

SECTION 27 STORM WATER MANAGEMENT SYSTEMS

A. General Criteria

1. All residential development involving more than three lots and all commercial developments are required to provide water quality detention and 2, 10 and 100 year storm peak flow attenuation by means of detention basins in accordance with the requirements of this chapter.
2. All storm drainage systems consisting of catch basins, underground sewers, paved swales, box culverts, rip-wrap or otherwise stabilized stream banks, dams, retention basins, detention basins, swales and other devices shall be installed so that all storm water is led to and continued in natural drainage channels without causing erosion, per the requirements of this chapter.
3. All items mentioned in section 2 (above) are to be approved by the municipal engineer. The municipal engineer reserves the right to revise any assumed design coefficients or run-off curve numbers utilized in the design of the above said items.
4. Design standards and criteria for such storm drainage systems shall be as shown as follows:

<u>Item</u>	<u>Figure Number</u>
Stormwater Manhole	3
Inlet Type B, B-1 and B-2	4
Inlet Type Double B	5
Inlet Type E and A	6
Headwall Detail	7

All proposed inlets are to have grates which are approved bicycle-safe type grates.

5. Any application for major subdivision or site plan approval shall include a stormwater drainage plan as outlined in Section 11.B.1. of this Article.
6. No land area in the municipality shall be developed so that:
  - a. the drainage of adjacent areas is adversely affected;
  - b. soil erosion after development is increased over what naturally occurs there;
  - c. the natural drainage pattern of the area is significantly altered.

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7. As-built drawings of all storm water facilities are required.

B. Detention Basin Design

1. Proposed detention and retention basins are to be located on-site, where possible.
2. Said proposed basins are not to be located within landscape strips or buffer zones.
3. Where it can be demonstrated that at the time of the Approving Authority review such on-site basin location is impractical due to engineering feasibility factors, the Approving Authority may permit such basins to be located off-tract, provided the following requirements are met:
  - a. All the conditions noted in this article are met.
  - b. The location of the basin does not hinder or discourage the appropriate development and use of the property on which it is located or the use of adjacent land and buildings.
  - c. Permanent access or easement to the basin for maintenance purposes shall be provided.
  - d. Utilization of other nearby off-tract basin facilities is not feasible or practicable, as determined by the municipal engineer.
  - e. All off-tract basins are to be provided with cross-easements to allow drainage from the respective subject parcels to drain to the applicable off-tract basins. The 100 year fluvial storm elevation is to be included in the drainage easement.
  - f. Water quality basins must be provided on-site or prior to discharge of natural stream channels or wetlands.
  - g. If subject site stormwater run-off is to be conveyed to an off-tract basin, the stormwater flows for the 10 year storm may not cause erosion to existing stream channels or wetlands enroute to the off-tract basin. Maximum allowable velocities for the said conveyed stormwater will be as determined by the Camden County Soil Conservation District, in consideration of the existing soils, cover type and ground slopes.

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- h. The storm water run-off is to be safely conveyed to the proposed basin within the requirements of Paragraph d.2. ("Storm Water Facilities").
4. Permanent access or easements to proposed basins are to be provided to the municipality for maintenance purposes.
5. Proposed dry detention basins are to be designed to provide adequate drainage of the basin. Minimum basin slope is to be 1%. Basin bottom elevation is to be a minimum of 12 inches above the seasonal high water table elevation. Low-flow channels shall be provided as required by the Camden County Soil Conservation District, NJDEP or the municipal engineer.
6. Basins are to be provided with a 20 foot buffer between residential uses.
7. Proposed wet detention basins or "ponds" are to be provided with a minimum of 4 feet of water depth. Areas adjacent to such basins shall contain protective landscaping (e.g., thorny, decorative shrubs) arranged to restrict access to its edge.
8. Where basins, in general, are to be located in parking lots or areas adjacent to pedestrian or vehicular traffic, dense plantings of shrubs to act as barriers and adequate low-level lighting for safety precautions shall be required.
9. A minimum of one soil boring, including information on ground water and seasonal high ground water table elevation, is to be provided for each proposed basin. The soil boring is to be a minimum of four (4') feet below the proposed basin bottom, whichever is deeper.
10. Storm water detention facilities shall be constantly maintained by the owner to ensure continual functioning of the systems at design capacity and to prevent the health hazards associated with debris buildup and stagnant water. In no case shall water be allowed to remain in any facility long enough to constitute mosquito breeding, disease or any other type of health problem, unless approved as a wet detention basin or pond. A proposed maintenance program is to be submitted.
11. If the land or storm water detention facility or facilities are proposed to be dedicated to the municipality and said dedication is accepted by the municipality, the procedures for the construction, dedication, acceptance and maintenance of such facilities set forth herein, including but not limited to, performance and maintenance bonds, inspections, etc., shall govern.

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12. Proof of the stability of the conditions downstream of proposed basin outfalls is required. Drainage easements must be provided for basin discharge, as necessary. A downstream impact statement is to be provided to demonstrate that there is no adverse effect to any public or private lands.
13. A maintenance bond is to be provided by the applicant for the future removal of silt material from the basin or required maintenance the fifth year of operation of said basin or earlier, as found necessary by the municipal engineer. The maintenance bond is to be posted at the time of posting the maintenance bond for the other constructed improvements.

The amount of the maintenance bond is to be approved by the municipal engineer and is to allow reasonable escalation of construction costs over the projected five years. The form of the bond is to be approved by the city solicitor.

14. The use of retention basins is discouraged. In cases where it is determined that their use is unavoidable, the following criteria are to apply:
  - a. The basin is to meet all the requirements of this Article.
  - b. Basins are to be designed to store the total post-developed run-off from the 100 year storm.
  - c. A minimum of one (1) percolation test result is required for each basin. Calculations are to show that the proposed basin will drain within 4 days.
  - d. A maintenance bond is to be provided by the applicant for future percolation testing and silt removal, if found necessary, at the fifth year of operation or earlier, if found necessary by the municipal engineer. At said time, a renewed maintenance bond is required for an additional five (5) years.
15. Maximum basin side slopes are to be 3H on 1V.

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C. Stormwater Run-off Criteria

1. Water Quality Design

- a. All stormwater run-off from proposed pavement surfaces is to be directed to a water quality basin.
- b. The water quality design storm shall be defined as the one year frequency S.C.S. Type III 24 hour storm or 1/4 inch two hour rainfall.
- c. Provisions shall be made to ensure that the run-off from the water quality design storm is retained in order that not more than 90% will be evacuated prior to 36 hours for all non-residential projects or 18 hours for all residential projects. The retention time shall begin at the time of peak storage in the basin. In either event above, a minimum 3 inch diameter orifice will be allowed.
- d. Water quality basins must be provided, prior to stormwater discharge, to natural stream channels or wetlands.

2. Peak Flow Control Design

- a. All applications shall assume to be non-tidal, unless the applicant presents adequate documentation demonstrating tidal dominance.
- b. If the site does not drain directly to tidal water, the applicant must be able to demonstrate the absence of any impediments in the drainage connection between the point of site discharge and the tidal water, as well as the absence of any adverse flooding effects (i.e., existing structures or land uses which might be adversely affected downstream), if quantitative peak rate concerns are to be set aside.
- c. If quantitative peak rate concerns are to be set aside, the stormwater run-off produced by the 10 year probability, 24 hour, S.C.S. Type III storm must still be shown not to cause any erosion to stream channels or wetlands enroute to the tidal stream. Maximum allowable velocities for the said conveyed stormwater will be as determined by the Camden County Soil Conservation Service District in consideration of the existing soils, cover type and ground slopes.

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- d. If the subject parcel does not drain directly to a tidal stream or meet the requirements of Item b. above, a detention basin must be constructed providing detention of the post-developed run-off resulting from a 2, 10 and 100 year probability, 24 hour S.C.S., Type III storm such that the resulting run-off does not exceed the run-off resulting from a similar storm under pre-developed conditions.
  - e. For purposes of computing run-off all lands in the site shall be assumed, prior to development, to be in good condition.
  - f. An emergency spillway is to be provided at the 100 year basin water elevation and it shall be capable of passing the 100 year storm. The stability of the exposed surface of the emergency spillway and downstream soils is free to be demonstrated. One foot minimum of free board is to be provided above the 100 year storm flow elevation over the emergency spillway.
3. Complete calculations for the basin should be supplied at the time that the preliminary plan is submitted. These calculations shall include: run-off hydrographs prior to development; run-off hydrographs after development; and calculations for sizing the basin and outfall pipe. Additionally, elevation versus storage in the basin is to be provided and routing of the 2, 10 and 100 year storm flows through the basin showing inflow, storage, elevation and outflow per time. The time increment to be a maximum of 0.2 hours.

**D. Storm Water Facilities**

1. Run-off Computations - Computation of the rate of flow at any given location shall be based on the following rational formula:  
Q = C.I.A., in which  
Q = volume in cubic feet per second  
C = runoff coefficient  
For all impervious surfaces (i.e. roofs, walks, parking areas and roads) c = 0.99 For all lawn and grass areas C is to be a minimum of 0.25  
I = Intensity of rainfall in inches/hour per NJDEP rainfall intensity curves.  
A = watershed area in acres

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In setting the value of the run-off coefficient "C", consideration will be given to the physical features of the drainage basin and the best available data on the future density of development of the drainage basin. Calculations shall be submitted justifying the derivation of the weighted run-off factor used for the individual development of the watershed.

2. The intensity of the storm shall be based on the following:
  - a. As a minimum, a 10 year storm shall be used where excess flow can continue downhill in the street without flooding adjoining properties. A 25 year storm is to be utilized to relieve local low points.
  - b. As a minimum, all box culverts shall be based on a 25 year storm with surface relief and 100 year storm without relief.
  - c. Standard headwalls or end sections shall be installed on all pipes.
  - d. Culverts, subject to tidal influences, are to be designed to handle the 100 year storm fluvial flow during the mean daily high tide under open channel flow conditions.
3. **Pipeline Design** - Storm sewer pipe lines shall be designed based on the Manning Equation and the following friction factors:  
 $n = 0.015$  concrete pipe  
 $n = 0.021$  Corrugated metal pipe, 1/2" corrugation, 50% paved

The minimum allowable pipe size is 15 inches. Reinforced concrete pipe shall be used, unless corrugated metal pipe is approved by the municipal engineer in specific cases.

The minimum velocity shall be two (2) feet per second and maximum velocity, within the piping system, shall be ten (10) feet per second. All headwalls or end sections shall be provided with rip-wrap pads and designed in accordance with soil erosion and sediment control standards. Preformed scour holes will not be allowed.

Pipe size changes shall be made at manholes or inlets and pipe crowns shall be matched.

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4. Inlet Design Capacity - Storm water inlets shall be equal to New Jersey State Highway Department inlet type "B". The maximum collecting capacities of the Type B inlet shall be considered as follows:
  - a. When installed on streets where the grade is 0.75% - 5 cubic feet per second (cfs).
  - b. When installed on streets where the grade is 2.00% - 4.8 cfs.
  - c. When installed on streets where the grade is 3.00% - 4.6 cfs.
  - d. When installed on streets where the grade is 4.00% - 4.4 cfs.
  - e. When installed on streets where the grade is 5.00% - 4.2 cfs.
  - f. When installed on streets where the grade is 6.00% - 4.0 cfs.

Sufficient inlets shall be located and constructed so that the length of surface run-off will not contribute a run-off to the inlet exceeding the preceding designated collecting capacities. In no case shall the distance between inlets be greater than four hundred feet (400 ft).

The gutter grate of all inlets shall be set not more than two (2") inches below the gutter grade. The surface of the paving adjacent to the inlets shall be constructed to blend into the lowered gutter grade at the inlet in such a manner that a sudden drop-off or dip at the inlet will not be created. At such locations, where drainage is entirely dependent on inlets, the collecting capacities of the inlets shall be designed for two-thirds (2/3) of the preceding considered capacities.

Where surface water is collected from two (2) directions at one street corner, inlets shall be placed at, or near the tangent points of both ends of the radius. The use of one inlet in the radius shall not be allowed.

Access manholes shall be spaced at four hundred 400 foot intervals (maximum) through rights-of-way and at sewer junctions where there are no inlets.

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5. Open Channel Design - Open ditches or channels will not be permitted when the design capacity requires a fifteen (15) inch pipe or larger unless approved by the municipal engineer. Where permitted open channel design should be based on the following hydraulic considerations:

a. Manning's Equation

n	=	0.014	concrete lined ditch
n	=	0.02 - 0.025	grass lined ditch
n	=	.03 - .15	fair to poor water streams and water courses.

- b. Maximum velocities are per NJ soil erosion and sediment control standards.
- c. Minimum of one free board foot shall be provided on all channels.
- d. The channel should be designed to conform, wherever possible, to the adjacent ground conditions.
- e. Continuous profiles for each reach of open channel shall be plotted, along with the adjacent average ground and the hydraulic information pertinent to each reach within the system. This information shall include the type of channel lining, the "n" factor, the width of the channel bottom, the side slopes, the water depth, the design capacity and the velocity at the design capacity.
- f. Open channels shall have slopes not steeper than three (3H) to one (1V) and shall have adequate slope protection as required by the Soil Erosion & Sediment Control Ordinance and New Jersey State Law.

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E. Grading Criteria

1. All lawn and grass areas are to be graded at a minimum of 2% and directed away from homes and buildings.
2. All proposed buildings and homes are to have finished first floor elevation and grade elevations at the building corners shown on the plans.
3. Maximum slope allowed on all lawn and grass areas is to be 3H on 1V.
4. Drainage easements are required where proposed swales cross adjoining properties.
5. At all roadway local low points, overland relief is to be provided such that not more than six (6") inches of water will pond in the road way.