

STRUCTURE GEOTECHNICAL REPORT

PR SN 084-7007
EX SN 084-9936

Sangamon Valley Trail over IL 97/125 (Jefferson St.)
FAP Route 67
Section: S(X) & W(X.TS)
Sangamon County

D-96-501-95

Contract 92621

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

Checked By: BKL

Approved By: Brian Laningham

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Lic. #062-053757

Date: January 22, 2021

Date: January 22, 2021

Prepared For: Michael Cima
Quigg Engineering
217-670-0563

Attachments: Preliminary TSL
Subsurface Profile
Boring Logs

This Report has been prepared based on a preliminary TSL from March 2020. 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 the 2012 IDOT Bureau of Bridges and Structures Bridge Manual and AASHTO LRFD Bridge Design Specifications 9th Edition –with Interims.

Project Description and Proposed Structure Information

The project includes building a single-span pedestrian structure over IL 97/125 (Jefferson St.) as part of the expressway project. The bridge will have a back-to-back length of 165'-9" and an out-to-out width of +/-12'-0". The proposed substructure will be stub abutments. The bridge will be constructed on the existing bike trail alignment, it will be lengthened, with north abutment being shifted to the north to accommodate a 5-lane roadway with open ditches.

Site Investigation

The project is located approximately 0.5 miles Northwest of IL 97 (Jefferson St.) and IL 4 (Veterans Pkwy.) intersection. The land surrounding this site is semi-urban with rolling farm ground with spots of timber. The bike trail is a converted railroad line that runs north and south and is lined with timber on both sides.

The original structure was built in 1917 by the C&NW Railroad. The existing structure is a single span plate girder bridge on spread footing and closed concrete abutments. The structure is 43'-4" face to face abutment backwalls with a 15'-0" ctr-ctr of girder deck width. It was rehabilitated in 2011 and currently has a timber deck and railing with a chain link fence enclosed. It currently carries pedestrian traffic.

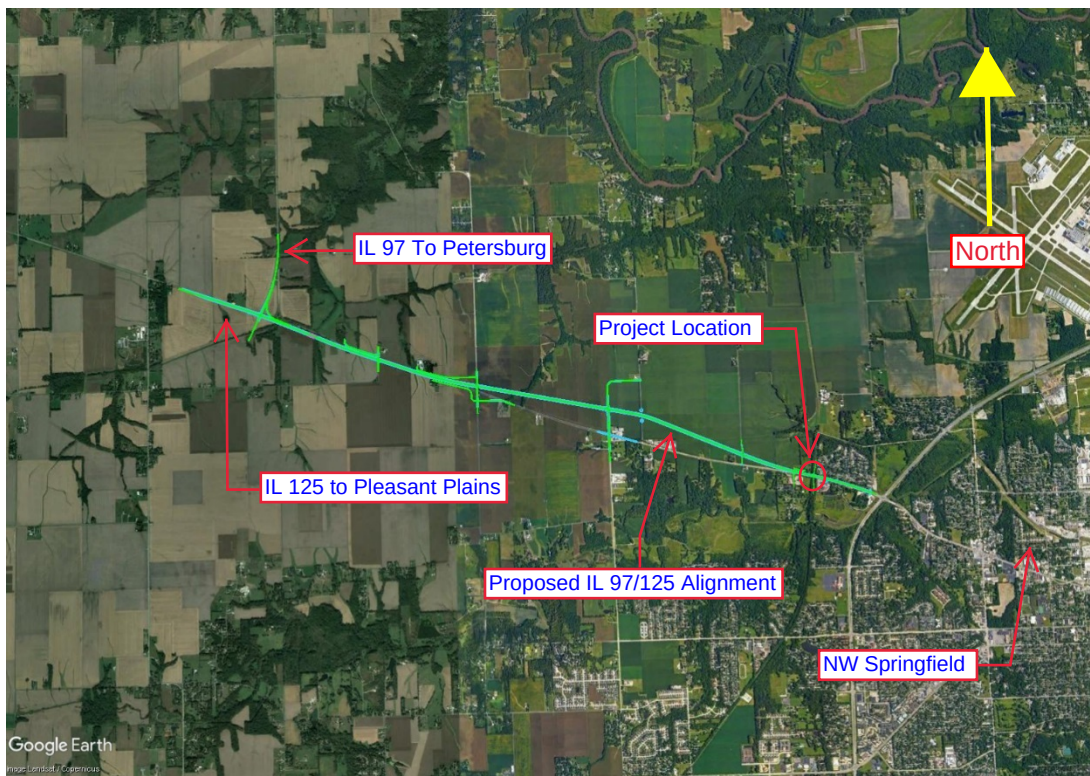
Currently IL 97/125 roadway is a 2-lane urban section with curb and gutter. The proposed new expressway will be a 5-lane roadway with open ditches. The roadway alignment will be shifted to the north approximately 50'. The IL 97 roadway profile increase of +/- 4' resulting in a profile increase for the bike trail of +/- 5'

To minimize the impact to pedestrian and bicyclist, this structure will be constructed during the winter months (November to March).

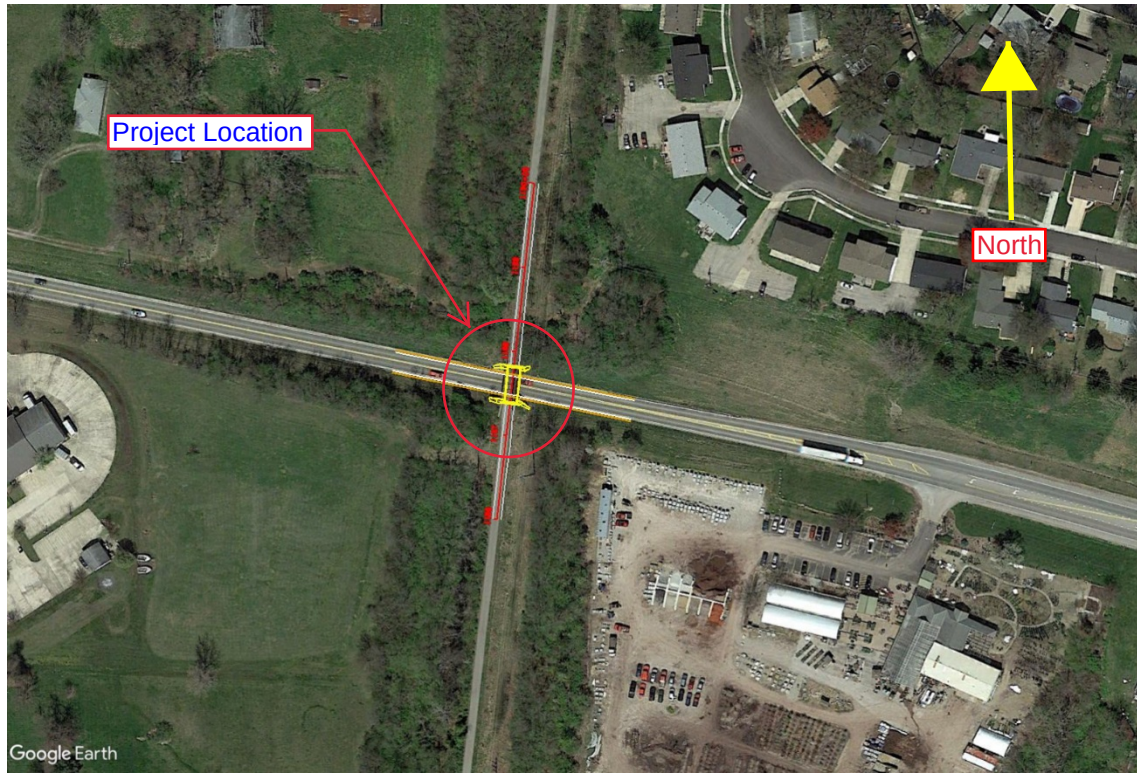
No existing boring information exists for this structure. Borings were advanced by the District 6 drill crew using hollow stem auger methods according to AASHTO T 206 and the IDOT Geotechnical Manual. Borings were filled with cuttings immediately after drilling to allow traffic on the roadway.

Shale Bedrock was encountered at an approximate elevation of 565.00 at both North and South Abutment borings.

Location Map



Existing Structure



Proposed Structure



Geotechnical Evaluation

Settlement: As stated earlier, there will be a +/-5.0' profile increase for the bike trail. Settlement is insignificant at (0.10 inch) that it poses no problems. There are no settlement issues.

Slope Stability: There is no evidence of any slope stability problems with the existing cross slopes. Slope analysis was run on the proposed 2:1 front slope of each bridge abutment. Results indicate only minor sloughing of the existing RR ballast rock would occur if left uncovered. The concrete slope wall will protect these slopes from sloughing. The overall Factor of Safety for each abutment was significantly higher than the required 1.5.

Seismic Considerations: The following table shows recommended seismic design data based on a 1000-year return period event.

Seismic Performance Zone (SPZ)	1
Spectral Acceleration at 1 second (S_{D1})	0.105g
Design Spectral Acceleration at 0.2 Seconds (S_{DS})	0.196g
Soil Site Class	C

Scour: Scour analysis is Not Applicable.

Foundation Evaluation

Vertical Loading

Preliminary maximum factored loads, provided by the structure designer, are approximately 230 kips vertical at the abutments. Because the depth to shale bedrock is relatively shallow, the bridge should be founded on H-piling or Drilled Shafts. Piling shoes **are not** required.

The following table will show the factored loads based on 3 ft. & 8 ft. pile spacing for 2 rows of pile along the length of the substructures.

Factored Loads Per Pile (kips)			
Location	3.0' Ctr.	8.0' Ctr.	Factored Loads
Abutment	28.75	76.67	230

Losses

Downdrag: None

Scour: None – Not Applicable

Liquefaction: None

Pile Design Tables

Pile Design Table -- South Abutment (Boring SPT #3)												
Est. Pile Cutoff Elev.	Est. Pile Tip Elev.	Est. Pile Length (ft.)	HP 8 X 36		HP 10 X 42		HP 10 X 57		HP 12 X 53		HP 12 X 63	
			R _{NRB} (kips)	R _{FRA} (kips)	R _{NRB} (kips)	R _{FRA} (kips)	R _{NRB} (kips)	R _{FRA} (kips)	R _{NRB} (kips)	R _{FRA} (kips)	R _{NRB} (kips)	R _{FRA} (kips)
580.00	574.00	6.00	9	5	11	6	11	6	13	7	14	8
580.00	572.50	7.50	16	9	20	11	21	11	24	13	25	14
580.00	570.00	10.00	26	14	32	17	33	18	38	21	39	21
580.00	567.50	12.50	36	20	45	25	46	25	54	30	55	30
580.00	565.00	15.00	55	30	67	37	72	39	81	45	85	47
580.00	564.00	16.00	103	57	128	70	132	73	153	84	158	87
580.00	563.00	17.00	152	83	189	104	193	106	226	124	231	127
580.00	562.00	18.00	189	104	247	136	253	139	298	164	305	167
580.00	561.00	19.00	222	122	288	158	295	162	366	202	371	204
Max NRB and FRA for each pile type			286	157	335	184	454	250	418	230	497	273
Nominal Required Bearing = R _{NRB} (kips)												
Factored Resistance Available = R _{FRA} (kips)												

Pile Design Table -- North Abutment (Boring SPT #4)												
Est. Pile Cutoff Elev.	Est. Pile Tip Elev.	Est. Pile Length (ft.)	HP 8 X 36		HP 10 X 42		HP 10 X 57		HP 12 X 53		HP 12 X 63	
			R _{NRB} (kips)	R _{FRA} (kips)	R _{NRB} (kips)	R _{FRA} (kips)	R _{NRB} (kips)	R _{FRA} (kips)	R _{NRB} (kips)	R _{FRA} (kips)	R _{NRB} (kips)	R _{FRA} (kips)
580.00	573.50	6.50	12	6	15	8	15	8	17	10	18	10
580.00	571.00	9.00	19	10	23	13	24	13	28	15	28	16
580.00	568.50	11.50	28	16	35	19	36	20	42	23	43	24
580.00	566.00	14.00	38	21	49	27	51	28	59	33	61	33
580.00	563.50	16.50	58	32	71	39	76	42	86	47	89	49
580.00	562.50	17.50	106	58	132	73	136	75	158	87	163	89
580.00	561.50	18.50	155	85	192	106	197	108	230	127	236	130
580.00	560.50	19.50	191	105	249	137	256	141	303	166	309	170
580.00	559.50	20.50	225	123	290	160	298	164	370	203	374	206
Max NRB and FRA for each pile type			286	157	335	184	454	250	418	230	497	273
Nominal Required Bearing = R _{NRB} (kips)												
Factored Resistance Available = R _{FRA} (kips)												

Drilled Shaft Design Tables

Unit Side Resistance and End Bearing -- South Abutment (Boring #3)								
Layer	Elevations		Unit Side Resistance	Resistance Factor	Adjusted Unit Side Resistance	End Bearing	Resistance Factor	Adjusted End Bearing
	To	From			ksf			ksf
1	578.75	574.75	-	-	-	-	-	-
2	574.75	572.25	1.1	0.45	0.50	16.54	0.45	7.44
3	572.25	569.75	1.55	0.45	0.70	25.38	0.45	11.42
4	569.75	567.25	1.89	0.45	0.85	31.86	0.45	14.34
5	567.25	564.75	2.03	0.45	0.91	35.64	0.45	16.04
6*	564.75	553.75	4	0.60	2.40	80.00	0.55	44.00
Unit Side Resistance and End Bearing -- North Abutment (Boring #4)								
Layer	Elevations		Unit Side Resistance	Resistance Factor	Adjusted Unit Side Resistance	End Bearing	Resistance Factor	Adjusted End Bearing
	To	From			ksf			ksf
1	578.75	574.75	-	-	-	-	-	-
2	574.75	572.25	1	0.45	0.45	14.88	0.45	6.70
3	572.75	569.75	1.55	0.45	0.70	25.38	0.45	11.42
4	569.75	567.25	2.15	0.45	0.97	39.42	0.45	17.74
5	567.25	564.75	1.9	0.45	0.86	32.04	0.45	14.42
6*	564.75	548.75	4	0.60	2.40	80.00	0.55	44.00

Note * -- Shale was encounter at layer #6 for both boring locations, however, no rock core samples were collected. Because no sampling of layer #6 occurred this author assumed a maximum cohesive strength of 8.8 ksf for layer #6. This is based on the 'Tip Resistance' formula for Cohesive soils. Where $q_p = N_c S_u \leq 80 \text{ ksf}$, $N_c = 9$ and $S_u = 8.8 \text{ ksf}$. This information is found in section 10.8.3.5.1 "Estimation of Drilled Shaft Resistance in Cohesive Soils."

Shales are classified as Intermediate GeoMaterials (IGMs), with compressive strength of 10 – 100 ksf. This author feels layer #6 has considerably more strength than 8.8 ksf, for that reason resistance factors for IGMs were used. These are 0.60 for skin resistance and 0.55 for end bearing.

Lateral Loading

Soil inputs have been provided to facilitate a more detailed analysis as requested by the structural designer.

Soil Parameters -- SN 084-7007									
Sub Unit	Layer	Depth		Unit Wt. (pcf)	Cohesion (psi)	ϕ (deg)	k (pci)	e ₅₀	Boring
		Top Elev.	Bottom Elev.						
South Abutment	1	578.8	574.8	125	-	36	123.8	-	SPT #3
	2	574.8	572.3	125	6.94	-	233.4	0.009	
	3	572.3	569.8	125	9.79	-	451.8	0.0074	
	4	569.8	567.3	125	12.29	-	589.7	0.0066	
	5	567.3	564.8	125	13.75	-	659.6	0.0064	
	6	564.8	553.8	Rock					
North Abutment	1	578.8	574.8	125	-	36	123.8	-	SPT #4
	2	574.8	572.3	125	6.25	-	180.2	0.0094	
	3	572.8	569.8	125	9.79	-	451.8	0.0074	
	4	569.8	567.3	125	15.21	-	729.6	0.0061	
	5	567.3	564.8	125	12.36	-	593.1	0.0066	
	6	564.8	548.8	Rock					

ϕ = phi angle

k = subgrade modulus

E₅₀ = strain at 50% deflection in p-y curve

Construction Considerations

Stage Construction: This project will be constructed during the winter months to minimize impacts to pedestrian.

Construction considerations: Because of the profile grade increase to the bike path and being constructed during the winter months, a retention wall system will need to be constructed to accommodate the new elevated bike path. This may be accomplished by building a cast-in-place, modular block, MSE and/or wall system. Because of the narrowness of the bike path roadway +/-16.0' slope stability may be an issue. For the South Abutment the Factor of Safety was greater than 1.5, while the North Abutment had a Factor of Safety less than 1.50. Further analysis will be required once final wall concept plans have been completed.

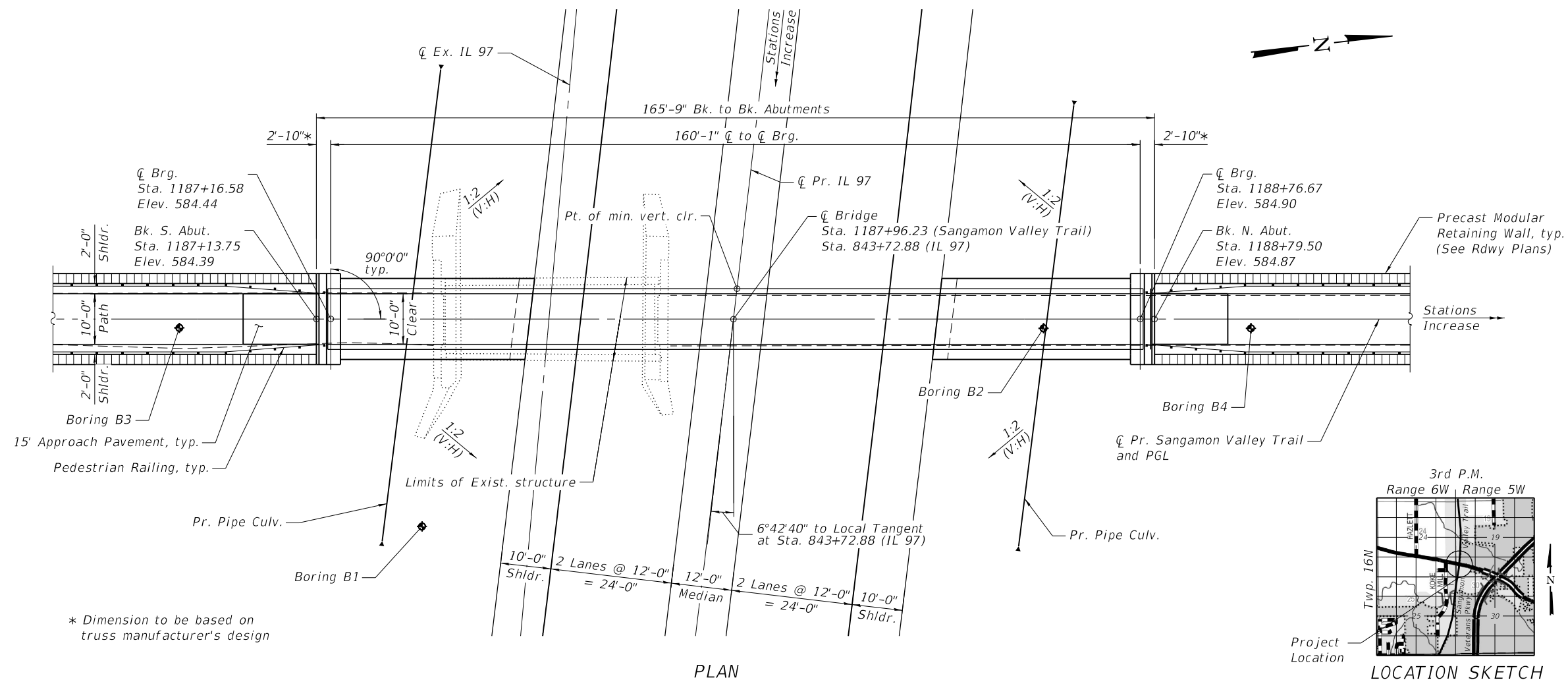
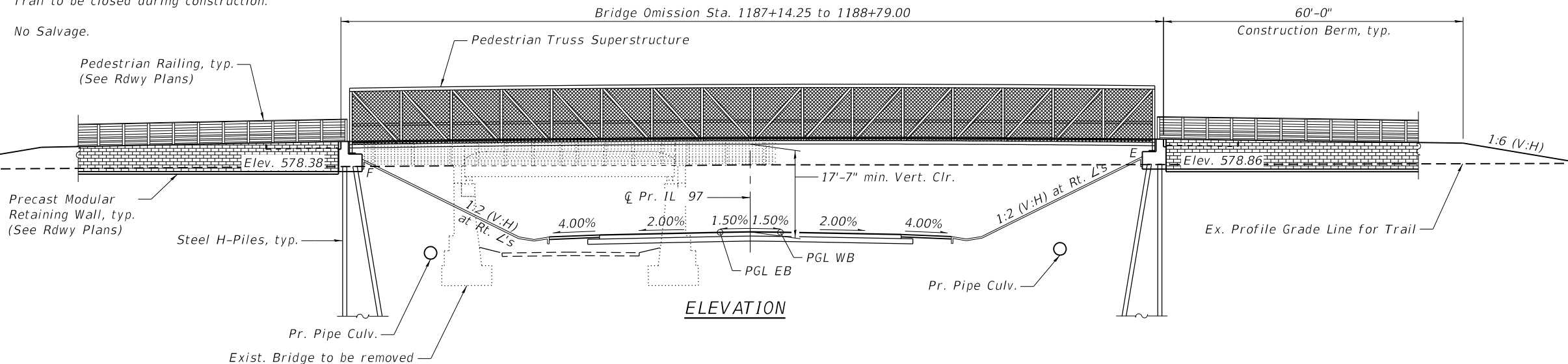
Ground Improvement: Ground improvement maybe required for the bike path retention system.

The following is a list of spreadsheets and software programs that were used in the geotechnical analysis:

- BBS – Soil Site Classification
- Rocscience – Slide Program
- BBS – IDOT Static Method of Estimating Pile Length.
- AASHTO LRFD Bridge Design Specification

Existing Structure: S.N. 084-9936, originally built in 1917 as C&NW Railway Bridge No 1862. The existing structure is a 1 span riveted thru plate girder bridge on spread footings and closed concrete abutments. The structure is 43'-4" face to face of abutment backwalls with a 15'-0" ctr-ctr of girder deck width. The existing structure was rehabilitated in 2011 and currently has a timber deck and railings with a chain link fence enclosure. The existing structure currently carries pedestrian traffic.

No Salvage.



* Dimension to be based on
truss manufacturer's design

2009 LRFD Guide Specifications for the
Design of Pedestrian Bridges,
2nd Edition with 2015 Interims

$f'_c = 3,500 \text{ psi}$
 $f_y = 60,000 \text{ psi (Reinforcement)}$
 $f_y = 50,000 \text{ psi (M270 Grade 50)}$

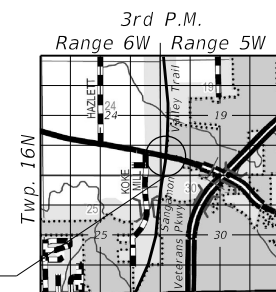
F.A.P. Rte. 67 – IL 97 (Jefferson Street)
Functional Class: Minor Arterial (Non Urban)
ADT: 13,100 (2020); 15,950 (2040)
ADTT: 603 (2020); 734 (2040)

Pedestrian Load = 90 psf uniform load

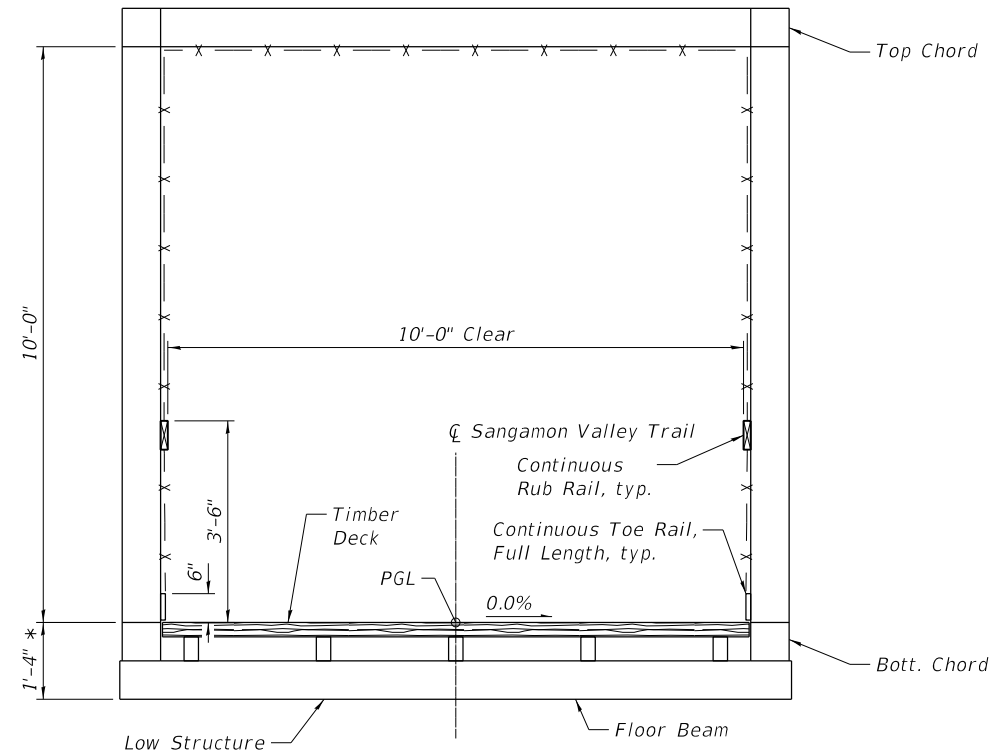
Seismic Performance Zone (SPZ) =
Design Spectral Acceleration at 1.0 sec. (SD1) =
Design Spectral Acceleration at 0.2 sec. (SDS) =
Soil Site Class =

P.I. Sta. = 850+75.96
 $\Delta = 6^\circ 42' 03''$
 $D = 0^\circ 22' 55''$
 $R = 15,000.00'$
 $T = 878.15'$
 $L = 1,754.29'$
 $E = 25.68'$
 $e = N.C.$
 $T.R. = N/A$
 $S.E. Run = N/A$
 $P.C. Sta. = 841+97.81$
 $P.T. Sta. = 859+52.10$

SANGAMON VALLEY TRAIL
OVER JEFFERSON STREET (IL 97)
FAP RTE 67 - SEC 5(X) & W(X,TS)
SANGAMON COUNTY
STATION 1187+96.23
STRUCTURE NO 084-7007

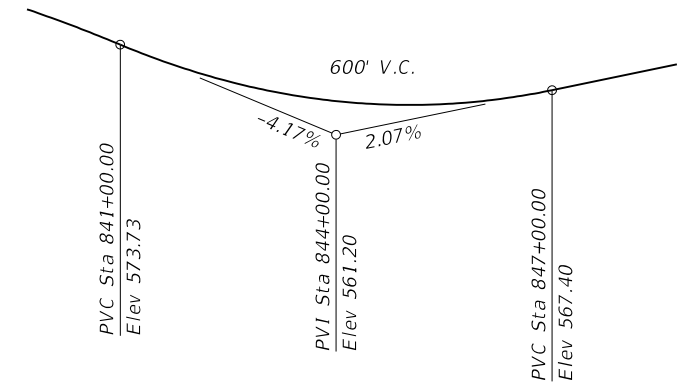


LOCATION SKETCH

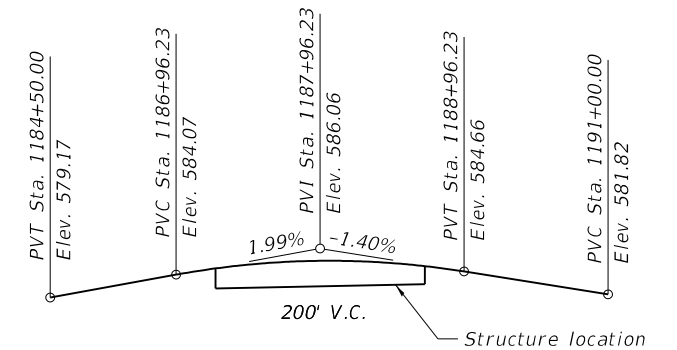


TYPICAL SECTION
(Looking North)

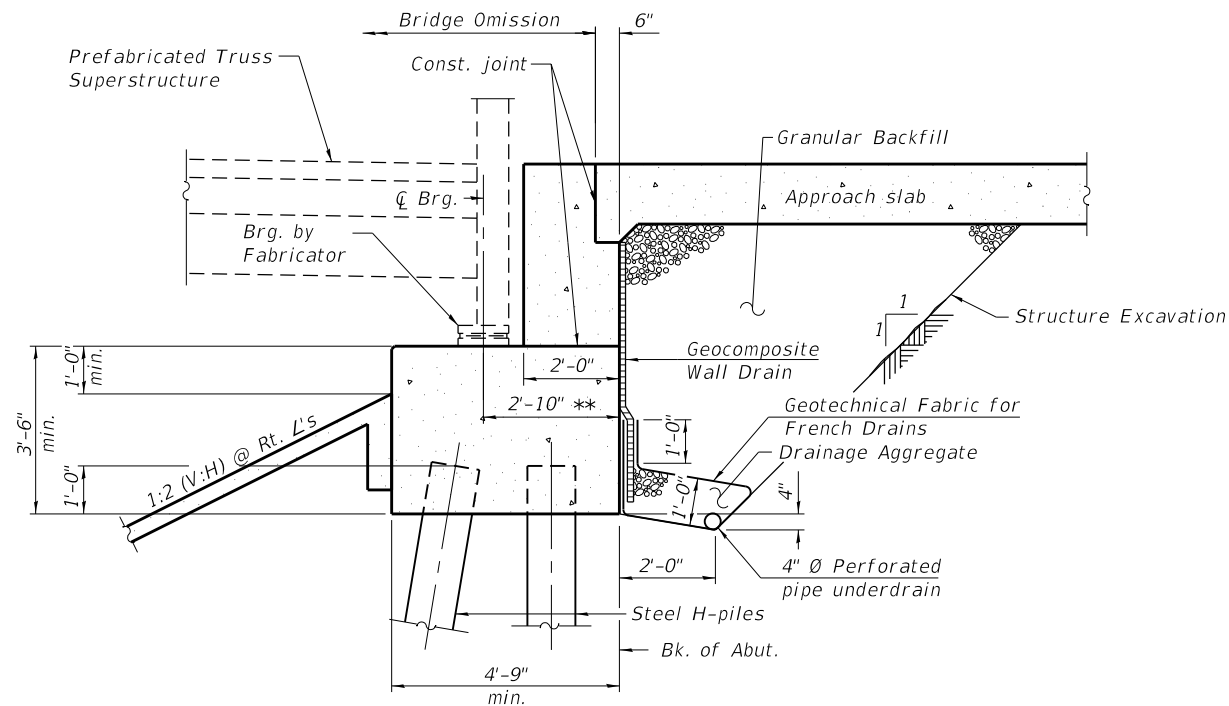
* Dimension is subject to change based on truss manufacturer's design. Contractor to verify with approved shop drawings.



PROFILE GRADE IL 97
(along median edge of pavement)

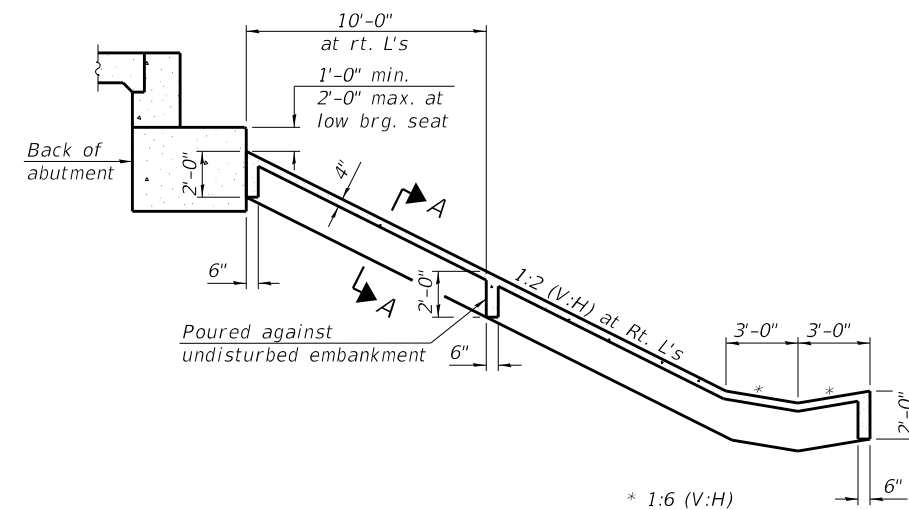


PROFILE GRADE SANGAMON VALLEY TRAIL
(along centerline of trail)

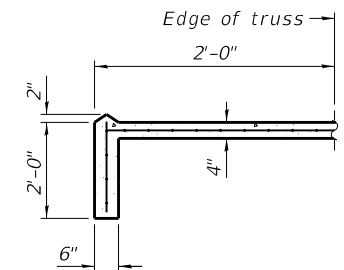


** Dimension to be based on truss manufacturer's design

**SECTION THRU PILE SUPPORTED
STUB ABUTMENT**
(Horiz. dim. @ Rt. L's)



**SECTION THRU
CONCRETE SLOPEWALL**



SECTION A-A

DETAILS
SANGAMON VALLEY TRAIL
OVER JEFFERSON STREET (IL 97)
FAP RTE 67 - SEC S(X) & W(X,TS)
SANGAMON COUNTY
STATION 1187+96.23
STRUCTURE NO 084-7007

**STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION**

SHEET 2 OF 2 SHEETS

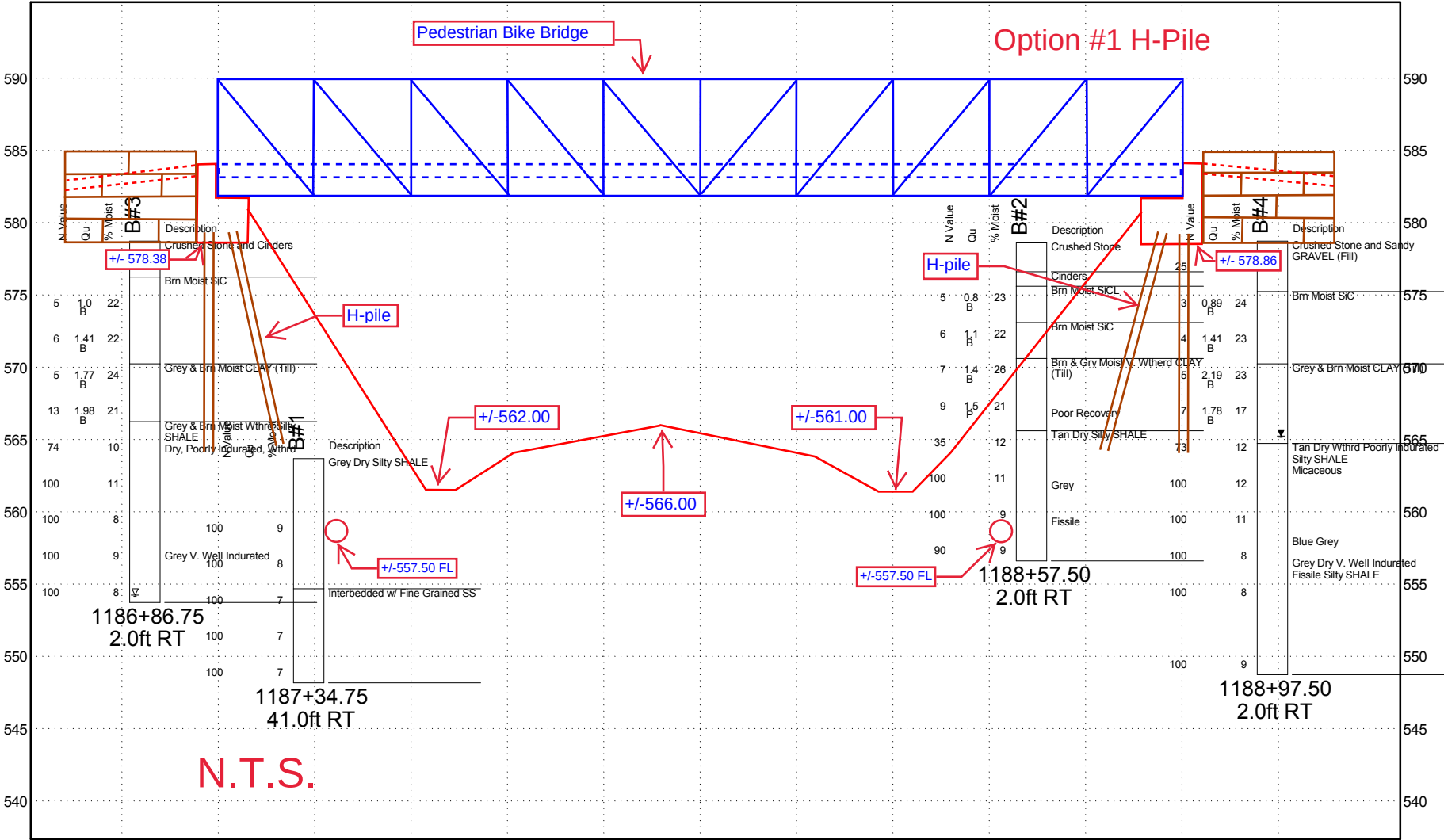
F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
67	S(X) & W(X,TS)	SANGAMON		
CONTRACT NO. 92621				
ILLINOIS FED. AID PROJECT				



QUIGG ENGINEERING INC

USER NAME	sdutakis	DESIGNED	SCD	REVISED	-
0847007-92621-002-TSL.dgn		CHECKED	KWB	REVISED	-
PLOT SCALE	0:2,0000 " = 1' in.	DRAWN	SCD	REVISED	-
PLOT DATE		CHECKED	MDC	REVISED	-

Structure Number 084-7007 IL 97 Bike Path
Located in the SW1/4 of Section 19, Township 16N, Range 5W of the 3 P.M.



NOT TO HORIZONTAL SCALE

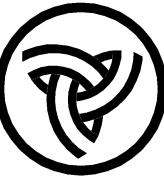
VARIATIONS IN SUBSURFACE
CONDITIONS MAY EXIST
BETWEEN BORINGS

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 67 (IL 97)
Section: S(X) & W(X, TS)
County: Sangamon

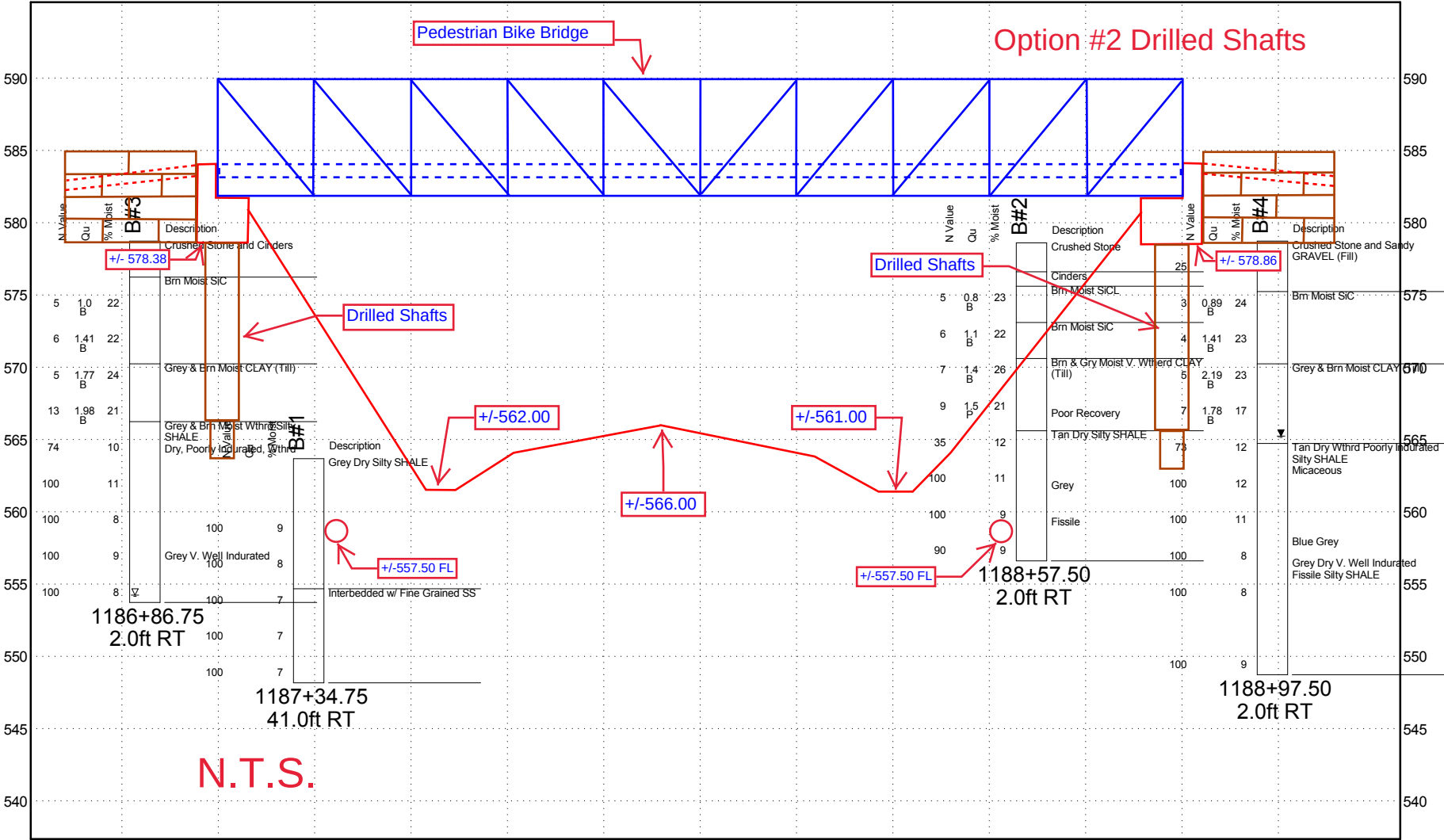


Illinois Department
of Transportation
Division of Highways
IDOT

SUBSURFACE DATA PROFILE 084-7007 IL 97 BIKE PATH.GPJ D6TEMPLT.GDT 1/21/21

SUBSURFACE DATA PROFILE 084-7007 IL 97 BIKE PATH.GPJ D6TEMPLT.GDT 1/21/21

Structure Number 084-7007 IL 97 Bike Path
Located in the SW1/4 of Section 19, Township 16N, Range 5W of the 3 P.M.



NOT TO HORIZONTAL SCALE

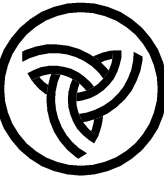
VARIATIONS IN SUBSURFACE
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SUBSURFACE DATA PROFILE

Route: FAP 67 (IL 97)
Section: S(X) & W(X, TS)
County: Sangamon



Illinois Department
of Transportation
Division of Highways
IDOT

SUBSURFACE DATA PROFILE 084-7007 IL 97 BIKE PATH.GPJ D6TEMPLT.GDT 1/21/21

SUBSURFACE DATA PROFILE 084-7007 IL 97 BIKE PATH.GPJ D6TEMPLT.GDT 1/21/21

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Date 9/25/02

COUNTY Sangamon DRILLING METHOD HSA HAMMER TYPE 140 # Auto

Surface Water Elev.	N/A	ft
Stream Bed Elev.	N/A	ft
Groundwater Elev.:		
▽ First Encounter	No Encounter	ft
▽ Upon Completion	Dry	ft
▽ After _____ Hrs.	Plugged	ft

Boring Completed

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)



SOIL BORING LOG

ROUTE FAP 67 (IL 97) DESCRIPTION Proposed bike path structure over IL 97 LOGGED BY M. Tappan

SECTION S(X) & W(X, TS) LOCATION SW 1/4, SEC. 19, TWP. 16 N, RNG. 5 W, 3 PM

COUNTY Sangamon DRILLING METHOD HSA HAMMER TYPE 140 # Auto

STRUCT. NO. 084-7007
Station 1187+96.23

BORING NO. 2
Station 1188+57.50
Offset 2.0ft RT
Ground Surface Elev. 578.61 ft

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. <u>N/A</u> ft	Stream Bed Elev. <u>N/A</u> ft	D E P T H (ft)	B L O W S (/6")	U C S Qu (tsf)	M O I S T (%)
				Groundwater Elev.:					
				▽ First Encounter <u>No Encounter</u> ft					
				▽ Upon Completion <u>Dry</u> ft					
				▽ After <u> </u> Hrs. <u>Plugged</u> ft					
Crushed Stone (Railroad Ballast)				Tan Dry Micaceous Silty SHALE (continued)			/4"		
576.61					556.61		10		
Cinders				Boring Completed			90		9
575.61							/5"		
Greyish Brown Moist SILTY CLAY LOAM	1			Refer STA to cL of Existing R.R. Bridge and IL 97 cL = +/- 9+986.5m STA Increase to North					
-5	2	0.8	23						
573.11	3	B					-25		
Greyish Brown Moist SILTY CLAY	1			Refer Elevation to cL of Existing R.R. Bridge cL = 176.40m					
570.61	2	1.1	22						
	4	B							
Brown and Grey Moist V. Weathered CLAY (Till)	1								
-10	2	1.4	26						
	5	B					-30		
Poor Recovery	2								
565.61	3	1.5	21						
	6	P							
Tan Dry Micaceous Silty SHALE	3								
-15	13		12						
	22						-35		
Olive Grey	16								
	48		11						
	52								
	/3"								
Grey Fissile	7								
-20	31		9						
	69						-40		

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Abbreviations W.O.H - Sampler Advanced By Weight of Hammer, W.O.P - Advanced by Weight of Pipe, B.S. - Before Seating
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Page 1 of 1

Date 7/29/05

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Date 7/29/05

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