

# New Jersey Turnpike Authority

P.O. Box 5042, Woodbridge, NJ 07095



March 12, 2026

## Document Change Announcement

*Design Manual*  
*Inlet Curb Piece*  
*DCA2026DM-02*

**Subject: Revisions to**  
**Section 5 Drainage Design, Subsection 5.8 Drainage of Roadway Pavement**

### Description of Change:

Barrier curb inlet details have been developed to integrate curb openings for drainage inlets with the Authority's standard concrete median barrier. Inlets Type D-6 shall be used along single faced barriers when an inlet is only necessary on one side of a concrete median barrier. Inlets Type D-7 shall be used along concrete median barrier when inlets are needed on both sides of the barrier. Both inlet types will utilize the Authority's standard Bicycle Safe Grates. Design Manual is updated to identify the types of inlets used by the Authority to match the updated details, and direct when Inlet Types D-4 and D-5 may still be used. DCAs to the Standard Drawings and Design Manual are released concurrently to address this.

### Notice to New Jersey Turnpike Authority Staff and Design Consultants

Effective immediately, all contracts currently in the design phase shall incorporate the revisions herein. For advertised contracts awaiting the opening of bids this revision shall be incorporated via addendum. Contact your New Jersey Turnpike Authority Project Manager for instruction.

The revisions may be accessed on the Authority's webpage: <https://www.njta.gov/business-hub/professional-services/document-change-announcements/>

### **Recommended By:**

*(signature on original)*

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### **Approved By:**

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**NOTE: All text herein are REVISIONS, as indicated by the tracked changes, to the latest version of the Design Manual.**

## 5.8. DRAINAGE OF ROADWAY PAVEMENT

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### 5.8.2. Types of Inlets Used by the Authority

Inlet grate types used by the Authority consist of two types, combination inlets (with a curb opening), and grate inlets (without a curb opening) as shown on the current standard details as summarized below:

1. Combination Inlets [Types D-3, D-6, and D-7](#)
2. Grate Inlets [Types D-1, and D-2, D-4, and D-5](#)

A special inlet shall also be designed, with the appropriate detail provided in the construction plans, and the item shall be designated "Special Inlet", when the transverse pipe size requires a structure larger than the standard inlet types.

All chamber type inlets on Authority roadways shall be D-1 inlets except where the diameter of the through sewer or specific grate capacity problems require a larger inlet, in which case D-2 or larger special inlets shall be used.

D-3 inlets with bicycle grates shall be used only at Authority facilities and on incidental roadway relocations under the jurisdiction of other agencies where D-3 inlets are standard.

[D-6 and D-7 inlets shall be used along concrete median barrier within all at-grade roadway sections. If placement of the curb opening for these inlets is restricted due to a local constraint, D-4 and D-5 inlets shall be used.](#)

A scupper is a grate inlet that is used for bridge deck drainage. See Standard "BR" Drawings for details of the bridge scuppers. For general design guidelines refer to HEC-21 "Design of Bridge Deck Drainage".

### 5.8.3. Flow in Gutters (Spread)

The hydraulic capacity of a gutter depends on its cross-section geometry, longitudinal grade, and roughness. The typical curbed gutter section is a right triangular shape with the curb forming the vertical leg of the triangle. The recurrence interval for design shall follow the requirements of Subsections 5.1.2.3 and 5.8.4.

The minimum inlet time (time of concentration) to the first inlet in a system shall follow the requirements of Subsections 5.1.2.3 and 5.8.4. The Manning equation has been modified to allow its use in the calculation of curbed gutter capacity for a

triangular shaped gutter. The resulting equation is:

$$Q = \left(\frac{0.56}{n}\right) \left(S_x^{5/3}\right) \left(S_0^{1/2}\right) T^{8/3} \tag{1}$$

where

- Q** = rate of discharge in cfs
- n** = Manning's coefficient of gutter roughness (EXHIBIT 5-1)
- S<sub>x</sub>** = cross slope, in ft/ft
- S<sub>0</sub>** = longitudinal slope, in ft/ft
- T** = spread or width of flow in feet

The relationship between depth of flow (y), spread (T), and cross slope (S<sub>x</sub>) is as follows:

y = TS<sub>x</sub>, depth in gutter, at deepest point in feet.

**EXHIBIT 5-1 MANNING’S ROUGHNESS (N) COEFFICIENTS - GUTTERS**

Street and Expressway Gutters		
a.	Concrete gutter troweled finish	0.012
b.	Asphalt pavement	
	1) Smooth texture	0.013
	2) Rough texture	0.016
c.	Concrete gutter with asphalt pavement	
	1) Smooth	0.013
	2) Rough	0.015
d.	Concrete pavement	
	1) Float finish	0.014
	2) Broom finish	0.016
e.	Brick	0.016
For gutters with small slope where sediment may accumulate, increase all above values of "n" by 0.002.		

**5.8.4. Limits of Spread**

The objective in the design of a drainage system for a highway pavement section is to collect runoff in the gutter and convey it to pavement inlets in a manner that provides reasonable safety for traffic and pedestrians at a reasonable cost. As spread from the curb increases, the risks of traffic accidents and delays and the nuisance and possible hazard to pedestrian traffic increase. The following shall be used to determine the allowable spread using a 15-year design storm and a 25-year design storm at low points except as noted:

1. Width of inside and outside shoulder along the Authority’s mainline roadways.
2. Width of narrow inner shoulder plus one-half of travel lane on structures only subject to Authority’s Engineering Department approval.

3. 1/3 width of ramps including service area ramps, 1/3 of live lanes next to curb and lanes adjacent to inside and outside shoulders on land service roads.
4. 1/2 width of acceleration or deceleration lanes.
5. 8-foot width next to curbs at service areas and maintenance yards (for a 5-year design storm).
6. 1/2 width of live lane when used temporarily during construction (for a 5-year design storm).

Since many roadway and bridge projects along the Turnpike and Parkway involve reconstruction of existing facilities it will be the Design Engineer's responsibility to determine the impact on gutter flow whenever an existing inlet grate is replaced with a new Eco grate or Eco curb piece. Each project presents a unique set of circumstances such as duration of each construction stage, speed limits, and whether the project involves a bridge or roadway. Each situation will need to be evaluated by the Design Engineer to determine the need for additional inlets or reductions in speed limits during construction and, if necessary, discussed with the Authority's Project Manager who will make the final determination.

#### 5.8.5. Inlets

There are separate design standards for grates in pavement or other ground surfaces, and for curb opening inlets. Each standard is described below. These standards help prevent certain solids and floatables (e.g., cans, plastic bottles, wrappers, and other litter) from reaching the surface waters of the State. For new roadway projects, reconstruction, repaving, repair (excluding individual pothole repair), or resurfacing of existing highways, storm drain inlets must be selected or retrofitted to meet the following design requirements:

##### 1. Grates in Pavement or Other Ground Surfaces

Many grate designs meet the standard. The first option (especially for storm drain inlets along roads) is simply to use the Authority's bicycle safe grate. G-1 and G-2 inlet frames and grates may be used in paved areas and in infields. Inlet grates shall be oriented to place the major bars of the grating parallel to the prevalent direction of water flow. The other option is to use a different grate, as long as each "clear space" in the grate (each individual opening) is:

- a. No larger than seven (7.0) square inches; or
- b. No larger than 0.5 inches ( $\frac{1}{2}$  inch) across the smallest dimension (length or width).

##### 2. Curb-Opening Inlets

If the storm drain inlet has a curb opening, the clear space in that curb opening (or each individual clear space, if the curb opening has two or more clear spaces) must be:

- a. No larger than two (2.0) inches across the smallest dimension (length or width) - many curb opening inlets installed in recent years meet this criterion; or
- b. No larger than seven (7.0) square inches

This complies with the latest NJDEP New Jersey Pollutant Discharge Elimination System requirements included in the NJDEP Highway Agency Stormwater Guidance Document and the NJDEP SWM Rules.

### 3. Exemptions

The requirements for Grates in Pavement or Other Ground Surfaces or Curb-Opening Inlets do not apply in certain circumstances. See the NJDEP Highway Agency Stormwater Guidance Document and the NJDEP SWM Rules for a complete list of exemptions.

Storm drain inlets that are located at rest areas, service areas, maintenance facilities, and along streets with sidewalks operated by the Authority are required to have a label placed on or adjacent to the inlet. The label must contain a cautionary message about dumping pollutants. The message may be a short phrase and/or graphic approved by the Authority's Engineering Department. The message may be a short phrase such as "The Drain is Just for Rain", "Drains to [Local Waterbody]", "No Dumping. Drains to River", "You Dump it, You Drink it. No Waste Here", or it may be a graphic such as a fish. Although a stand-alone graphic is permissible, the Authority strongly recommends that a short phrase accompany the graphic.

The hydraulic capacity of an inlet depends on its geometry and gutter flow characteristics. Inlets on grade demonstrate different hydraulic operation than inlets in at a low point. The design procedures for inlets on grade are presented in Subsection 5.8.5.1, "Capacity of Gutter Inlets on Grade". The design procedures for inlets at a low point are presented in Subsection 5.8.5.2, "Capacity of Grate Inlets at Low Points". Proper hydraulic design in accordance with the design criteria maximizes inlet capture efficiency and spacing. The inlet efficiency should be a minimum of 75%.

#### 5.8.5.1. Capacity of Inlet on Grade

Collection capacity for gutter inlets on grade shall be determined using the following empirical equation:

$$Q_1 = 16.88y^{1.54} \left( \frac{S^{0.233}}{S_x^{0.276}} \right)$$

where

$Q_1$  = Flow rate intercepted by the grate (cfs)

$y$  = gutter depth (ft) for the approach flow

$S$  = longitudinal pavement slope

$S_x$  = transverse pavement slope

The equation was developed for the standard Authority's Type "G-1" grate configuration and is to be used for all inlet grate types without modification.

On a roadway profile vertical curve, the gutter slope shall be defined for the purpose of these calculations, by the slope of a short chord not exceeding 25 feet at the inlet under consideration.

An alternative procedure, that yields results reasonably close to those obtained by using the runoff collection capacity equation presented above, is to compute the collection capacity in accordance with the procedures presented in FHWA, Hydraulic Engineering Circular No. 22 (HEC-22) "Urban Drainage Design Manual" using the following parameter values:

Grate type P-1-7/8 x 4 (P-50 x 100)

Constant representative splash-over velocity of 5.77 ft/s

Constant effective grate length of 2.66 feet

All other parameter values for use in this procedure are as stated in HEC-22. Use of computer programs is encouraged to perform the tedious hydraulic capacity calculations. HEC-22 contains useful charts and tables. The HEC-22 procedure is also incorporated in a number of computer software programs. Additional design assistance can be found in FHWA, Hydraulic Circular No. 22 (HEC-22) "Urban Drainage Design Manual".

#### 5.8.5.2. Capacity of Inlets at Low Points

Hydraulic evaluation of the bicycle safe grate reveals that the grate functions as a weir for approach flow depths equal to or less than 9 inches and as an orifice for greater depths. Procedures to compute the collection capacity for each condition are presented separately below.

##### **Weir Flow**

Collection capacity shall be determined using equation 4-26 presented in HEC-22:

$$Q_i = C_w P y^{1.5}$$

where

$Q_i$  = flow rate intercepted by the grate (cfs)

$C_w$  = weir coefficient

$P$  = perimeter around the open area of the grate (as shown on Chart 9B of HEC-22)

$y$  = depth (feet) for the approach flow

The weir flow coefficient is 3.0. The perimeter around the open area for various Authority bicycle safe grate configurations and the resultant product of  $C_w P$  are summarized as follows:

Inlet Type	Perimeter*(ft)	$C_w P^*$
D-1, D-4, D-5	5.28	15.84
D-2, D-3, D-6, D-7	6.96	20.88

\*Type "D-3", D-6, and D-7 inlets have a curb opening that allows runoff to enter the inlet even when debris partly clogs the grate. The equations must be modified for use with inlets that do not have a curb opening to account for reduced interception capacity resulting from debris collecting on the grate. The perimeter around the open area of the grate (P) used in the weir equation should be divided in half for inlets without a curb opening. The perimeter and resultant product of  $C_w P$  for inlet types "D-1", and "D-2", shown in the table reflect this modification.

**Orifice Flow**

Collection capacity shall be determined using equation 4-27 presented in HEC-22:

$$Q_i = C_o A_o (2gy)^{0.5}$$

where

$Q_i$  = flow rate intercepted by the grate (cfs)

$C_o$  = orifice coefficient

$A_o$  = clear opening area of a single grate

$y$  = depth (ft) for the approach flow

$g$  = gravitational acceleration of 32.2 feet/sec<sup>2</sup>

The orifice flow coefficient is 0.67. The clear opening area and resultant product of  $C_o A_o$  for various Authority bicycle safe grate configurations are summarized as follows:

Inlet Type	Clear Opening Area* (ft <sup>2</sup> )	C <sub>o</sub> A <sub>o</sub> *
D-1, D-4, D-5	1.45	0.97
D-2, D-3, D-6, D-7	2.90	1.94

\*Type D-3, D-6, and D-7 inlets have a curb opening that allows runoff to enter the inlet even when debris partly clogs the grate. The equations must be modified for use with inlets that do not have a curb opening to account for reduced interception capacity resulting from debris collecting on the grate. The clear opening area of the grate (A<sub>o</sub>) used in the orifice equation should be divided in half for inlets without a curb opening. The clear opening area and resultant product of C<sub>o</sub>A<sub>o</sub> for inlet types "D-1" and "D-2," reflect this modification.