

Proposed Code Change:

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Supporting Statement (Reason for change should include an “authoritative source” and cost analysis where appropriate.):

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Changes to the technical requirements in the standards must be based on recommended site improvement standards that are published by an academic or professional institution or organization, similar to those used in the original Rutgers Model Subdivision and Site Plan Ordinance.

New Rule, R.2001 d.352, effective October 1, 2001.  
 See: 33 N.J.R. 1237(a), 33 N.J.R. 3427(a).

TABLE 4.1

AVERAGE DAILY MOTOR VEHICLE  
 TRAFFIC TRIP GENERATION  
 PER DWELLING UNIT<sup>1</sup>

SUBCHAPTER 4. STREETS AND PARKING

Subchapter Historical Note

Administrative change.

See: 35 N.J.R. 609(b).

5:21-4.1 Street hierarchy

(a) Streets shall be classified in a hierarchy with design tailored to function. The street hierarchy definitions contained within this section are applicable only to local residential streets and are not to be considered related to the U.S. Department of Transportation, Federal Highway Administration's Functional Classification of Highways.

(b) The street hierarchy system shall be defined by road function and average daily traffic (ADT), calculated by trip generation rates from the current edition of "Trip Generation" by the Institute of Transportation Engineers, as indicated in Table 4.1 below. Trip generation rates from other sources may be used if the applicant demonstrates to the appropriate approving authority that these sources better reflect local conditions. In addition, the applicant shall investigate the opportunities for, and availability of, transit facilities and, if appropriate, consider their impact(s) on motor vehicle traffic trip generation rates per dwelling unit.

(c) Each residential street shall be classified and designed to meet the standards for one of the street types defined in Table 4.2 below. The entire length of the street need not be designed based on the highest ADT where the ADT varies along the street's length. However, each street segment between intersections shall be designed based on the highest ADT served in that segment.

(d) The municipality and the developer shall determine the highest order street required to be used in a given residential development, considering all of the following:

1. The size of the development (number and type of units). For example, using size to determine the highest order of street required, a development of up to 150 single-family detached units would not require any minor collectors or streets of a higher order;
2. The actual or potential development of adjacent sites (whether there is likely to be traffic passing through from neighboring developments). A "potential" development means a development having approvals granted, applications pending, or undergoing preliminary review; and
3. The streets proposed for that area, if any, as contained in the municipal master plan.

| Land use <sup>2</sup>               | Peak rate |
|-------------------------------------|-----------|
| Single-family detached housing      | 10.1      |
| Townhouse                           | 5.9       |
| Low-rise apartment                  | 7.2       |
| Mid-rise apartment                  | 5.5       |
| High-rise apartment                 | 5.0       |
| Mobile home park                    | 5.0       |
| Retirement community                | 2.8       |
| Recreational homes (owner occupied) | 3.2       |

Notes:

<sup>1</sup> The trip generation rates listed are guidelines only. The actual use of trip generation rates is derived by the use of regression analysis and should be computed only by professionals proficient in the use of the ITE Trip Generation manual. The "Land Use" definitions are based on the ITE manual with slight modifications to address inconsistencies contained within the ITE manual.

<sup>2</sup> For two-family dwellings (duplexes), apply the values for single-family dwellings to each unit.

Source: Institute of Transportation Engineers, Trip Generation (Washington, D.C.: ITE, 1982), 3rd Edition. The table was updated with data from the 6th Edition of the manual published by ITE in 1997. The peak ADT rates take into consideration Saturday and Sunday rates, as well as weekday rates.

DEFINITIONS

| Land use                       | Definition  |
|--------------------------------|---|
| Single-family detached housing | Any single-family detached home on an individual lot.   |
| Townhouse                      | Attached multiple-family dwelling units where the only separation between units is vertical.  |
| Apartment                      | A dwelling unit located within the same building with at least three other dwelling units.  |
| Low-rise apartment             | Apartments in buildings that have one or two levels (floors).   |
| Mid-rise apartment             | Apartments in buildings that have more than two levels (floors) and less than ten levels.   |
| High-rise apartment            | Apartments in buildings with ten or more levels (floors).   |
| Mobile home park               | Generally trailers shipped, sited and installed on permanent foundations and in areas that typically have community facilities, such as recreation rooms, swimming pools, and laundry facilities. |

| <u>Land use</u>      | <u>Definition</u>   | <u>Land use</u>   | <u>Definition</u>   |
|----------------------|---|-------------------|---|
| Retirement community | Residential units similar to apartments and condominiums usually restricted to adults or senior citizens, and located in self-contained villages. Special services such as medical, dining, and retail facilities may be available. | Recreational home | Dwellings usually located in a resort containing local services and complete recreational facilities. These are often second homes used by the owner or rented on a seasonal basis. |

TABLE 4.2  
RESIDENTIAL STREET HIERARCHY DEFINITIONS

| <u>Street type</u>                    | <u>Description</u>   | <u>Average daily traffic (maximum)</u> |
|---------------------------------------|--|--|
| Residential Access <sup>‡</sup>       | <p>Lowest order, other than rural street type, of residential streets Provides frontage for access to lots and carries traffic with destination or origin on the street itself. Designed to carry the least amount of traffic at the lowest speed. All, or the maximum number of housing units, shall front on this class of street.</p> <p><sup>†</sup> Residential access streets of “loop” configuration, that is, two ways out, should be designed so no section conveys an ADT greater than 1500. Each half of a loop street may be classified as a single residential access street, but the total traffic volume generated on the loop street should not exceed 1500 ADT, nor should it exceed 750 ADT at any point of traffic concentration.</p> | 1,500 <sup>†</sup>                     |
| Residential Neighborhood <sup>‡</sup> | <p>A type of residential access street conforming to traditional subdivision street design, and providing access to building lots fronting on a street and parking on both sides of street.</p> <p><sup>‡</sup> Applicant may choose either the RESIDENTIAL ACCESS or the RESIDENTIAL NEIGHBORHOOD street type for new streets. See section 4.8(b) for specific right-of-way and cartway width requirements for new streets that are a continuation of an existing street.</p>   |  |
| Minor Collector                       | <p>Middle order of residential street. Provides frontage for access to lots and carries traffic of adjoining residential access streets. Designed to carry somewhat higher traffic volumes than lower-order streets such as rural and residential access streets, with traffic limited to motorists having origin or destination within the immediate neighborhood. Is not intended to carry regional traffic.</p> <p>Each half of a loop-configured minor collector may be classified as a single minor collector street, but the total traffic volume conveyed on the loop should not exceed 3,500 ADT, nor should it exceed 1750 ADT at any point of traffic concentration.</p>   | 3,500                                  |
| Major Collector                       | <p>Highest order of residential streets. Conducts and distributes traffic between lower-order residential streets and higher-order streets—arterials and expressways. Carries the largest volume of traffic at higher speeds. Function is to promote free traffic flow; therefore, parking should be prohibited and direct access to homes from this level of street should be avoided. Collectors should be designed so they cannot be used as shortcuts by non-neighborhood traffic.</p>   | 7,500                                  |
| Special Purpose Streets               |  |  |
| Rural                                 | <p>A rural street is a street that serves dwellings on lots that are one acre or greater, AND primarily serves as access to abutting building lots, AND has no on-street parking, AND has lot-to-street access designed so vehicles do not back out of lots onto the street. Rural streets shall only connect to rural streets, rural residential lanes, or mixed-use collectors. However, a rural street shall not connect two mixed-use collectors.</p>  | 500                                    |
| Rural residential lane                | <p>A rural residential lane is a street that serves dwellings on lots that are two acres or greater, AND primarily serves as access to abutting building lots, AND has no on-street parking, AND has lot-to-street access designed so vehicles do not have to back out of lots onto the street. Rural residential lanes shall only connect to rural streets, rural residential lanes, or mixed-use collectors. However, a rural residential lane shall not connect two mixed-use collectors.</p>   | 200                                    |

| <u>Street type</u>            | <u>Description</u>  | <u>Average daily traffic<br/>(maximum)</u>                        |
|-------------------------------|---|---|
| Alley                         | A service road that provides a secondary means of access to lots. On same level as residential access street, but different standards apply. No parking shall be permitted; alleys should be designed to discourage through traffic. ADT level shall not exceed that of a residential access street.  | 500   |
| Cul-de-sac <sup>1</sup>       | A street with a single means of ingress and egress and having a turnaround, the design of which may vary. A divided-type entrance roadway to at least the first cross street, with median of sufficient width to ensure freedom of continued emergency access by lanes on one side, shall not be considered part of a cul-de-sac. Parking lots with a single means of ingress and egress shall not be included within the definition of cul-de-sac. | 250   |
| Marginal access street        | A service street that runs parallel to a higher-order street and provides access to abutting properties and separation from through traffic. May be designed as residential access street or minor collector, according to anticipated daily traffic.   | 1,500 (residential access total)<br>3,500 (minor collector total) |
| Divided street                | Municipalities may require streets to be divided to provide alternate emergency access, protect the environment, or avoid grade changes. Design standards should be applied to the combined dimensions of the two street segments, as required by the street class.   |   |
| Multifamily access cul-de-sac | A street with a single means of ingress and egress, which serves multifamily development, that provides a means for vehicles to turn around.  | 1,000   |
| Multifamily court             | A street with a single means of ingress and egress, which serves multifamily development, that does not provide a means for vehicles to turn around. The length of multifamily courts is limited to 300 feet.   | Note <sup>2</sup>   |

Notes:

<sup>1</sup> Streets serving multifamily developments with a single means of ingress and egress shall be classified as multifamily access cul-de-sacs.

<sup>2</sup> There is no ADT limit for multifamily courts specified because the length of the court will effectively limit the ADT to acceptable levels.

Administrative correction.  
See: 29 N.J.R. 1296(a).  
Amended by R.1999 d.374, effective November 1, 1999 (operative May 1, 2000).  
See: 31 N.J.R. 477(a), 31 N.J.R. 3259(a).  
In (c), added a second sentence; and in Table 4.2, added a third sentence in the Cul-de-sac Description, and substituted a reference to non-parallel parking for a reference to perpendicular parking in the Parking Loop Description.  
Administrative correction.  
See: 32 N.J.R. 684(b).  
Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).  
See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).  
Rewrote Table 4.1 and in Table 4.2, rewrote the description of "Rural residential lane".  
Amended by R.2002 d.399, effective December 16, 2002.  
See: 34 N.J.R. 2615(a), 34 N.J.R. 4412(a).  
In Table 4.1, inserted "Trip General" preceding "manual" in the second sentence of footnote 1, and added footnote 2; rewrote Table 4.2.  
Public Notice: Notice regarding the Publication of two Notices of Adoption in the December 16, 2002 New Jersey Register.  
See: 34 N.J.R. 4343(a), 4412(a), 35 N.J.R. 219(b).

5:21-4.2 Cartway width

(a) Cartway width for each street classification shall be determined by parking and curbing requirements that are based on intensity of development.

(b) Intensity of development shall be based on dwelling units per gross acre as follows:

| <u>Intensity</u> | <u>Dwelling Units per Gross Acre<sup>†</sup></u>  |
|------------------|---|
| Low              | Less than or equal to 4   |
| Medium           | More than 4 and less than or equal to 8   |
| High             | More than 8   |
| Note:            | <sup>†</sup> In determining the intensity of development, the gross acreage shall not include dedicated common open space or other such areas restricted from future development. |

(c) Cartway widths for each street classification are as shown in Table 4.3 below.

(d) Cartway width also shall consider possible limitations imposed by sight distances, climate, terrain, and maintenance needs.

(e) Municipalities may require additional cartway width for major or minor collectors which are part of a designated bike route as indicated in the bicycle circulation part of the municipal master plan to make them consistent with the AASHTO guidelines for bicycle-compatible streets.

TABLE 4.3  
CARTWAY AND RIGHT-OF-WAY WIDTHS

| Street type <sup>a</sup>            | Total avg. daily traffic                   | Traveled way | No. of parking lanes <sup>b</sup> | Parking lane width | Cartway width        | Curb or shoulder <sup>h</sup> | Sidewalk or graded area <sup>j</sup> | Right-of-way width                      |
|-------------------------------------|--|--------------|-----------------------------------|--------------------|----------------------|-------------------------------|--------------------------------------|---|
| Residential access                  | 1,500 <sup>†</sup><br>(loop—750 each half) |              |                                   |                    |                      |                               |                                      |   |
| a. Parallel parking                 |  |              |                                   |                    |                      |                               |                                      |   |
| Low intensity                       |  | 21 feet      | 1                                 | 7 feet             | 28 feet              | None                          | 1 SW<br>GA                           | 50 feet                                 |
| Medium intensity                    |  | 21 feet      | 1                                 | 7 feet             | 28 feet              | Curb                          | 2 SW                                 | 50 feet                                 |
| High intensity                      |  | 21 feet      | 1                                 | 7 feet             | 28 feet              | Curb                          | 2 SW                                 | 50 feet                                 |
| (on-street parking)                 |  |              |                                   |                    |                      |                               |                                      |   |
| b. Nonparallel parking              |  |              |                                   |                    |                      |                               |                                      |   |
| (all intensities)                   |  |              |                                   |                    |                      |                               |                                      |   |
| One-side parking                    |  | 24 feet      | 1                                 | 18 feet            |                      | Curb                          | 2 SW <sup>n</sup>                    | 54 feet                                 |
| Two-side parking                    |  | 24 feet      | 2                                 | 36 feet            |                      | Curb                          | 2 SW <sup>n</sup>                    | 72 feet                                 |
| c. No parking                       |  |              |                                   |                    |                      |                               |                                      |   |
| High intensity                      |  | 20 feet      | 0                                 | 0 feet             | 20 feet              | None                          | 2 SW                                 | 50 feet                                 |
| (off-street parking)                |  |              |                                   |                    |                      |                               |                                      |   |
| Neighborhood                        | 1,500                                      | 16 feet      | 2                                 | 14 feet            | 30 feet <sup>c</sup> | Curb                          | 2 SW                                 | 50 feet                                 |
| (all intensities)                   |  |              |                                   |                    |                      |                               |                                      |   |
| Minor Collector <sup>l</sup>        | 3,500                                      |              |                                   |                    |                      |                               |                                      |   |
| Low intensity <sup>d</sup>          |  | 20 feet      | 0                                 | 0 feet             | 20 feet              | None                          | 1 SW<br>1 GA                         | 50 feet                                 |
| with no parking                     |  |              |                                   |                    |                      |                               |                                      |   |
| Low with one parking lane           |  | 21 feet      | 1                                 | 7 feet             | 28 feet              | Curb                          | 1 SW<br>1 GA                         | 50 feet                                 |
| Medium and High intensity           |  |              |                                   |                    |                      |                               |                                      |   |
| With one parking lane               |  | 21 feet      | 1                                 | 7 feet             | 28 feet              | Curb                          | 2 SW                                 | 50 feet                                 |
| With two parking lanes              |  | 22 feet      | 2                                 | 14 feet            | 36 feet              | Curb                          | 2 SW                                 | 60 feet                                 |
| With off-street parking             |  | 22 feet      | 0                                 | 0 feet             | 22 feet              | Curb or shoulder              | 2 SW                                 | 50 feet                                 |
| Major Collector <sup>l</sup>        | 7,500                                      |              |                                   |                    |                      |                               |                                      |   |
| Low intensity                       |  | 24 feet      | 0                                 | 0 feet             | 24 feet              | None                          | 2 SW                                 | 50 feet                                 |
| Medium and High                     |  | 24 feet      | 0                                 | 0 feet             | 24 feet              | Curb or shoulder              | 2 SW                                 | 50 feet if curb,<br>54 feet if shoulder |
| Multifamily access                  | 1,000                                      |              |                                   |                    |                      |                               |                                      |   |
| cul-de-sac <sup>m</sup>             |  |              |                                   |                    |                      |                               |                                      |   |
| Multifamily court <sup>o</sup>      | Note <sup>p</sup>                          |              |                                   |                    |                      |                               |                                      |   |
| Special Purpose Streets             |  |              |                                   |                    |                      |                               |                                      |   |
| Rural street <sup>k</sup>           | 500  | 20 feet      | 0                                 | 0 feet             | 20 feet              | None                          | 2 GA                                 | 40 feet                                 |
| Rural lane <sup>k</sup>             | 200  | 18 feet      | 0                                 | 0 feet             | 18 feet              | None                          | 2 GA                                 | 40 feet                                 |
| Alley (one way)                     |  |              |                                   |                    | 9 feet               |                               |                                      | 11 feet                                 |
| Alley (two way)                     |  | 18 feet      | 0                                 | 0 feet             | 18 feet              | None                          | 2 GA                                 | 22 feet                                 |
| Cul-de-sac (stem) <sup>e</sup>      | 250  |              |                                   |                    |                      |                               |                                      |   |
| Marginal access street <sup>f</sup> |  |              |                                   |                    |                      |                               |                                      |   |
| Divided street <sup>g</sup>         |  |              |                                   |                    |                      |                               |                                      |   |

NOTES:  
a See Table 4.2 for definitions of street hierarchy and N.J.A.C. 5:21-4.2 for definitions of low, medium, and high intensity of development.  
b Parking lane refers to parallel parking, except in the case of residential access streets with nonparallel parking, which have perpendicular parking.  
c The 30 foot cartway would accommodate two seven foot parking lanes and a 16 foot traveled way.  
d 20 foot minor collector cartways are permitted only when there is no direct building lot access to or from the street in question.  
e Cartway widths of cul-de-sac stems should conform to the applicable street type. Right-of-ways for cul-de-sac stems shall extend a minimum of eight feet beyond the cartway. Cul-de-sacs shall provide for a cartway turning radius of 40 feet and a right-of-way line eight feet beyond the edge of the cartway.

f Cartway and right-of-way widths of marginal access streets and right-of-way requirements should conform to standards of either residential access or minor collector streets, as dictated by average daily traffic. If the classification is a minor collector requiring a 36 foot cartway, cartway width may be reduced to 28 feet, since frontage is restricted to one side of the street.

g Cartway widths of divided streets should conform to standards of street classification, as dictated by anticipated average daily traffic, and be applied as aggregate dimensions of two street segments. Divided streets shall be provided with cut-throughs at a maximum of 1,200 feet intervals.

h See N.J.A.C. 5:21-4.3(c) for additional requirements.

i Right-of-way width applies only to streets proposed for dedication as shown on approved plans.

j See N.J.A.C. 5:21-4.5(b) for additional requirements.

k Rural streets and rural lanes are permitted only within developments which do not exceed an average daily traffic count of 500 and 200, respectively.

l Municipalities may require additional width for major or minor collectors which are part of a designated bicycle route as indicated in the circulation part of the municipal master plan to make them consistent with the AASHTO guidelines for bicycle-compatible streets

m Cartway widths of multifamily cul-de-sac stems should conform to the applicable residential access street type. Cul-de-sacs shall provide for a cartway turning radius of 40 feet or other suitable means for vehicles to turn around, such as hammerheads. Where not located on private property, a right-of-way line eight feet beyond the edge of the cartway shall be provided.

n Sidewalks provided for streets with nonparallel parking shall be placed in accordance with N.J.A.C. 5:21-4.5(e).

o Cartway and right-of-way widths for multifamily courts shall comply with the design criteria for residential access streets, based on the parking configuration. Multifamily courts need not be provided with a means of turning around; however, their length shall not exceed 300 feet.

p There is no ADT limit for multifamily courts; however, the length of a multifamily court is limited to 300 feet.

#### Administrative correction.

See: 29 N.J.R. 1296(a).

Amended by R.1999 d.374, effective November 1, 1999 (operative May 1, 2000).

See: 31 N.J.R. 477(a), 31 N.J.R. 3259(a).

In Table 4.3, combined Medium and High Intensity Street Types, changed Parking Loop Right-of-Way Widths, rewrote Note e, added "as shown on approved plans" at the end of Note i, and added Note l. Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).

See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).

In (b), substituted "8" for "15" under Dwelling Units per Gross Acre; inserted (e); and in Table 4.3, inserted footnote "m" and all references thereto in the body of the table.

Public Notice: Special area standards.

See: 33 N.J.R. 897(a).

Amended by R.2002 d.399, effective December 16, 2002.

See: 34 N.J.R. 2615(a), 34 N.J.R. 4412(a).

Rewrote Table 4.3.

Public Notice: Notice regarding the Publication of two Notices of Adoption in the December 16, 2002 New Jersey Register.

See: 34 N.J.R. 4343(a), 4412(a), 35 N.J.R. 219(b).

Amended by R.2004 d.35, effective January 20, 2004.

See: 35 N.J.R. 3981(a), 36 N.J.R. 447(a).

Revised Table 4.3.

### 5:21-4.3 Curbs or curbs and gutters

(a) Curbs or curbs and gutters shall be used for drainage purposes, safety, and delineation and protection of pavement edge. Where, based on stormwater management system design, there is determined to be a problem with runoff, curbs or curbs and gutters shall be used.

(b) Curb requirements shall vary according to street hierarchy and intensity of development, in accordance with the requirements set forth in Table 4.3 in N.J.A.C. 5:21-4.2. Generally, curbs shall be required on streets with on-street parking.

(c) Where curbing is not required, edge definition and stabilization shall be furnished for safety reasons, and to prevent pavement unraveling. Curbing may be required for: stormwater management, road stabilization, delineation of parking areas, 10 feet on each side of drainage inlets, intersections, corners, and tight radii.

(d) Curb requirements may be waived by the appropriate municipal approving agency, and shoulders and/or drainage swales used when it can be shown that: shoulders are required by CAFRA; soil and/or topography make the use of shoulders and/or drainage swales preferable; and/or the community desires to preserve its rural character by using shoulders and/or drainage swales instead of curbs. In cases of medium development intensity, the curbing requirement may be waived where front setbacks exceed 40 feet and it can be demonstrated that sufficient on-site parking exists.

(e) A municipality may designate a curb type by ordinance. Where curb type is not established by municipal ordinance, flexibility regarding curb type shall be permitted as long as the curb type accommodates the system of drainage proposed. Generally, curbs should be constructed of concrete or granite block. Curbing materials shall accommodate the purposes set forth in (c) above.

(f) Curbs shall be constructed according to the specifications set forth in N.J.A.C. 5:21-4.17.

(g) Curbing shall be designed to provide a curb ramp in compliance with the Americans with Disabilities Act or the Barrier Free Subcode of the New Jersey Uniform Construction Code (N.J.A.C. 5:23-7) at street intersections, as applicable.

(h) Where curbs and gutters are used and where the street is part of a designated bike route as indicated in the bicycle circulation part of the municipal master plan, the municipality may require that the cartway width be increased by one foot on each side of a street that uses a curb and gutter.

Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).

See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).

Added (h).

### 5:21-4.4 Shoulders

(a) Shoulders should be used instead of curbs when:

1. Shoulders are required by CAFRA;

Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).

See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).

In (c), rewrote 3, inserted last sentence of introductory paragraph to 6, rewrote 6ii(4) and (5), inserted reference to AWWA C909 and inserted last sentence in 8, and rewrote 11v; and amended Figure 6.1.

## SUBCHAPTER 7. STORMWATER MANAGEMENT

### 5:21-7.1 Stormwater management: general system strategy

(a) Stormwater management systems prepared by design engineers shall emphasize a natural, as opposed to an engineered, drainage strategy.

(b) The applicability of a natural approach depends on such factors as site storage capacity, open channel hydraulic capacity, and maintenance needs and resources. N.J.A.C. 5:21-7.6(c)4 references authoritative sources on natural and nonstructural approaches. Applicability of a stormwater approach also can be limited by regulatory constraints that govern certain structures (for example, dams) or areas (for example, development in a floodplain or wetland). (See N.J.A.C. 5:21-7.5(c).)

(c) Where a municipal ordinance requires the control of runoff from a site that is the subject of a site plan or subdivision application, then the runoff shall be estimated in accordance with provisions of this subchapter. Any structures designed to control volume or rate of flow shall be designed and constructed in accordance with these provisions. Where this subchapter does not include provisions for a particular technique or method, then the design and construction shall be in accordance with best management practices listed in N.J.A.C. 5:21-7.6(b)4.

1. All stormwater collection and conveyance structures shall be designed in accordance with the provisions of this subchapter.

(d) Construction practices shall conform to Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90, as administered by the New Jersey Department of Agriculture.

(e) Design engineers shall determine hydraulic capacity for open-channel or closed-conduit flow based on the Manning equation, or charts/monographs based on this equation. The hydraulic capacity is termed  $Q$  and expressed as discharge in cubic feet per second as follows:

$$Q = (1.486/n) AR^{2/3}S^{1/2}$$

where

$n$  = Mannings roughness coefficient

$A$  = Cross-section area of flow in square feet

$R$  = Hydraulic radius in feet,  $R = A/P$  where  $P$  is equal to the wetted perimeter, measured in feet and

defined as the length of a line of contact between the flowing water and the channel.

$S$  = Slope of energy grade line in feet per foot

The manning roughness coefficients used by design engineers appear in Table 7.1 in N.J.A.C. 5:21-7.2.

1. A direct application of Manning's equation may be used for piped storm sewer systems. As an option, design engineers can use a standard step backwater calculation for storm sewer systems if the use of this approach is deemed appropriate by the designer. For other than pipe storm sewer systems, design engineers shall apply Manning's equation only when there is uniform flow, as defined by the following conditions: the bottom slope of the channel, energy grade line, and water surface (hydraulic grade line) are parallel; where the flow regime is in the turbulent range of Reynolds number; and where the boundaries of the cross section of the channel do not move.

(f) Velocities in open channels, excluding water quality swales, at design flow shall not be less than 0.5 of a foot per second and not greater than a velocity that will begin to cause erosion or scouring of the channel. Design engineers shall determine permissible velocities for swales, open channels, and ditches using methods presented in Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90, New Jersey State Soil Conservation Committee, Division of Rural Resources, New Jersey Department of Agriculture, revised to date.

(g) Velocities in closed conduits at design flow shall be at least two feet per second but not more than the velocity that will cause erosion damage to the conduit, as per the manufacturer's specifications. Minimum allowable pipe slopes shall produce velocity of at least three feet per second when the flow depth is full or half of the pipe diameter.

(h) Design engineers shall base culvert capacity on inlet/outlet analysis, as specified in *Hydraulic Design of Highway Culverts*, Hydraulic Design Series (HDS) No. 5, Report No. FHWA-IP-85-15, U.S. Department of Transportation, Federal Highway Administration, September 1985, incorporated here in by reference.

Amended by R.1999 d.374, effective November 1, 1999 (operative May 1, 2000).

See: 31 N.J.R. 477(a), 31 N.J.R. 3259(a).

Inserted a new (c); recodified former (c) through (g) as (d) through (h); in the new (e)1, inserted "there is a uniform flow, as defined by the following conditions:" following "only when" in the last sentence; and in the new (g), substituted a reference to three feet per second for a reference to two feet per second.

Administrative correction.

See: 32 N.J.R. 684(b).

### 5:21-7.2 Runoff estimation techniques

(a) Watershed stormwater management requires the determination of a watershed runoff hydrograph that displays and compares the peak discharge rate and volume. Both

parameters shall compare pre- and post-development conditions. The design engineer shall determine the status of the drainage area. All significant land features such as ponds, depressions, or hedgerows that increase ponding factors shall be considered by the design engineer to compute pre-development runoff. If the design engineer is able to verify that a given hydrologic condition has existed on the site for a period of at least five years prior to the time of computation, then this existing condition may be used by the design engineer to determine runoff coefficients. As an alternative, however, the design engineer should assume the drainage area in the pre-development condition to be in good hydrologic condition (if the lands are pastures, lawns, or parks), to have good cover (if the lands are woods), or to have had conservation treatment (if the lands are cultivated).

(b) Design engineers shall use the runoff hydrograph peak rate to determine the configuration and sizes of pipes, channels, and other routing or flow-control structures. They also shall use runoff volume calculations generated by the hydrograph to determine the size of detention and retention facilities.

(c) For the runoff peak rate of discharge calculation, design engineers shall have the option to choose the methodology to estimate peak rate of discharge. For relatively small drainage areas of up to one-half square mile (320 acres), the peak rate of runoff may be calculated by the Rational Method, its derivatives, or the referenced methods that follow:

1. For areas greater than 320 acres, design engineers shall calculate peak rate of runoff in accordance with the following procedures and methods, incorporated herein by reference.

i. *Urban Hydrology for Small Watersheds, Technical Release No. 55 (TR-55)*, U.S. Department of Agriculture, Soil Conservation Service, Engineering Division, as supplemented or amended to date;

ii. *Computer Program for Project Formulation—Hydrology, Technical Release No. 20 (TR-20)*, U.S. Department of Agriculture, Soil Conservation Service, Engineering Division, as supplemented or amended to date; or

iii. *The New HEC-1 Flood Hydrograph Package, Technical Paper No. 82*, Hydraulic Engineering Center, U.S. Army Corps of Engineers, used in appropriate conditions with appropriate values.

2. The equation for the Rational Method is:

$$Q_p = C I A$$

where

$Q_p$  = the peak runoff rate in cubic feet per second

$C$  = the runoff coefficient

$I$  = the average rainfall intensity in inches per hour occurring at the time of concentration  $t_c$

$t_c$  = time of concentration in minutes

$A$  = the size of the drainage area in acres

i. Typical  $C$  values for 100 year frequency storm events appear in Table 7.2 below. Coefficients for recurrence intervals more frequent than the 100-year storm should be reduced in accordance with Table 7.3 below. Impervious surfaces are not subject to adjustment.

ii. The Rational Method is most accurate when dealing with uniform drainage areas. Design engineers may divide nonuniform drainage areas into "uniform" sub-drainage areas and calculate the runoff from each of these areas separately, or they may use the weighted average technique for a composite drainage area. Design engineers also may use runoff coefficients from the following sources, incorporated herein by reference:

(1) *Design of Roadside Drainage Channels—Hydraulic Design Series No. 4, Report No. FHWA-EPD-86-103*, May 1965, U.S. Department of Transportation, Federal Highway Administration, as supplemented or amended to date; and

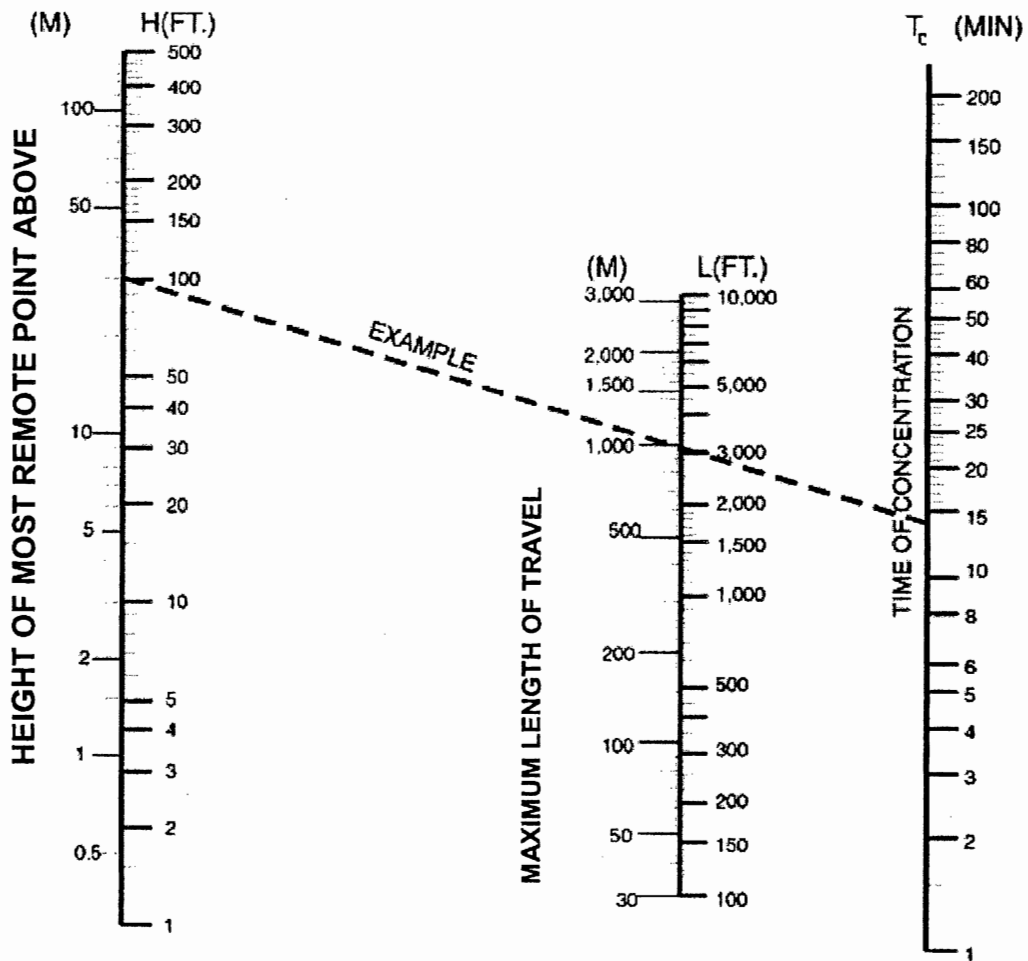
(2) *Airport Drainage, AC<sup>150</sup>/5320-5B*, U.S. Department of Transportation, Federal Aviation Administration, July 1970, as supplemented or amended to date.

3. Design engineers may estimate time of concentration ( $t_c$ ) with Figure 7.1, Time of Concentration nomograph from *Design Manual—Roadway*, New Jersey Department of Transportation, Division of Roadway Design, Bureau of Roadway Design Standards, May 1992, below. Use of this figure is limited to the design of storm sewer systems. For other purposes, design engineers shall use the procedures outlined in Chapter 3 of *Technical Release No. 55, Urban Hydrology for Small Watersheds (TR-55)*, U.S. Department of Agriculture, Soil Conservation Service, Engineering Division, as supplemented or amended to date.

FIGURE 7.1

TIME OF CONCENTRATION

**Example**  
 Height = 100 ft.  
 Length = 3000 ft.  
 Time of Concentration = 14 Min.



**Notes:**

Use Nomograph T<sub>c</sub> for natural basins with well-defined channels, for overland or bare earth, and for mowed grass roadside channels.

For overland flow, grassed surfaces, multiply T<sub>c</sub> by 2.

For overland flow, concrete or asphalt surfaces, multiply T<sub>c</sub> by 0.4.

For concrete channels, multiply T<sub>c</sub> by 0.2.

on a study by P.Z. Kirpich, Civil Engineering, Vol.10, No.6, June 1940, p.362

TABLE 7.1

## MANNING'S ROUGHNESS COEFFICIENTS

| <u>Closed Conduits</u>                       | <u>Smooth</u>  | <u>Normal</u> | <u>Rough</u>   |
|--|----------------|---------------|----------------|
| Cast Iron                                    |                |               |                |
| Coated                                       | 0.010          | 0.013         | 0.014          |
| Uncoated                                     | 0.011          | 0.014         | 0.016          |
| Clay   |                |               |                |
| Vitrified Sewer                              | 0.011          | 0.014         | 0.017          |
| Vitrified sewer with manholes                | 0.013          | 0.015         | 0.017          |
| Common drainage tile                         | 0.011          | 0.013         | 0.017          |
| Concrete                                     |                |               |                |
| Culvert strait and free of debris            | 0.010          | 0.011         | 0.013          |
| Culvert with bends, connections              | 0.011          | 0.013         | 0.014          |
| Finished                                     | 0.011          | 0.012         | 0.014          |
| Sewer with manhole inlets                    | 0.013          | 0.015         | 0.017          |
| Unfinished steel form                        | 0.012          | 0.013         | 0.014          |
| Unfinished smooth wood form                  | 0.012          | 0.014         | 0.016          |
| Unfinished rough wood form                   | 0.015          | 0.017         | 0.020          |
| Metal, Corrugated                            |                |               |                |
| Subdrain                                     | 0.017          | 0.019         | 0.021          |
| Storm drain                                  | 0.021          | 0.024         | 0.030          |
| Polyvinyl Chloride (PVC)                     | 0.010          | 0.010         | 0.010          |
| Polyethylene (PE)                            | 0.008          | 0.009         | 0.011          |
| Steel  |                |               |                |
| Lockbar and welded                           | 0.010          | 0.012         | 0.014          |
| Riveted and spiral                           | 0.013          | 0.016         | 0.017          |
| Wrought Iron                                 |                |               |                |
| Black  | 0.012          | 0.014         | 0.015          |
| Galvanized                                   | 0.013          | 0.016         | 0.017          |
| <u>Lined or Built-up Channels</u>            | <u>Minimum</u> | <u>Normal</u> | <u>Maximum</u> |
| Asphalt                                      |                |               |                |
| Smooth                                       | 0.013          | 0.013         |                |
| Rough  | 0.016          | 0.016         |                |
| Brick  |                |               |                |
| Glazed                                       | 0.011          | 0.013         | 0.015          |
| In cement mortar                             | 0.012          | 0.015         | 0.018          |
| Cement                                       |                |               |                |
| Neat surface                                 | 0.010          | 0.011         | 0.013          |
| Mortar                                       | 0.011          | 0.013         | 0.015          |
| Concrete                                     |                |               |                |
| Trowel finish                                | 0.011          | 0.013         | 0.015          |
| Float finish                                 | 0.013          | 0.015         | 0.016          |
| Finished with gravel on bottom               | 0.015          | 0.017         | 0.020          |
| Unfinished                                   | 0.014          | 0.017         | 0.020          |
| Guniting (good section)                      | 0.016          | 0.019         | 0.023          |
| Guniting (wavy section)                      | 0.018          | 0.022         | 0.025          |
| On good excavated rock                       | 0.017          | 0.020         |                |
| On irregular excavated rock                  | 0.022          | 0.027         |                |
| Concrete Bottom Float Finished with sides of |                |               |                |
| Dressed stone in mortar                      | 0.015          | 0.017         | 0.020          |
| Random stone in mortar                       | 0.017          | 0.020         | 0.024          |
| Cement rubble masonry, plastered             | 0.016          | 0.020         | 0.024          |
| Cement rubble masonry                        | 0.020          | 0.025         | 0.030          |
| Dry rubble or rip rap                        | 0.020          | 0.030         | 0.035          |
| Dressed Ashlar                               | 0.013          | 0.015         | 0.017          |
| Gravel Bottom Sides of                       |                |               |                |
| Formed concrete                              | 0.017          | 0.020         | 0.025          |
| Random stone in mortar                       | 0.020          | 0.023         | 0.026          |
| Dry rubble or rip rap                        | 0.023          | 0.033         | 0.036          |
| Masonry                                      |                |               |                |
| Cement rubble                                | 0.017          | 0.025         | 0.030          |
| Dry rubble                                   | 0.023          | 0.032         | 0.035          |
| Metal, Corrugated                            | 0.021          | 0.025         | 0.030          |
| Steel, Smooth Surface                        |                |               |                |

| <u>Closed Conduits</u>  | <u>Smooth</u>  | <u>Normal</u> | <u>Rough</u>   |
|---|----------------|---------------|----------------|
| Unpainted   | 0.011          | 0.012         | 0.014          |
| Painted   | 0.012          | 0.013         | 0.017          |
| <u>Wood</u>   |                |               |                |
| Planed, untreated   | 0.010          | 0.012         | 0.014          |
| Planed, treated   | 0.011          | 0.012         | 0.015          |
| Unplaned  | 0.011          | 0.013         | 0.015          |
| Plank with battens  | 0.012          | 0.015         | 0.018          |
| Lined with roofing  | 0.010          | 0.014         | 0.017          |
| Vegetal Lining  | 0.030          |               | 0.500          |
| <u>Excavated, Dredged, or Natural Channels</u>  | <u>Minimum</u> | <u>Normal</u> | <u>Maximum</u> |
| <u>Channels Not Maintained and Brush Uncut</u>  |                |               |                |
| Dense weeds, high flow depth  | 0.050          | 0.080         | 0.120          |
| Clean bottom, brush on sides  | 0.040          | 0.050         | 0.080          |
| Same, highest stage of flow   | 0.045          | 0.070         | 0.110          |
| Dense brush, high stage   | 0.080          | 0.100         | 0.140          |
| <u>Drag Line—Excavated or Dredged</u>   |                |               |                |
| No vegetation   | 0.025          | 0.028         | 0.033          |
| Light brush or banks  | 0.035          | 0.050         | 0.060          |
| <u>Earth, Straight and Uniform</u>  |                |               |                |
| Clean, recently completed   | 0.016          | 0.018         | 0.020          |
| Clean, after weathering   | 0.018          | 0.022         | 0.025          |
| Gravel, uniform section, clean  | 0.022          | 0.025         | 0.030          |
| Short grass, few weeds  | 0.022          | 0.027         | 0.033          |
| <u>Earth, Winding and Sluggish</u>  |                |               |                |
| No vegetation   | 0.023          | 0.025         | 0.030          |
| Grass, some weeds   | 0.025          | 0.030         | 0.033          |
| Dense weeds or aquatic plants   | 0.030          | 0.035         | 0.040          |
| Earth bottom and rubble sides   | 0.028          | 0.030         | 0.035          |
| Stony bottom and weedy banks  | 0.025          | 0.035         | 0.040          |
| Cobble bottoms and clean sides  | 0.030          | 0.040         | 0.050          |
| <u>Rock Cuts</u>  |                |               |                |
| Smooth and uniform  | 0.025          | 0.035         | 0.040          |
| Jagged and irregular  | 0.035          | 0.040         | 0.050          |
| <u>Minor Streams (top width at flood stage &lt; 100 ft)</u>   |                |               |                |
| (a) Streams on plain  |                |               |                |
| 1. Clean, straight, full stage, no rifts or deep pools  | 0.025          | 0.030         | 0.033          |
| 2. Same as above, but some stones and weeds   | 0.030          | 0.035         | 0.040          |
| 3. Clean, winding, some pools and shoals  | 0.033          | 0.040         | 0.045          |
| 4. Same as above, but some weeds and stones   | 0.035          | 0.045         | 0.050          |
| 5. Same as above, lower stages, more ineffective slopes and sections  | 0.040          | 0.048         | 0.055          |
| 6. Same as 4, but more stones   | 0.045          | 0.050         | 0.060          |
| 7. Sluggish reaches, weedy, deep pools  | 0.050          | 0.070         | 0.080          |
| 8. Very weedy reaches, deep pools, or floodways with heavy stand of timber and underbrush                                 | 0.075          | 0.100         | 0.150          |
| (b) Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high stages |                |               |                |
| 1. Bottom: gravels, cobbles, and few boulders   | 0.030          | 0.040         | 0.050          |
| 2. Bottom: cobbles with large boulders  | 0.040          | 0.050         | 0.070          |

TABLE 7.2  
 RUNOFF COEFFICIENTS (ANTECEDENT MOISTURE CONDITION) AMCII

| Land Use Description                                 | Hydrologic Soil Group |      |      |      |
|--|-----------------------|------|------|------|
|  | A                     | B    | C    | D    |
| Cultivated land:                                     |                       |      |      |      |
| without conservation treatment                       | 0.49                  | 0.67 | 0.81 | 0.88 |
| with conservation treatment                          | 0.27                  | 0.43 | 0.61 | 0.67 |
| Pasture or range land:                               |                       |      |      |      |
| poor condition                                       | 0.38                  | 0.63 | 0.78 | 0.84 |
| good condition                                       | NA                    | 0.25 | 0.51 | 0.65 |
| Meadow: good condition                               | NA                    | NA   | 0.44 | 0.61 |
| Wood or forest land:                                 |                       |      |      |      |
| thin stand, poor cover, no mulch                     | NA                    | NA   | 0.59 | 0.79 |
| good cover   | NA                    | NA   | 0.45 | 0.59 |
| Open spaces, lawns, parks, golf courses, cemeteries: |                       |      |      |      |
| good condition, grass cover on 75% or more of area   | NA                    | 0.25 | 0.51 | 0.65 |
| fair condition, grass cover on 50-75% of area        | NA                    | 0.45 | 0.63 | 0.74 |
| Commercial and business areas (85% impervious)       | 0.84                  | 0.90 | 0.93 | 0.96 |
| Industrial districts (72% impervious)                | 0.67                  | 0.81 | 0.88 | 0.92 |
| Residential:   |                       |      |      |      |
| Average lot size                                     | Average impervious    |      |      |      |
| 1/8 acre   | 65%                   | 0.59 | 0.76 | 0.86 |
| 1/4 acre   | 38%                   | 0.25 | 0.55 | 0.70 |
| 1/2 acre   | 30%                   | NA   | 0.49 | 0.67 |
| 3/4 acre   | 25%                   | NA   | 0.45 | 0.65 |
| 1 acre   | 20%                   | NA   | 0.41 | 0.63 |
| Paved parking lots, roofs, driveways, etc.           | 0.99                  | 0.99 | 0.99 | 0.99 |
| Streets and roads:                                   |                       |      |      |      |
| paved with curbs and storm sewers                    | 0.99                  | 0.99 | 0.99 | 0.99 |
| gravel   | 0.57                  | 0.76 | 0.84 | 0.88 |
| dirt   | 0.49                  | 0.69 | 0.80 | 0.84 |

Note: NA denotes information is not available; design engineers should rely on another authoritative source.  
 Source: New Jersey Department of Environmental Protection, Technical Manual for Land Use Regulation Program, Bureaus of Inland and Coastal Regulations, Stream Encroachment Permits (Trenton, New Jersey: Department of Environmental Protection, Revised September 1995) p. 12.

TABLE 7.3  
 ADJUSTMENT FACTORS FOR  
 RUNOFF COEFFICIENTS

| Frequency of Event<br>(years) | Runoff Coefficient<br>Adjustment Factor |
|-------------------------------|---|
| 2 to 10                       | 0.80                                    |
| 25                            | 0.88                                    |
| 50                            | 0.96                                    |
| 100                           | 1.00                                    |

Note: These adjustment factors are from a similar table presented on page 3-61 of *Design of Urban Highway Drainage, The State of the Art*, Report No. FHWA-TS-79-225, U.S. Department of Transportation, Federal Highway Administration, Offices of Research and Development, Implementation Division (HDV-21), August 1979. The values in this table are to be used with the Rational formula, where the runoff coefficient is taken from Table 7.2.

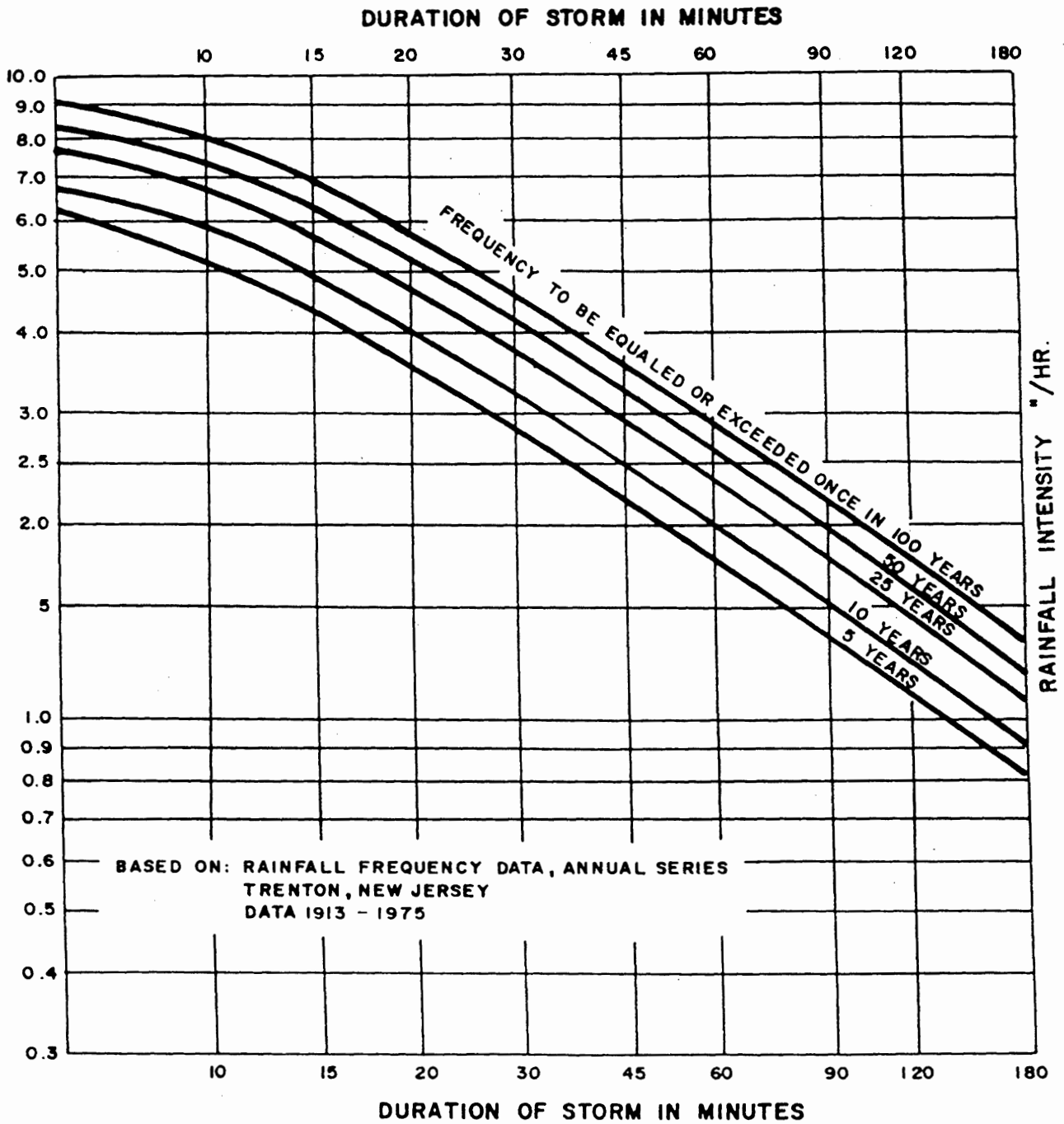
4. When using the Rational Method, rainfall intensity as a function of duration and storm frequency shall be based upon Figure 7.2 Rainfall Intensity Curves below and/or local rainfall frequency data, where available. A copy of Figure 7.2 also appears in the New Jersey Department of Transportation's Design Manual—Roadway, May 1992. Figure 7.2 shows rainfall intensity curves for Trenton, New Jersey. Design engineers may use this information for other parts of the State or they may substitute local rainfall frequency data, when available. In all instances, design engineers shall use a minimum time of concentration of 10 minutes. For storm sewer design, a 10-year to 25-year storm frequency consistent with localized circumstances should be considered as a minimum, unless special circumstances are involved such as inadequate downstream stormwater facilities, lack of positive overland relief, or evidence of local flooding. In such special circumstances, design engineers shall design facilities to accommodate, as a minimum, the following storm frequencies:

i. Ten-year storm for storm drain systems where excess flow can continue downgrade in the street and not exceed the gutter capacity. Also, ten-year storms shall be used at low points in storm drain systems with overland relief.

ii. Twenty-five-year storm where flow in a storm drain is totally carried by pipe when conditions under (c)4i above do not apply.

FIGURE 7.2

RAINFALL INTENSITY CURVES



iii. Twenty-five-year storm for culvert design where the culvert will be located in streams shown as a blue line on the New Jersey State Atlas or the United States Coast and Geodetic Survey maps. Culverts with an upstream drainage area of 50 acres or more shall be designed to accommodate a 100-year frequency storm in accordance with Flood Hazard Area Control Regulations, N.J.A.C. 7:13-2.16.

iv. Twenty-five-year storms for open channels where the upstream drainage area is less than 50 acres. When the upstream drainage area is 50 acres or more, design engineers shall design open channels to accommodate the 100-year storm, in accordance with Flood Hazard Area Control Regulations, N.J.A.C. 7:13-2.16.

5. The size of the drainage area shall include onsite and offsite lands contributing to the design point.

6. Computer software adaptations of the Rational Method or the S.C.S. TR-55 are acceptable, provided their data and graphic printout allow review and evaluation.

(d) Design engineers shall use a consistent method to calculate peak rate of runoff and volume when computing runoff hydrographs. If TR-55, TR-20 or HEC-1 is used to calculate peak rate of runoff, then the same method shall be used to determine volume. If the Rational Method is used for peak flow calculations, the design engineer shall use the Modified Rational Method to calculate peak volume to be used for basin routing. A maximum drainage area of 20 acres shall be used for the Modified Rational Method.

Administrative correction.  
 See: 29 N.J.R. 1296(a).  
 Amended by R.1999 d.374, effective November 1, 1999 (operative May 1, 2000).  
 See: 31 N.J.R. 477(a), 31 N.J.R. 3259(a).  
 In (b), substituted "size" for "necessity for, and sizing" in the second sentence; in (c), added a third sentence in 2i, and inserted new third and fourth sentences in the introductory paragraph of 4; in (d), inserted "when computing runoff hydrographs" at the end of the first sentence; and in Table 7.1, added a reference to Minor Streams.  
 Administrative correction.  
 See: 32 N.J.R. 684(b).  
 Amended by R.2004 d.35, effective January 20, 2004.  
 See: 35 N.J.R. 3981(a), 36 N.J.R. 447(a).  
 In (c)3, amended Figure 7.1.

**5:21-7.3 Runoff collection system design**

(a) Design engineers shall determine pipe size based on design runoff, conduit entrance conditions, and hydraulic capacity.

(b) In general, no pipe size in the storm drainage system shall be less than 15 inches in diameter. Design engineers may use a 12-inch diameter pipe as a cross-drain to a single inlet. Design engineers shall use the Manning equation to determine hydraulic capacity of pipes.

(c) All discharge pipes shall terminate with an appropriate precast concrete or flared-end section or concrete headwall with or without wingwalls, as conditions require. Design engineers shall consider such site conditions as slope, soil stability, vegetation, grade, and size of conduit to determine whether or not to use wingwalls.

(d) Materials used in the construction of storm sewers shall be constructed of reinforced concrete, ductile iron, or corrugated polyethylene, or, when approved by the municipal engineer, corrugated metal. The most cost-effective materials shall be permitted that conform to local site conditions and reflect the relevant operations, maintenance, and system character of the municipal stormwater system. Specifications referred to, such as ASTM or AWWA, shall be the latest revision in effect at the time of application.

1. The following apply to reinforced concrete pipe:
  - i. Circular reinforced concrete pipe and fittings shall meet the requirements of ASTM C76.
  - ii. Elliptical reinforced concrete pipe shall meet the requirements of ASTM C507.
  - iii. Joint design and joint material for circular pipe shall conform to ASTM C443.
  - iv. Joints for elliptical pipe shall be bell and spigot or tongue and groove sealed with butyl, rubber tape, rubber ring gaskets, or external sealing bands conforming to ASTM C877.
  - v. All pipe shall be Class III, minimum unless loading conditions call for stronger pipe (that is, higher class).
  - vi. The minimum depth of cover over the concrete pipe shall be as designated by the American Concrete Pipe Association in Table 7.4 below as follows.

TABLE 7.4  
 MINIMUM DEPTH OF COVERAGE OVER  
 CONCRETE PIPE

| Pipe Diameter<br>(in inches) | ASTM<br>Class Pipe | Minimum Cover<br>(surface to top of<br>pipe in inches) |
|------------------------------|--------------------|--|
| 12                           | III                | 17   |
|                              | IV                 | 12   |
|                              | V                  | 7  |
| 15                           | III                | 16   |
|                              | IV                 | 11   |
|                              | V                  | 7  |
| 18                           | III                | 16   |
|                              | IV                 | 10   |
|                              | V                  | 6  |
| 24                           | III                | 15   |
|                              | IV                 | 6  |
|                              | V                  | 6  |

| Pipe Diameter<br>(in inches) | ASTM<br>Class Pipe | Minimum Cover<br>(surface to top of<br>pipe in inches) |
|------------------------------|--------------------|--|
| 30                           | III                | 10   |
|                              | IV                 | 6  |
|                              | V                  | 6  |
| 36 & above                   | III                | 6  |
|                              | IV                 | 6  |

Minimum depth of coverage as designated by the American Concrete Pipe Association.

vii. Minimum depth of cover standards for ductile iron and corrugated polyethylene pipe shall conform to manufacturer standards.

2. Ductile iron pipe shall conform to ANSI/AWWA C151/A21.51. Joints shall conform to ANSI/AWWA C111/A21.11 or ANSI/AWWA C115/A21.15 as appropriate. Pipe shall be designed in accordance with ANSI/AWWA C150/A21.50. The outside of the pipe shall be coated in accordance with ANSI/AWWA C151/A21.51, and the inside lined in accordance with ANSI/AWWA C104/A21.4. Ductile iron pipe shall be installed in accordance with AWWA C600.

3. Corrugated polyethylene pipe shall conform to AASHTO M252 for three through 10 inches and AASHTO M294 for sizes 12 inches and larger. All pipes greater than 12 inches in diameter shall be Type S, unless conditions dictate otherwise. Materials shall conform to ASTM D3350, "Standard Specification for Polyethylene Plastics Pipe and Fittings Materials." Pipe joints and fittings shall be compatible with the pipe material and shall conform to the same standards and specifications as the pipe material. Pipe couplers shall not cover less than one full corrugation on each section of pipe. Installation shall be in accordance with ASTM D2321, "Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications." Backfill material shall be placed in six-inch lifts and compacted to 95 percent minimum dry density, per AASHTO T99. In areas of high groundwater tables, design engineers shall check for floatation.

4. Corrugated metal pipe, when approved by the municipal engineer, shall meet the requirements and be installed in the manner specified in the subchapter appendix.

(e) Pipe bedding and backfill shall be provided as specified in *Design and Construction of Urban Stormwater Management Systems*, ASCE Manuals and Reports of Engineering Practice No. 77, 1993, incorporated herein by reference. Bedding and backfill for any pipe material not covered by this manual shall be installed in accordance with manufacturer's recommendations. The municipal engineer may require the developer to provide professional certification as to the suitability of backfill material and where such suitability does not exist, any modifications needed to use on-site material and the appropriate methods to install this material. The municipal and/or utility engineer shall rely on this certification.

(f) No pipe shall be placed on private property unless the owner of the land is to own or operate the pipe, or an easement deeded to the municipality is obtained. All easements shall be a minimum of 20-feet wide unless depth of pipe, soil conditions, or additional utilities require wider. Where the easement is located adjacent to a right-of-way, the municipality may approve a narrower easement.

Amended by R.1999 d.374, effective November 1, 1999 (operative May 1, 2000).

See: 31 N.J.R. 477(a), 31 N.J.R. 3259(a).

In (d), inserted a reference to Table 7.4 in 1vi, rewrote 2, and rewrote the first sentence in 3.

Amended by R.2000 d.480, effective December 4, 2000 (operative June 3, 2001).

See: 32 N.J.R. 2670(b), 32 N.J.R. 4277(a).

Rewrote (f).

#### 5:21-7.4 Inlets, catch basins, manholes, and outlets

(a) Design engineers shall design inlets, catch basins, and manholes in accordance with the New Jersey Department of Transportation's *Standard Specifications for Road and Bridge Construction* (1989). Design engineers shall use bicycle-safe grates. For Type A inlets, they should use a frame and single grate. Type B inlets require a frame, grate, and curb-type inlet with back piece. Type E inlets require a frame and double grate.

(b) Inlet spacing depends on the inlet capacity. Maximum gutter line flow is 400 feet. The maximum capacity of a curb inlet shall be six cubic feet per second. Area inlets in parking lots should be limited to three cubic feet per second.

(c) Manholes shall be precast concrete or concrete block coated with two coats of portland cement mortar outside the manhole. Masonry brick may be used to make vertical adjustment to rims, as long as the adjustments are 12 inches or less. In acidic soils, all manholes shall have two coats of black bitumastic waterproofing applied per manufacturer's instruction.

(d) If precast manhole barrels and cones are used, they shall conform to ASTM Specification C478, with round rubber gasketed joints, conforming to ASTM Specification C923. Both ASTM Specifications are incorporated herein by reference. Maximum absorption shall be eight percent in accordance with ASTM Specification C478, method A.

(e) If precast manholes are used, the top riser section shall terminate less than one foot below the finished grade, and the manhole cover shall be flush with the finished grade.

(f) Manhole frames and covers shall be of cast iron, conforming to ASTM Specification A48, Class 30, incorporated herein by reference, and be suitable for H-20 loading capacity. Manhole covers in remote locations may have a locking device.