existing Structure = 4.22 fps
10 yr Outlet Velocity from Proposed Structure = 5.55 fps

CURVE DATA

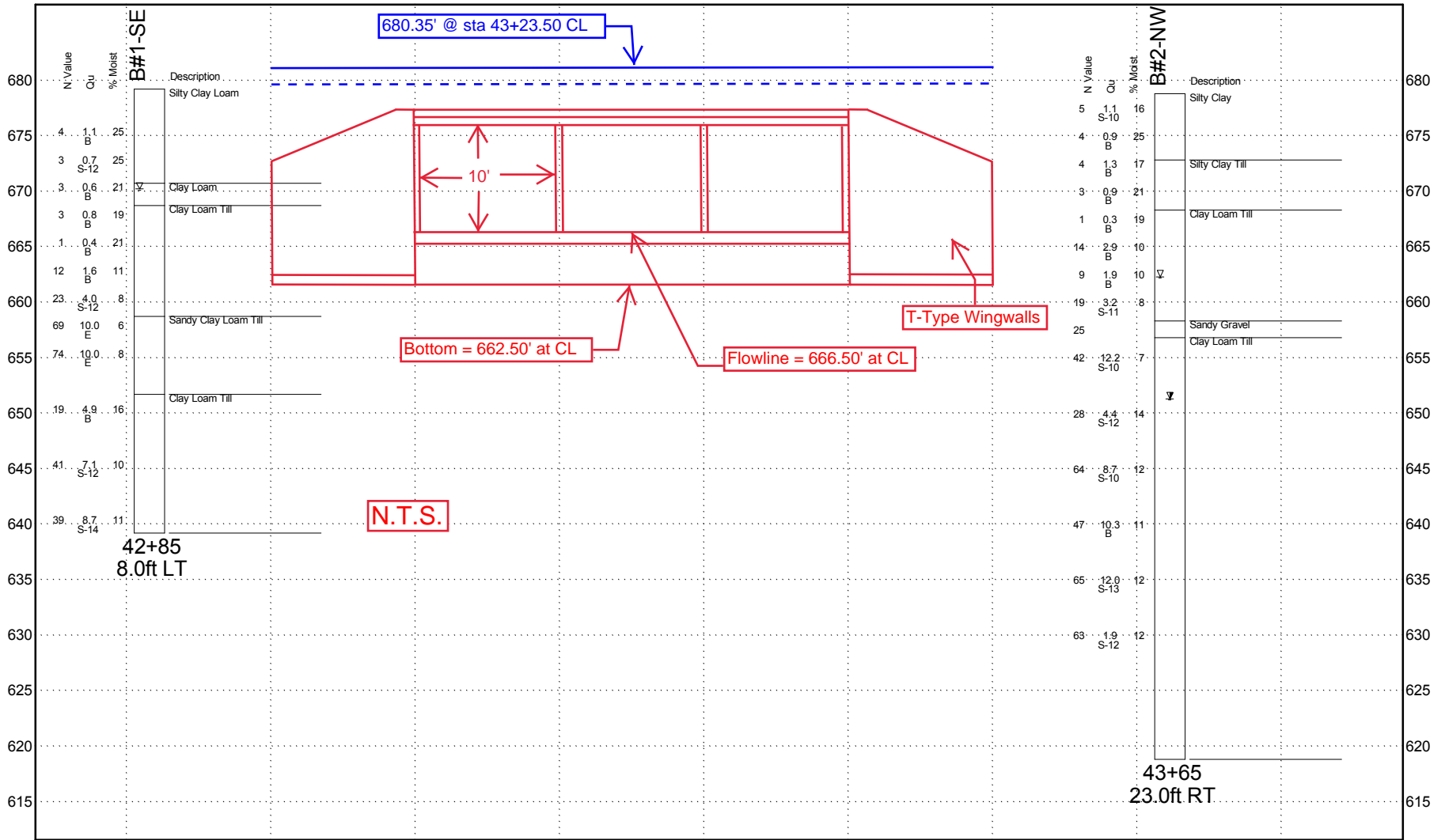
Δ = 7°06'00" (L.I.)
D = 0°51'37"
T = 413.13'
L = 825.20'
E = 12.80'
R = 6659.20'
S.E. = 2.2%
P.C. = Sta. 43+00.00
P.T. = Sta. 51+25.20
P.I. = Sta. 47+13.13
SE Transition from 43+00.00 (0.00%) to 43+51.55'



DATE: 4/2/12
DRAWN BY: JMB/MLC
CHECKED BY: JMB/MLC
SCALE: 1" = 10'-0"

PROJECT NO. 10005-2	SHEET NO. 1	F.A.P. RTE. 325	SECTION 18(B-2, B-3)	COUNTY MONTGOMERY	TOTAL SHEETS	SHEET NO.
DATE	1 SHEETS					
DRAWN BY MCB/CME						
CHECKED BY SEC						
APPROVED BY MCB						
		FED. ROAD DIST. NO.	ILLINOIS	FED. AID PROJECT	CONTRACT NO. 72984	

Structure Number 068-0509 Culvert carrying IL 16 over Sangamon Creek
 Located in the NE 1/4 of Section 5, Township 10N, Range 1W of the 3 P.M.



NOT TO HORIZONTAL SCALE

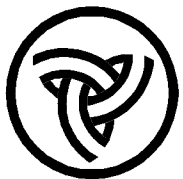
VARIATIONS IN SUBSURFACE
 CONDITIONS MAY EXIST
 BETWEEN BORINGS

Groundwater
 First Encounter
 Completion
 after (refer to log) hours

Abbreviations
 WOH - Sampler Advanced by Weight
 of Hammer, WOP - Weight of Pipe
 B.S. - Before Seating

SUBSURFACE DATA PROFILE

Route: FAP 325
 Section: 18(B-2,B-3)
 County: Montgomery



**Illinois Department
 of Transportation**
 Division of Highways
 IDOT



SOIL BORING LOG

ROUTE FAP 325 DESCRIPTION Culvert carrying IL 16 over Sangamon Creek LOGGED BY M. Tappan

SECTION 18(B-2,B-3) LOCATION NE 1/4, SEC. 5, TWP. 10N, RNG. 1W, 3 PM

COUNTY Montgomery DRILLING METHOD HSA HAMMER TYPE 140# Auto

STRUCT. NO. <u>068-0509</u>	D E P T H S (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)	Surface Water Elev. <u>668.7</u> ft	D E P T H S (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)
Station <u>43+23.5</u>					Stream Bed Elev. <u>667.5</u> ft				
BORING NO. <u>1-SE</u>	D E P T H S (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)	Groundwater Elev.:	D E P T H S (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)
Station <u>42+85</u>					▽ First Encounter <u>670.2</u> ft				
Offset <u>8.0ft LT</u>					▽ Upon Completion <u>Plugged</u> ft				
Ground Surface Elev. <u>679.2</u> ft					▽ After <u> </u> Hrs. <u>Plugged</u> ft				

Soil Description	Depth (ft)	Blow Count (/6")	UCS (tsf)	Moist (%)	Soil Description	Depth (ft)	Blow Count (/6")	UCS (tsf)	Moist (%)
V Dark Gray Moist SILTY CLAY LOAM	0				Gray Dry SANDY CLAY LOAM (Till)	5			
	2	1.1	25			30	10.0	6	
	-5	2	B			39	E		
	0					7			
	2	0.7	25			27	10.0	8	
	-5	2	S-12			-25	47	E	
	0								
	1	0.7	25						
	2	S-12							
	0								
	1	0.6	21						
	-10	2	B			-30	10	B	16
	0								
	1	0.8	19						
	2	B							
	0								
	0	0.4	21						
	-15	1	B			-35	23	S-12	10
	1								
	5	1.6	11						
	7	B							
	2								
	9	4.0	8						
	-20	14	S-12			-40	24	S-14	11

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer, E-Estimated) Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

File Name S:\SOIL\SIGINT FILES\MONTGOMERY\068-0509 IL 16 OVER SANGAMON CREEK.GPJ Data Template D6TEMP.LT.GDT Date Printed 3/21/11 Latitude 38D 20.619N Longitude 89D 13.263W Datum NAD83 Job Number 72984



SOIL BORING LOG

ROUTE FAP 325 DESCRIPTION Culvert carrying IL 16 over Sangamon Creek LOGGED BY M. Tappan

SECTION 18(B-2,B-3) LOCATION NE 1/4, SEC. 5, TWP. 10N, RNG. 1W, 3 PM

COUNTY Montgomery DRILLING METHOD HSA HAMMER TYPE 140# Auto

STRUCT. NO.	Station	BORING NO.	Station	Offset	Ground Surface Elev.	D E P T H (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)	Surface Water Elev.	Stream Bed Elev.	Groundwater Elev.:	First Encounter	Upon Completion	After Hrs.	Cuttings	D E P T H (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)				
068-0509	43+23.5	2-NW	43+65	23.0ft RT	678.8					668.7	667.5		662.3	651.3										
Dk Gray Moist SILTY CLAY (Fill)							1			Gray Dirty Med SANDY GRAVEL														
							2	1.1	16															
							3	S-10		Gray Dry CLAY LOAM (Till)														
							1																	
Gray Moist Silty Clay Fill							2	0.9	25															
							-5	B																
						672.80																		
Gray Moist SILTY CLAY (Till)							1																	
							2	1.3	17															
							2	B																
							1																	
w/Gray Wet Med Sandy Gravel at 10'							1	0.9	21															
							-10	B																
						668.30																		
Gray and Brown Wet CLAY LOAM (Till)							0																	
							0	0.3	19															
							1	B																
							1																	
Gray and Brown Moist							5	2.9	10	Brown														
							-15	B																
							1																	
Gray Moist Clay Loam Till							4	1.9	10															
FREE WATER							5	B																
							2																	
							8	3.2	8	Gray and Brown														
							-20	S-11																
							6																	
							18	10.3	11															
							-40	B																

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrator, E-Estimated) Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206) BBS, from 137 (Rev. 8-99)

ROCKFILL - FOUNDATION 6M10 6/15/17

This work consists of constructing a layer of rockfill below culverts or spread footings having unstable or unsuitable soil conditions. When shown on the plans, the rockfill limits and thickness shall be confirmed by the Engineer prior to excavating below the theoretical top of rockfill line.

Rockfill materials shall meet the requirements of Article 1005.01 of the Standard Specifications. The gradation of rockfill shall be primary crusher run. The maximum dimension shall be 8 inches. Rockfill may contain broken pavement or rock excavation as defined in Article 205.04 and with the approval of the Engineer.

Materials shall meet the requirements of the following Articles of the Standard Specifications:

Bedding or Capping Material 1003.04 or 1004.05

The method of rockfill placement shall be approved by the Engineer. Rockfill shall be capped according to application as shown below:

Spread Footing	4 to 6 inches CA-6
Cast-In-Place Box Culverts	4 to 6 inches CA-7 or CA-11
Pre-Cast Box Culverts	Porous Granular Bedding Material (Article 540.02)
Pre-Cast Pipe Culverts	Coarse or Fine Aggregate Bedding (Article 542.04)

Excavation shall be performed according to Section 202 of the Standard Specifications.

In spread footing applications, the CA-6 cap shall be compacted to the satisfaction of the Engineer. No compaction of rockfill is required for culvert applications.

This work will be measured and paid for at the contract unit price per ton for ROCKFILL - FOUNDATION. The contract price for ROCKFILL-FOUNDATION shall include excavation, aggregate materials, aggregate material placement, and placement of excavated materials within right-of-way or disposal off right-of-way. *Excavation will not be measured or paid for separately or as part of EARTH EXCAVATION.* For precast concrete box culverts, porous granular bedding material and the excavation volume required for bedding will be paid for according to Article 540.08. For pipe culverts, the aggregate bedding material and excavation volume required for the aggregate bedding material will be paid for according to Article 542.11.

GRANULAR CULVERT BACKFILL 6M6 10/15/13

This work consists of backfilling box culverts or three-sided structures with granular materials. This work shall be performed at locations shown on the plans or as directed by the Engineer.

Backfilling shall be performed according to Article 502.10. The backfill material shall meet the requirements of Article 1004.05, except the gradation shall be CA-06 or CA-10. This work satisfies select granular backfill (porous granular material) requirements of ASTM C 1577.

Granular Culvert Backfill will be measured for payment in cubic yards compacted in place. Additional material required to backfill excavation outside the limits shown on the plans will not be measured for payment. This work shall be paid for at the contract unit price per cubic yard for GRANULAR CULVERT BACKFILL.

Existing Structure Plans

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

REINFORCED CONCRETE SLAB
SPAN - THIRTY FEET

FED. ROAD DIST. NO.	STATE PROJ. NO.	FISCAL YEAR	TOTAL SHEETS
7	11L 58	1923	27

RAIL	18 FT. ROADWAY	24 FT. ROADWAY	30 FT. ROADWAY
A	Steel-Lbs. 8350 Concrete-Cu Yds. 433	Steel-Lbs. 10100 Concrete-Cu Yds. 513	Steel-Lbs. 11600 Concrete-Cu Yds. 586
B	Steel-Lbs. 8070 Concrete-Cu Yds. 286	Steel-Lbs. 8880 Concrete-Cu Yds. 312	Steel-Lbs. 10000 Concrete-Cu Yds. 358
C	Steel-Lbs. 8440 Concrete-Cu Yds. 426	Steel-Lbs. 9550 Concrete-Cu Yds. 486	Steel-Lbs. 10550 Concrete-Cu Yds. 536

USE RAIL C - 30 FT. ROADWAY.

Class A concrete to be used throughout
Proportions - 1:2:4.

PLAN

W. J. Sweeney
J. J. Sweeney
E. J. Sweeney
E. J. Sweeney

Sheet No. 2
2 Sheets.

FED. ROAD STATE PROJ. NO. FISCAL YEAR SHEET NO. TOTAL SHEETS

7	11L 58	1923	26	27
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Sta. 43+23

State Bond Issue - Route 16

Section 18 - Montgomery County

STATE OF ILLINOIS
DEPARTMENT OF PUBLIC WORKS & BUILDINGS
DIVISION OF HIGHWAYS

R.C. ABUTMENTS FOR SLAB BRIDGE
HEIGHT OVER ALL 13 FEET 6 IN.

FED. ROAD DIST. NO.	STATE PROJ. NO.	FISCAL YEAR	TOTAL SHEETS
7	11L 58	1923	26

USE RAIL C - 30 FT. ROADWAY.

Class A concrete to be used throughout
Proportions - 1:2:4.

PLAN

W. J. Sweeney
J. J. Sweeney
E. J. Sweeney
E. J. Sweeney

Sheet No. 2
2 Sheets.

FED. ROAD STATE PROJ. NO. FISCAL YEAR SHEET NO. TOTAL SHEETS

7	11L 58	1923	26	27
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Sta. 43+23

State Bond Issue - Route 16

Section 18 - Montgomery County

068-0017