SECTION 1B
GARDEN STATE PARKWAY GEOMETRIC DESIGN

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SECTION 1B

GARDEN STATE PARKWAY GEOMETRIC DESIGN

1B.1 GENERAL

The geometric design criteria contained herein were developed by the Authority for its own particular needs. They are intended to equal or exceed standards currently being used for limited access highways and should be considered minimum criteria and increased wherever economically feasible. The use of substandard criteria, including absolute minimum / maximum values listed in this manual, shall require a Design Element Modification Request subject to approval by the Authority's Engineering Department. For any items not adequately outlined in this section, the Engineer should refer to the latest edition of AASHTO *A Policy on Geometric Design of Highways and Streets* and AASHTO *Roadside Design Guide*.

The design criteria are intended to be used as an aid toward sound engineering design. When individual circumstances arise that are not specifically covered, engineering judgment is to be exercised that represents the intent of the criteria shown. The overall objective should be an aesthetically pleasing and safe design that is geometrically compatible in all respects.

1B.1.1 Design Controls

The following design controls shall be applicable on all Parkway roadways

1. All types of design vehicles are permitted on the Parkway south of Interchange 105 at Milepost 106.4, while North of Interchange 105, trucks with a gross weight exceeding 6,999 pounds are prohibited. To be conservative the Design Vehicle WB-67 will be used to control geometric design for the entire roadway, (see Exhibit 1B - 1).

2. Clearances

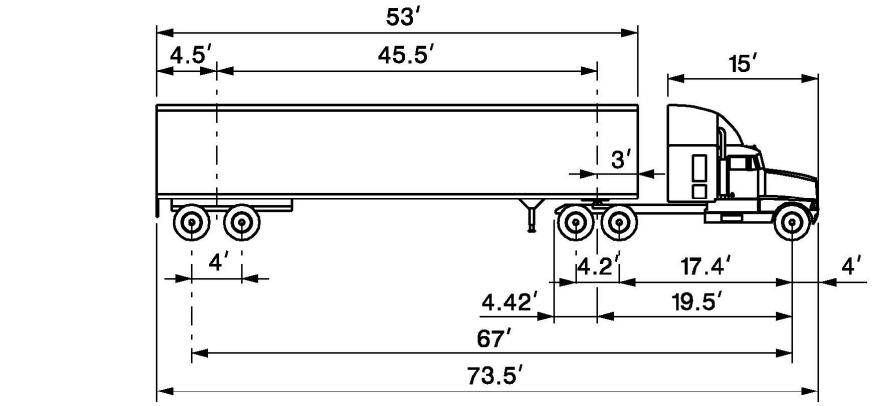
   a. Horizontal – Minimum 4 feet clear of left or right edge of shoulder to obstruction, with appropriate roadside protection (see Section 3 of this manual).

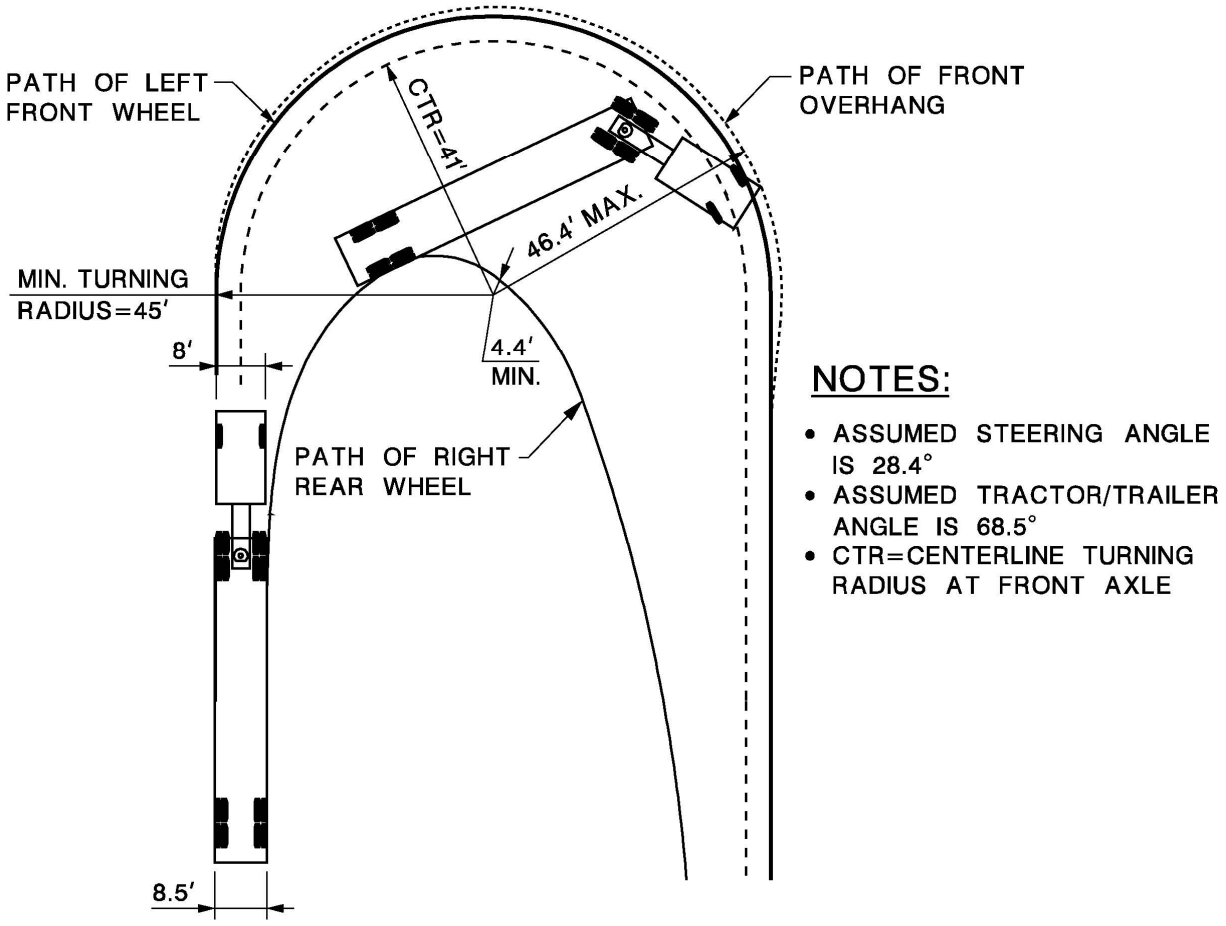
   b. Vertical – Maintained over all roadways, including shoulders. Verification of all clearances shall be made with the controlling agency.

      Roadway over Parkway – 15 feet minimum or existing vertical clearance, whichever is greater. When resurfacing or widening under an existing bridge whose vertical clearance is less than 15 feet, the existing vertical clearance must be maintained as a minimum.

      Parkway over any other road - as required by agency having jurisdiction.

EXHIBIT 1B - 1
MINIMUM TURNING PATH FOR INTERSTATE SEMI-TRAILER (WB-67) DESIGN VEHICLE





1B.2 BASIC GEOMETRIC DESIGN ELEMENTS

1B.2.1 Sight Distances

1. Stopping Sight Distances
   The minimum stopping sight distance is the distance required by the driver of a vehicle, traveling at a given speed, to bring his vehicle to a stop after an object on the road becomes visible. Stopping sight distance is measured from the driver's eyes, which is 3.5 feet above the pavement surface, to an object 6 inches high on the road. An object height of 2 feet may be used with Authority approval. See Exhibit 1B - 2 for minimum stopping sight distances for a given design speed, and Section 1B.2.3 and Exhibit 1B - 12 for minimum and desirable K values.

EXHIBIT 1B - 2
MINIMUM STOPPING SIGHT DISTANCES

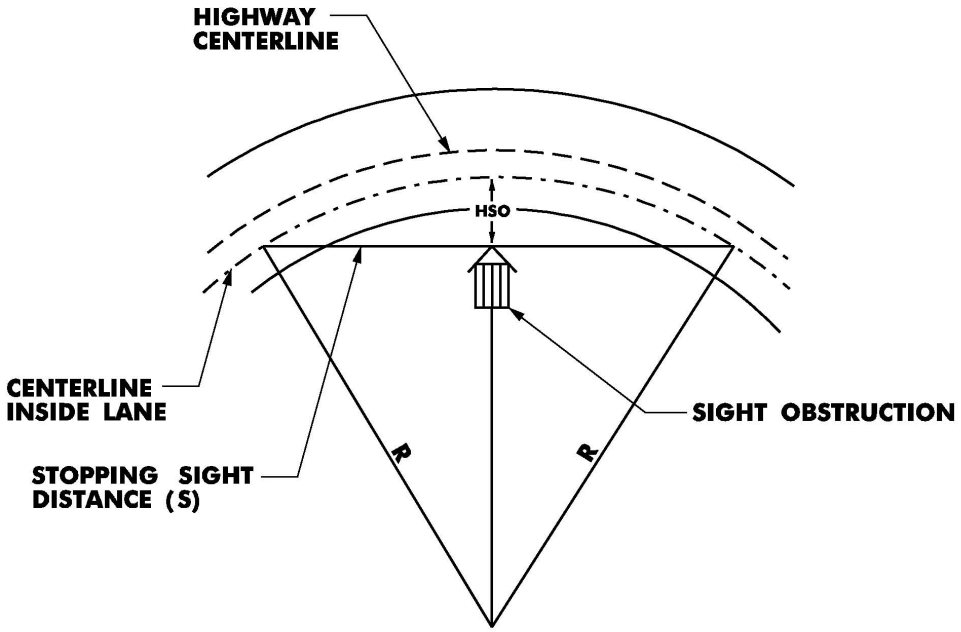
Design Speed (MPH)	Stopping Sight Distance in Feet, Minimum
25	155
30	200
35	250
40	305
45	360
50	425
55	495
60	570
65	645
70	730

2. Stopping Sight Distance on Horizontal Curves
   The horizontal sightline offsets needed for clear sight areas that satisfy the stopping sight distance criteria presented in Exhibit 1B - 2 shall be investigated using one or both of the methods listed below:

   a. Where obstruction and vehicle are located within the limits of a vertical curve, use Exhibit 1B - 3.

   b. Where the vehicle, the obstruction, or both are situated beyond the limits of a simple curve or within the limits of a compound curve, the design should be checked by utilizing graphical procedures.

EXHIBIT 1B - 3
ILLUSTRATES COMPONENTS FOR DETERMINING HORIZONTAL SIGHT DISTANCE



US Customary

$$HSO = R - \sqrt{R^2 - (S/2)^2}$$

Where:

s = Stopping sight distance, feet

R = Radius of curve, feet

HSO = Horizontal sightline offset, feet

1B.2.2 Horizontal Alignment

1B.2.2.1 Superelevation

If a design assignment involves modification or resurfacing of an existing roadway, the rate of superelevation to be used shall normally follow the current standard, as described in this section. However, if a bridge deck falls within the horizontal curve and the deck superelevation is not being upgraded, the rate of superelevation for the entire length of the horizontal curve shall not exceed that on the bridge deck.

A 6% maximum superelevation rate shall be used (see Exhibit 1B - 4), for the entire length of the Parkway mainline and all interchange ramps.

The superelevation tables included in this section are based on AASHTO distribution of "*e*" Method 5. Superelevation rates based on other AASHTO methods will be considered in certain cases with written approval from the Authority.

EXHIBIT 1B - 4
MINIMUM RADII FOR DESIGN SUPERELEVATION RATES, DESIGN SPEEDS, AND E_{MAX} = 6%

e (%)	V_d= 25 mph R(ft)	V_d= 30 mph R(ft)	V_d= 35 mph R(ft)	V_d= 40 mph R(ft)	V_d= 45 mph R(ft)	V_d= 50 mph R(ft)	V_d= 55 mph R(ft)	V_d= 60 mph R(ft)	V_d= 65 mph R(ft)	V_d= 70 mph R(ft)
1.5	2290	3130	4100	5230	6480	7870	9410	11100	12600	14100
2.0	1630	2240	2950	3770	4680	5700	6820	8060	9130	10300
2.2	1450	2000	2630	3370	4190	5100	6110	7230	8200	9240
2.4	1300	1790	2360	3030	3770	4600	5520	6540	7430	8380
2.6	1170	1610	2130	2740	3420	4170	5020	5950	6770	7660
2.8	1050	1460	1930	2490	3110	3800	4580	5440	6200	7030
3.0	944	1320	1760	2270	2840	3480	4200	4990	5710	6490
3.2	850	1200	1600	2080	2600	3200	3860	4600	5280	6010
3.4	761	1080	1460	1900	2390	2940	3560	4250	4890	5580
3.6	673	972	1320	1740	2190	2710	3290	3940	4540	5210
3.8	583	864	1190	1590	2010	2490	3040	3650	4230	4860
4.0	511	766	1070	1440	1840	2300	2810	3390	3950	4550
4.2	452	684	960	1310	1680	2110	2590	3140	3680	4270
4.4	402	615	868	1190	1540	1940	2400	2920	3440	4010
4.6	360	555	788	1090	1410	1780	2210	2710	3220	3770
4.8	324	502	718	995	1300	1640	2050	2510	3000	3550
5.0	292	456	654	911	1190	1510	1890	2330	2800	3330
5.2	264	413	595	833	1090	1390	1750	2160	2610	3120
5.4	237	373	540	759	995	1280	1610	1990	2420	2910
5.6	212	335	487	687	903	1160	1470	1830	2230	2700
5.8	186	296	431	611	806	1040	1320	1650	2020	2460
6.0	150	235	340	485	650	840	1060	1330	1660	2040

1B.2.2.2 Superelevation Transition

The superelevation transition consists of the superelevation runoff (length of roadway needed to accomplish the change in outside-lane cross slope from zero to full superelevation or vice versa) and tangent runout (length of roadway needed to accomplish the change in outside-lane cross slope from the normal cross slope to zero or vice versa).

Superelevation Runoff

$$L_r = (w)(n)(e)(b)/\Delta$$

Where:
L_r = minimum length of superelevation runoff (feet)
Δ = maximum relative gradient, percent (Exhibit 1B-5)
n = number of lanes rotated
b = adjustment factor for number of lanes rotated (Exhibit 1B-6)
w = width of one traffic lane (feet), (typically 12 feet)
e = design superelevation rate (%)

Tangent Runout

$$L_t = (L_r)\ (e_{NC})/e$$

Where:
L_t = minimum length of tangent runout (feet)
L_r = minimum length of superelevation runoff (feet)
e_{NC} = normal cross slope rate (%)
e = design superelevation rate

EXHIBIT 1B - 5
MAXIMUM RELATIVE GRADIENT

Design Speed (mph)	25	30	35	40	45	50	55	60	65	70
Maximum Relative Gradient	0.70	0.66	0.62	0.58	0.54	0.50	0.47	0.45	0.43	0.40

EXHIBIT 1B - 6
ADJUSTMENT FACTOR FOR NUMBER OF LANES ROTATED

Number of Lanes Rotated (n)	**Adjustment Factor (b)**
1	1.00
1.5	0.83
2	0.75
2.5	0.70
3	0.67
3.5	0.64

With respect to the beginning or ending of a curve, the amount of runoff on the tangent should desirably be based on Exhibit 1B - 7. However, runoff lengths on the tangent ranging from 60 to 90 percent are acceptable.

EXHIBIT 1B - 7
PERCENT OF RUNOFF ON TANGENT

Design Speed (mph)	**Portion of Runoff Located Prior to the Curve**			
	Number of Lanes Rotated			
	1.0	**1.5**	**2.0-2.5**	**3.0-3.5**
25-45	0.80	0.85	0.90	0.90
50-80	0.70	0.75	0.80	0.85

1B.2.2.3 General Controls for Horizontal Alignment

1. Curves should be at least 500 feet long for a central angle of 5 degrees, and the minimum length should be increased 100 feet for each 1-degree decrease in the central angle.

2. For compound curves, the ratio of the flatter radius to the sharper radius should not exceed 1.5 for mainline roadways.

3. The tangent distance between reverse curves should, as a minimum, be sufficient to accommodate the superelevation transition as specified in Subsection 1B.2.2.2. The desirable tangent lengths are as shown in Exhibit 1B - 8.

EXHIBIT 1B - 8
DESIRABLE TANGENT LENGTH BETWEEN REVERSE CURVES

Design Speed (mph)	Desirable Tangent (ft)
50	500
60	600
70	800

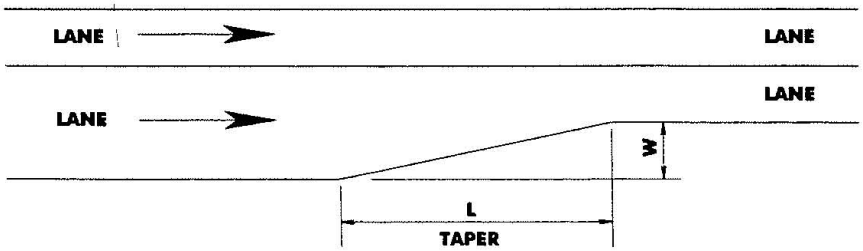
4. The "broken back" arrangement of curves (short tangent between two curves in the same direction) should be avoided except where very unusual topographical or right of way conditions make other alternatives impractical. Exhibit 1B - 9 indicates the desirable and absolute minimum tangent lengths between same direction curves.

EXHIBIT 1B - 9
DESIRABLE TANGENT LENGTH BETWEEN SAME DIRECTION CURVES

Design Speed (mph)	Desirable Tangent (ft)	Absolute Minimum Tangent(ft)
50	1000	600
60	1500	900
70	2500	1500

5. Transitions in roadway width should be made on tangent sections whenever possible and should avoid locations with horizontal and/or vertical sight distance restrictions. The desirable taper length for the Parkway mainline is 1,000 feet per lane. Exhibit 1B - 10 shows the minimum required taper length when reducing the roadway width. In general, when a lane is dropped by tapering, the transition should be on the right so that traffic merges to the left.

EXHIBIT 1B - 10
MINIMUM TAPER LENGTH WHEN REDUCING ROADWAY WIDTH



FOR DESIGN SPEEDS GREATER THAN 40 MPH, L=VW.

V= DESIGN SPEED (MPH)
W= LANE WIDTH REDUCTION (FT.)
L= TAPER LENGTH (FT.)

FOR DESIGN SPEEDS EQUAL TO OR LESS THAN 40 MPH, $L = \frac{V^2 W}{60}$

1B.2.3 Vertical Alignment

1. Grades for Mainline Roadway
   a. Desirable minimum profile grade shall be 0.5 percent. Absolute minimum profile grade shall be 0.3 percent.
   b. Desirable maximum profile grade shall be 3.0 percent. Absolute maximum profile grade shall be 5.0 percent.

2. Vertical Curves
   a. Minimum vertical curve length determined by L = AK, see Exhibit 1B - 12 for desirable and minimum K values.

      Where:

      L = Length of Curve

      A = Algebraic difference in tangent grades, percent.

      K = Length of vertical curve per percent change in A.

   b. Special attention to drainage should be exercised where values in excess of K=167 are used.
   c. The PVI station should be located at even 5 or 10-foot station increments, or 25 feet where feasible.
   d. Length of vertical curves to be in 10-foot increments where feasible.
   e. Short tangents (less than 100 feet) between vertical curves should be avoided if possible. In this case, it is preferable for the location of the PVT and PVC of successive curves to coincide.

f. No vertical curve is necessary and angle points can be used in accordance with Exhibit 1B - 11.

g. Refer to Exhibit 1B - 2 for minimum stopping sight distances for a given speed.

EXHIBIT 1B - 11
USE OF A PROFILE ANGLE POINT

Design Speed (mph)	A_{max} %
25	.70
30	.55
35	.50
40	.40
45	.40
50	.35
55	.30
60	.30
65	.25
70	.25

EXHIBIT 1B - 12
DESIGN CONTROLS FOR VERTICAL CURVES

Design Speed (mph)	Desirable (6 inch Object Height)		Minimum (2 foot Object Height)	
	Crest K (minimum)	Sag K (minimum)	Crest K (minimum)	Sag K (minimum)
25	20	30	12	26
30	30	40	19	37
35	47	50	29	49
40	70	64	44	64
45	98	79	61	79
50	136	96	84	96
55	185	114	114	115
60	245	136	151	136
65	313	157	193	157
70	400	181	247	181

1B.3 MAINLINE ROADWAY

1B.3.1 Design Speed

A design speed of 70 miles per hour is to be used on the Parkway mainline, except where existing alignment and sight distance restrictions occur or restrictions are caused by existing physical constraints. Design speeds of less than 70 MPH will require written approval from the Authority and in any case shall be a minimum of 5 MPH greater than the posted speed limit.

1B.3.2 Pavement Sections and Details

Refer to Exhibit 1B - 13 through Exhibit 1B - 18 for typical pavement sections and details. The following notes apply:

1. When required, Embankment, Grade A, to be a minimum of 8 inches. Inclusion of Embankment Grade A to be determined on a contract-by-contract basis following an existing substrata investigation.

2. In locations where existing pavement is widened, Grade A material is to be deeper, if necessary, to match template grade of existing pavement.

3. Template grade for Embankment, Grade A is to slope transversely a minimum of 2% or match cross slope of roadway. Template grade (top of subgrade) is to be constructed transversely without breaks in cross slope in such a manner as to provide positive drainage (daylight section or provide underdrains).

4. In areas where existing and currently designed resurfacing depth approaches 9 inches or more at the existing pavement/shoulder interface, investigations are to be made as to the feasibility of leaving the existing shoulder in place as a portion of the proposed pavement section.

5. Account for stepping (see Exhibit 1B - 15) in quantity calculations. With curb, courses terminate at the curb face. Any stepping shall be from back of curb.

6. For parking lots and driveways at toll plaza buildings and other locations within the Parkway right of way, the pavement section shall be as shown on Exhibit 1B - 14.

7. U and Z-Turn pavement shall be the same as Parkway mainline pavement.

8. When computing quantities for asphaltic concrete items, the following conversion factors are to be used for preliminary estimates.

Surface Course	156.0± lb/cu.ft.
Intermediate Course	157.5± lb/cu.ft.
Base Course	159.0± lb/cu.ft.

   Conversion factors are to be verified for each project prior to completion of final quantities.

9. Tack coat shall be applied to all existing (milled) pavement surfaces just prior to asphalt resurfacing. Tack coat shall also be applied to all exposed cut surfaces of an existing asphalt pavement section which is stepped to interface with a proposed pavement section. Tack coat will not be required between subsequent asphalt layers of proposed pavement unless:

   a. The underlying layer has been contaminated.

   b. The underlying layer has been exposed to prolonged traffic use.

   c. It is otherwise required on the drawings or in special provisions.

10. Hot mixed asphalt pavements shall be constructed in accordance with the Standard Specifications, as amended by the Supplemental Specifications. The surface course for Parkway Pavement shall be placed in a single lift. The base course for Parkway Pavement shall be placed in two lifts. Pavement course lifts shall conform to the following:

    a. The minimum lift thickness shall be three times the nominal maximum aggregate size of the specified pavement mix type.

    b. The maximum lift thickness shall be five times the nominal maximum aggregate size of the specified pavement mix type.

    The above lift requirements shall apply to Car Parking pavement sections, as well as any variations of Parkway Pavement used in resurfacing / re-grading projects. Pavement mix types shall be as directed by the Authority.

EXHIBIT 1B - 13
PARKWAY PAVEMENT (MAINLINE, RAMPS & SHOULDERS)

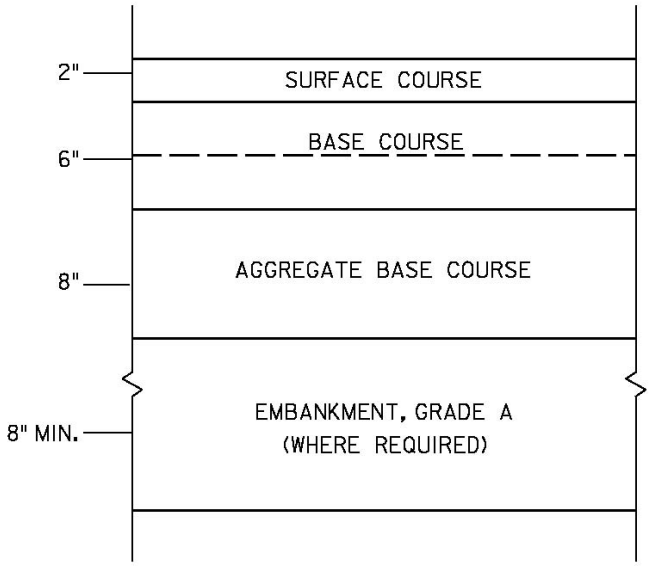
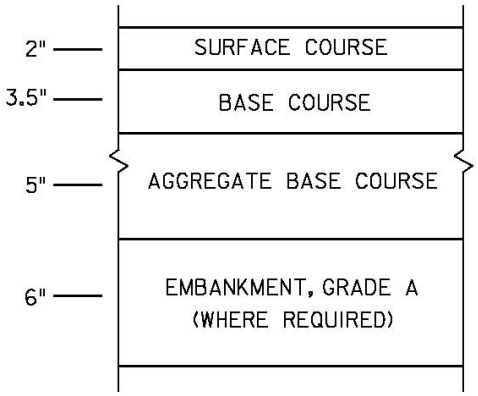


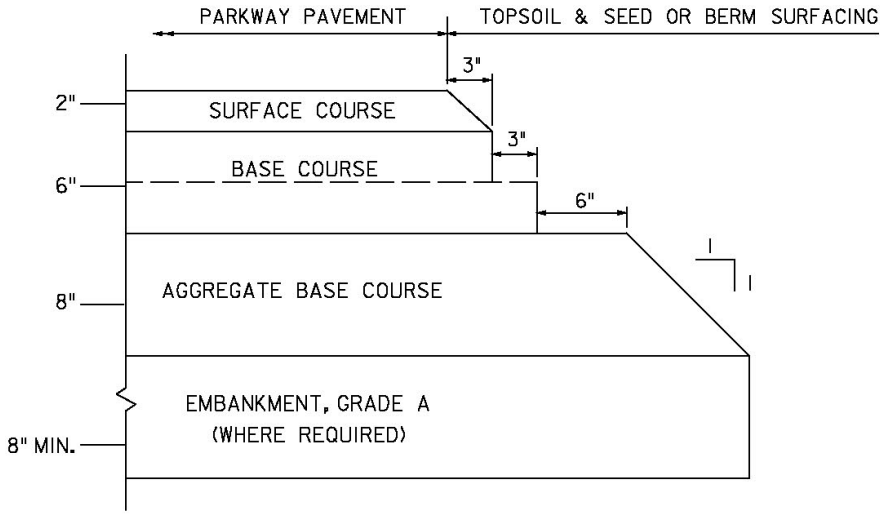
EXHIBIT 1B - 14
CAR PARKING PAVEMENT



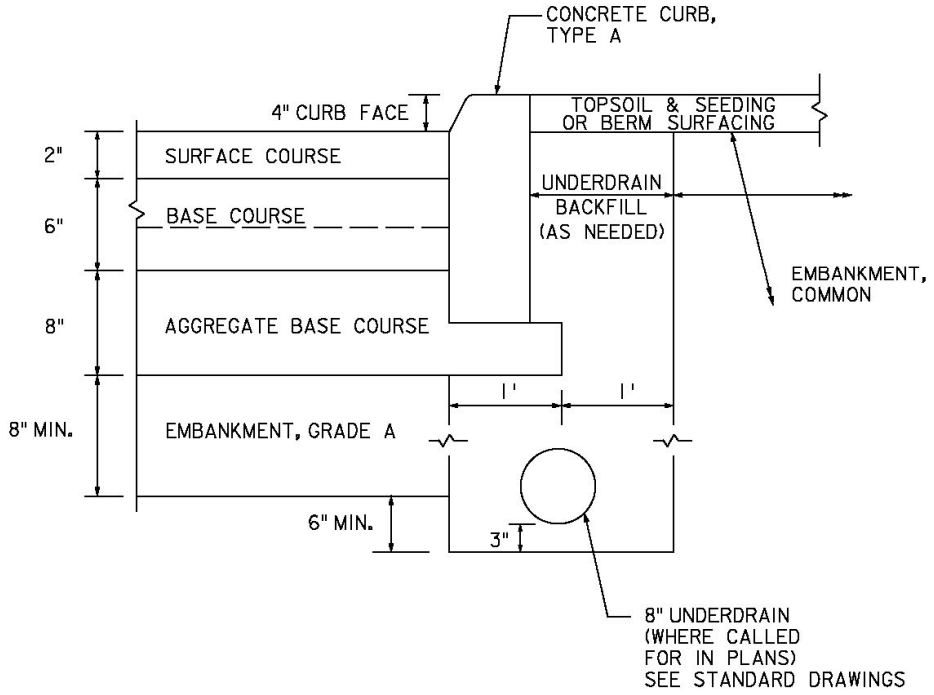
NOTE:

TRUCK PARKING AREAS ARE TO BE PAVED WITH PARKWAY PAVEMENT.

EXHIBIT 1B - 15
PARKWAY PAVEMENT STEPPING DETAIL



WITHOUT CURB



WITH CURB

EXHIBIT 1B - 16
LONGITUDINAL PAVING INTERFACE

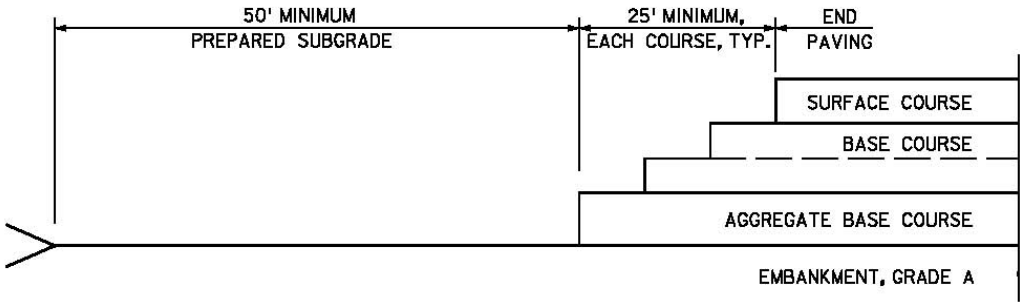


EXHIBIT 1B - 17
PAVEMENT REMOVAL & RECONSTRUCTION DETAIL

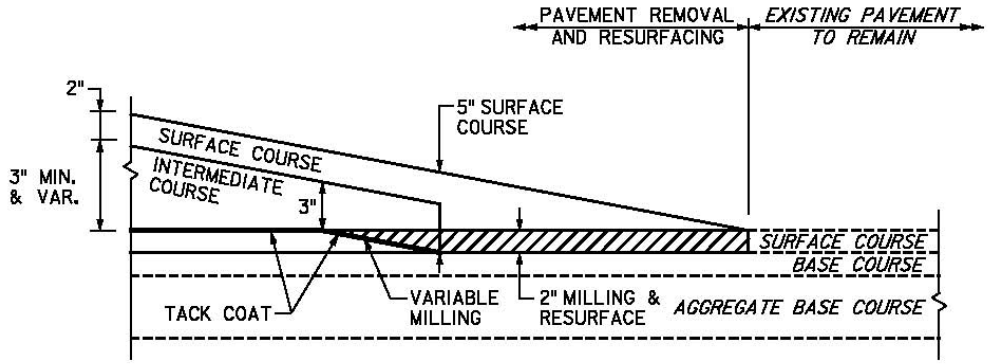
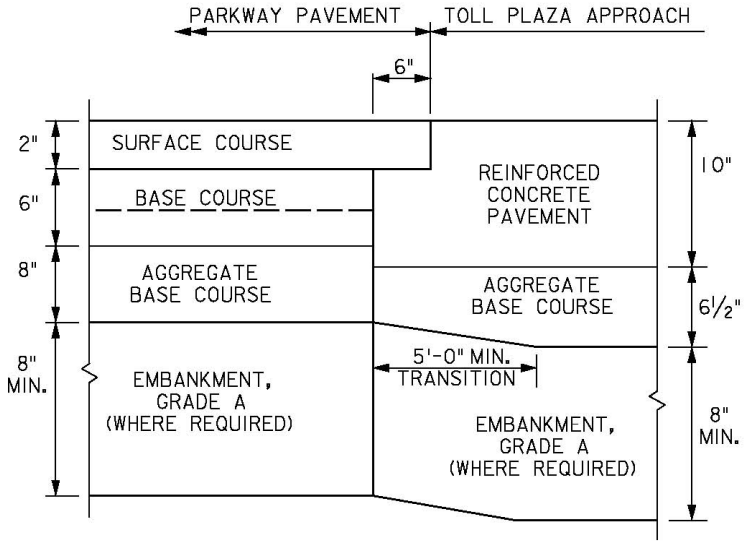


EXHIBIT 1B - 18
TOLL PLAZA-TRANSVERSE / LONGITUDINAL PAVING INTERFACE



1B.3.3 Typical Sections

Refer to Exhibit 1B - 19 for typical shoulder and lane widths and cross slopes. Also refer to the following notes.

1. All lane widths shall be 12 feet with an absolute minimum of 11 feet.

2. Shoulders on the high side of a superelevated section should drain away from the adjacent traffic lanes with a desirable rollover of 7 percent (max rollover 8 percent) and a minimum shoulder cross slope of 2 percent. See Exhibit 1B - 20.

3. Rumble strips shall be constructed on all mainline roadway outside shoulders and on all median shoulders that are 5 feet or greater in width. Placement of rumble strips along mainline roadways shall be limited as follows:

   a. On approach to mainline toll plazas, the rumble strips shall terminate at the end of the mainline normal section.

   b. At entrance ramp terminals, rumble strips on outside shoulders shall terminate at the point of the physical gore and resume at the end of the acceleration lane taper.

   c. At exit ramp terminals, rumble strips on outside shoulders shall terminate at the start of the deceleration lane taper and resume at the point of the physical gore.

   d. Rumble strips may be eliminated at other locations at the direction of the Authority's Engineering Department.

   e. On approaches to bridges, rumble strips shall terminate at the abutment joint.

   f. Rumble strips shall not be placed within 400 feet of Z-Turn and U-Turn openings on either side of the median.

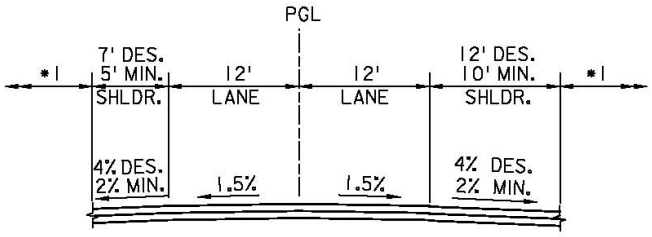
4. New installations of concrete vertical curb shall not be constructed on mainline roadway. However, if surface drainage control is required, asphalt lip curb shall be provided under the face of guide rail.

5. Medians must have barrier or guide rail as applicable unless they satisfy the clear zone requirements as shown in Exhibit 3 - 1 of Section 3 (Guide Rail / Median Barrier / Attenuator Design) of this Manual.

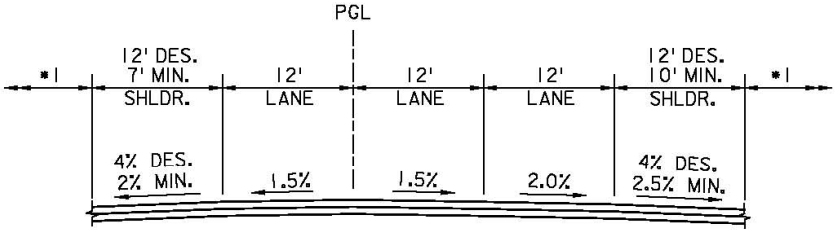
6. Lateral bridge clearances for ramps and mainline roadways shall be provided as shown on Exhibit 1B - 22 and Exhibit 1B - 23.

7. For deviations to left shoulder widths on approach roadways to structures, refer to Section 2.2.1.3. Should width shall be reduced in accordance with Section 1B.2.2.3.5.

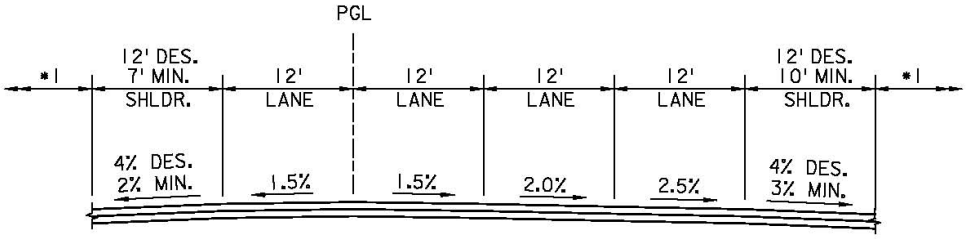
EXHIBIT 1B - 19
TYPICAL NORMAL SECTIONS



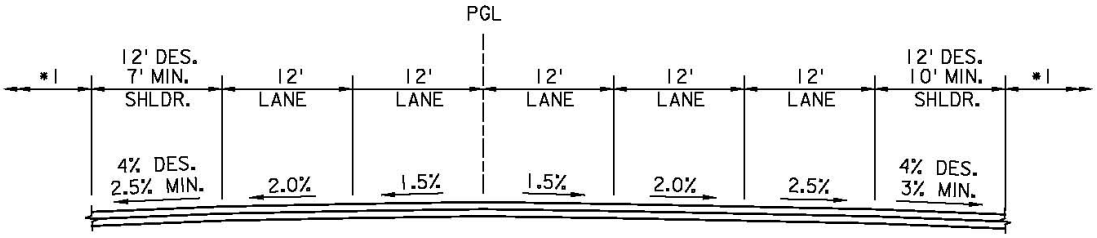
TWO LANE TRAVELWAY (ONE DIRECTION) - SECTION



THREE LANE TRAVELWAY (ONE DIRECTION) - SECTION



FOUR LANE TRAVELWAY (ONE DIRECTION) - SECTION

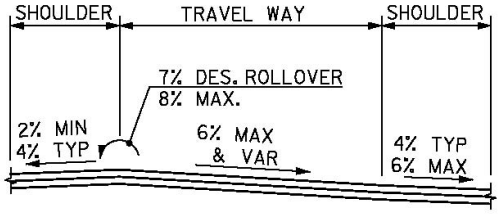


FIVE LANE TRAVELWAY (ONE DIRECTION) - SECTION

* 1. SEE EXHIBIT 1B-21 FOR GRADING CRITERIA.

2. PGL AND CROWN LINE CAN BE ADJUSTED TO MATCH SPECIFIC SIGHT CONDITIONS.

EXHIBIT 1B - 20
TYPICAL SUPERELEVATED SECTION

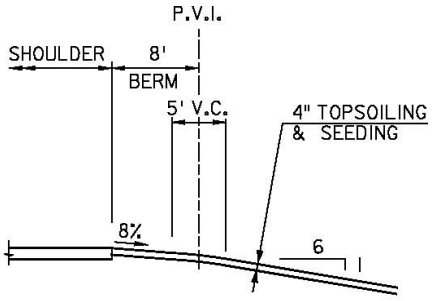


NOTES:

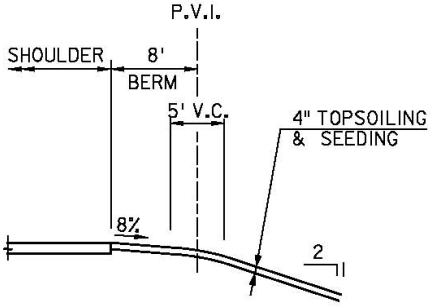
1. PGL LOCATION, LANE AND SHOULDER WIDTHS SAME AS NORMAL SECTION (SEE EXHIBIT 1B-19).

2. SHOULDER CROSS SLOPE ON LOW SIDE OF SUPERELEVATED SECTION SHOULD BE 4.0% OR MATCH THE TRAVEL WAY SUPERELEVATION, WHICHEVER IS GREATER.

EXHIBIT 1B - 21
DESIRABLE GRADING CRITERIA - MAINLINE AND RAMPS



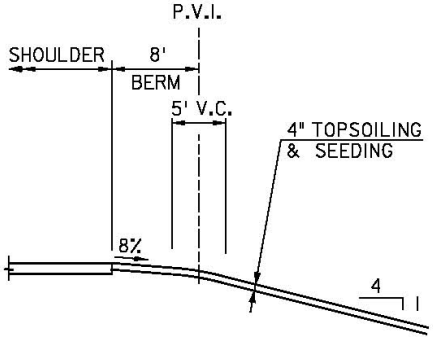
FILLS LESS THAN 5'



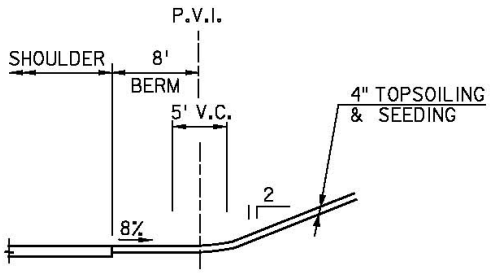
FILLS GREATER THAN 10'

NOTES:

1. HEIGHT OF FILL IS MEASURED FROM P.V.I. OF BERM.
2. SEE SECTION 3 FOR GUIDE RAIL PLACEMENT.

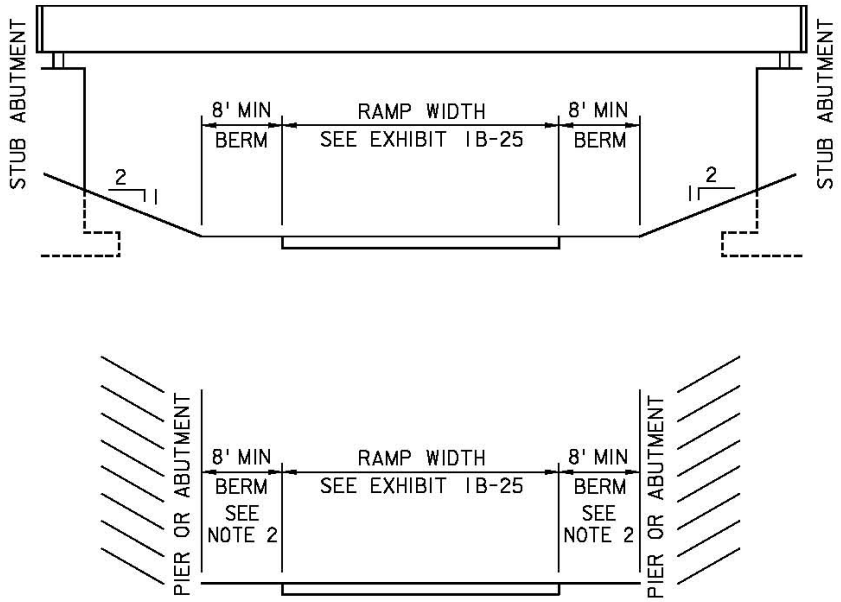


FILLS 5' TO 10'

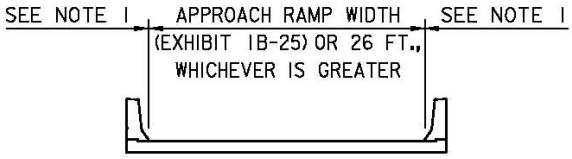


TYPICAL CUT SECTION

EXHIBIT 1B - 22
LATERAL BRIDGE CLEARANCES - RAMPS



RAMP UNDERPASS

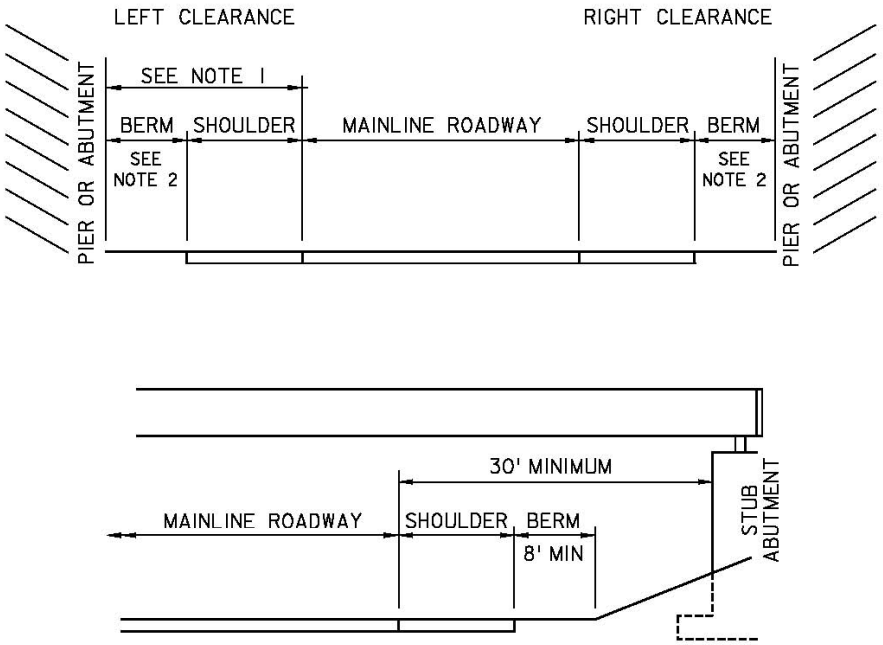


RAMP OVERPASS

NOTES:

1. STOPPING SIGHT DISTANCE ON HORIZONTAL CURVES GOVERNS WIDTH OF RAMP (SEE EXHIBIT 1B-3)
2. STOPPING SIGHT DISTANCE ON HORIZONTAL CURVES GOVERNS OFFSET TO PIER OR ABUTMENT.
3. THE CONTROLLING WIDTH OF 26 FEET ON THE RAMP OVERPASS IS TO ALLOW FOR FUTURE LANE CLOSINGS FOR MAINTENANCE SUCH AS DECK PATCHING OR REPLACEMENT.

EXHIBIT 1B - 23
LATERAL BRIDGE CLEARANCES - MAINLINE



PARKWAY UNDERPASS

NOTES:

1. WHEN PRACTICAL, PLACE PIER AT CENTERLINE OF MEDIAN. PROVISION FOR ADDITIONAL LANES SHOULD BE CONSIDERED WHEN DETERMINING PIER OR ABUTMENT LOCATION. IF THERE IS A CONTINUOUS MEDIAN BARRIER THE OFFSET SHOULD BE SUFFICIENT TO CONSTRUCT THE BARRIER IN FRONT OF THE PIER WITHOUT REDUCING THE SHOULDER WIDTH.

2. ROADSIDE PROTECTION OF PIERS AND ABUTMENTS SHALL BE DESIGNED IN ACCORDANCE WITH SECTION 3.2.3.3 (GUIDE RAIL PROTECTION) AND SECTION 3.2.7 (CONCRETE BARRIER CURB PROTECTION) OF THIS MANUAL.

1B.4 INTERCHANGE RAMPS

1B.4.1 Roadway Designation

See Section 1 of the Procedures Manual for ramp naming convention.

1B.4.2 Design Speed

1. Loop ramps = 30 MPH; Absolute minimum = 25 MPH
2. Semi-direct connections = 30 MPH
3. Outer cloverleaf connections = 35 MPH
4. Direct connections = 40 MPH

1B.4.3 Horizontal Alignment

1. For minimum radii see Exhibit 1B - 24.
   a. The desirable minimum radius shall be 235 feet. The absolute minimum radius shall be 150 feet (waiver required from Chief Engineer). It is desirable to use as large a radius as project conditions will allow.
   b. For compound curves, the ratio of the flatter radius to the sharper radius should not exceed 2.0.
2. For pavement widths, see Exhibit 1B - 25.
3. Loop ramp configuration and transition curves shall be as indicated on Exhibit 1B - 26
4. The minimum length of tangent between reverse curves shall be sufficient to accommodate the superelevation transition.
5. For typical Exit and Entrance Terminal treatments, see Exhibit 1B - 27.

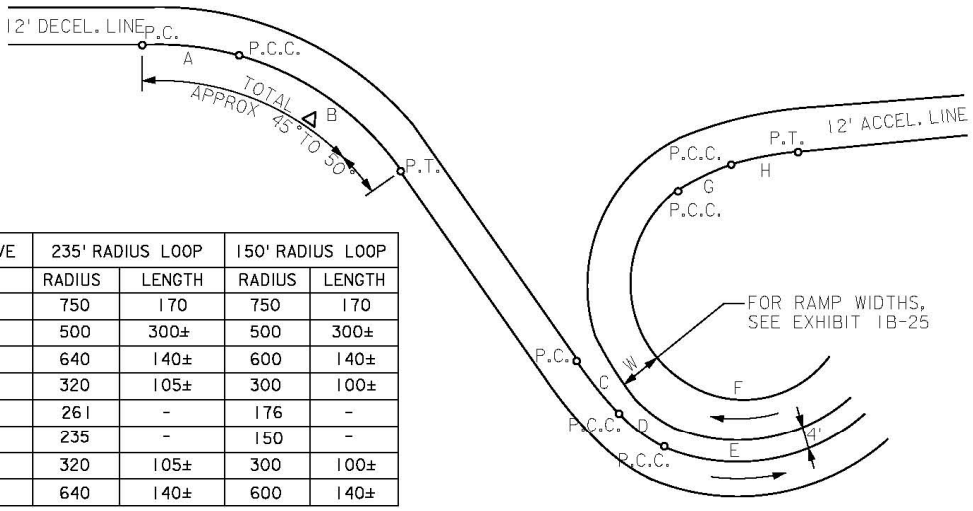
EXHIBIT 1B - 24
MINIMUM CURVE RADII FOR RAMP DESIGN SPEEDS

Ramp Central Radius in feet (minimum)	Recommended Design Speed (mph)
150	25
235	30
340	35
485	40
650	45
840	50

EXHIBIT 1B - 25
DESIGN WIDTH OF PAVEMENT FOR RAMPS

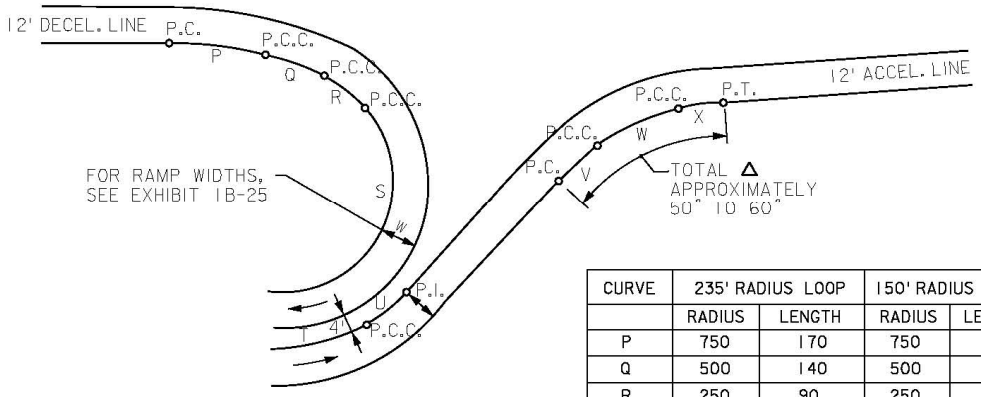
Radius at Lane edge of Inside Curve	One Lane Entrance Terminal Width (W1)	Ramp Proper Width for One Lane Ramp (W)	Ramp Proper Width for Two Lane Ramp (W)
150’	18’	22’	32’
235’	18’	22’	31’
300’	17’	22’	30’
400’	17’	22’	30’
500’	17’	22’	30’
Tangent	17’	22’	29’

EXHIBIT 1B - 26
TYPICAL LOOP RAMP GEOMETRY



CURVE	235' RADIUS LOOP		150' RADIUS LOOP	
	RADIUS	LENGTH	RADIUS	LENGTH
A	750	170	750	170
B	500	300±	500	300±
C	640	140±	600	140±
D	320	105±	300	100±
E*	261	-	176	-
F	235	-	150	-
G	320	105±	300	100±
H	640	140±	600	140±

TURNOUTS TO AND FROM ENTRANCE LOOP

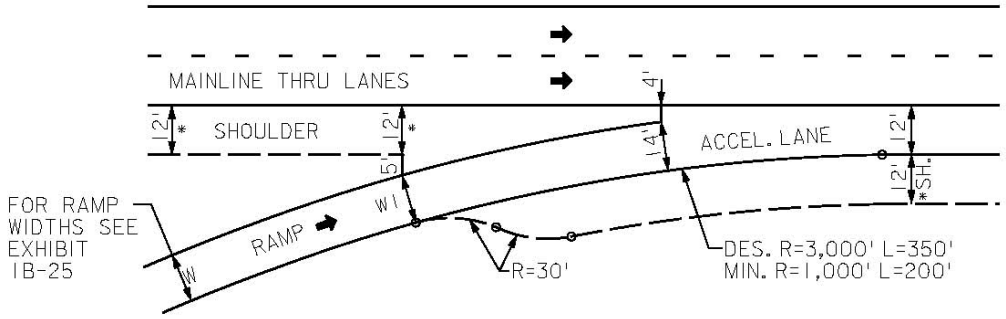


* INCREASE RADII AS NECESSARY FOR TWO LANE INNER LOOP RAMP.

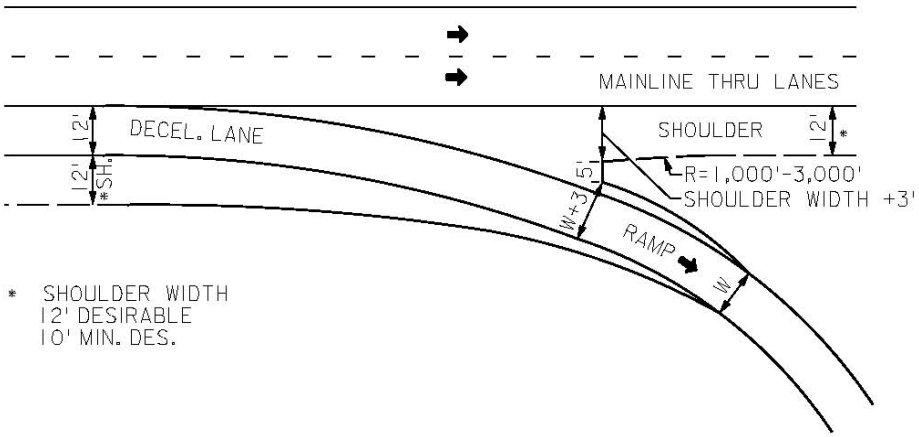
CURVE	235' RADIUS LOOP		150' RADIUS LOOP	
	RADIUS	LENGTH	RADIUS	LENGTH
P	750	170	750	170
Q	500	140	500	140
R	250	90	250	90
S	235	-	150	-
T*	261	-	176	-
U	350±	110±	300±	100+
V	640±	140±	640	140±
W	320±	200±	320	200±
X	640	140±	640	140±

TURNOUTS TO AND FROM EXIT LOOP

EXHIBIT 1B - 27
ENTRANCE AND EXIT TERMINAL LAYOUTS



ENTRANCE TERMINAL - NO CURB



EXIT TERMINAL - NO CURB

1B.4.4 Superelevation

1. Cross slope on tangent sections are typically sloped one-way at 2.0 percent.

2. Minimum cross slope of 1.5 percent.

3. Maximum cross slope of 6.0 percent.

4. The desirable length of superelevation transition should be in accordance with Subsection 1B.2.2.2 and in no case should be less than the rate of two percent per second of time for the associated design speed.

5. Exhibit 1B - 28 provides a suggested range of superelevation rates from minimum to desirable for various interchange ramp radii.

6. Exhibit 1B - 29 indicates the maximum algebraic difference between ramp and mainline pavement.

EXHIBIT 1B - 28
INTERCHANGE RAMP SUPERELEVATION

Design Speed (mph)	Radius (ft)								
	150	230	340	485	650	1000	1500	2000	3000
25	4 – 6	3 – 6	3 – 6	3 – 5	2 – 4	2 – 3	2	2	2
30	--	6	5 - 6	4 - 6	3 – 5	3 – 4	2 – 3	2	2
35	--	--	6	6	5 – 6	4 – 5	3 – 4	2 – 3	2
40	--	--	--	6	6	5 – 6	4 – 5	3 – 4	2 - 3

EXHIBIT 1B - 29
MAXIMUM DIFFERENCE IN CROSS SLOPE RATES AT CROSSOVER CROWN LINE

Ramp Design Speed (mph)	Max. Δ in Cross Slope at Crossover Line (%)
V ≤ 35 mph	6
V > 35 mph	5

1B.4.5 Vertical Alignment

1. Desirable maximum profile upgrade shall be 5.0 percent. Absolute maximum profile upgrade shall be 7.0 percent.

2. Maximum profile downgrade shall be 5.0 percent.

3. Desirable minimum profile grade shall be 0.5 percent. Absolute minimum profile grade shall be 0.3 percent.

4. See Subsection 1B.2.3 for Vertical Curve requirements.

1B.4.6 Pavement Sections and Details

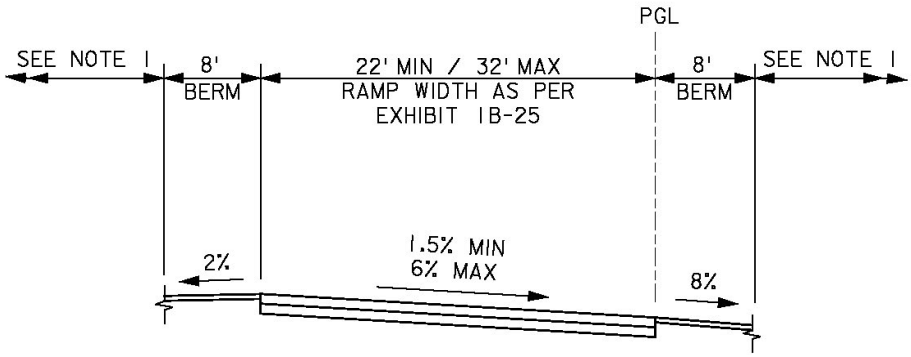
The interchange ramp pavement section shall be the same as the mainline section. See Subsection 1B.3.2.

1B.4.7 Typical Sections

1. Refer to Exhibit 1B - 25 and Exhibit 1B - 30 for typical interchange ramp and berm widths and cross slopes.

2. Ramps should be designed without curbs whenever possible. However, if surface drainage control is required, curb can be specified as shown in Section 3.2.6.11.

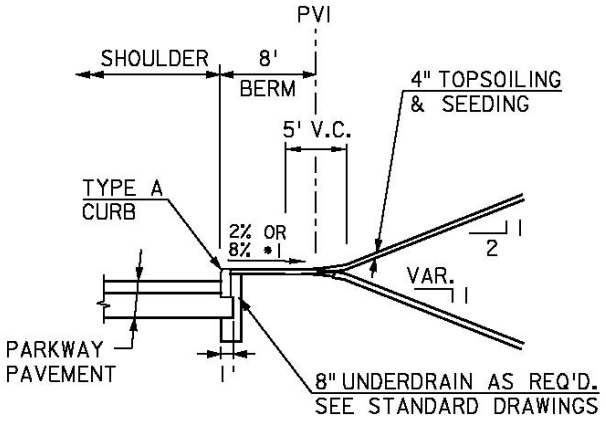
EXHIBIT 1B - 30
TYPICAL SECTION – RAMPS



NOTES:

1. SIDE SLOPE GRADING (SEE EXHIBIT 1B-21).
2. CROSS SLOPE AND SIDE SLOPES APPLY TO BOTH CURBED AND NON-CURBED SECTIONS.
3. PGL AND CROSS SLOPE AS SHOWN ARE TYPICAL FOR A RIGHT LANE EXIT OR ENTRANCE RAMP AND CAN BE ADJUSTED AS NECESSARY.

EXHIBIT 1B - 31
INTERCHANGE RAMPS – CURB SECTION DETAIL



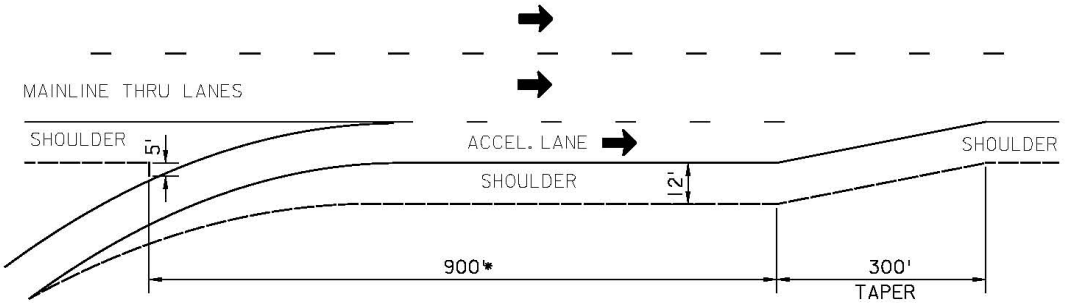
TYPICAL CURB SECTION

*1 BERM TO BE SLOPED AS INDICATED IN EXHIBIT 1B-30.

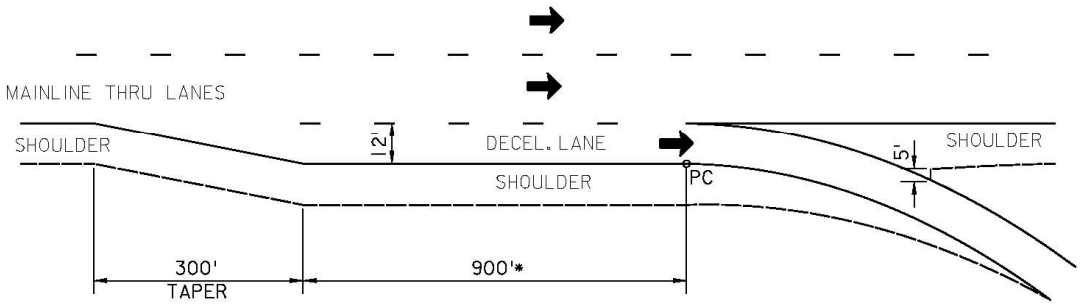
1B.5 AUXILIARY LANES

The minimum length of acceleration and deceleration lanes is shown in Exhibit 1B - 32 through Exhibit 1B - 33. Desirably all interchange entrances and exits should connect at the right of through traffic. Freeway entrances and exits should be located on tangent sections where possible in order to provide maximum sight distance and optimum traffic operation.

EXHIBIT 1B - 32
RAMP TERMINAL TREATMENT – SINGLE LANE RAMP



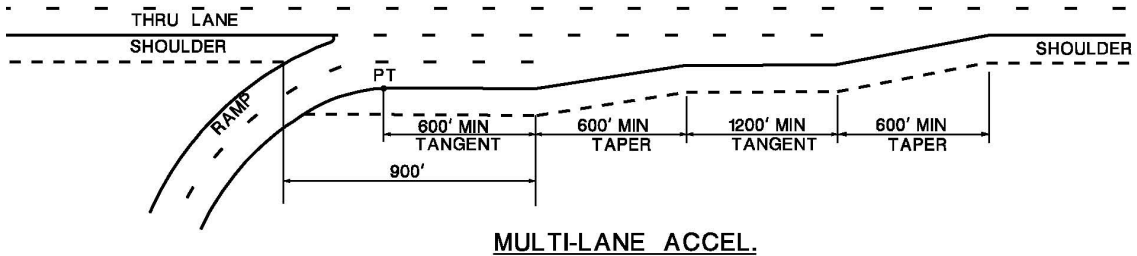
ACCELERATION LANE



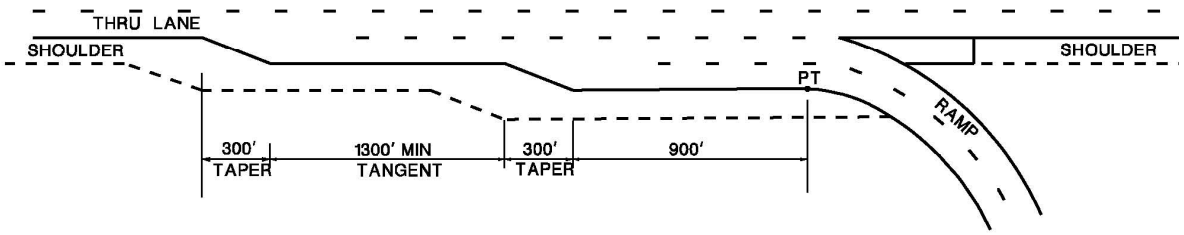
DECELERATION LANE

* FOR ABSOLUTE MINIMUM LENGTH REFER TO AASHTO GEOMETRIC DESIGN OF HIGHWAYS AND STREETS.

EXHIBIT 1B - 33
RAMP TERMINAL TREATMENT MULTI-LANE RAMP



MULTI-LANE ACCEL.



MULTI-LANE DECEL.

1B.6 OTHER ROADWAYS

1B.6.1 Crossroads

Where local roads are being replaced, the intent of the Authority with respect to any work under the jurisdiction of the state, county, municipality, or any other agency is "replacement in kind", according to present standards of that agency. All such work is subject to the approval of the Authority's Engineering Department and must be previously agreed to in writing by the concerned agency, as noted elsewhere in this manual ***and the Procedures Manual***.

Similarly, all detouring and / or closing of local roads during construction must be ***approved by the appropriate agencies in accordance with the Procedures Manual***.

1B.6.2 Access and Service Roads

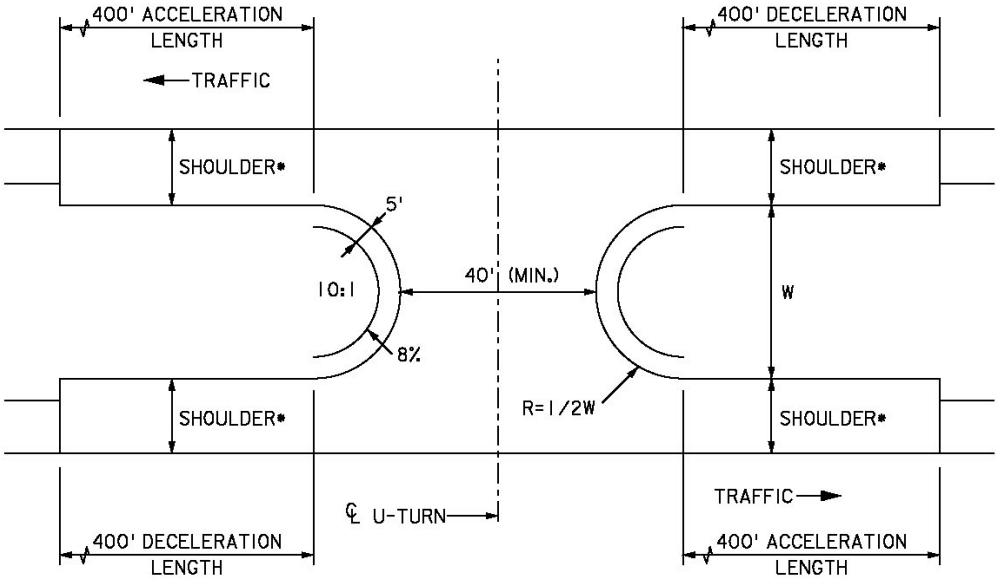
Treatment similar to "Crossroads" above.

1B.6.3 U-Turns and Z-Turns

1. U-Turns and Z-Turns shall be designated by milepost location. Refer to Section 6B for signing.
2. Use and Location
   Consult NJTA for location criteria.

3. The pavement section for U-Turns and Z-Turns shall be Parkway Pavement as shown on Exhibit 1B - 13.

EXHIBIT 1B - 34
U-TURN GEOMETRIC CRITERIA



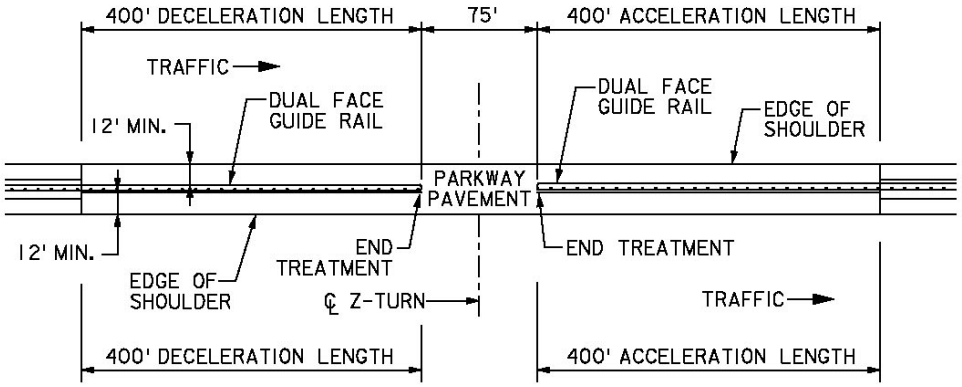
U-TURN GEOMETRIC CRITERIA

NOTES:

1. MAINTAIN DRAINAGE WITHIN U-TURN MEDIAN.
2. RUMBLE STRIPS SHALL NOT BE PLACED WITHIN 400 FEET OF ACCELERATION/DECELERATION LENGTH.

* 10' MINIMUM
12' DESIRABLE
14' WHEN GUIDE RAIL IS PRESENT OR CONSTRAINING GEOMETRY DICTATES

EXHIBIT 1B - 35
Z-TURN GEOMETRIC CRITERIA



Z-TURN GEOMETRIC CRITERIA

NOTES:
1. MAINTAIN DRAINAGE WITHIN Z-TURN MEDIAN.
2. RUMBLE STRIPS SHALL NOT BE PLACED WITHIN ACCELERATION/DECELERATION LANES.

1B.7 GRADING CRITERIA

1. Grading in Fill Areas

   a. Variable side slopes, depending on the height of fill at the PVI of berm, shall be used for all ramps and for existing Parkway roadways. See Exhibit 1B - 21.
      i. 0 - 5 feet fills - 6:1 slope
      ii. 5-10 feet fills - 4:1 slope
      iii. 10 feet and greater fills - 2:1 slope maximum

   b. Refer to Section 3 (Guide Rail / Median Barrier / Attenuator Design) of this Manual for guide rail requirements related to height of fill. Safety grading criteria may be utilized on mainline roadways as directed by the Authority's Engineering Department in order to eliminate guide rail warrants.

   c. Mainline and ramp sections shall have a berm width of 8 feet minimum sloping away from the roadway at an 8 percent grade with the exception of the berm on the high side of a superelevated ramp which will slope away at a 2 percent grade as indicated on Exhibit 1B - 30 .

   d. All roundings shall have 5-foot vertical curves.

2. Grading in Cut Areas

   a. 2:1 maximum side slopes are recommended throughout.

      See Exhibit 1B - 21.

   b. Berm widths are the same as for fill sections.

   c. All roundings shall have 5-foot vertical curves.

d. Cut sections in rock will be subject to Authority's Engineering Department approval of the Engineer's soils recommendations.

e. In borrow projects, the Engineer shall investigate the possibility of using flatter cut slopes in an attempt to achieve a more favorable earthwork balance.

1B.8 FENCING

1B.8.1 General Policy

The policy of the Authority is to fence all of their right of way.

1B.8.2 Fence Usage

Chain Link fence shall be used around interchanges, service areas and maintenance areas; along the right of way adjacent to existing commercial or residential areas or areas zoned for future commercial or residential development and 1,000 feet either side of the limits of these areas; along local roads and 500 feet either side of local roads along the Authority's right of way; and at all other locations at the direction of the Authority.

Chain link fence shall be as per the Standard Details.

1B.8.3 Configuration

The following criteria will be followed in placing ROW fence at or across waterway openings:

Fence intersecting waterways which have a bottom width of 6 feet or greater will be turned and run parallel to the stream, and along the top of bank, to the culvert headwall through the roadway embankment. Fencing will then be carried up behind the wingwall, across behind the headblock and back out to the right of way along the far side of the waterway. The median area crossed by the waterway will not be fenced. On one selected side of that portion of the fence running perpendicular between the ROW and roadway embankment, the engineer shall consider placing a single vehicular gate.

Vehicular gate dimensions shall be as shown on the Standard Details. These gates shall be placed on that side of each water course which affords best access for maintenance. Consideration is to be given to proximity of local road access, the extent of trees, vegetation and ground contour to determine if a gate is required and if so where it is to be placed.

A right of way fence is to be carried across streams and ditches having less than a 6-foot bottom width. Line posts are to be spaced so that no post is erected in the bed or slopes of the ditch. The bottom of the fence shall provide for one foot freeboard above the ditch high water elevation. When the profile line of the fence bottom is greater than one foot above the high water elevation, the fence fabric shall be extended lower as necessary to maintain the specified freeboard across the width of the ditch.

See Exhibit 1B - 36 for general fence placement criteria at streams and ditches.

EXHIBIT 1B - 36
STREAM FENCING CRITERIA