



Temporary Barrier Guidance Manual

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1. INTRODUCTION

The use of the terms 'shall', 'should', and 'may' in this document follow the conventions of the [Minnesota Manual on Uniform Traffic Control Devices \(MN MUTCD\)](#).

1.1 Temporary Barrier Use Applications

Temporary barrier is effective in providing positive separation between traffic and work areas; it is primarily used for protecting vehicles from severe hazards (e.g. drop-offs, embankments, fixed objects), protecting workers from errant vehicles, and to separate opposing directions of traffic in certain temporary traffic control applications. When used appropriately, temporary barrier has the potential to reduce the severity of crashes; however, care should be used in the application of temporary barrier since:

- the temporary barrier itself can be considered a hazard, but when used appropriately it protects from a more serious hazard, and
- the placement and removal of the temporary barrier adds exposure and risk to both the traveling public and the workers placing and removing the barrier.

Due to the above reasons, the following alternatives should be strongly considered before placing temporary barrier:

- Remove the hazard when the hazard is within the Work Zone Clear Zone
- Utilize closures and detours to allow the work to be done without the presence of vehicular traffic
- Provide buffer spaces
- Nightly backfill of excavations

1.2 Definitions

Deflection – Also known as lateral deflection. The distance the barrier travels laterally during impact, under the guidance of crash testing standards. Note that lateral deflection can be expected whether the barriers are anchored or unanchored.

Fixed Object - Hazards that are firm, unyielding, and greater than 4 inches in height along the roadside such as bridge piers, abutments, footings, walls, posts, trees, construction equipment, supplies, stockpiles, and large boulders.

Lateral offset to obstruction – In urban environments, a lateral offset to vertical obstructions (e.g. signs, fire hydrants, etc.), including breakaway devices, is needed to accommodate motorists operating on the roadway. Urban environments with lower operating speeds tend to have sidewalks beginning at the face of the curb, enclosed drainage, numerous fixed objects (e.g., signs, utility poles, luminaire supports, fire hydrants, sidewalk furniture), and frequent traffic stops.

Longitudinal Drop-off – Any slope steeper than 1V:3H.

Portable Concrete Barrier (PCB) - Specifically Type "F" concrete barrier per the latest version of [MnDOT Standard Plate No. 8337](#).

Posted Speed Limit - The posted speed indicates the posted speed limit in force prior to construction or the recommended speed due to engineered work zone geometry.

Traveled Way - The portion of the roadway for the movement of vehicles, exclusive of the shoulders, berms, sidewalks, and parking lanes.

Work Zone Clear Zone - The unobstructed (clear of obstructions, hazards, or fixed objects), relatively flat (1V:4H slope or flatter) area impacted by construction that extends outward from the edge of the traveled way. The clear zone concept applied to work zones differs from clear zone concepts applied to permanent roadways.

2. WORK ZONE CLEAR ZONE AND ROADSIDE SAFETY

The Work Zone Clear Zone concept does not apply to preexisting conditions unless the work operation moves the traffic flows such that the preexisting condition is subsequently within the Work Zone Clear Zone. An example of this would be a crossover such that a multi-lane divided is converted to a two-way, two-lane operation--fixed objects and blunt ends (bridge railings, barrier, guardrails, sign bases, etc.) may now be in the Work Zone Clear Zone for the opposing direction.

[Table 6K-1](#) from the Minnesota Temporary Traffic Control Field Manual (duplicated following this paragraph) indicates the minimum Work Zone Clear Zone distances for MnDOT projects. For urban areas with curbs, a wide clear zone is more difficult to achieve; in these areas with speeds ≤ 35 mph, a minimum of 1.5 feet (called the **lateral offset to obstruction**) should be provided behind the curb face.

Table 2-1: Clear Zone distances for work zones

Speed (mph)	Width (ft)
≤ 35	10*
40	15
45-55	20
≥ 60	30

* or 1.5 feet behind the curb face in curbed urban sections

2.1 Fixed Objects

In construction projects, the use of temporary barrier shall be permitted only if shown in the plan or if approved by the Engineer.

During nonworking hours, fixed objects (including equipment and materials) shall not be within the Work Zone Clear Zone unless they are protected by properly installed temporary barrier. If the Engineer agrees that it is not practical to provide temporary barrier or to move fixed objects, the fixed objects shall be delineated with Type B channelizing devices.

During hours of work, unless protected as described above, only materials necessary to the work shall be within the Work Zone Clear Zone and only equipment necessary to the work shall be allowed within the Work Zone Clear Zone or allowed to stop or park on the shoulder of the roadway.

When temporary barrier is used, the deflection distance should be clear during non-working hours. During working hours, as much deflection distance should be clear as the work allows.

Work vehicles within 15 feet of the traveled way should operate vehicle warning lights. Nonessential and private vehicles shall not park within the Work Zone Clear Zone at any time unless protected as described above.

Trailer mounted traffic control devices, such as Arrow Boards and Portable Changeable Message Signs (PCMSs), are exempt from the temporary barrier requirement when in operation. If practical, PCMSs should be placed off the shoulder and behind a traffic barrier. When trailer mounted devices are deployed and operating on the shoulder, they shall be placed and delineated per [Layout 7](#) of the Minnesota Temporary Traffic Control Field Manual. When not in use, they should be relocated such that they are outside of the clear zone or shielded behind a traffic barrier and turned away from traffic. If relocation or shielding is not practical, they shall be placed and delineated per the aforementioned [Layout 7](#).

2.2 Longitudinal Drop-offs

Longitudinal drop-offs up to 1 foot shall be delineated and treated as shown in [Figure 6K-7 \(Longitudinal Drop-off Guidelines\)](#) of the Minnesota Temporary Traffic Control Field Manual.

Longitudinal drop-offs greater than 1 foot may require temporary barrier. See [Temporary Barrier for Hazard Protection – Placement and Deflection Distance Guidance](#) section for guidance and requirements.

3. TEMPORARY BARRIER FOR HAZARD PROTECTION - PLACEMENT AND DEFLECTION DISTANCE GUIDANCE

Due to the reasons mentioned in the [Temporary Barrier Use Applications](#) section, engineering judgment should be exercised regarding the placement of temporary barrier for hazard protection.

3.1 Protection from Fixed Objects

Work should be planned to keep fixed objects and other hazards outside of the Work Zone Clear Zone following the [Work Zone Clear Zone and Roadside Safety](#) section. If the duration of the work is greater than 3 days, temporary barrier should be used if fixed objects that are not practical to remove are present within the Work Zone Clear Zone.

3.2 Protection from Longitudinal Drop-offs

- Longitudinal drop-offs up to 1 foot shall be delineated and treated as shown in [Figure 6K-7 \(Longitudinal Drop-off Guidelines\)](#) of the Minnesota Temporary Traffic Control Field Manual.
- Anchored Temporary barrier shall be used when bridge barrier is removed and the bridge is open to traffic.

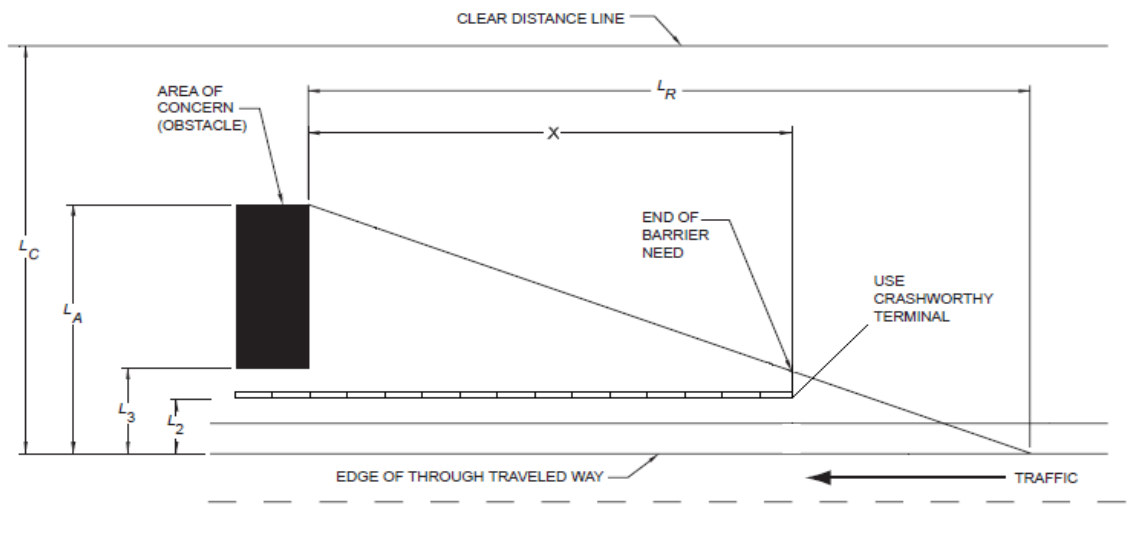
- Temporary barrier shall be used when the following longitudinal drop-offs depths are within 8 feet of the edge of the traveled way, unless otherwise approved by the Engineer:
 - Greater than 3 feet when the posted speed limit is ≤ 30 MPH
 - Greater than 1 foot when the posted speed limit is ≥ 35 MPH
 - When temporary barrier is not used, channelizing devices shall be used to delineate the longitudinal drop-off.
- When temporary barrier is used, deflection distance (see section 3.4) shall be provided between the barrier and the longitudinal drop-off.

3.3 Length of Need Calculation

The length of need is defined as the length of temporary barrier needed in advance (upstream) of a fixed object hazard or to prevent a vehicle that has left the roadway from reaching the shielded feature, it is not the total length of barrier required for a hazard. It is determined by selecting the appropriate variables and using the formula to calculate the Length of Need. Provide the temporary barrier for the calculated length of need; a minimum run of 100' of portable concrete barrier should be placed before and after the hazard for which the barrier is placed.

For construction staff to verify enough PCB has been placed, a PCB Length of Need Field Check Procedure has been included in [Appendix A](#).

Figure 3-a: Approach Barrier Layout Variables



Ref: AASHTO Roadside Design Guide, 4th Edition 2011, Figure 5-39, pg. 5-49.

L_C = **Clear zone**, design clear zone width as shown in [Table 2-1](#)

L_A = **Lateral Extent of the Area of Concern**, distance from edge of traveled way to back of obstacle or design clear zone width, whichever is less.

L_R = **Runout length**, distance measured along the edge of the travel lane as shown in the diagram based on design speed and ADT ([Table 3-1](#)).

L_2 = Distance from edge of travel lane to face of traffic barrier measured at obstacle.

L_3 = Distance from edge of through traveled way to obstruction.

X = Length of Need for traffic barrier from upstream face of obstacle to the effective point of the end treatment.

Table 3-1: Runout Length

Design Speed (MPH)	Runout Length (L_R) for Given Traffic Volume (ADT) (ft)			
	>10,000 veh/day	5,000 – 10,000 veh/day	1,000 – 5,000 veh/day	<1,000 veh/day
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

Ref: AASHTO Roadside Design Guide, 4th Edition 2011, Chapter 5, Table 5-10(b), Pg. 5-50.

3.3.1 Length of Need Procedure

1. Choose an appropriate L_A as it is a critical part of the design process. This distance should include all features or hazards that need to be shielded, up to the design clear zone at each site.
2. Select a Runout Length (L_R) from Table 3-1.
3. For parallel installations i.e. no flare rate, the equation is:

$$\text{Length of need, } X = \frac{L_A - L_2}{(L_A/L_R)}$$

Example calculation for length of need:

Design Speed = 40 MPH

ADT = 11,000 veh/day

L_A = Clear zone = 15 ft

L_2 = Distance from edge of travel lane to face of traffic barrier measured at obstacle = 2 ft

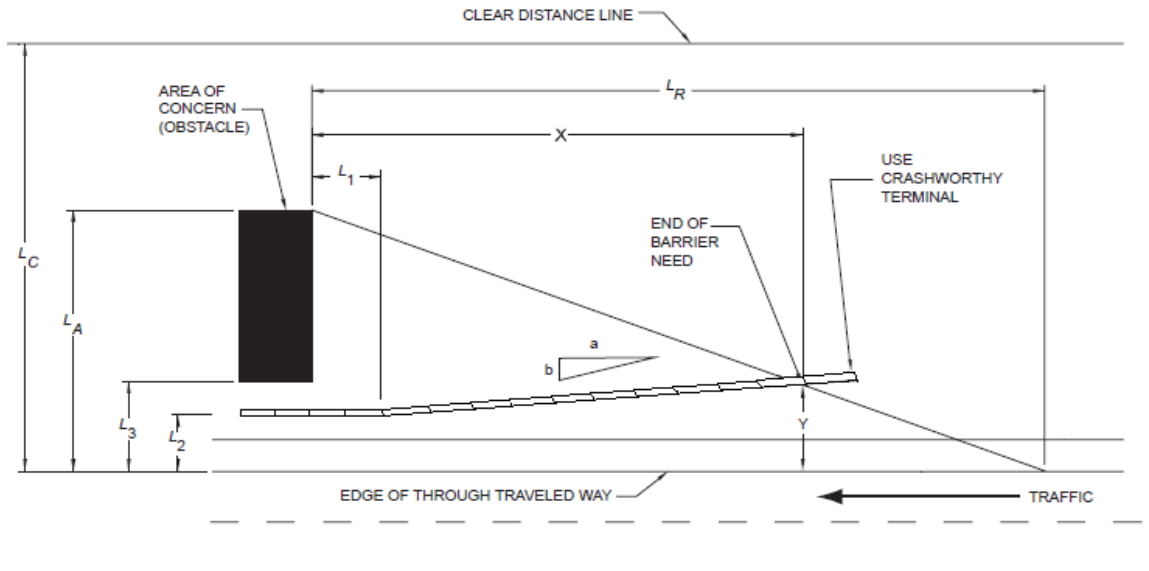
L_R = Runout length (from table 3-1) = 160 ft

$$\text{Length of need, } X = \frac{15 - 2}{(15/160)} = \mathbf{138.66 \text{ ft.}}$$

A minimum of 100' behind the hazard is also needed, so a total of **238.66 ft** of barrier is required to shield the area of concern. (Keep in mind this assumes a single point area of concern, the length of the area of concern would also need to be added to this value)

3.3.2 Length of Need Procedure for Barrier Flare

Figure 3-b: Approach Barrier Layout Variables for barriers with flare



Ref: AASHTO Roadside Design Guide, 4th Edition 2011, Figure 5-39, pg. 5-49.

See [Figure 3-a](#) for other variables required for the calculation.

b/a = Flare rate for the selected design speed (not shown in the diagram, use if the run out barriers need to be flared) ([Table 4-1](#)).

L_1 = Tangent section in advance of obstacle (transitions should be tangent).

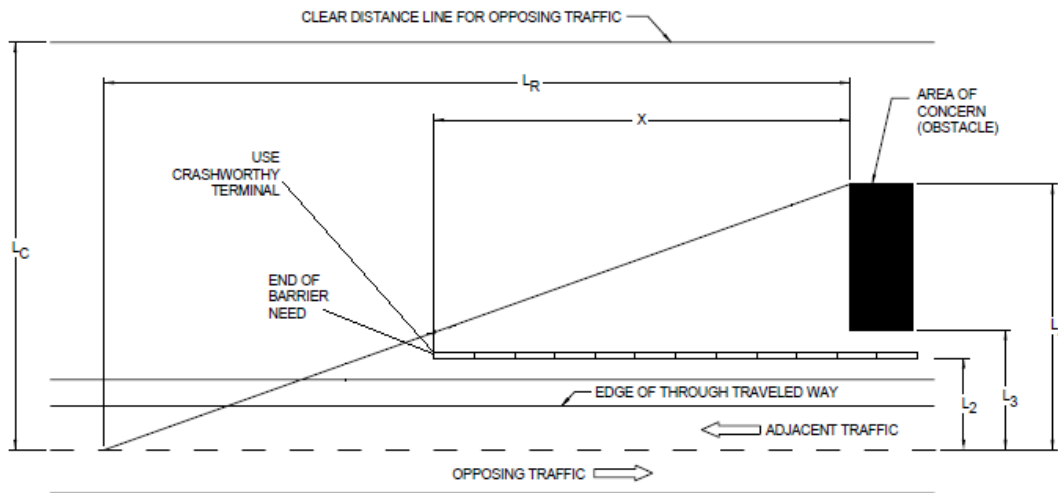
1. If the barrier is flared away from the roadway, the maximum recommended flare rate shown on [Table 4-1](#), should not be exceeded.
2. If a semi rigid barrier is connected to a rigid barrier, the tangent length (L_1) should be at least as long as the transition section.
3. Once the appropriate variables have been selected, the required length-of-need (X) in advance of the area of concern for straight or nearly straight sections of roadway can be calculated with the following:

$$\text{Length of need, } X = \frac{L_A + (b/a)(L_1) - (L_2)}{(b/a) + (L_A/L_R)}$$

3.3.3 Length of Need for Opposing Traffic

The following is the procedure required to adjust Length of Need for opposing traffic:

Figure 3-c: Approach Barrier Layout for Opposing Traffic



Ref: AASHTO Roadside Design Guide, 4th Edition 2011, Figure 5-42, pg. 5-54.

- Length of need (X) is determined using the same equation as in section [3.3.1](#).
- All lateral dimensions are measured from the centerline for a two-lane roadway.
- Three ranges of clear zone width (L_C) deserve special attention for an approach barrier for opposing traffic:
 - If the barrier is beyond the appropriate clear zone, no additional barrier and no crashworthy terminals are needed.
 - If the barrier is within the appropriate clear zone but the area of concern is beyond it, no additional barrier is needed, but a crashworthy terminal should be used.
 - If the area of concern extends well beyond the appropriate clear zone (e.g., a river), the designer may choose to shield only that portion that lies within the clear zone by setting L_A equal to L_C .

3.4 Required Deflection Distance for Portable Concrete Barrier (PCB)

MnDOT has significant experience in the application of portable concrete barrier, specifically Type "F" Barrier per the latest version of [MnDOT Standard Plate No. 8337](#). The tables in this section are based on this design of portable concrete barrier. If proprietary temporary barriers are used, refer to manufacturer for design assistance. Barrier segments must be connected together to be effective.

When used, place portable concrete barrier such that the deflection distance in the following tables is provided.

Table 3-2: Deflection distance for Unanchored Portable Barrier

Deflection Distance Required Behind <u>Unanchored</u> Portable Concrete Barrier						
		Longitudinal Drop-off Depth				Fixed Object
		<1'	1' - 3'	>3' – 8'	Edges of bridges and drop-offs >8'	
Posted Speed (MPH)	≤ 30	Barrier not required for hazard protection		2'	3'	3' ^[2]
	35 - 50	0.5' ^[1]	2'	3'	6'	6' ^[2]
	≥ 55	2' ^[1]	2'	4'	8'	8'

Table 3-3: Deflection distance for Anchored Portable Barrier

Deflection Distance Required Behind <u>Anchored</u> Portable Concrete Barrier						
		Longitudinal Drop-off Depth				Fixed Object
		<1'	1' - 3'	>3' – 8'	Edges of bridges and drop-offs >8'	
Posted Speed (MPH)	≤ 30	Barrier not required for hazard protection		0.5'	0.5'	0.5' ^[2]
	35 - 50	0.5' ^[1]	0.5'	1'	1.5' (2' ^[3])	[1.5' (2' ^[3])] ^[2]
	≥ 55	0.5' ^[1]	1'	2'	2' (4' ^[3])	2' (4' ^[3])

[1] Temporary barrier is optional if the work is less than 50 feet in length and the duration is ≤ 3 calendar days. Follow delineation requirements of [Figure 6K-7](#) in the Minnesota Temporary Traffic Control Field Manual.

[2] If the fixed object is beyond 1.5 feet from an in place curb and the posted speed limit is ≤ 35 mph, temporary barrier is optional.

[3] Denotes deflection distance for the Tie-Down Strap anchoring system, which is **NOT** to be used on bridge decks. See notes below and [MnDOT Standard Plan 5-297.680](#) for more details on anchorage system required according to type of surface below the Portable Barriers.

3.4.1 Notes:

- These tables were developed based on crash tests (FHWA Eligibility Letters [B-180](#) & [B-215](#)), reports (MwRSF Research Report No. [TRP-03-115-02](#) & [TRP-03-134-03](#)), and construction experience. Some deflections in these tables are reduced from the crash tested values because work zones often reduce the width of traveled way and available shoulders, which likely reduces the angle of incidence and crash severity.
- Temporary barrier deflection distance should be clear during non-working hours. During working hours as much deflection distance should be clear as work allows.
- If Engineering Judgement is being used to modify the required deflection distance for Anchored PCB, the PCB shall be anchored with a minimum of 6" of full-depth pavement behind the barrier.
- Anchoring in a head-to-head situation is only allowed when using the Tie-Down Strap Anchor system on concrete pavements.
- Anchoring or increasing deflection distance should be considered if:
 - Alignment is not tangent;
 - Placing in roads and bridges where travel speeds may significantly exceed the posted speed limit;
 - Work continues longer than one season; or
 - Truck presence is above normal (>10%).
- Types of anchoring that should be considered include:
 - **Bolt-Down Anchor:** This system is used with concrete pavements and bridge decks. It consists of three 1 ½" diameter MnDOT Spec. 3385 Type A anchor rods with adhesives per barrier segment on the traffic side which is bolted to reinforced concrete. See [MnDOT Standard Plate B920](#) for bridge deck applications. See [MnDOT Standard Plan 5-297.680](#) for approach panels and other concrete pavement applications.
 - **Thru-Bolt Anchor:** This system is used with bridge decks. It consists of three 1 ½" diameter MnDOT Spec. 3385 Type A anchor rods per barrier segment on the traffic side which are bolted through bridge deck. See [MnDOT Standard Plate B920](#).
 - **Tie-Down Strap Anchor:** This system is used with concrete pavements. It consists of a tie down strap ([MnDOT Standard Plate 8347](#)) which connects the barrier and the concrete pavement using ¾" diameter drop-in anchors on both sides of the barrier. Tie-Down Strap Anchor shall not be used on bridge decks.
 - **Bituminous Anchorage:** This system is used with bituminous pavements. It consists of three 3' long and 1 ½" diameter ASTM A36 Rods driven into bituminous pavement on the traffic side. See [MnDOT Standard Plan 5-297.680](#) for more details.
- Anchoring should be used for portable concrete barrier left in place on a bridge over winter if an unprotected longitudinal drop-off is behind it.
- Sheet pile or other temporary retaining wall systems are not permitted within the deflection distance limits.

4. PORTABLE CONCRETE BARRIER (PCB) DESIGN DETAILS AND REQUIREMENTS

1. Portable Concrete Barrier shall follow [Standard Plate No. 8337](#).
2. Portable Concrete Barrier shall follow [MnDOT Standard Plan 5-297.680](#) and [MnDOT Standard Bridge Detail B920](#) for barrier anchoring.
3. Portable Concrete Barrier should be placed on pavement. The barriers may be placed on compacted aggregate if a paved surface is not available. The surface must be able to bear traffic. This also applies to the deflection area.
4. Provide the temporary barrier for the calculated length of need approaching the hazard for which the barrier is placed; a minimum run of 100' of portable concrete barrier should be placed before and after the hazard.
5. In order to keep the angle of impact with the barrier from being too severe and to mitigate the effect of striking the end of a temporary traffic barrier, the end shall be appropriately flared until it is outside the acceptable clear zone or protected with properly installed and maintained crashworthy cushions/end treatments. Adjacent temporary traffic barrier segments shall be properly connected in order to provide the overall strength required for the temporary traffic barrier to perform properly. The minimum flare rate values shown in the table below should be followed.

Table 4-1: Flare Rates

Posted Speed (MPH)	Flare rate for concrete barrier
≥45	15:1
40-45	12:1
≤35	8:1

Ref: MN MUTCD Figure 6F-9

Note: For Portable Concrete Barriers, the flare rates in the table above can be used. However, Portable Concrete Barriers were only tested on paved surfaces. Since a flare will likely run into a non-paved soil surface, designers are recommended to consider more conservative flare rates when placing portable concrete barrier on compacted aggregate. Also, the compacted aggregate surface must be able to bear traffic.

6. Adequate transitions shall be made between temporary barriers of differing flexibility or between temporary and permanent barriers. To shield the blunt end of the portable concrete barrier rail section, a transition consisting of a steel plate (such as a Thrie Beam Guardrail Connection) and a special precast concrete barrier transition section that connects to the permanent concrete median barrier should be used. See [MnDOT Standard Plan 5-297.680](#) (page 2) and [MnDOT Standard Plate No. 8350A](#) for Thrie Beam Anchorage Plate details. Any transition system used must be crashworthy.
7. In case of a PCB overlap with other barriers (temporary or permanent), a minimum of 100' overlap between the PCB and the overlapped barrier should be provided. The barriers should be spaced 6"-12" from each other.

8. Placement near curbs should be evaluated on a case-by-case basis using engineering judgment. Curbs may cause the PCB to tip over, so adequate deflection distance should be provided between the PCB and the curb. If this cannot be achieved, remove the curb. Do not place temporary barrier directly in front of curb face, if necessary place PCB on top of the curb, flush with the face of it. The deflection area must meet the requirements of section [3.4 Required Deflection Distance for PCB](#).

5. APPENDIX

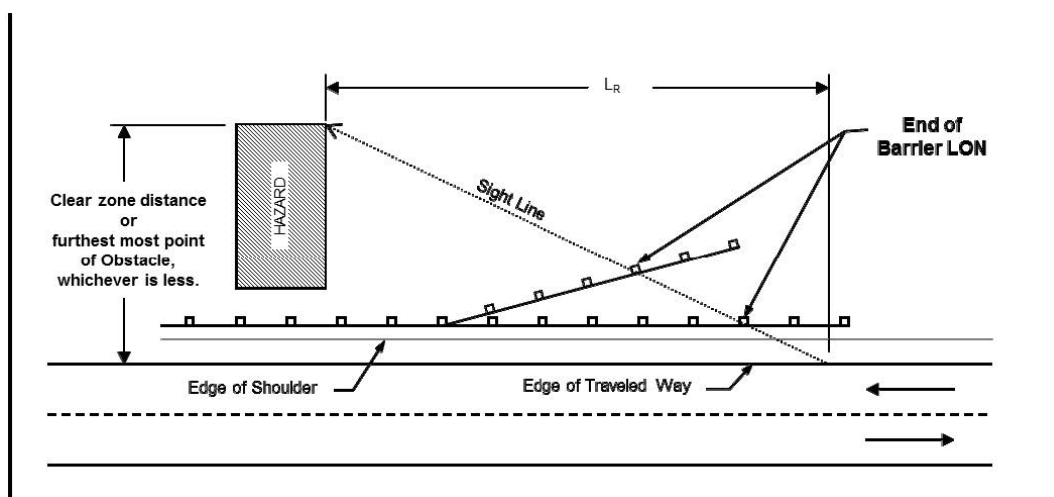
5.1 PCB Length of Need Field Check

Walk upstream along the edge of traveled way from the edge of the hazard, a distance of L_R (known as, runout length) as shown in the table below.

From this position sight downstream toward the hazards's furthest corner, or toward a point along the obstacle at the Clear Zone distance, whichever is less.

If the PCB length is sufficient, the PCB should intercept the sight line.

Figure 5: Length of Need Approach Barrier Layout



Ref: Federal Lands Highway Division Guardrail Field LON Card, 2016, Pg. 1.

Table 5-1: PCB Field Check Runout Length

Design Speed (MPH)	Runout Length (L_R) for Given Traffic Volume (ADT) (ft)			
	>10,000 veh/day	5,000 – 10,000 veh/day	1,000 – 5,000 veh/day	<1,000 veh/day
70	360	330	290	250
65	330	290	250	225
60	300	250	210	200
55	265	220	185	175
50	230	190	160	150
45	195	160	135	125
40	160	130	110	100
35	135	110	100	100
30	110	100	100	100

Ref: Federal Lands Highway Division Guardrail Field LON Card, 2016, Pg. 2.