



**Tollway Barrier Guidelines  
Online Training Series**

**Sample Analyses**

# Table of Contents

- I) Sample Speed Profile (Acceleration)
- II) Sample Speed Profile (Deceleration)
- III) Level 2 Example 1 Problem (Cantilever Sign)
- IV) Level 2 Example 1 Solution
- V) Sample Summary Site Plan
- VI) Level 2 Example 2 Problem (Embankment Cone)
- VII) Level 2 Example 2 Solution
- VIII) Level 3 Example Problem & Solution

# **Tollway Barrier Guidelines**

## **Online Training Series**

### **I) Sample Speed Profile (Acceleration)**

## SPEED PROFILE

### EXAMPLE

POINT WHERE THE RIGHT EDGE OF THE TAPERED WEDGE IS  
APPROXIMATELY 12 FEET FROM THE RIGHT EDGE OF THE FUTURE  
THROUGH LANE = STA. 824+10.46

70 MPH = STA. 824+10.46

Using Sta. 807+07.49 as assumed 15 MPH for departing Tollbooth

FIND STA. @ 30 MPH

15-30 = 140'

807+07.49 + 140' = STA. 808+47.49

FIND STA. @ 40 MPH

15-40 = 300'

807+07.49 + 300' = STA. 810+07.49

FIND STA. @ 50 MPH

15-50 = 660'

807+07.49 + 660' = STA. 813+67.49

Continue 50 MPH thru. 50 MPH curve to Sta. 814+95.49

FIND STA. @ 60 MPH

50-60 = 180'

814+95.49 + 180' = STA. 816+75.49

FIND STA. @ 70 MPH

50-70 = 580'

814+95.49 + 580' = STA. 820+75.49

70 MPH = STA. 820+75.49

60 MPH = STA. 816+75.49

50 MPH = STA. 813+67.49

40 MPH = STA. 810+07.49

30 MPH = STA. 808+47.49

(use calculated from 50 MPH)



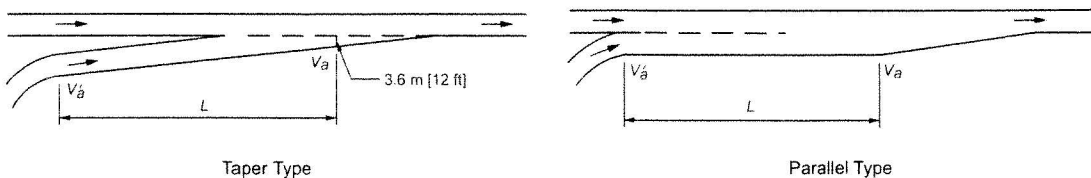
Table 10-3. Minimum Acceleration Lengths for Entrance Terminals with Flat Grades of Two Percent or Less

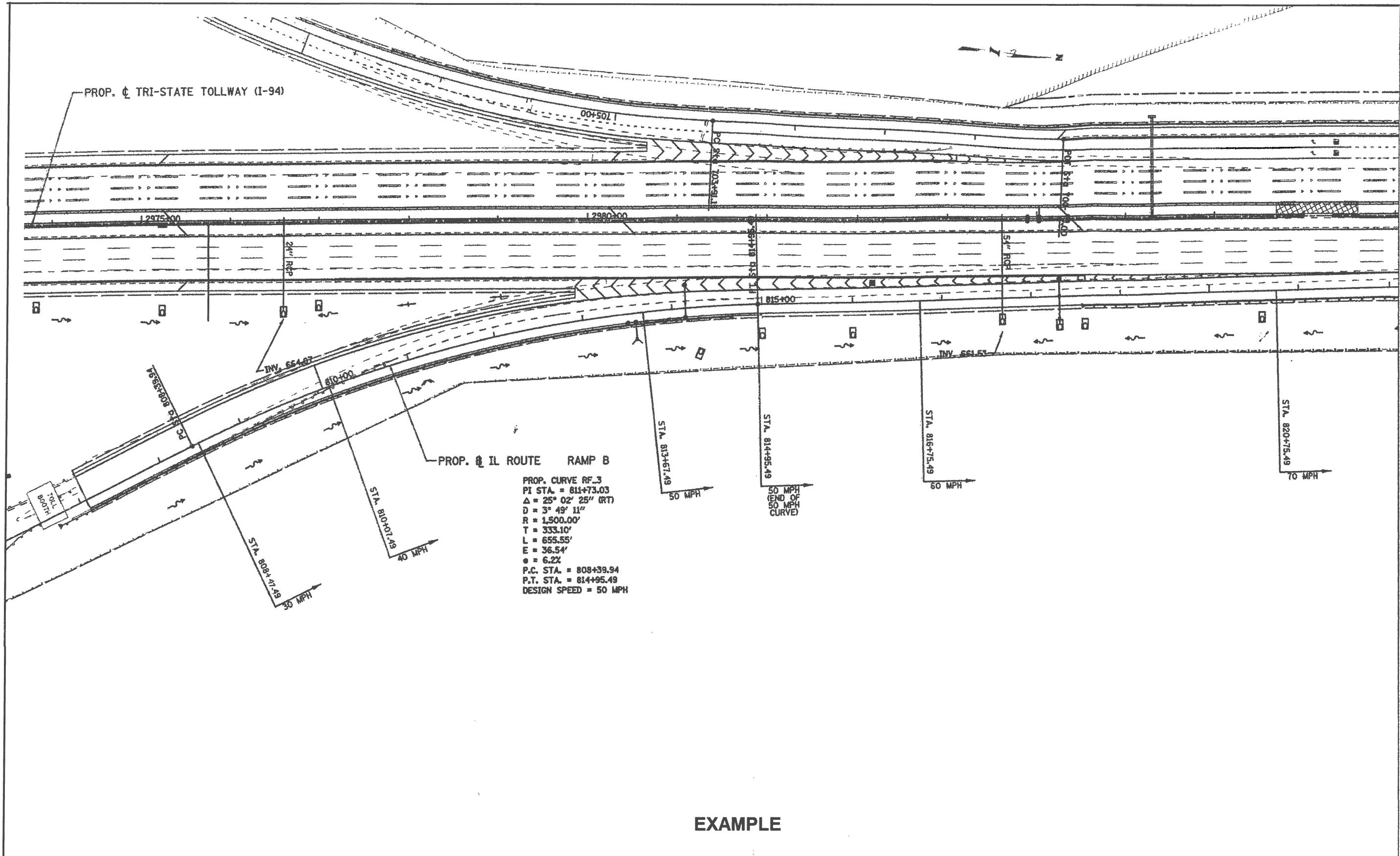
Metric									
Acceleration Length, $L$ (m) for Entrance Curve Design Speed (km/h)									
Highway		Stop Condition	20	30	40	50	60	70	80
Design Speed, $V$ (km/h)	Speed Reached, $V_a$ (km/h)	and Initial Speed, $V'_a$ (km/h)							
		0	20	28	35	42	51	63	70
50	37	60	50	30	—	—	—	—	—
60	45	95	80	65	45	—	—	—	—
70	53	150	130	110	90	65	—	—	—
80	60	200	180	165	145	115	65	—	—
90	67	260	245	225	205	175	125	35	—
100	74	345	325	305	285	255	205	110	40
110	81	430	410	390	370	340	290	200	125
120	88	545	530	515	490	460	410	325	245

Note: Uniform 50:1 to 70:1 tapers are recommended where lengths of acceleration lanes exceed 400 m.


U.S. Customary										
Acceleration Length, $L$ (ft) for Entrance Curve Design Speed (mph)										
Highway		Stop Condition	15	20	25	30	35	40	45	50
Design Speed, $V$ (mph)	Speed Reached, $V_a$ (mph)	and Initial Speed, $V'_a$ (mph)								
		0	14	18	22	26	30	36	40	44
30	23	180	140	—	—	—	—	—	—	—
35	27	280	220	160	—	—	—	—	—	—
40	31	360	300	270	210	120	—	—	—	—
45	35	560	490	440	380	280	160	—	—	—
50	39	720	660	610	550	450	350	130	—	—
55	43	960	900	810	780	670	550	320	150	—
60	47	1200	1140	1100	1020	910	800	550	420	180
65	50	1410	1350	1310	1220	1120	1000	770	600	370
70	53	1620	1560	1520	1420	1350	1230	1000	820	580
75	55	1790	1730	1630	1580	1510	1420	1160	1040	780

Note: Uniform 50:1 to 70:1 tapers are recommended where lengths of acceleration lanes exceed 1,300 ft.





EXAMPLE

 <p>THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY 2700 OGDEN AVENUE DOWNERS GROVE, ILLINOIS 60515</p>	<p>TRI-STATE TOLLWAY (I-94 NB) SPEED PROFILE, ILLINOIS ROUTE RAMP B</p>	Date: 10-31-07	Contract No.	Drawing No. 1 of 1
		Scale: 1" = 100'		

# **Tollway Barrier Guidelines**

## **Online Training Series**

### **II) Sample Speed Profile (Deceleration)**

**SPEED PROFILE**  
EXAMPLE  
DECELERATION FOR RAMP

Proposed Curve RA Design Speed is 40 MPH (444' Radius)  
Proposed Curve RA P.C. STA = 106+83.95

70 MPH - 40 MPH: 440' Per AASHTO Deceleration Table 10-5  
106+83.95 - 440' = 102+43.95

60 MPH - 40 MPH: 350' Per AASHTO Deceleration Table 10-5  
106+83.95 - 350' = 103+33.95

50 MPH - 40 MPH: 225' Per AASHTO Deceleration Table 10-5  
106+83.95 - 225' = 104+58.95

70 MPH = STATION 102+43.95
60 MPH = STATION 103+33.95
50 MPH = STATION 104+58.95
40 MPH = STATION 106+83.95

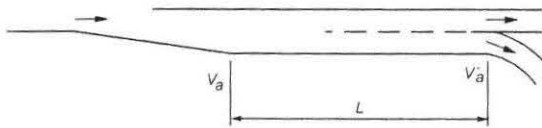
Table 10-5. Minimum Deceleration Lengths for Exit Terminals with Flat Grades of Two Percent or Less

Metric									
Deceleration Length, $L$ (m) for Design Speed of Exit Curve, $V'$ (km/h)									
Highway Design Speed, $V$ (km/h)	Speed Reached, $V_a$ (km/h)	Stop Condition	20	30	40	50	60	70	80
		For Average Running Speed on Exit Curve $V'_a$ (km/h)							
		0	20	28	35	42	51	63	70
50	47	75	70	60	45	—	—	—	—
60	55	95	90	80	65	55	—	—	—
70	63	110	105	95	85	70	55	—	—
80	70	130	125	115	100	90	80	55	—
90	77	145	140	135	120	110	100	75	60
100	85	170	165	155	145	135	120	100	85
110	91	180	180	170	160	150	140	120	105
120	98	200	195	185	175	170	155	140	120

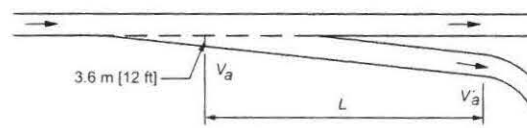
- $V$  = design speed of highway (km/h)
- $V_a$  = average running speed on highway (km/h)
- $V'$  = design speed of exit curve (km/h)
- $V'_a$  = average running speed on exit curve (km/h)

U.S. Customary										
Deceleration Length, $L$ (ft) for Design Speed of Exit Curve $V'$ (mph)										
Highway Design Speed, $V$ (mph)	Speed Reached, $V_a$ (mph)	Stop Condition	15	20	25	30	35	40	45	50
		For Average Running Speed on Exit Curve, $V'_a$ (mph)								
		0	14	18	22	26	30	36	40	44
30	28	235	200	170	140	—	—	—	—	—
35	32	280	250	210	185	150	—	—	—	—
40	36	320	295	265	235	185	155	—	—	—
45	40	385	350	325	295	250	220	—	—	—
50	44	435	405	385	355	315	285	225	175	—
55	48	480	455	440	410	380	350	285	235	—
60	52	530	500	480	460	430	405	350	300	240
65	55	570	540	520	500	470	440	390	340	280
70	58	615	590	570	550	520	490	440	390	340
75	61	660	635	620	600	575	535	490	440	390

- $V$  = design speed of highway (mph)
- $V_a$  = average running speed on highway (mph)
- $V'$  = design speed of exit curve (mph)
- $V'_a$  = average running speed on exit curve (mph)



Parallel Type



Taper Type

8/27/2015 2:20:27 PM  
WELLS

DRAWN BY.....**ABC**..... DATE. **9/4/15**  
 CHECKED BY.....**DEF**..... DATE. **9/4/15**

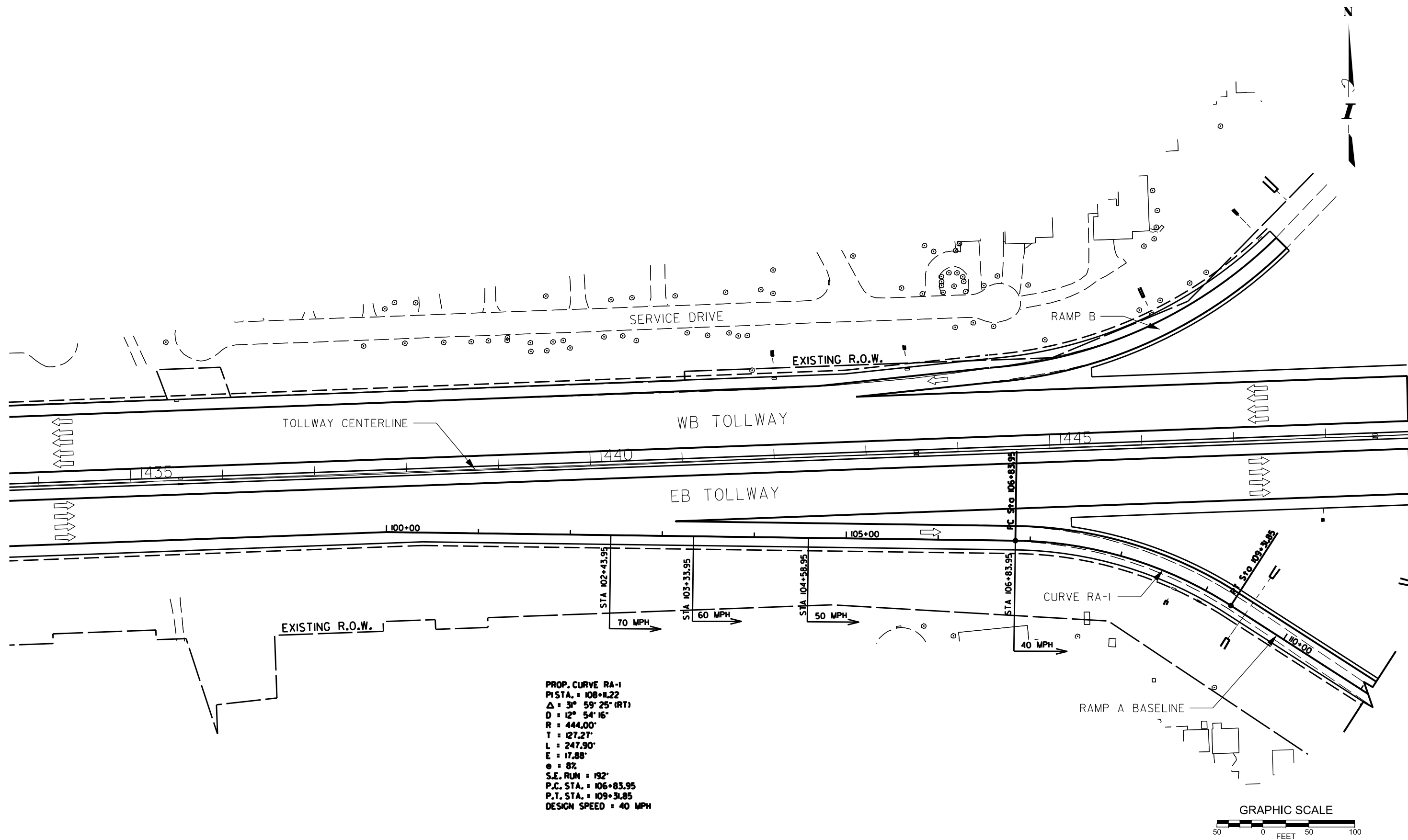


THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

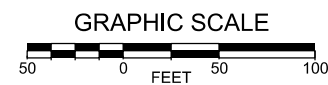
REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. X-XX-XXXX  
 BARRIER WARRANT  
 SPEED PROFILE - RAMP A

DRAWING NO.  
 E001 (1)



PROP. CURVE RA-1  
 P.I.S.T.A. = 108+11.22  
 $\Delta = 31^\circ 59' 25" (RT)$   
 $D = 12^\circ 54' 16"$   
 $R = 444.00'$   
 $T = 127.27'$   
 $L = 247.90'$   
 $E = 17.88'$   
 $e = 8\%$   
 $S.E. RUN = 192'$   
 $P.C. STA. = 106+83.95$   
 $P.T. STA. = 109+31.85$   
 DESIGN SPEED = 40 MPH

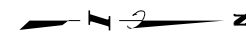


# **Tollway Barrier Guidelines**

## **Online Training Series**

### **III) Level 2 Example 1**

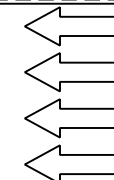
#### **Problem (Cantilever Sign Foundation)**



EXISTING R.O.W.



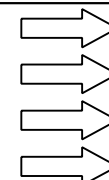
☉ TOLLWAY



SOUTHBOUND

3940+00

3945+00



NORTHBOUND

EOTW

CANTILEVER SIGN FOUNDATION

EOP

12.7'

49.0'

11.0'

+00

1:4'

+00

1:4'

+00

1:4'

+00

1:4'

EXISTING R.O.W.



HORIZONTAL  
SCALE: 1" = 50'

DRAWN BY ..... DATE .....

CHECKED BY ..... SCALE 1"=50' .....



THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY  
2700 OGDEN AVENUE  
DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. XX-XX-XXXX

BARRIER WARRANT  
PLAN  
AOC NB-9

DRAWING NO.



# **Tollway Barrier Guidelines**

## **Online Training Series**

### **IV) Level 2 Example 1**

#### **Solution (Cantilever Sign Foundation)**

TOLLWAY PROJECT X-XX-XXXX  
Roadway Reconstruction  
Tollway M.P. 200 to M.P. 205  
Barrier Warrant Analysis

**DATA SHEET**

Area of Concern: AOC NB-9

**DESCRIPTION OF OBSTACLE**

Cantilever Sign Foundation @ Sta. 3946+07.5, 22.4' from EOTW to Centerline of Foundation  
Sign Foundation is 6'-0" x 18'-0" grade beam

**DESIGN CONCEPTS**

Design Speed = 70 MPH (Tollway Design Speed)

ADT = 34,220 (2014)

$L_2 = 13.0'$

Clear Zone = 46 Feet based on 1:4 foreslope (from Table 3-1 AASHTO Roadside Design Guide 2011)

Runout Length = 360 feet (from Table 5-10b AASHTO Roadside Design Guide 2011)

A Level 3 analysis is not necessary since there are no other feasible alternatives.

**POTENTIAL ALTERNATIVES**

There are no feasible alternatives that locate the obstacle outside the clear zone; therefore, a level 3 analysis is not necessary.

## Area of Concern NB-9 – Cantilever Sign Foundation

$$L_A = 22.4' + 3.0' = 25.4'$$

$$L_2 = 1' + 11' + 1' = 13.0'$$

$$L_R = 360.0'$$

$$Y = L_2 + 0.69' = 13.0' + 0.69'$$

$$Y = 13.69'$$

### Area of Concern (AOC)

$$SF_{\text{Southface\_Foundation\_Station}} = SF$$

$$SF = (3945+98.50)$$

$$L_{\text{AOC}} = \text{Length of AOC} = 18.0'$$

### Length of Need – Formula

$$X = (L_A - Y) / (L_A / L_R)$$

$$X = (25.4 - 13.69) / (25.4 / 360.0)$$

$$X = 165.97'$$

$$\text{Point of Need} = \text{PON} = SF - X$$

$$\text{PON} = (3945+98.50) - 165.97'$$

$$\text{PON} = (3944+32.53)$$

(Distance from back of guardrail posts to foundation is 4.64'. Therefore, LON includes 10' overlap (OL). See Condition 1, TBG Figure 5.12)

$$\text{Length of Need} = \text{LON} = X + L_{\text{AOC}} + \text{OL} = 165.97' + 18.0' + 10.0'$$

$$\text{LON} = 193.97'$$

### Terminals

Terminal = Type T2 = T2 = 12.5' (does not count toward length of need)

Terminal = Type T1 (Special) = T1 = 46.88' (34.38' counts toward length of need)

### Barrier Limits Determination

Length of Guardrail =  $L_{\text{Guardrail}} = \text{LON} - \text{T1}$  (LON contribution)

$$L_{\text{Guardrail}} = 193.97' - 34.38'$$

$$L_{\text{Guardrail}} = 159.59'$$

$L_{\text{Guardrail, R}} = L_{\text{Guardrail}}$  (Round up to the nearest 12.5' increment)

$$L_{\text{Guardrail, R}} = 162.5'$$

$$T2_{\text{End\_Station}} = SF + L_{\text{AOC}} + \text{OL} + \text{T2}$$

$$T2_{\text{End\_Station}} = (3945+98.50) + 18' + 10 + 12.5'$$

$$T2_{\text{End\_Station}} = (3946+39.00)$$

$$GR_{\text{End\_Station}} = T2_{\text{Begin\_Station}} = T2_{\text{End\_Station}} - 12.5'$$

$$GR_{\text{End\_Station}} = (3946+39.00) - 12.5'$$

$$GR_{\text{End\_Station}} = (3946+26.50)$$

$$GR_{\text{Begin\_Station}} = GR_{\text{End\_Station}} - L_{\text{Guardrail, R}}$$

$$GR_{\text{Begin\_Station}} = (3946+26.50) - 162.5'$$

$$GR_{\text{Begin\_Station}} = (3944+64.00)$$

$$T1_{\text{Begin\_Station}} = GR_{\text{Begin\_Station}} - \text{T1}$$

$$T1_{\text{Begin\_Station}} = (3944+64.00) - 46.88'$$

$$T1_{\text{Begin\_Station}} = (3944+17.12)$$

### Barrier Limits Check:

$$12.5' < \text{PON} - T1_{\text{Begin\_Station}} < 25'$$

$$12.5' < (3944+32.53) - (3944+17.12) < 25'$$

$$12.5 < 15.41' < 25'$$

**OK**

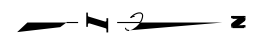
**U.S. Customary Units**

Design Speed (mph)	Design ADT	Foreslopes			Backslopes		
		1V:6H or flatter	1V:5H to 1V:4H	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or flatter
≤40	UNDER 750 <sup>c</sup>	7-10	7-10	<i>b</i>	7-10	7-10	7-10
	750-1500	10-12	12-14	<i>b</i>	12-14	12-14	12-14
	1500-6000	12-14	14-16	<i>b</i>	14-16	14-16	14-16
	OVER 6000	14-16	16-18	<i>b</i>	16-18	16-18	16-18
45-50	UNDER 750 <sup>c</sup>	10-12	12-14	<i>b</i>	8-10	8-10	10-12
	750-1500	14-16	16-20	<i>b</i>	10-12	12-14	14-16
	1500-6000	16-18	20-26	<i>b</i>	12-14	14-16	16-18
	OVER 6000	20-22	24-28	<i>b</i>	14-16	18-20	20-22
55	UNDER 750 <sup>c</sup>	12-14	14-18	<i>b</i>	8-10	10-12	10-12
	750-1500	16-18	20-24	<i>b</i>	10-12	14-16	16-18
	1500-6000	20-22	24-30	<i>b</i>	14-16	16-18	20-22
	OVER 6000	22-24	26-32 <sup>a</sup>	<i>b</i>	16-18	20-22	22-24
60	UNDER 750 <sup>c</sup>	16-18	20-24	<i>b</i>	10-12	12-14	14-16
	750-1500	20-24	26-32 <sup>a</sup>	<i>b</i>	12-14	16-18	20-22
	1500-6000	26-30	32-40 <sup>a</sup>	<i>b</i>	14-18	18-22	24-26
	OVER 6000	30-32 <sup>a</sup>	36-44 <sup>a</sup>	<i>b</i>	20-22	24-26	26-28
65-70 <sup>d</sup>	UNDER 750 <sup>c</sup>	18-20	20-26	<i>b</i>	10-12	14-16	14-16
	750-1500	24-26	28-36 <sup>a</sup>	<i>b</i>	12-16	18-20	20-22
	1500-6000	28-32 <sup>a</sup>	34-42 <sup>a</sup>	<i>b</i>	16-20	22-24	26-28
	OVER 6000	30-34 <sup>a</sup>	38-46 <sup>a</sup>	<i>b</i>	22-24	26-30	28-30

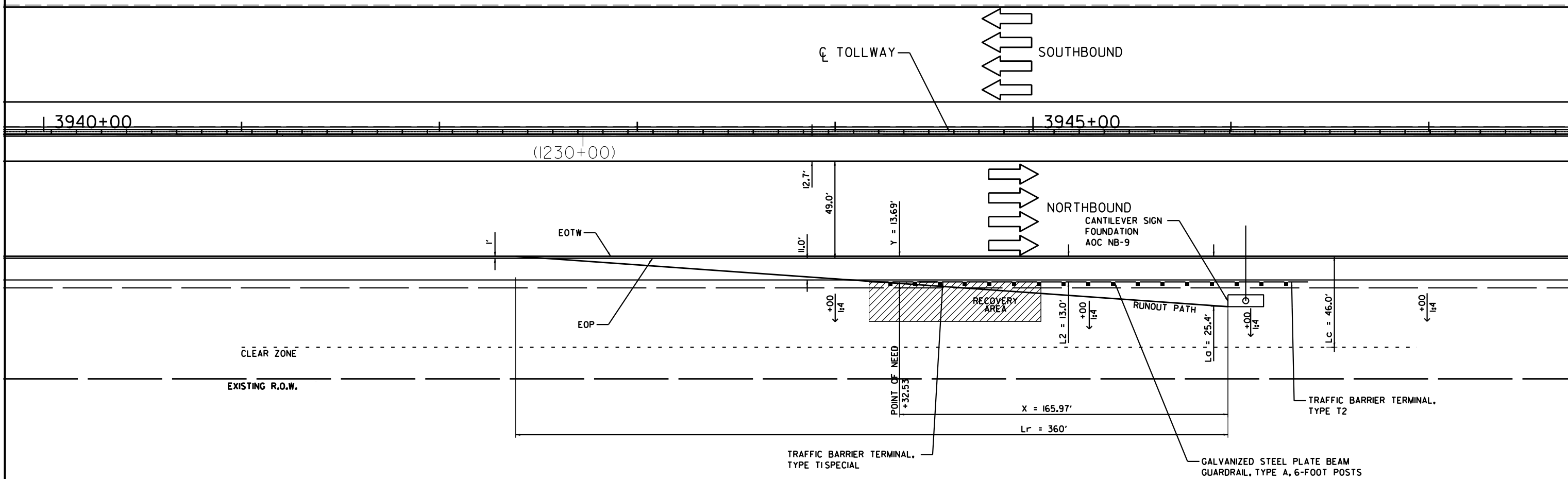
**Table 5-10b. Suggested Runout Lengths for Barrier Design (U.S. Customary Units)**

Design Speed (mph)	Runout Length ( $L_R$ ) Given Traffic Volume (ADT) (ft)			
	Over 10,000	5,000 to 10,000	1,000 to 5,000	Under 1,000
80	470	430	380	330
70	360	330	290	250
60	300	250	210	200
50	230	190	160	150
40	160	130	110	100
30	110	90	80	70

Note that these have lower values as compared to the previous edition of this guide. These runout lengths have been extensively reviewed in numerous studies and the results could vary depending on the assumptions made and the methodology used. Prior to the development of the runout lengths shown in [Table 5-10](#), some highway agencies considered the values in the previous publication to be excessive. Many of those agencies developed different methods to determine the length-of-need based on their available data. One alternate method is to determine a specific encroachment angle through cost-effectiveness analysis and install a length of barrier that will intercept a vehicle's runout path.

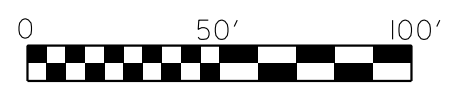


EXISTING R.O.W.



CLEAR ZONE

EXISTING R.O.W.



HORIZONTAL SCALE: 1" = 50'

9/22/2015 5:10:28 PM FILES

DRAWN BY.....**ABC**..... DATE. **9/4/15**  
 CHECKED BY.....**DEF**..... DATE. **9/4/15**

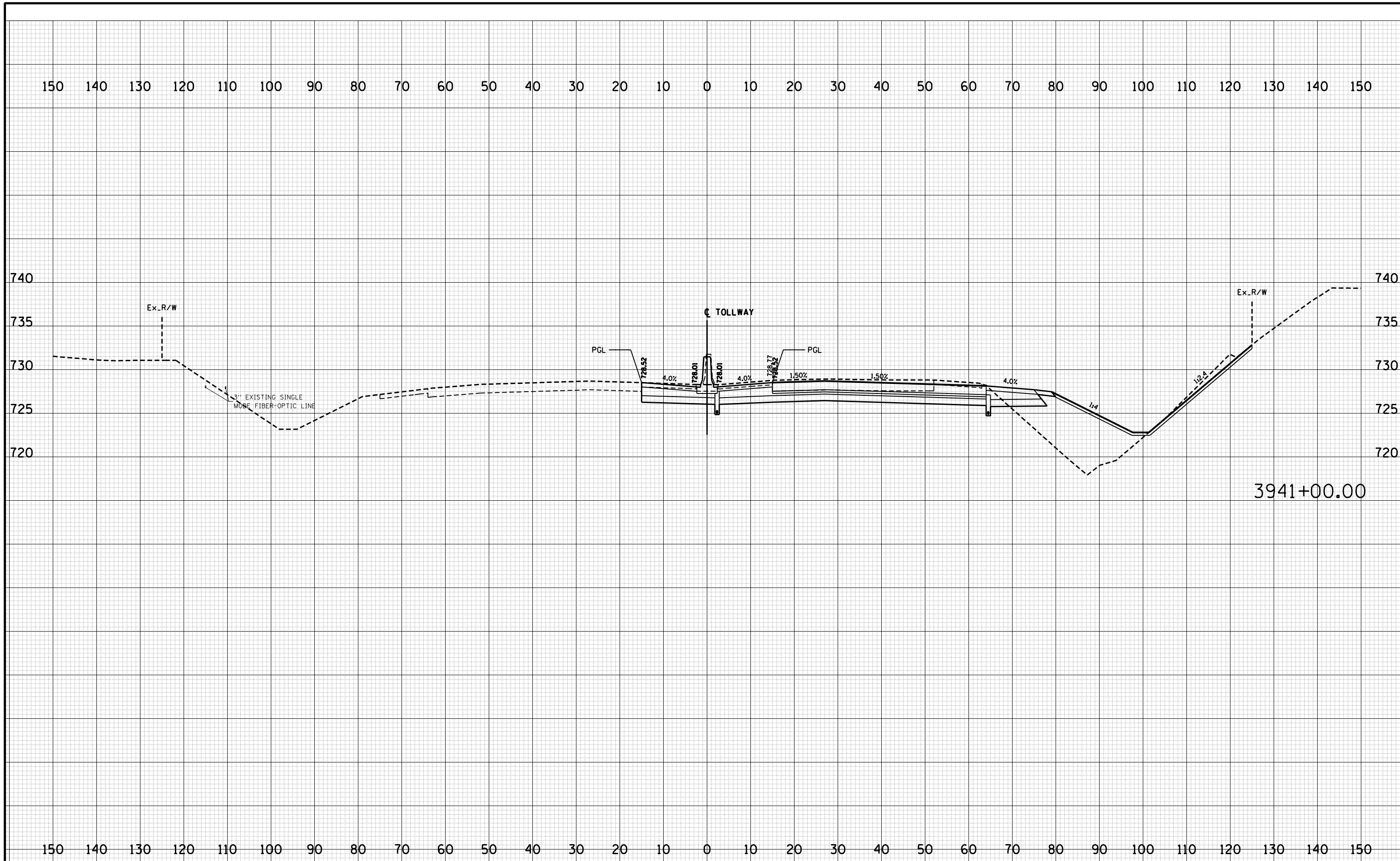


**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

**CONTRACT NO. XX-XX-XXXX**  
**BARRIER WARRANT**  
**SITE PLAN**  
**AOC NB-9**

DRAWING NO.  
**NB-9-5**



DRAWN BY..... DATE.....

CHECKED BY..... SCALE: HORIZ: 1"=20'  
VERT: 1"=10'

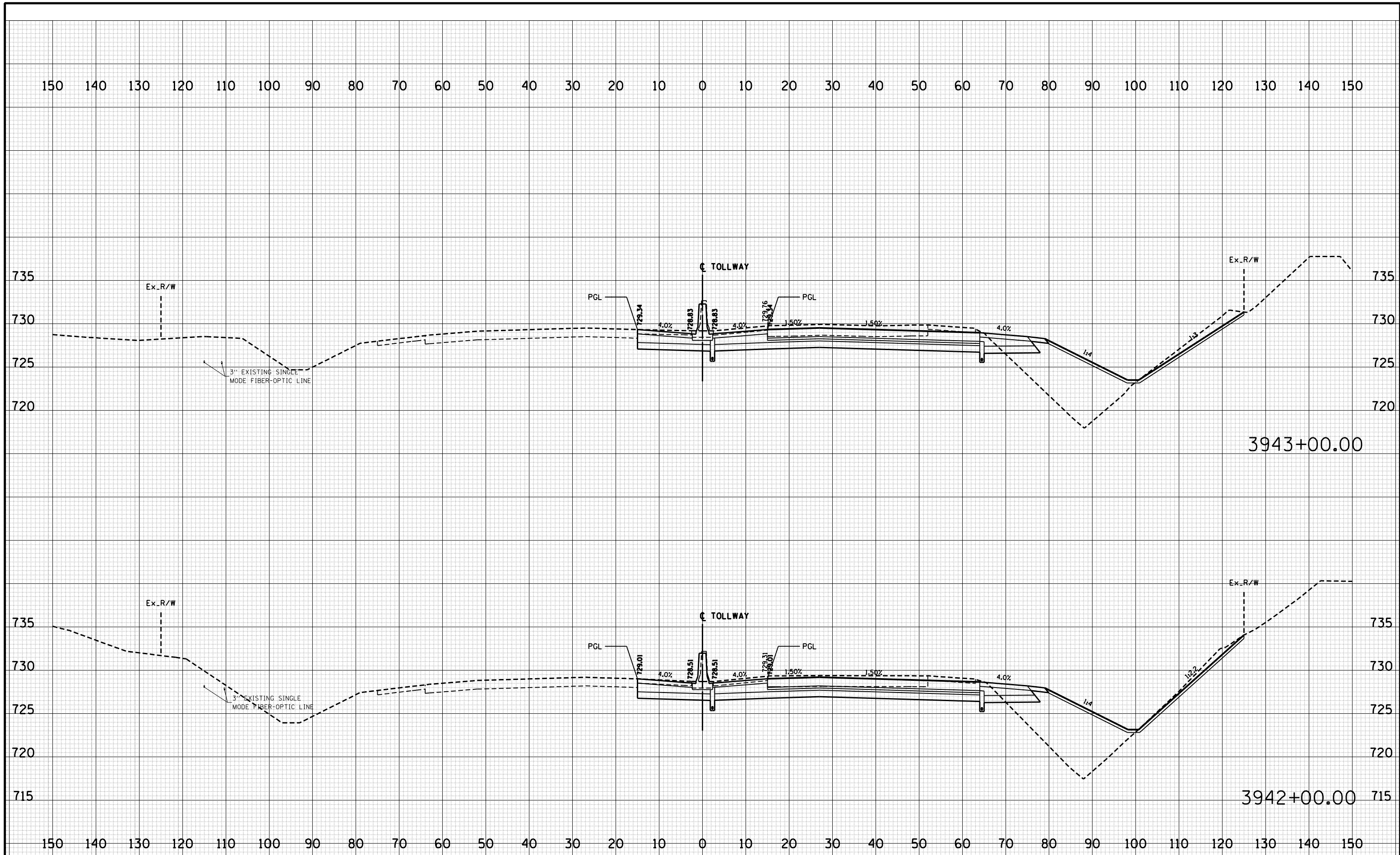


**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
2700 OGDEN AVENUE  
DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

MAINLINE CROSS SECTIONS

DRAWING NO.  
NB-9-6



DRAWN BY..... DATE.....

CHECKED BY..... SCALE: HORIZ: 1"=20'  
VERT: 1"=10'



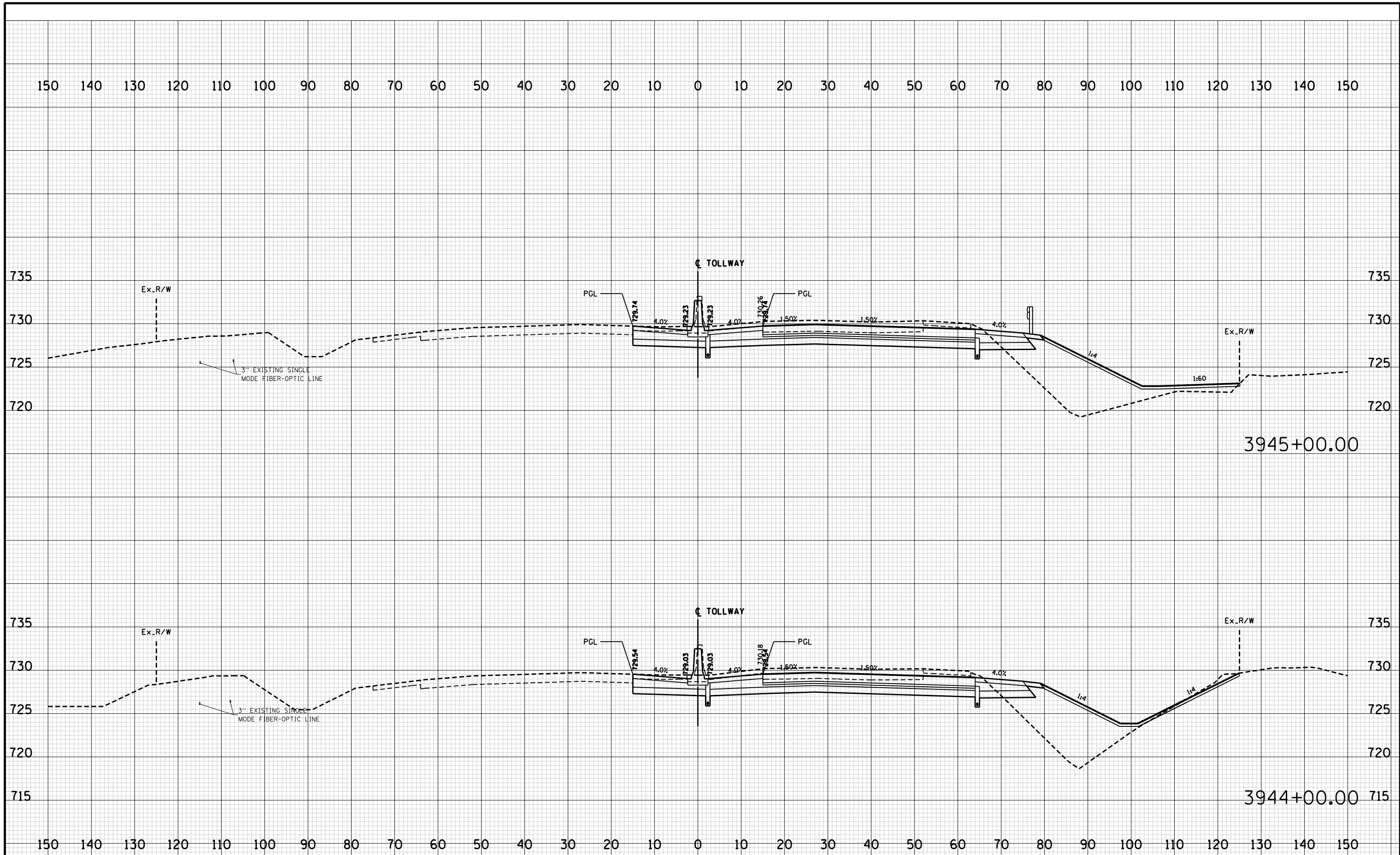
**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
2700 OGDEN AVENUE  
DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

MAINLINE CROSS SECTIONS

DRAWING NO.  
NB-9-7





DRAWN BY..... DATE.....

CHECKED BY..... SCALE: HORIZ: 1"=20'  
VERT: 1"=10'

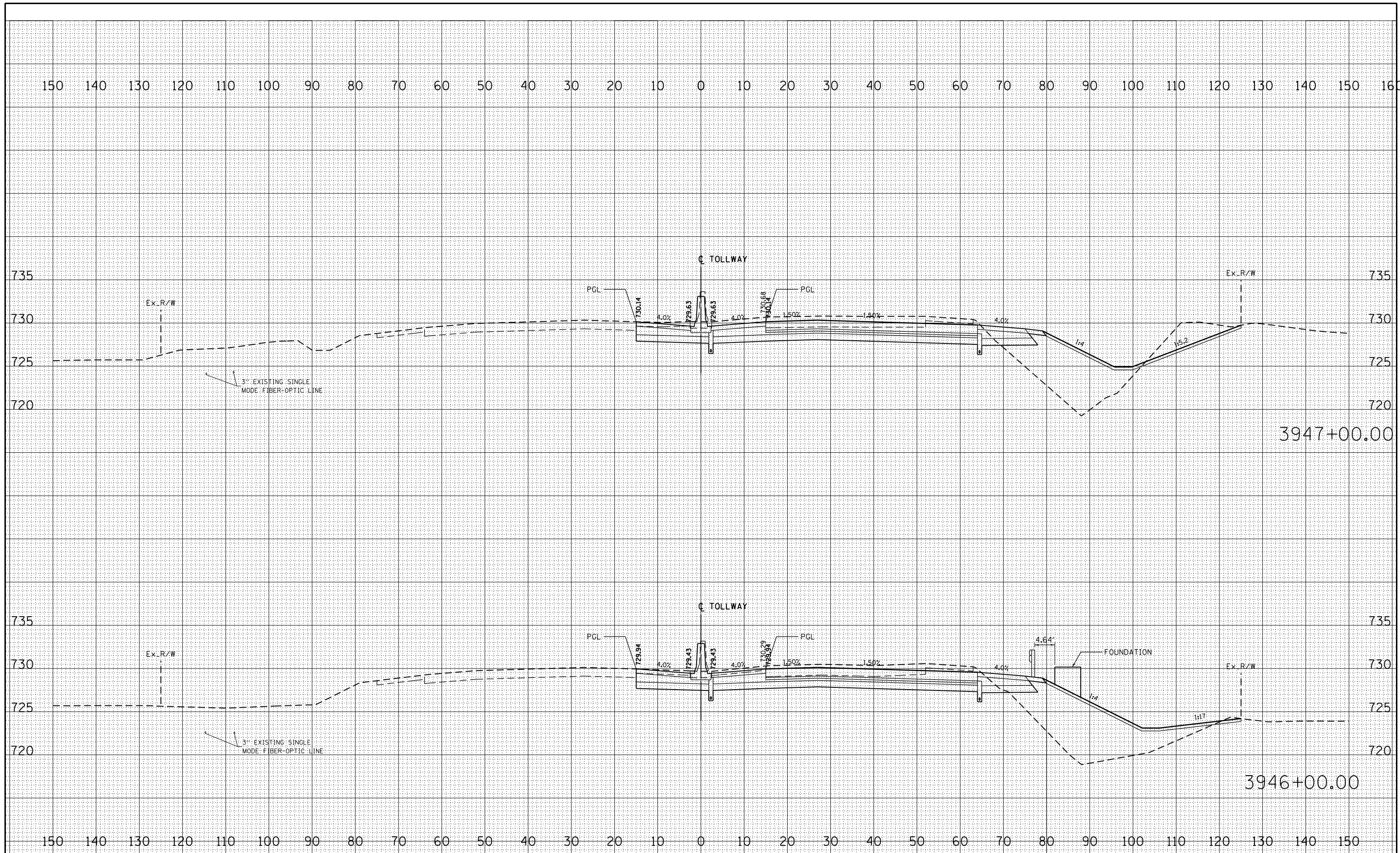


**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
2700 OGDEN AVENUE  
DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

MAINLINE CROSS SECTIONS

DRAWING NO.  
NB-9-8



DRAWN BY ..... DATE .....  
 CHECKED BY ..... SCALE HORIZ: 1"=20'  
 VERT: 1"=10'



REVISIONS		
NO.	DATE	DESCRIPTION

DRAWING NO.  
 MAINLINE CROSS SECTIONS  
 NB-9-9

# **Tollway Barrier Guidelines**

## **Online Training Series**

### **V) Sample Summary Analysis**

Summary Analysis - AOC's NB-9 & NB-11

Name	PON	U/S Sta.	D/S. Sta.	Overlap	Gap
AOC NB-9	3944+32.53	3944+17.12	3946+39.00		
AOC NB-11	3943+48.29	3943+32.88	3945+54.76	137.64	

Note: Analyses overlap; therefore, use single run of guardrail.

AOC NB-11 controls upstream end.  
 AOC NB-9 controls downstream end.

$$\begin{aligned} \text{Final LON} &= [\text{D/S End of Guardrail (AOC NB-9)}] - [\text{U/S PON (AOC NB-11)}] \\ &= 3946+26.5 - 3943+48.29 \\ &= 278.21' \end{aligned}$$

Terminals (Lengths in Feet):

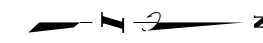
	Length Contributing to LON	Length Not Contributing to LON	Total Length
U/S Terminal: Type T1	34.38	12.50	46.88
D/S Terminal: Type T2	0.00	12.50	12.50

$$\begin{aligned} \text{Final length of guardrail} &= \text{LON} - \text{Length Contributing to LON} \\ &= 278.21 - 34.38' = 243.83' \\ &= 250.00' \text{ (rounded)} \end{aligned}$$

$$\begin{aligned} \text{Guardrail (Begin Station)} &= \text{Downstream Station} - \text{Length of Guardrail} \\ &= 3946.26.50 - 250.00 \\ &= 3943+76.50 \end{aligned}$$

Final Station:

Downstream Terminal (End Station):	3946+39.00
Guardrail (End Station):	3946+26.50
Guardrail (Begin Station):	3943+76.50
Upstream Terminal (Begin Station):	3943+29.62



EXISTING R.O.W.



☐ TOLLWAY

SOUTHBOUND

3940+00

3945+00

(1230+00)

NORTHBOUND

CANTILEVER SIGN  
FOUNDATION  
AOC NB-9

EOTW

EOP

CLEAR ZONE

EXISTING R.O.W.

RECOVERY AREA

EXISTING ITS POLE  
AOC NB-11

TRAFFIC BARRIER TERMINAL,  
TYPE T2

TRAFFIC BARRIER TERMINAL,  
TYPE T1SPECIAL

GALVANIZED STEEL PLATE BEAM  
GUARDRAIL, TYPE A, 6-FOOT POSTS

12.7'  
49.0'  
11.0'  
Y = 13.69'

LC = 46.0'



HORIZONTAL  
SCALE: 1" = 50'

DRAWN BY ABC DATE 9/4/15  
CHECKED BY DEF DATE 9/4/15



THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY  
2700 OGDEN AVENUE  
DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. XX-XX-XXXX  
SUMMARY  
SITE PLAN  
AOC-9 & 11

DRAWING NO.  
NB-II-12

# **Tollway Barrier Guidelines**

## **Online Training Series**

### **VI) Level 2 Example 2**

#### **Problem (Embankment Cone)**



# **Tollway Barrier Guidelines**

## **Online Training Series**

### **VII) Level 2 Example 2**

#### **Solution (Embankment Cone)**



TOLLWAY PROJECT X-XX-XXXX  
Roadway Rehabilitation  
Tollway M.P. 200 to M.P. 205  
Barrier Warrant Analysis

**DATA SHEET**

Area of Concern: AOC EB-17

**DESCRIPTION OF OBSTACLE**

Embankment Cone - Sta. 132+18.58 to Sta. 132+53.45 – AOC EB-17A  
Blunt End of Crash Wall at Bridge Pier @ Sta. 132+35.72, 11' from EOTW to Pier – AOC EB-17B

AOC's can be combined per TBG Art. 4.0(5). AOC EB-17A controls.

**DESIGN CONCEPTS**

Existing guardrail and terminals do not meet current standards  
There is a crash wall in front of the bridge piers.  
Concrete Shoulder Barrier Transition (CSBT) is required per Structural Design Manual, Article 11.6, (35' length, Standard Drawing C4).  
Regrading of the bridge cone is not a feasible alternative.

Design Speed = 60 MPH (Tollway Design Speed)  
ADT = 23,490 (2013)  
Clear Zone = 32' based on 1:6 foreslope (from Table 3-1 AASHTO Roadside Design Guide 2011)

Curve Radius = 2,864.79'  
Horizontal curve adjustment required because radius is less than 2,950'  
 $K_{CZ} = 1.2$  (from Table 3-2 AASHTO Roadside Design Guide 2011)  
Adjusted Clear Zone = 32' x 1.2 = 38.4'

Runout Length = 300' (from Table 5-10b AASHTO Roadside Design Guide 2011)

## Area of Concern EB-17 – Embankment Cone / Crash Wall for Bridge Pier

$$L_A = 38.4'$$

$$L_2 = 11' + 1' = 12'$$

$$L_R = 300.0'$$

$$Y = L_2 + 0.69' = 12.0' + 0.69'$$

$$Y = 12.69'$$

### Areas of Concern

$$\text{Crash Wall Upstream Station} = CW_{\text{Station}}$$

$$CW_{\text{Station}} = (132+35.72)$$

$$\text{Embankment Cone (EC) Upstream Station} = EC_{\text{US}}$$

$$EC_{\text{US}} = (132+18.58)$$

$$\text{Embankment Cone (EC) Downstream Station} = EC_{\text{DS}}$$

$$EC_{\text{DS}} = (132+53.45)$$

$$\text{Length of EC} = EC_{\text{DS}} - EC_{\text{US}} = (132+53.45) - (132+18.58) =$$

$$EC = 34.87'$$

$$L_{\text{AOC}} = \text{Length of AOC} = EC$$

$$L_{\text{AOC}} = 34.87'$$

### Length of Need – Graphical Solution

$$\text{Tangent Runout Path from EC} = 474.85'$$

$$\text{Tangent Runout Path} = 474.85' > L_R = 300.0'$$

Therefore, use  $L_R$  to determine upstream end of the runout path

$$X = \text{Calculated Graphically}$$

$$X = 167.08'$$

$$\text{Point of Need} = \text{PON} = EC_{\text{US}} - X$$

$$\text{PON} = (132+18.58) - 167.08'$$

$$\text{PON} = (130+51.50)$$

$$\text{Length of Need} = \text{LON} = X + L_{\text{AOC}} = 167.08' + 34.87' =$$

$$\text{LON} = 201.95'$$

### Terminals

$$\text{Terminal} = \text{Type T6B} = T6B = 58.15' = (43.15' \text{ counts toward Length of Need})$$

$$\text{Terminal} = \text{Type T1 (Special)} = T1 = 46.88' (34.38' \text{ counts toward Length of Need})$$

### Barrier Limits Determination

$$\text{Concrete Shoulder Barrier Transition} = \text{CSBT}$$

$$\text{CSBT} = 35'$$

$$\text{CSBT}_{\text{Station}} = CW_{\text{Station}} - \text{CSBT} = (132+35.72) - 35'$$

$$\text{CSBT}_{\text{Station}} = (132+00.72)$$

Lengths of Crash Wall and CSBT also contribute to Length of Need (15' of T6B included in CSBT)

$$\text{Length of Crash Wall} = CW = EC_{\text{DS}} - CW_{\text{Station}}$$

$$CW = (132+53.45) - (132+35.72)$$

$$CW = 17.73'$$

$$\text{Length of Guardrail} = L_{\text{Guardrail}} = \text{LON} - CW - \text{CSBT} - T6B - T1$$

$$L_{\text{Guardrail}} = 201.95' - 17.73' - 35' - 43.15' - 34.38'$$

$$L_{\text{Guardrail}} = 71.69'$$

$$L_{\text{Guardrail, R}} = L_{\text{Guardrail}} \text{ (Round up to the nearest 12.5' increment)}$$

$$L_{\text{Guardrail, R}} = 75.0'$$

$$T6B_{\text{End_Station}} = \text{CSBT}_{\text{Station}} + 15'$$

$$T6B_{\text{End_Station}} = (132+00.72) + 15'$$

$$T6B_{\text{End_Station}} = (132+15.72)$$

$$T6B_{\text{Begin_Station}} = \text{CSBT}_{\text{Station}} - 43.15'$$

$$T6B_{\text{Begin_Station}} = (132+00.72) - 43.15'$$

$$T6B_{\text{Begin_Station}} = (131+57.57)$$

$$GR_{\text{End_Station}} = T6B_{\text{Begin_Station}}$$

$$GR_{\text{End_Station}} = (131+57.57)$$

$$GR_{\text{Begin_Station}} = GR_{\text{End_Station}} - L_{\text{Guardrail, R}}$$

$$GR_{\text{Begin_Station}} = (131+57.57) - 75.0'$$

$$GR_{\text{Begin_Station}} = (130+82.57)$$

$$T1_{\text{Begin_Station}} = GR_{\text{Begin_Station}} - 46.88'$$

$$T1_{\text{Begin_Station}} = (130+82.57) - 46.88'$$

$$T1_{\text{Begin_Station}} = (130+35.69)$$

Barrier Limits Check:

$$12.5' < \text{PON} - \text{T1}_{\text{Begin_Station}} < 25'$$

$$12.5' < (130+51.50) - (130+35.69) < 25'$$

$$12.5' < 15.81' < 25' \quad \mathbf{OK}$$

Compare Existing Guardrail Length to Proposed:

Existing (with terminals): 308.30'

Proposed (with terminals): 165.03'

Proposed length of guardrail is less than the existing length due to both the shorter  $L_R$  length in the current AASHTO Roadside Design Guide (2011), Table 5-10b, and the addition of 35' of Concrete Shoulder Barrier Transition.

**U.S. Customary Units**

Design Speed (mph)	Design ADT	Foreslopes			Backslopes		
		1V:6H	1V:5H to 1V:4H	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or flatter
		or flatter					
≤40	UNDER 750 <sup>c</sup>	7-10	7-10	<i>b</i>	7-10	7-10	7-10
	750-1500	10-12	12-14	<i>b</i>	12-14	12-14	12-14
	1500-6000	12-14	14-16	<i>b</i>	14-16	14-16	14-16
	OVER 6000	14-16	16-18	<i>b</i>	16-18	16-18	16-18
45-50	UNDER 750 <sup>c</sup>	10-12	12-14	<i>b</i>	8-10	8-10	10-12
	750-1500	14-16	16-20	<i>b</i>	10-12	12-14	14-16
	1500-6000	16-18	20-26	<i>b</i>	12-14	14-16	16-18
	OVER 6000	20-22	24-28	<i>b</i>	14-16	18-20	20-22
55	UNDER 750 <sup>c</sup>	12-14	14-18	<i>b</i>	8-10	10-12	10-12
	750-1500	16-18	20-24	<i>b</i>	10-12	14-16	16-18
	1500-6000	20-22	24-30	<i>b</i>	14-16	16-18	20-22
	OVER 6000	22-24	26-32 <sup>a</sup>	<i>b</i>	16-18	20-22	22-24
60	UNDER 750 <sup>c</sup>	16-18	20-24	<i>b</i>	10-12	12-14	14-16
	750-1500	20-24	26-32 <sup>a</sup>	<i>b</i>	12-14	16-18	20-22
	1500-6000	26-30	32-40 <sup>a</sup>	<i>b</i>	14-18	18-22	24-26
	OVER 6000	30-32 <sup>a</sup>	36-44 <sup>a</sup>	<i>b</i>	20-22	24-26	26-28
65-70 <sup>d</sup>	UNDER 750 <sup>c</sup>	18-20	20-26	<i>b</i>	10-12	14-16	14-16
	750-1500	24-26	28-36 <sup>a</sup>	<i>b</i>	12-16	18-20	20-22
	1500-6000	28-32 <sup>a</sup>	34-42 <sup>a</sup>	<i>b</i>	16-20	22-24	26-28
	OVER 6000	30-34 <sup>a</sup>	38-46 <sup>a</sup>	<i>b</i>	22-24	26-30	28-30

**Table 5-10b. Suggested Runout Lengths for Barrier Design (U.S. Customary Units)**

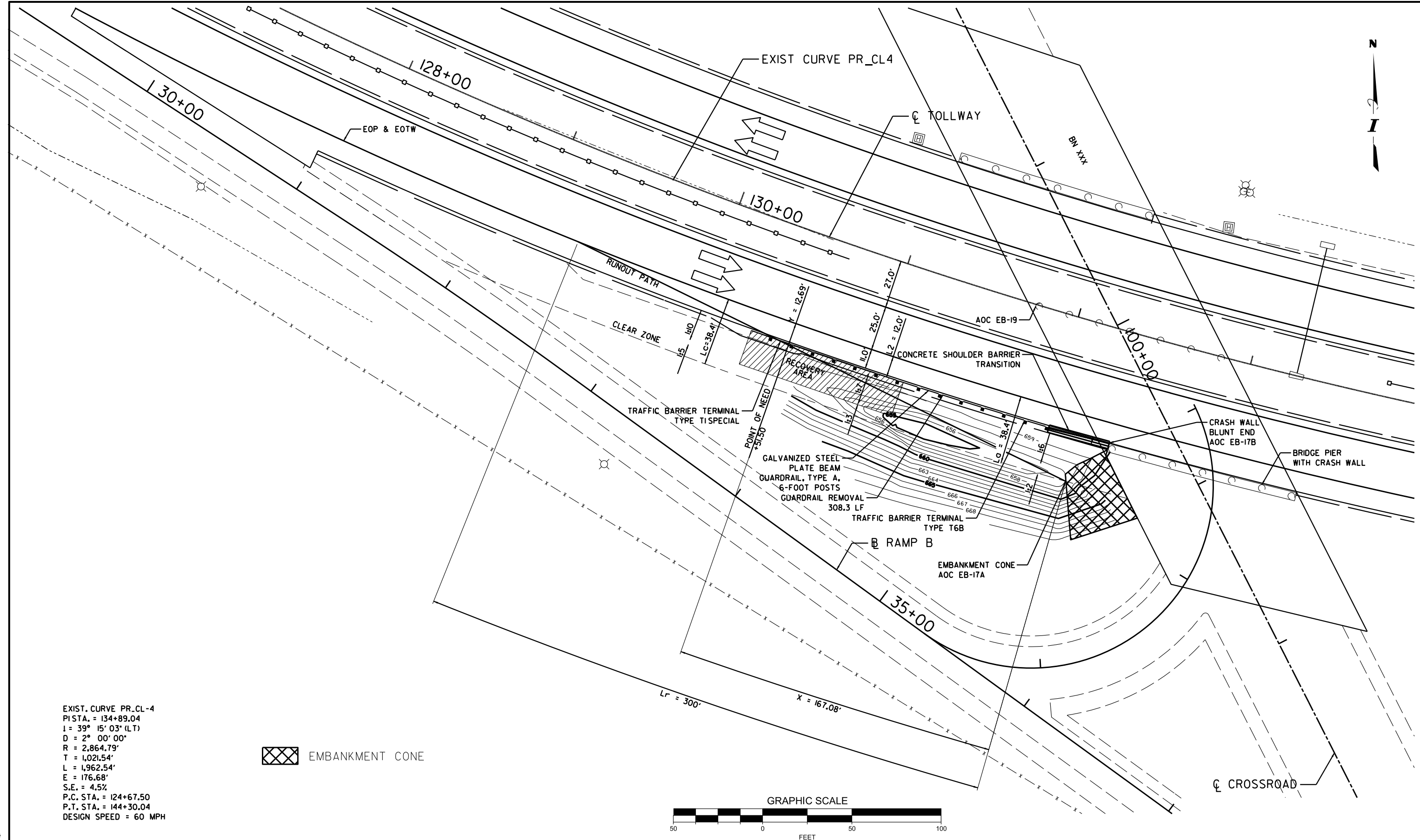
Design Speed (mph)	Runout Length ( $L_R$ ) Given Traffic Volume (ADT) (ft)			
	Over 10,000	5,000 to 10,000	1,000 to 5,000	Under 1,000
80	470	430	380	330
70	360	330	290	250
60	300	250	210	200
50	230	190	160	150
40	160	130	110	100
30	110	90	80	70

Note that these have lower values as compared to the previous edition of this guide. These runout lengths have been extensively reviewed in numerous studies and the results could vary depending on the assumptions made and the methodology used. Prior to the development of the runout lengths shown in [Table 5-10](#), some highway agencies considered the values in the previous publication to be excessive. Many of those agencies developed different methods to determine the length-of-need based on their available data. One alternate method is to determine a specific encroachment angle through cost-effectiveness analysis and install a length of barrier that will intercept a vehicle's runout path.

TOLLWAY PROJECT X-XX-XXXX  
 Roadway Rehabilitation  
 Tollway M.P. 200 to M.P. 205  
 Barrier Warrant Analysis

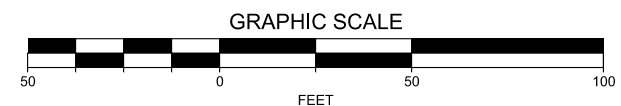
**Table 3-2. Horizontal Curve Adjustment Factor**

Radius, m [ft]	Design Speed km/h [mph]					
	60 [40]	70 [45]	80 [50]	90 [55]	100 [65]	110 [70]
900 [2,950]	1.1	1.1	1.1	1.2	1.2	1.2
700 [2,300]	1.1	1.1	1.2	1.2	1.2	1.3
600 [1,970]	1.1	1.2	1.2	1.2	1.3	1.4
500 [1,640]	1.1	1.2	1.2	1.3	1.3	1.4
450 [1,475]	1.2	1.2	1.3	1.3	1.4	1.5
400 [1,315]	1.2	1.2	1.3	1.3	1.4	
350 [1,150]	1.2	1.2	1.3	1.4	1.5	
300 [985]	1.2	1.3	1.4	1.5	1.5	
250 [820]	1.3	1.3	1.4	1.5		
200 [660]	1.3	1.4	1.5			
150 [495]	1.4	1.5				
100 [330]	1.5					



EXIST. CURVE PR\_CL-4  
 P.I.S.T.A. = 134+89.04  
 I = 39° 15' 03" (LT)  
 D = 2° 00' 00"  
 R = 2,864.79'  
 T = 1,021.54'  
 L = 1,962.54'  
 E = 176.68'  
 S.E. = 4.5%  
 P.C. STA. = 124+67.50  
 P.T. STA. = 144+30.04  
 DESIGN SPEED = 60 MPH

 EMBANKMENT CONE



9/17/2015 2:36:20 PM FILES

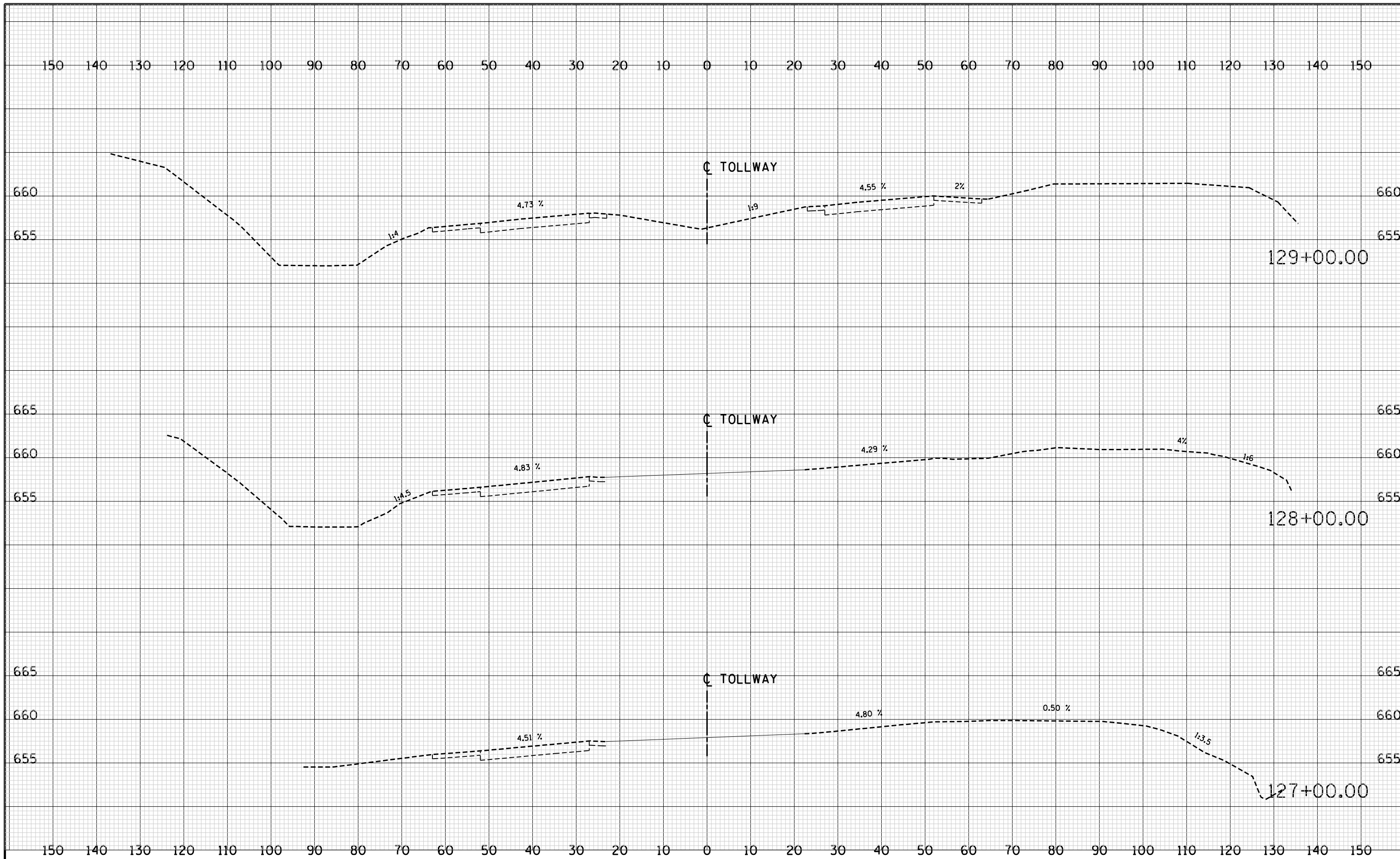
DRAWN BY... ABC... DATE... 9/4/15  
 CHECKED BY... DEF... DATE... 9/4/15

 THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. XX-XX-XXXX  
 BARRIER WARRANT  
 SITE PLAN  
 AOC EB-17

DRAWING NO.  
 EB-17-7



DRAWN BY..... DATE.....

CHECKED BY..... SCALE: HORIZ. 1"=20'  
VERT. 1"=10'



**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
2700 OGDEN AVENUE  
DOWNERS GROVE, ILLINOIS 60515

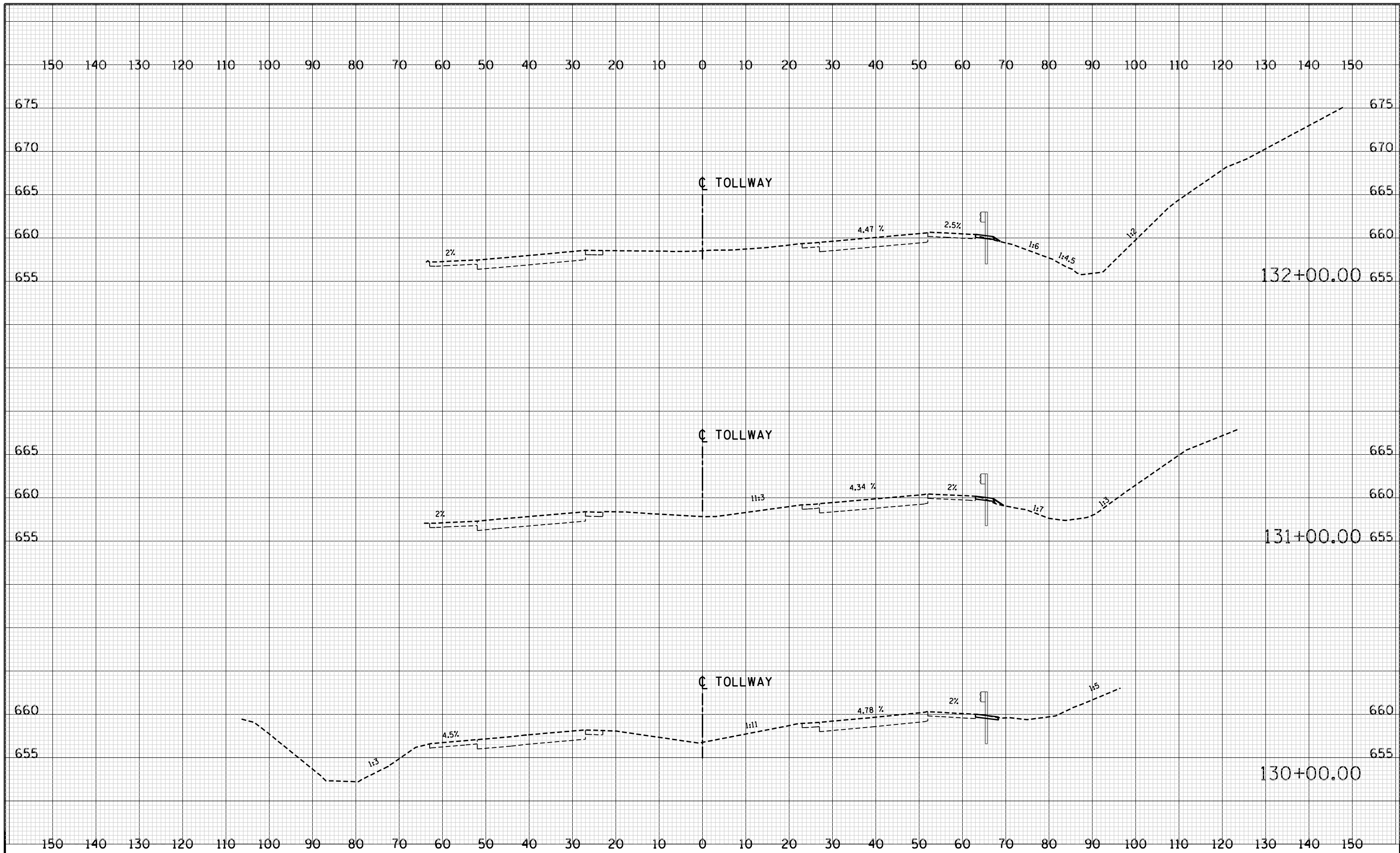
REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. XX-XX-XXXX

MAINLINE CROSS SECTIONS

DRAWING NO.  
EB-17-8





DRAWN BY..... DATE.....

CHECKED BY..... SCALE: HORIZ: 1"=20'  
VERT: 1"=10'



**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
2700 OGDEN AVENUE  
DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. XX-XX-XXXX  
MAINLINE CROSS SECTIONS

DRAWING NO.  
EB-17-9

**Tollway Barrier Guidelines**  
**Online Training Series**

**VIII) Level 3 Example (Problem  
& Solution)**

## **Level 3 Analysis - AOC #E074**

Alternative #1: Utilize 95' sign truss span length and install foundation within the clear zone. Shield foundation with guardrail.

Alternative #2: Utilize 105' sign truss span length and install foundation just outside the clear zone, unshielded.

Alternative #3: Utilize 115' sign truss span length and install foundation well outside the clear zone, unshielded.

All three alternatives are feasible. Therefore, a level 3 analysis will compare cost-benefit ratios for all three alternatives.

TOLLWAY PROJECT NO. RR-XX-XXXX  
Roadway Reconstruction  
Tollway M.P. 200 to M.P. 205  
Barrier Warrant Analysis

**DATA SHEET**

Area of Concern: E074

**DESCRIPTION OF OBSTACLE**

Sign truss foundation (AOC E074) at Sta. 3162+99.65. The foundation is 18.0' long (parallel to traffic) by 3.5' wide. The full 18' length of foundation is considered an obstacle.

This analysis is to determine the shielding required for Alternative #1.

**DESIGN CONCEPTS**

Design Speed = 70 MPH (Mainline design speed)

ADT = 74,759 (2014 Tollway Traffic Data Report, pg. A-14)

Clear Zone ( $L_C$ ) = 30' based on 1:6 backslope (Table 3-1 AASHTO Roadside Design Guide 2011)

Tangent section; no horizontal curve adjustments necessary.

Runout length ( $L_R$ ) = 360 ft. (from Table 5-10b AASHTO Roadside Design Guide 2011)

Stationing increases going downstream.

Area of Concern E074 – Sign Truss Foundation

Alternative #1

$$L_3 = 25.75'$$

$$L_A = L_3 + 3.5' = 29.25'$$

$$L_2 = 15' + 1' + 2.23' = 18.23'$$

$$L_R = 360.0'$$

$$Y = L_2 + 0.69'$$

$$Y = 18.92'$$

Area of Concern (AOC)

$$USF_{\text{Sign Truss Fndn\_Upstream\_Station}} = USF$$

$$USF = 3162+99.65$$

$$L_{AOC} = \text{Length of AOC} = 18.0'$$

$$DSF_{\text{Sign Truss Fndn\_Downstream\_Station}} = DSF$$

$$DSF = 3163+17.65$$

Length of Need - Formula

$$X = (L_A - Y) / (L_A / L_R)$$

$$= (29.25 - 18.92) / (29.25 / 360) =$$

$$X = 127.14'$$

$$\text{Point of Need} = \text{PON} = USF - X$$

$$\text{PON} = 3162+99.65 - 127.14'$$

$$\text{PON} = 3161+72.51$$

Downstream Condition:

Offset from back of guardrail to face of foundation is = 5.76'

Therefore, Condition 1 applies (See TBG figure 5.12)

Overlap Distance = OL = 10.0'

$$\text{Length of Need} = \text{LON} = X + L_{AOC} + OL$$

$$\text{LON} = 127.14' + 18.0' + 10.0'$$

$$\text{LON} = 155.14'$$

Proposed Guardrail Terminals

Downstream End

$$\text{Terminal} = \text{Type T2} = T_2 = 12.5'$$

(0' counts toward length of need)

Upstream End

$$\text{Terminal} = \text{Type T1(Special)} = T_1 = 46.88'$$

(34.38' counts toward length of need)

Barrier Limits Determination

$$\text{Length of Guardrail} = L_{\text{Guardrail}} = \text{LON} - T_1 \text{ (LON contribution)}$$

$$L_{\text{Guardrail}} = 155.14' - 34.38'$$

$$L_{\text{Guardrail}} = 120.76'$$

$$L_{\text{Guardrail, R}} = L_{\text{Guardrail}} \text{ (Round up to nearest 12.5' increment)}$$

$$L_{\text{Guardrail, R}} = 125.0'$$

Minimum length check:      Okay

$$T2_{\text{End\_Station}} = DSF + OL + T_2$$

$$T2_{\text{End\_Station}} = 3163+17.65 + 10.0' + 12.5' \quad T2_{\text{End\_Station}} = (3163+40.15)$$

$$GR_{\text{End\_Station}} = T2_{\text{Begin\_Station}} = T2_{\text{End\_Station}} - T_2$$

$$GR_{\text{End\_Station}} = 3163+40.15 - 12.5' \quad GR_{\text{End\_Station}} = (3163+27.65)$$

$$GR_{\text{Begin\_Station}} = GR_{\text{End\_Station}} - L_{\text{Guardrail,R}}$$

$$GR_{\text{Begin\_Station}} = 3163+27.65 - 125.0' \quad GR_{\text{Begin\_Station}} = (3162+02.65)$$

$$T1_{\text{Begin\_Station}} = GR_{\text{Begin\_Station}} - T1$$

$$T1_{\text{Begin\_Station}} = 3162+02.65 - 46.88' \quad T1_{\text{Begin\_Station}} = (3161+55.77)$$

Recovery Area Check:

There are no objects within the recovery area.

Barrier Limits Check:

$$12.5' < \text{PON} - T1_{\text{Begin\_Station}} < 25'$$

$$12.5 < (3161+72.51) - (3161+55.77) < 25'$$

$$12.5 < 16.74' < 25' \quad \Rightarrow \text{OK}$$

Existing Guardrail v. Proposed condition (including terminals)

No existing guardrail

Recommendation:

Install guardrail and terminals to stations listed above, pending results of Level 3 analysis.

Table 3-1. Suggested Clear-Zone Distances in Feet from Edge of Through Traveled Lane (6)

U.S. Customary Units							
Design Speed (mph)	Design ADT	Foreslopes			Backslopes		
		1V:6H or flatter	1V:5H to 1V:4H	1V:3H	1V:3H	1V:5H to 1V:4H	1V:6H or flatter
≤40	UNDER 750 <sup>c</sup>	7-10	7-10	<i>b</i>	7-10	7-10	7-10
	750-1500	10-12	12-14	<i>b</i>	12-14	12-14	12-14
	1500-6000	12-14	14-16	<i>b</i>	14-16	14-16	14-16
	OVER 6000	14-16	16-18	<i>b</i>	16-18	16-18	16-18
45-50	UNDER 750 <sup>c</sup>	10-12	12-14	<i>b</i>	8-10	8-10	10-12
	750-1500	14-16	16-20	<i>b</i>	10-12	12-14	14-16
	1500-6000	16-18	20-26	<i>b</i>	12-14	14-16	16-18
	OVER 6000	20-22	24-28	<i>b</i>	14-16	18-20	20-22
55	UNDER 750 <sup>c</sup>	12-14	14-18	<i>b</i>	8-10	10-12	10-12
	750-1500	16-18	20-24	<i>b</i>	10-12	14-16	16-18
	1500-6000	20-22	24-30	<i>b</i>	14-16	16-18	20-22
	OVER 6000	22-24	26-32 <sup>a</sup>	<i>b</i>	16-18	20-22	22-24
60	UNDER 750 <sup>c</sup>	16-18	20-24	<i>b</i>	10-12	12-14	14-16
	750-1500	20-24	26-32 <sup>a</sup>	<i>b</i>	12-14	16-18	20-22
	1500-6000	26-30	32-40 <sup>a</sup>	<i>b</i>	14-18	18-22	24-26
	OVER 6000	30-32 <sup>a</sup>	36-44 <sup>a</sup>	<i>b</i>	20-22	24-26	26-28
65-70 <sup>d</sup>	UNDER 750 <sup>c</sup>	18-20	20-26	<i>b</i>	10-12	14-16	14-16
	750-1500	24-26	28-36 <sup>a</sup>	<i>b</i>	12-16	18-20	20-22
	1500-6000	28-32 <sup>a</sup>	34-42 <sup>a</sup>	<i>b</i>	16-20	22-24	26-28
	OVER 6000	30-34 <sup>a</sup>	38-46 <sup>a</sup>	<i>b</i>	22-24	26-30	28-30

**Table 5-10b. Suggested Runout Lengths for Barrier Design (U.S. Customary Units)<sup>1</sup>**

Design Speed (mph)	Runout Length ( $L_R$ ) Given Traffic Volume (ADT) (ft)			
	Over 10,000	5,000 to 10,000	1,000 to 5,000	Under 1,000
80	470	430	380	330
70	360	330	290	250
60	300	250	210	200
50	230	190	160	150
40	160	130	110	100
30	110	90	80	70

Note that these have lower values as compared to the previous edition of this guide. These runout lengths have been extensively reviewed in numerous studies and the results could vary depending on the assumptions made and the methodology used. Prior to the development of the runout lengths shown in [Table 5-10](#), some highway agencies considered the values in the previous publication to be excessive. Many of those agencies developed different methods to determine the length-of-need based on their available data. One alternate method is to determine a specific encroachment angle through cost-effectiveness analysis and install a length of barrier that will intercept a vehicle's runout path.

<sup>1</sup>AASHTO Roadside Design Guide, 4<sup>th</sup> Edition, 2011





EXISTING R.O.W.

AOC W101

AOC W102

AOC W103

WB I-90 JANE ADDAMS MEMORIAL TOLLWAY

3160+00

AOC E072

3164+00

LR=360.00'

EB I-90 JANE ADDAMS MEMORIAL TOLLWAY

TBT TYPE T1(SP)

X=127.14'

AOC E074  
SIGN TRUSS FOUNDATION  
STA 3162+99.65  
ALTERNATIVE 1 (95' SPAN)

EOTW

EOP

RUNOUT PATH

Y=18.92'

LA=29.25'

CLEAR ZONE

AOC E073

TBT TYPE T2

EXISTING R.O.W.

G-3 GUTTER

20'X95'  
RECOVERY AREA

POINT OF NEED  
STA 3161+72.51

L2=18.23'

AOC E074  
SIGN TRUSS FOUNDATION  
ALTERNATIVE 2 (105' SPAN)  
JUST OUTSIDE CLEAR ZONE

AOC E074  
SIGN TRUSS FOUNDATION  
ALTERNATIVE 3 (115' SPAN)  
WELL OUTSIDE CLEAR ZONE

GRAPHIC SCALE



9/21/2015 4:59:59 PM  
FILES

DRAWN BY.....ABC..... DATE 9/4/15  
CHECKED BY.....DEF..... DATE 9/4/15



THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY  
2700 OGDEN AVENUE  
DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. X-XX-XXXX  
BARRIER WARRANT  
SITE PLAN

DRAWING NO.  
E074 (7)

## Level 3 Cost Breakdown - AOC E074

### Alternative #1: Shield Sign Foundation

Installation Costs:

95' sign structure (span type)	<u>\$95,000</u>
TBT, Type T1 (SP)	<u>\$3,000</u>
TBT, Type T2	<u>\$1,000</u>
Galvanized Steel Plate Beam Guardrail, Type A, 6ft.	
Length = 125.0 LF	
Rate = \$22 /LF	= <u>\$2,750</u>
	Total = <u>\$101,750</u>

Annual Maintenance Costs:

Length of guardrail = 184.38 ft.  
(Total length including terminals)

$$\text{Annual maintenance cost} = \text{Length} \times \$2/\text{ft} = \underline{\$369}$$

### Alternative #2: Do Not Shield Sign Foundation (Just Outside Clear Zone)

Installation Costs:

105' sign structure (span type) \$105,000

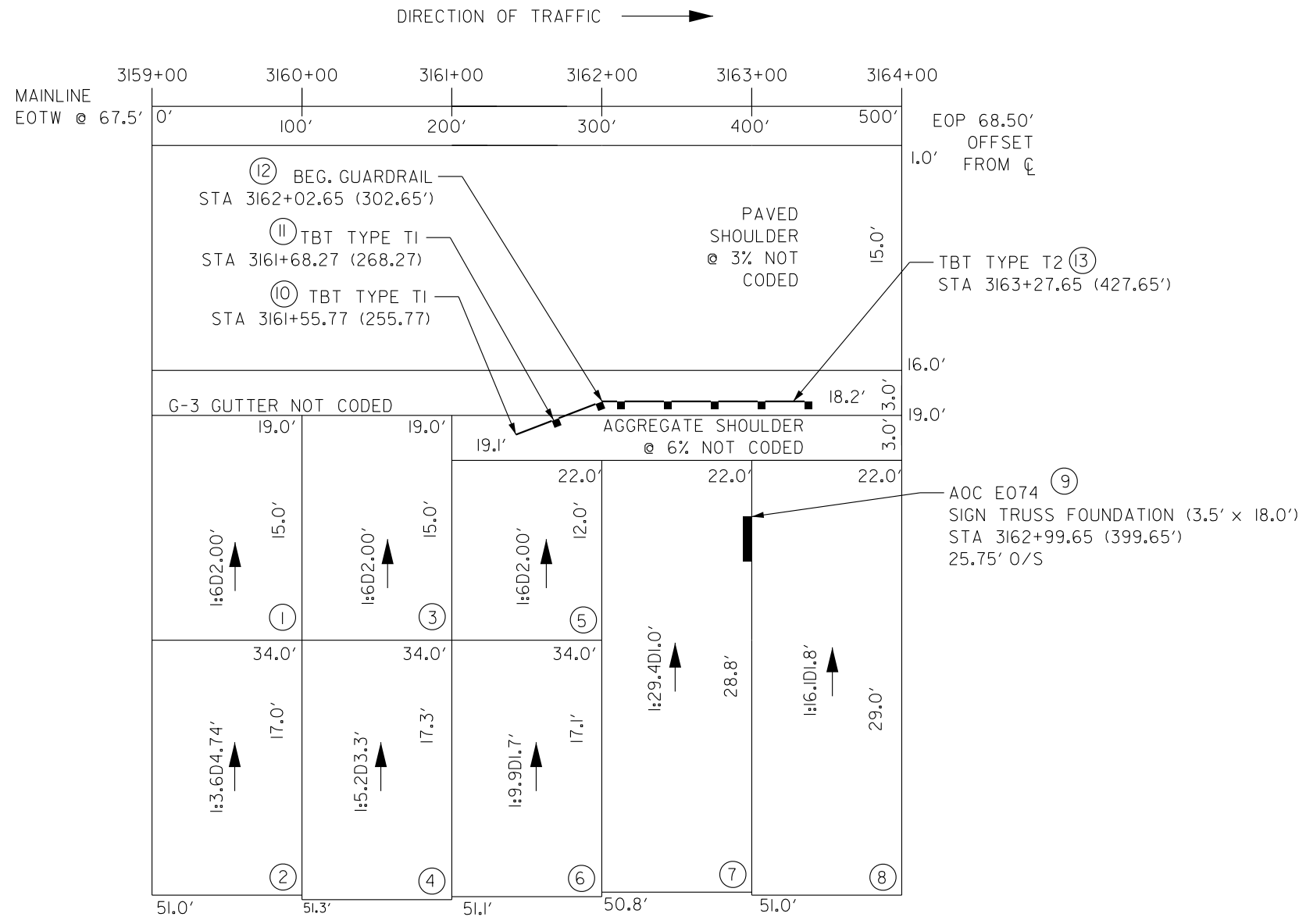
Annual Maintenance Costs: \$0

### Alternative #3: Do Not Shield Sign Foundation (Well Outside Clear Zone)

Installation Costs:

115' sign structure (span type) \$115,000

Annual Maintenance Costs: \$0



- NOTES:
1. ALTERNATIVE #1 - 95' SPAN SIGN TRUSS FOUNDATION INSIDE CLEAR ZONE WITH SHIELDING
  2. CROSS SECTION INFORMATION SHOWN IS USED FOR THE 100' BEFORE THE STATION, i.e., FROM STA. 3159+00 TO 3160+00 USES CROSS SECTION INFO FROM STA. 3160+00.

9/21/2015 5:10:40 PM FILES

DRAWN BY.....**ABC**..... DATE **9/4/2015** .  
 CHECKED BY.....**DEF**..... DATE **9/4/2015** .

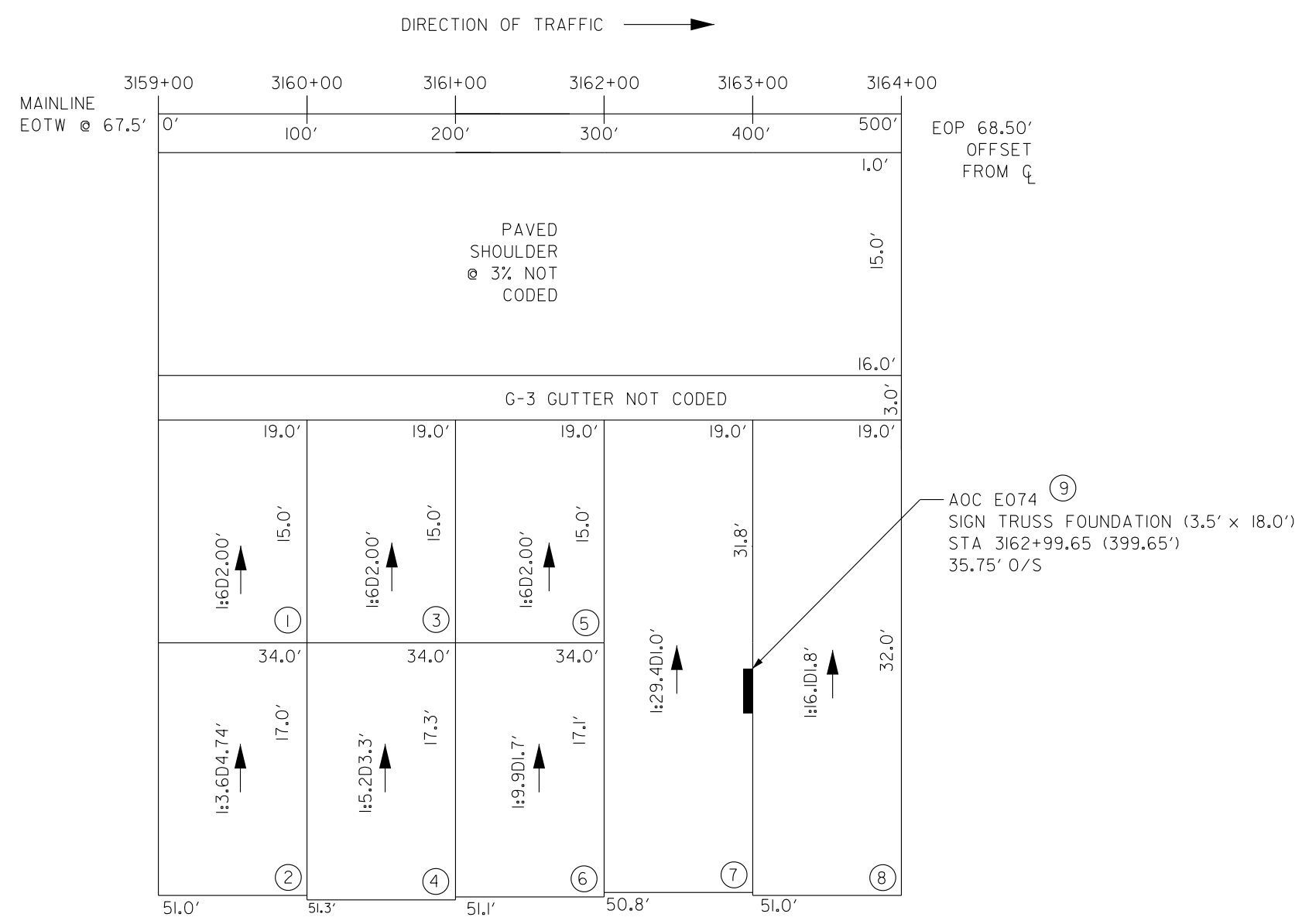


THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. X-XX-XXXX  
 BARRIER WARRANT  
 FEATURE SKETCH  
 AOC #E074 - ALT #1

DRAWING NO.  
 E074 (9)



- NOTES:
1. ALTERNATIVE #2 - 105' SPAN SIGN TRUSS FOUNDATION JUST OUTSIDE CLEAR ZONE WITH SHIELDING
  2. CROSS SECTION INFORMATION SHOWN IS USED FOR THE 100' BEFORE THE STATION, i.e., FROM STA. 3159+00 TO 3160+00 USES CROSS SECTION INFO FROM STA. 3160+00.

9/21/2015 5:23:55 PM FILES

DRAWN BY.....**ABC**..... DATE **9/4/2015**.  
 CHECKED BY.....**DEF**..... DATE **9/4/2015**.

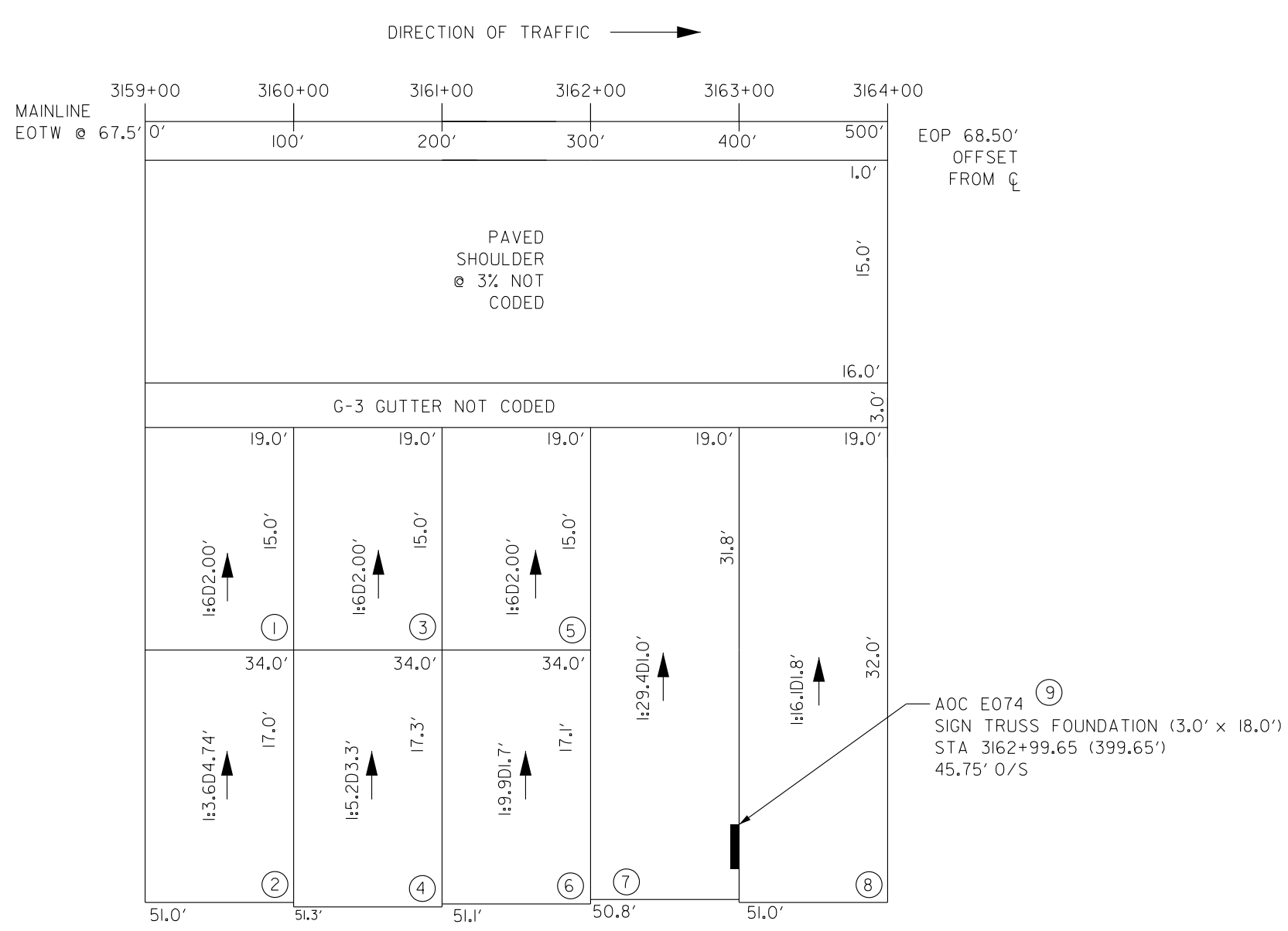


THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

REVISIONS	
NO.	DATE

CONTRACT NO. X-XX-XXXX  
 BARRIER WARRANT  
 FEATURE SKETCH  
 AOC #E074 - ALT #2

DRAWING NO.  
 E074 (10)



NOTES:  
 1. ALTERNATIVE #3 - 115' SPAN SIGN TRUSS FOUNDATION WELL OUTSIDE CLEAR ZONE WITH SHIELDING  
 2. CROSS SECTION INFORMATION SHOWN IS USED FOR THE 100' BEFORE THE STATION, i.e., FROM STA. 3159+00 TO 3160+00 USES CROSS SECTION INFO FROM STA. 3160+00.

9/21/2015 5:19:05 PM FILES

DRAWN BY.....ABC..... DATE.9/4/2015.  
 CHECKED BY.....DEF..... DATE.9/4/2015.



THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

REVISIONS	
NO.	DATE

CONTRACT NO. X-XX-XXXX  
 BARRIER WARRANT  
 FEATURE SKETCH  
 AOC #E074 - ALT #3

DRAWING NO.  
 E074 (II)

Date: September 22, 2015

Time: 09:24:12AM

**Benefit/Cost Ratio Report**

Page: 1

**File Name:** AOC E074  
**Project Description:** Widening

<u>Alternative</u>	<u>Description</u>
1	Alternative 1: Sign truss foundation shortest span with shielding
2	Alternative 2: Sign truss foundation just outside clear zone no shielding
3	Alternative 3: Sign truss foundation well outside clear zone no shielding

<u>Alternative</u>	<u>Alternative</u>		
	<u>2</u>	<u>1</u>	<u>3</u>
2	0.00	-142.83	23.54
1	0.00	0.00	134.43
3	0.00	0.00	0.00

Date: September 22, 2015

Time: 09:24:12AM

**Alternative Cost Report**

Page: 2

File Name: AOC E074

Project Description: Widening

<u>Alternative</u>	<u>Description</u>
1	Alternative 1: Sign truss foundation shortest span with shielding
2	Alternative 2: Sign truss foundation just outside clear zone no shielding
3	Alternative 3: Sign truss foundation well outside clear zone no shielding

<u>Alternative</u>	<u>Expected Crash Frequency (Acc/Yr)</u>	<u>Annual Crash Cost (\$)</u>	<u>Annual Installation Cost (\$)</u>	<u>Annual Maintenance Cost (\$)</u>	<u>Annual Repair Cost (\$)</u>
1	1.024393	63623.79	6513.22	369.00	95.06
2	0.716629	27056.72	6721.26	0.00	0.00
3	0.599495	11989.76	7361.38	0.00	0.00

# Feature Cost Report

**File Name:** AOC E074  
**Project Description:** Widening

**Alternative:** 1  
**Description:** Alternative 1: Sign truss foundation shortest span with shielding

<u>Feature</u>	<u>Distance From Beginning Of First Segment</u>	<u>Expected Crash Freq (Acc/Year)</u>	<u>Average Severity</u>	<u>Annual Crash Cost (\$)</u>	<u>Category</u>	<u>Type</u>
1.1	0.0	0.114825	0.39	149.74	Backslopes	6:1, H >= 0.5 m (1.5 ft)
2.1	0.0	0.015385	0.68	58.96	Backslopes	4:1, H >= 0.15 m (6 in.)
3.1	100.0	0.142354	0.39	130.99	Backslopes	6:1, H >= 0.5 m (1.5 ft)
4.1	100.0	0.000000	0.62	0.00	Backslopes	6:1, H < 0.3 m (1 ft)
5.1	200.0	0.085550	0.39	21.21	Backslopes	6:1, H >= 0.5 m (1.5 ft)
6.1	200.0	0.000000	0.39	0.00	Backslopes	10:1, H >= 0.3 m (1 ft)
7.1	300.0	0.095597	0.45	0.00	Backslopes	10:1, H < 0.3 m (1 ft)
8.1	400.0	0.123181	0.39	62.31	Backslopes	10:1, H >= 0.3 m (1 ft)
9.1	399.6	0.037464	6.67	2557.71	Fixed Objects	Rectangle, W = 1.25 m (4 ft), H > 1.0 m (3 ft)
10.1	255.8	0.063600	3.79	6963.73	Terminals and Crash Cushions	TL-3 Guardrail Terminal
11.1	268.3	0.076587	3.78	12524.32	Longitudinal Barriers	TL-3 Guardrail
12.1	302.6	0.249849	3.93	38362.49	Longitudinal Barriers	TL-3 Guardrail
13.1	427.6	0.020001	3.73	2792.33	Terminals and Crash Cushions	TL-3 Guardrail Terminal



# Feature Cost Report

**File Name:** AOC E074  
**Project Description:** Widening

**Alternative:** 2  
**Description:** Alternative 2: Sign truss foundation just outside clear zone no shielding

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost (\$)	Category	Type
						6:1, H >= 0.5 m (1.5 ft)
1.1	0.0	0.085507	0.39	147.59	Backslopes	6:1, H >= 0.5 m (1.5 ft)
2.1	0.0	0.011143	0.68	58.75	Backslopes	4:1, H >= 0.15 m (6 in.)
3.1	100.0	0.107586	0.39	138.46	Backslopes	6:1, H >= 0.5 m (1.5 ft)
4.1	100.0	0.000000	0.62	0.00	Backslopes	6:1, H < 0.3 m (1 ft)
5.1	200.0	0.123166	0.39	73.57	Backslopes	6:1, H >= 0.5 m (1.5 ft)
6.1	200.0	0.031612	0.39	0.00	Backslopes	10:1, H >= 0.3 m (1 ft)
7.1	300.0	0.198922	0.45	190.00	Backslopes	10:1, H < 0.3 m (1 ft)
8.1	400.0	0.127267	0.39	181.76	Backslopes	10:1, H >= 0.3 m (1 ft)
9.1	399.6	0.031426	6.65	26266.58	Fixed Objects	Rectangle, W = 1.25 m (4 ft), H > 1.0 m (3 ft)

# Feature Cost Report

File Name: AOC E074  
 Project Description: Widening

Alternative: 3  
 Description: Alternative 3: Sign truss foundation well outside clear zone no shielding

Feature	Distance From Beginning Of First Segment	Expected Crash Freq (Acc/Year)	Average Severity	Annual Crash Cost (\$)	Category	Type
1.1	0.0	0.074814	0.39	151.50	Backslopes	6:1, H >= 0.5 m (1.5 ft)
2.1	0.0	0.009674	0.68	58.75	Backslopes	4:1, H >= 0.15 m (6 in.)
3.1	100.0	0.094132	0.39	122.49	Backslopes	6:1, H >= 0.5 m (1.5 ft)
4.1	100.0	0.000000	0.62	0.00	Backslopes	6:1, H < 0.3 m (1 ft)
5.1	200.0	0.107764	0.39	70.54	Backslopes	6:1, H >= 0.5 m (1.5 ft)
6.1	200.0	0.027438	0.39	0.00	Backslopes	10:1, H >= 0.3 m (1 ft)
7.1	300.0	0.166923	0.45	242.39	Backslopes	10:1, H < 0.3 m (1 ft)
8.1	400.0	0.106757	0.39	181.76	Backslopes	10:1, H >= 0.3 m (1 ft)
9.1	399.6	0.011993	6.61	11162.33	Fixed Objects	Rectangle, W = 1.25 m (4 ft), H > 1.0 m (3 ft)

Date: September 22, 2015

Time: 09:24:12AM

# Input Data Report

Page: 6

**File Name:** AOC E074  
**Project Description:** Widening

**Alternavtive** 1 [Baseline(Existing)Condition]

<b>Description</b>	Alternative 1: Sign truss foundation shortest span with shielding
<b>Life(years)</b>	25
<b>Total Installation Cost (\$)</b>	101750.00
<b>Annual Maintenance Cost (\$)</b>	369.00
<b>Discount Rate</b>	4.00
<b>Area Type</b>	Urban
<b>Functional Class</b>	Freeway
<b>Highway Type</b>	Two-Way, Divided
<b>Number of Lanes</b>	8
<b>Lane Width(ft)</b>	12.0
<b>Right Shoulder Width(ft)</b>	14.8
<b>Left Shoulder Width(ft)</b>	14.8
<b>Speed Limit(mph)</b>	70.0
<b>Nominal Percent Truck(%)</b>	10.0
<b>ADT</b>	74759
<b>Traffic Growth Factor(%)</b>	1.0
<b>Encroachment Rate Adjustment Factor</b>	1
<b>Random Seed Number</b>	13000 (User Specified)

<u>Segment</u>	<u>Length(ft)</u>	<u>Median Width(ft)</u>	<u>Percent Grade(%)</u>	<u>Curvature Direction</u>	<u>Curvature Radius(ft)</u>
1	500.0	35.0	0.4	None	

# Input Data Report

**File Name:** AOC E074

**Project Description:** Widening

**Alternative** 1 [Baseline(Existing) Conditions]

<u>Feature</u>	<u>Category</u>	<u>Type</u>
1	Backslopes	6:1, H >= 0.5 m (1.5 ft)
2	Backslopes	4:1, H >= 0.15 m (6 in.)
3	Backslopes	6:1, H >= 0.5 m (1.5 ft)
4	Backslopes	6:1, H < 0.3 m (1 ft)
5	Backslopes	6:1, H >= 0.5 m (1.5 ft)
6	Backslopes	10:1, H >= 0.3 m (1 ft)
7	Backslopes	10:1, H < 0.3 m (1 ft)
8	Backslopes	10:1, H >= 0.3 m (1 ft)
9	Fixed Objects	Rectangle, W = 1.25 m (4 ft), H > 1.0 m (3 ft)
10	Terminals and Crash Cushions	TL-3 Guardrail Terminal
11	Longitudinal Barriers	TL-3 Guardrail
12	Longitudinal Barriers	TL-3 Guardrail
13	Terminals and Crash Cushions	TL-3 Guardrail Terminal

# Input Data Report

**File Name:** AOC E074  
**Project Description:** Widening

**Alternative** 1 [Baseline(Existing) Conditions]

<u>Feature</u>	<u>Length(ft)</u>	<u>Width(ft)</u>	<u>Flare Rate</u>	<u>Location</u>	<u>Offset(ft)</u>	<u>Distance(ft)</u>	<u>Repetitions</u>	<u>Spacing(ft)</u>
1	100.0	15.0	0.000	Right	19.0	0.0		
2	100.0	17.0	0.000	Right	34.0	0.0		
3	100.0	15.0	0.000	Right	19.0	100.0		
4	100.0	17.3	0.000	Right	34.0	100.0		
5	100.0	12.0	0.000	Right	22.0	200.0		
6	100.0	17.1	0.000	Right	34.0	200.0		
7	100.0	28.8	0.000	Right	22.0	300.0		
8	100.0	29.0	0.000	Right	22.0	400.0		
9	18.0	3.5	0.000	Right	25.8	399.6		
10	12.5	1.8	0.020	Right	19.1	255.8		
11	34.4	1.8	0.020	Right	18.9	268.3		
12	125.0	1.8	0.000	Right	18.2	302.6		
13	12.5	1.8	0.000	Right	18.2	427.6		

Date: September 22, 2015

Time: 09:24:12AM

# Input Data Report

Page: 9

**File Name:** AOC E074  
**Project Description:** Widening

**Alternavtive 2**

<b>Description</b>	Alternative 2: Sign truss foundation just outside clear zone no shielding
<b>Life(years)</b>	25
<b>Total Installation Cost (\$)</b>	105000.00
<b>Annual Maintenance Cost (\$)</b>	0.00
<b>Discount Rate</b>	4.00
<b>Area Type</b>	Urban
<b>Functional Class</b>	Freeway
<b>Highway Type</b>	Two-Way, Divided
<b>Number of Lanes</b>	8
<b>Lane Width(ft)</b>	12.0
<b>Right Shoulder Width(ft)</b>	14.8
<b>Left Shoulder Width(ft)</b>	14.8
<b>Speed Limit(mph)</b>	70.0
<b>Nominal Percent Truck(%)</b>	10.0
<b>ADT</b>	74759
<b>Traffic Growth Factor(%)</b>	1.0
<b>Encroachment Rate Adjustment Factor</b>	1
<b>Random Seed Number</b>	13000 (User Specified)

<u>Segment</u>	<u>Length(ft)</u>	<u>Median Width(ft)</u>	<u>Percent Grade(%)</u>	<u>Curvature Direction</u>	<u>Curvature Radius(ft)</u>
1	500.0	35.0	0.4	None	

# Input Data Report

File Name: AOC E074  
Project Description: Widening

Alternative 2

<u>Feature</u>	<u>Category</u>	<u>Type</u>
1	Backslopes	6:1, H >= 0.5 m (1.5 ft)
2	Backslopes	4:1, H >= 0.15 m (6 in.)
3	Backslopes	6:1, H >= 0.5 m (1.5 ft)
4	Backslopes	6:1, H < 0.3 m (1 ft)
5	Backslopes	6:1, H >= 0.5 m (1.5 ft)
6	Backslopes	10:1, H >= 0.3 m (1 ft)
7	Backslopes	10:1, H < 0.3 m (1 ft)
8	Backslopes	10:1, H >= 0.3 m (1 ft)
9	Fixed Objects	Rectangle, W = 1.25 m (4 ft), H > 1.0 m (3 ft)

## Input Data Report

**File Name:** AOC E074  
**Project Description:** Widening

**Alternative**     **2**

<u>Feature</u>	<u>Length(ft)</u>	<u>Width(ft)</u>	<u>Flare Rate</u>	<u>Location</u>	<u>Offset(ft)</u>	<u>Distance(ft)</u>	<u>Repetitions</u>	<u>Spacing(ft)</u>
1	100.0	15.0	0.000	Right	19.0	0.0		
2	100.0	17.0	0.000	Right	34.0	0.0		
3	100.0	15.0	0.000	Right	19.0	100.0		
4	100.0	17.3	0.000	Right	34.0	100.0		
5	100.0	15.0	0.000	Right	19.0	200.0		
6	100.0	17.1	0.000	Right	34.0	200.0		
7	100.0	31.8	0.000	Right	19.0	300.0		
8	100.0	32.0	0.000	Right	19.0	400.0		
9	18.0	3.5	0.000	Right	35.8	399.6		



Date: September 22, 2015

Time: 09:24:13AM

# Input Data Report

Page: 12

**File Name:** AOC E074  
**Project Description:** Widening

**Alternavtive** 3

**Description** Alternative 3: Sign truss foundation well outside clear zone no shielding  
**Life(years)** 25  
**Total Installation Cost (\$)** 115000.00  
**Annual Maintenance Cost (\$)** 0.00  
**Discount Rate** 4.00  
**Area Type** Urban  
**Functional Class** Freeway  
**Highway Type** Two-Way, Divided  
**Number of Lanes** 8  
**Lane Width(ft)** 12.0  
**Right Shoulder Width(ft)** 14.8  
**Left Shoulder Width(ft)** 14.8  
**Speed Limit(mph)** 70.0  
**Nominal Percent Truck(%)** 10.0  
**ADT** 74759  
**Traffic Growth Factor(%)** 1.0  
**Encroachment Rate Adjustment Factor** 1  
**Random Seed Number** 13000 (User Specified)

<u>Segment</u>	<u>Length(ft)</u>	<u>Median Width(ft)</u>	<u>Percent Grade(%)</u>	<u>Curvature Direction</u>	<u>Curvature Radius(ft)</u>
1	500.0	35.0	0.4	None	

# Input Data Report

File Name: AOC E074  
 Project Description: Widening

Alternative 3

<u>Feature</u>	<u>Category</u>	<u>Type</u>
1	Backslopes	6:1, H >= 0.5 m (1.5 ft)
2	Backslopes	4:1, H >= 0.15 m (6 in.)
3	Backslopes	6:1, H >= 0.5 m (1.5 ft)
4	Backslopes	6:1, H < 0.3 m (1 ft)
5	Backslopes	6:1, H >= 0.5 m (1.5 ft)
6	Backslopes	10:1, H >= 0.3 m (1 ft)
7	Backslopes	10:1, H < 0.3 m (1 ft)
8	Backslopes	10:1, H >= 0.3 m (1 ft)
9	Fixed Objects	Rectangle, W = 1.25 m (4 ft), H > 1.0 m (3 ft)

# Input Data Report

**File Name:** AOC E074  
**Project Description:** Widening

**Alternative**      **3**

<u>Feature</u>	<u>Length(ft)</u>	<u>Width(ft)</u>	<u>Flare Rate</u>	<u>Location</u>	<u>Offset(ft)</u>	<u>Distance(ft)</u>	<u>Repetitions</u>	<u>Spacing(ft)</u>
1	100.0	15.0	0.000	Right	19.0	0.0		
2	100.0	17.0	0.000	Right	34.0	0.0		
3	100.0	15.0	0.000	Right	19.0	100.0		
4	100.0	17.3	0.000	Right	34.0	100.0		
5	100.0	15.0	0.000	Right	19.0	200.0		
6	100.0	17.1	0.000	Right	34.0	200.0		
7	100.0	31.8	0.000	Right	19.0	300.0		
8	100.0	32.0	0.000	Right	19.0	400.0		
9	18.0	3.5	0.000	Right	45.8	399.6		

# Level 3 Output Results - AOC E074

**Alternative   Description**

- 1      95' sign truss span; shield foundation within clear zone.
- 2      105' sign truss span; do not shield sign foundation just outside clear zone.
- 3      115' sign truss span; do not shield sign foundation well outside clear zone.

Alternative	Alternative		
	2	1	3
2	0.00	-142.83	23.54
1	0.00	0.00	134.43
3	0.00	0.00	0.00

**Pair-Wise Comparison:**

- 1) Alt. 2 vs. Alt. 1 has a negative B/C ratio.
- 2) Alt. 2 vs. Alt. 3 has a positive B/C ratio, greater than 1.5.



**Alt. 2 is better.**



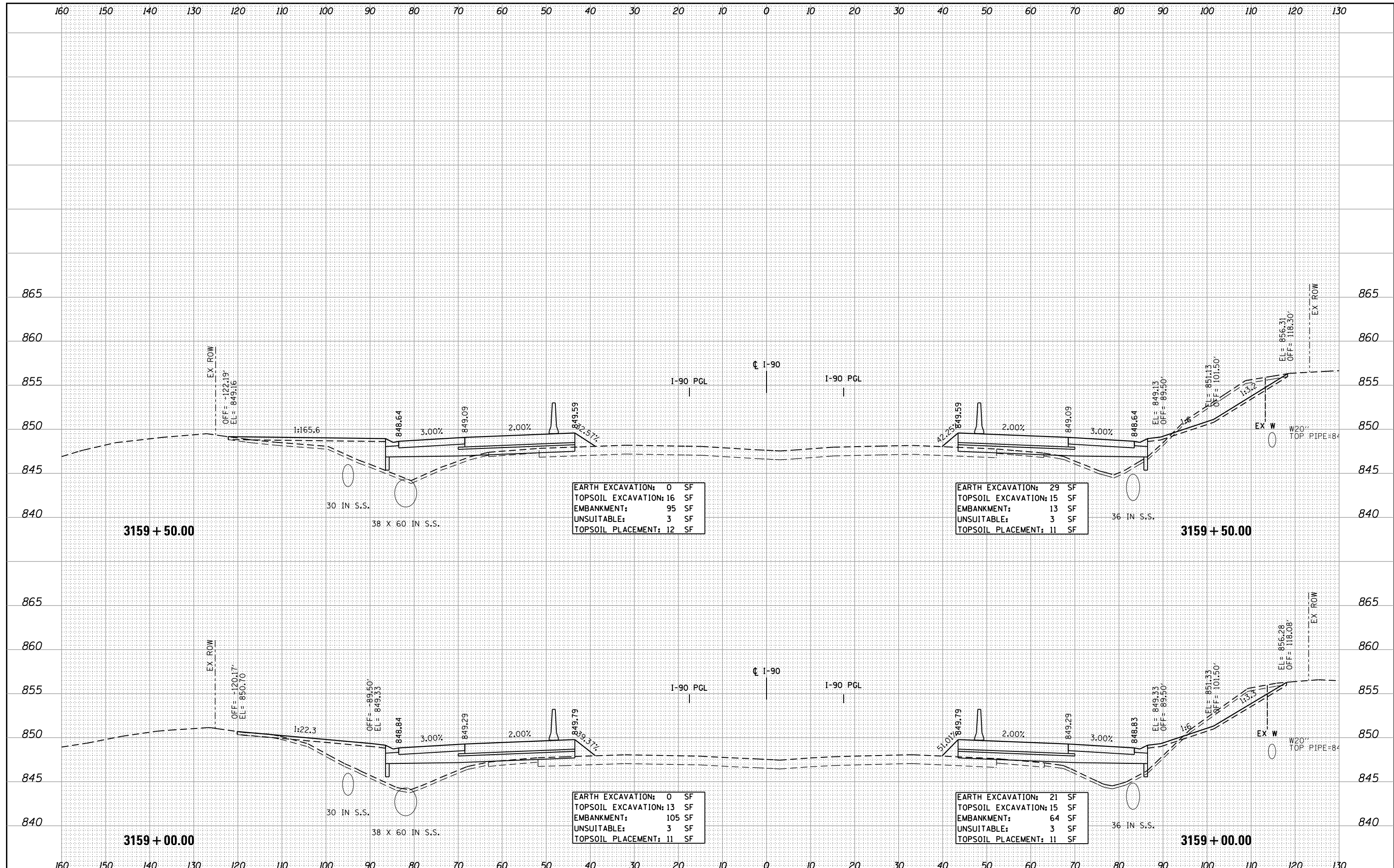
**Alt. 3 is better.**



**Select Alternative #3.**

**Recommendation:**

Install 115' sign truss span. Do not shield sign foundation.



**EARTH EXCAVATION: 0 SF**  
**TOPSOIL EXCAVATION: 16 SF**  
**EMBANKMENT: 95 SF**  
**UNSUITABLE: 3 SF**  
**TOPSOIL PLACEMENT: 12 SF**

**EARTH EXCAVATION: 29 SF**  
**TOPSOIL EXCAVATION: 15 SF**  
**EMBANKMENT: 13 SF**  
**UNSUITABLE: 3 SF**  
**TOPSOIL PLACEMENT: 11 SF**

**EARTH EXCAVATION: 0 SF**  
**TOPSOIL EXCAVATION: 13 SF**  
**EMBANKMENT: 105 SF**  
**UNSUITABLE: 3 SF**  
**TOPSOIL PLACEMENT: 11 SF**

**EARTH EXCAVATION: 21 SF**  
**TOPSOIL EXCAVATION: 15 SF**  
**EMBANKMENT: 64 SF**  
**UNSUITABLE: 3 SF**  
**TOPSOIL PLACEMENT: 11 SF**

DRAWN ..... DATE .....  
 CHECKED ..... SCALE:  $H_v 1"=10'$ ,  $V_h 1"=5'$

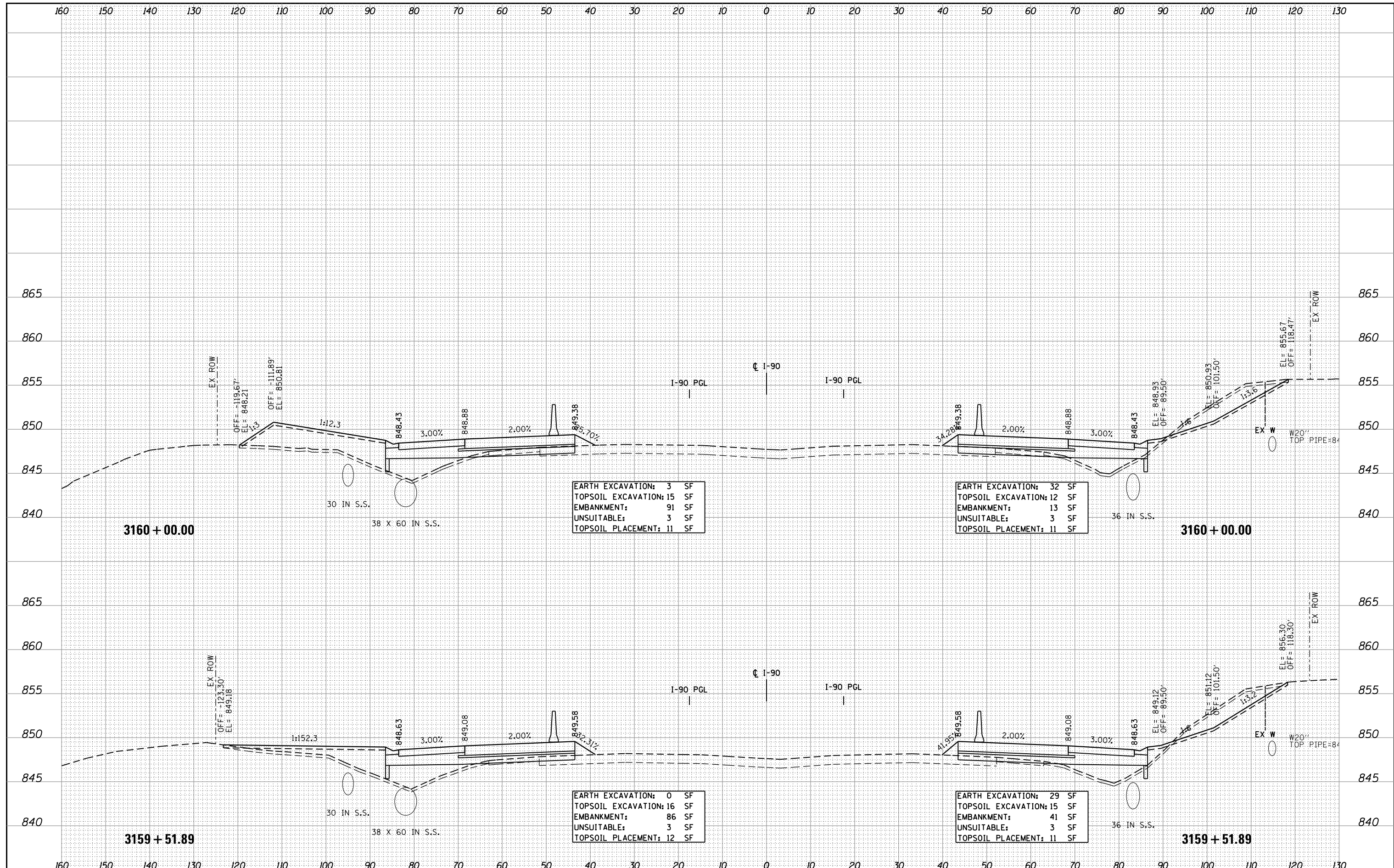
**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. ....  
 I-90 CROSS SECTIONS  
 STA. 3159+00.00 TO STA. 3159+50.00

**E074-27**  
 DRAWING NO. ....  
 OF .....

4018JA46Cr301.shd  
 5401



DRAWN .....  
 CHECKED .....  
 DATE .....  
 SCALE:  $H_v: 1"=10'$ ,  $V_h: 1"=5'$

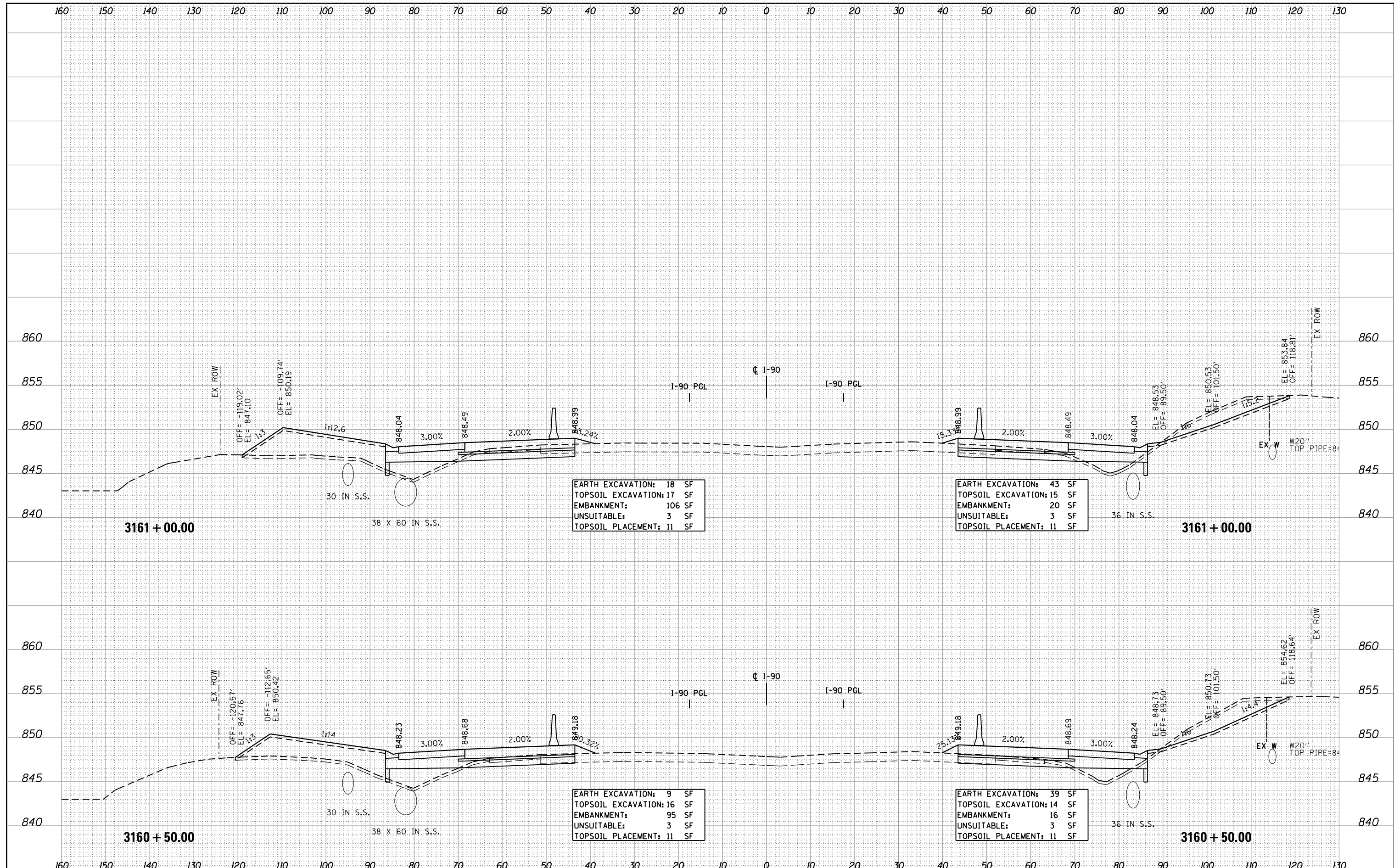

**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. \_\_\_\_\_  
**E074-28**  
 DRAWING NO. \_\_\_\_\_  
 I-90 CROSS SECTIONS  
 STA. 3159+51.89 TO STA. 3160+00.00  
 OF \_\_\_\_\_

4018JA46Cr301.sht  
5401





EARTH EXCAVATION: 18 SF  
 TOPSOIL EXCAVATION: 17 SF  
 EMBANKMENT: 106 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 11 SF

EARTH EXCAVATION: 43 SF  
 TOPSOIL EXCAVATION: 15 SF  
 EMBANKMENT: 20 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 11 SF

EARTH EXCAVATION: 9 SF  
 TOPSOIL EXCAVATION: 16 SF  
 EMBANKMENT: 95 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 11 SF

EARTH EXCAVATION: 39 SF  
 TOPSOIL EXCAVATION: 14 SF  
 EMBANKMENT: 16 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 11 SF

DRAWN .....  
 CHECKED .....

DATE .....  
 SCALE: H<sub>1</sub> 1"=10', V<sub>1</sub> 1"=5'

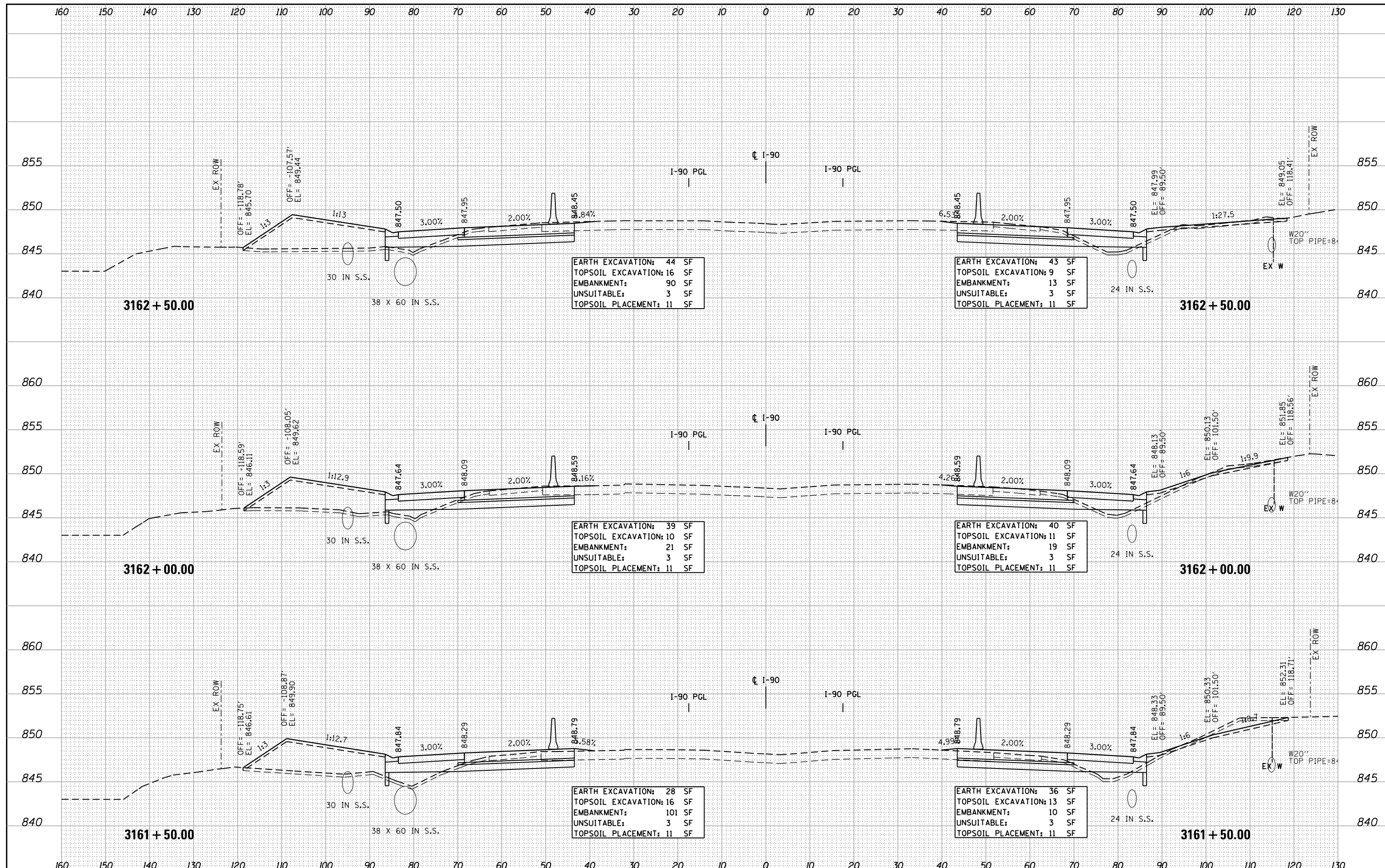


REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. ....  
 I-90 CROSS SECTIONS  
 STA. 3160+50.00 TO STA. 3161+00.00

E074-29  
 DRAWING NO. ....  
 OF .....

4018JA46Cr301.shd  
 5401



DRAWN .....  
 CHECKED .....

DATE .....  
 SCALE: H<sub>1</sub>"=10', V<sub>1</sub>"=5'

**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

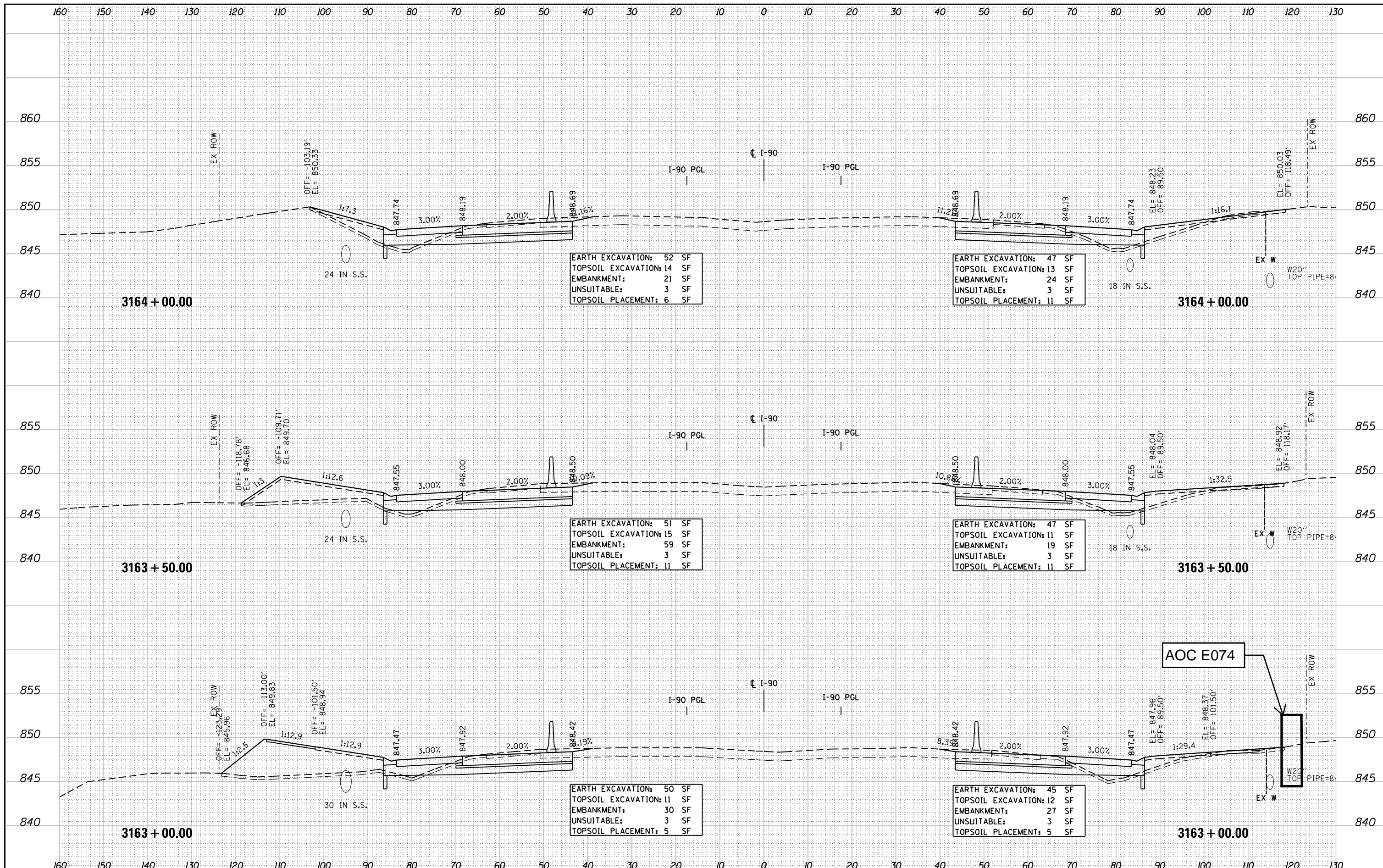
REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO. ....  
 I-90 CROSS SECTIONS  
 STA. 3161+50.00 TO STA. 3162+50.00

**E074-30**  
 DRAWING NO. ....  
 OF .....

4018JA46Cr301.shp  
 5401





EARTH EXCAVATION: 52 SF  
 TOPSOIL EXCAVATION: 14 SF  
 EMBANKMENT: 21 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 6 SF

EARTH EXCAVATION: 47 SF  
 TOPSOIL EXCAVATION: 13 SF  
 EMBANKMENT: 24 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 11 SF

EARTH EXCAVATION: 51 SF  
 TOPSOIL EXCAVATION: 15 SF  
 EMBANKMENT: 59 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 11 SF

EARTH EXCAVATION: 47 SF  
 TOPSOIL EXCAVATION: 11 SF  
 EMBANKMENT: 19 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 11 SF

EARTH EXCAVATION: 50 SF  
 TOPSOIL EXCAVATION: 11 SF  
 EMBANKMENT: 30 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 5 SF

EARTH EXCAVATION: 45 SF  
 TOPSOIL EXCAVATION: 12 SF  
 EMBANKMENT: 27 SF  
 UNSUITABLE: 3 SF  
 TOPSOIL PLACEMENT: 5 SF

AOC E074

DRAWN .....  
 CHECKED .....

DATE .....  
 SCALE: H<sub>1</sub>"=10', V<sub>1</sub>"=5'

**THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY**  
 2700 OGDEN AVENUE  
 DOWNERS GROVE, ILLINOIS 60515

REVISIONS		
NO.	DATE	DESCRIPTION

CONTRACT NO.  
 I-90 CROSS SECTIONS  
 STA. 3163+00.00 TO STA. 3164+00.00

**E074-31**  
 DRAWING NO.  
 OF

4018JA46Cr301.shx  
 5401