

# UNIFIED DEVELOPMENT ORDINANCE

*Greenville County, South Carolina*



## Article 14: Stormwater Management

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# ARTICLE 14: STORMWATER MANAGEMENT<sup>1</sup>

## 14.1 GENERAL PROVISIONS

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### 14.1.1 PURPOSE

This Article provides baseline stormwater management requirements for roadway infrastructure and to maintain or improve water quality in the County from all development.

### 14.1.2 APPLICABILITY

- A. This Article applies to all development in unincorporated Greenville County, except where otherwise indicated.
- B. All development must comply with the provisions set forth in the current [Greenville County Stormwater Management Ordinance](#) in addition to the provisions in this Article. In the event of a conflict between the two, the Greenville County Stormwater Management Ordinance supersedes this Article.

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<sup>1</sup> This Article establishes requirements for the use of low impact development techniques to manage stormwater, mitigate heat island effects, and improve the aesthetic quality of development. Implements *Plan Greenville County* Objective D-1, Strategy 5 (“Promote sustainable, low impact development practices including, but not limited to, stormwater management, green infrastructure, maintenance of vegetative cover, stream buffers, purchase of development rights, and conservation set-asides in development plans and the zoning code”); and Objective F-4, Strategy 2 (“Encourage the use of low impact development stormwater solutions.”). The Article cross-references the Stormwater Management and Flood Damage Prevention Ordinances, which will be maintained outside the UDO.

This Article incorporates LDR Section 3.5.6: *Stormwater Management*, LDR Article 17: *Stormwater Management*, LDR Section 8.17.3: *Conveyance System*, and LDR Appendix E: *Low Impact Development Features within the Centers and Corridors*. Proposed is to not carry forward LDR Appendix D: *Water Quality Guidelines for Commercial & Community Facility Parking Lots*, since more widespread use of LID is required and Article 5: *Parking & Loading* already allows for pervious parking areas in certain instances.

Proposed is to eliminate LDR Appendix G: *Density Bonus for Low Impact Development Program (Stormwater Banking Program)*. This program was originally implemented in March 2013. Staff recommends discontinuation of the program since it is complex to administer and has never been used. Further, some of the items that qualify for points under the program are proposed to be required in UDO, and the UDO can achieve the same or similar results through conventional standards.

### 14.1.3 AREAS SUBJECT TO FLOODING<sup>2</sup>

All development must comply with the provisions set forth in the County’s current [Flood Damage Prevention Ordinance](#).

### 14.2 STORMWATER MANAGEMENT DESIGN MANUAL<sup>3</sup>

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- A. Greenville County has established requirements and procedures to control the potential adverse effects of increased stormwater runoff associated with future development.
- B. The County is also required by federal law to obtain a National Pollutant Discharge Elimination System permit from the S.C. Department of Health and Environmental Control (SCDHEC) for stormwater discharges from the Greenville County stormwater system. The NPDES permit requires the County to impose controls to reduce the discharge of pollutants in stormwater to the maximum extent practical using management practices, control techniques, and system design and engineering methods.
- A. Thus, all storm drainage design shall comply with the latest edition of the [Greenville County Stormwater Management Design Manual](#) (SMDM). The design manual can be viewed by accessing the “Design Manual” tab on the Land Development Division’s website.
- C. Refer to [Section 12.8.4.F: Storm Drainage](#) for additional stormwater requirements for public roads.

### 14.3 EASEMENTS FOR STORMWATER FACILITIES

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- A. **Generally.** Stormwater facilities shall be located in common areas or easements, as specified in the [Greenville County Stormwater Management Ordinance](#) and in [Section 15.2: Drainage & Utility Easements](#).
- B. **Conveyance System.**<sup>4</sup>
  - 1. Off-site stormwater that flows through a proposed development must be routed through a designed conveyance system within a designated easement, preferably through a common area.

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<sup>2</sup> Carries forward LDR Section 17.1: *Areas Subject to Flooding* with minor edits.

<sup>3</sup> Carries forward LDR Section 17.2: *Stormwater Design Manual* with minor revisions to formatting.

<sup>4</sup> Carries forward LDR 8.17.3 *Conveyance System* and changes the term “subdivision” in B.1. to “development” for broader applicability.

2. The conveyance system easements are intended to be reciprocal easements and not a dedication to the County.

## 14.4 ROADWAY DRAINAGE SYSTEM DESIGN

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### A. Catch Basin Design.

1. *Generally.* The following methods are acceptable submittals to demonstrate that the catch basin system's design meets the requirements of this Section:
  - (a) Hydraflow Express Extension;
  - (b) Hydraflow Storm Sewers Extensions;
  - (c) Hand Calculations;
  - (d) Table 14.4-1: *Gutter Spread* and Table 14.4-2: *Minimum Curb Transition and Apron Length*, below.
2. *Spread Limits.*
  - (a) The maximum allowable spread in the roadway shall be based on the 2-year design storm and shall be limited to no more than:
    - (1) 8.5 feet of spread for grades from 1% to 3%;
    - (2) 8 feet of spread for grades from 3.1% to 6%;
    - (3) 7.5 feet of spread for grades from 6.1% to 10%; and
    - (4) 7 feet of spread for grades from 10.1% to 15%.
  - (b) Catch basins shall be located along the roadway at sufficient intervals to intercept flows before they exceed the maximum spread limit.
  - (c) Calculations for gutter spread are to be from computer software models if more than 20 joints in a pipe run.
    - (1) The formula to be used is the Manning's formula for gutter spread or USDOT Federal Highway Administration for gutter spread.
    - (2) If gutter spread calculations are not by computer model, show all work to substantiate the calculations.

- (d) Table 14.4-1: *Gutter Spread* is for determining the gutter spread (in feet) for a roadway with 3% cross slope and Miami rolled curb. Gutter flow is for the 2-year design storm.
- (e) At sag locations, the roadway shall have a minimum of 0.5% longitudinal slope within 50 feet of the level point in the sag. For large flows, flanking inlets are recommended on either side of the low point to prevent exceeding the spread limit.

**Table 14.4-1: Gutter Spread**

Gutter Flow	Road Grade														
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
0-2 CFS	6.7	5.9	5.5	5.2	5.0	4.8	4.7	4.5	4.4	4.3	4.3	4.2	4.0	3.9	3.9
3-4 CFS	8.4	7.4	6.8	6.5	6.2	6.0	5.8	5.7	5.6	5.5	5.4	5.3	5.2	5.1	5.0
5-6 CFS	9.7	8.6	8.0	7.5	7.2	7.0	6.8	6.6	6.5	6.3	6.2	6.1	6.0	6.0	5.9
7-8 CFS	--	9.6	8.9	8.4	8.1	7.8	7.6	7.4	7.2	7.1	7.0	6.8	6.7	6.6	6.5
9-10 CFS	--	--	9.6	9.1	8.8	8.5	8.2	8.0	7.9	7.7	7.6	7.4	7.3	7.2	7.1
11-12 CFS	--	--	--	9.8	9.4	9.1	8.8	8.6	8.4	8.2	8.1	8.0	7.8	7.7	7.6
13-14 CFS	--	--	--	--	9.9	9.6	9.3	9.1	8.9	8.7	8.6	8.4	8.3	8.2	8.1
15-16 CFS	--	--	--	--	--	--	--	--	--	9.2	9.0	8.9	8.7	8.6	8.5
17-18 CFS	--	--	--	--	--	--	--	--	--	--	--	--	9.1	9.0	8.9

Key: CFS = cubic feet per second | -- = not applicable

3. *Capture Efficiency.*

- (a) For the 10-year design storm, the capture efficiency for inlets on grade shall be no less than 90%, and the capture efficiency for inlets at sump locations shall be 100%.
- (b) For inlets on grade, the following table may be used for determining the required curb transition and apron length on the upstream side of the catch basin. For steep grades, large flows, or where the required transition is longer than desired, the cross slope of the roadway and depressed curb section may be increased to provide equivalent capture efficiency with a shorter transition.
- (c) Table 14.4-2: *Minimum Curb Transition and Apron Length* is for determining the minimum curb transition and apron length on the upstream side of the catch basin.

- (1) The calculations are for a basin that is open on two sides (front and upstream side), is set back 24 inches from the curb or 30 inches from the curb if a type 9 catch basin is being used with sidewalks, and has 6 inches of fall from the edge of pavement to the throat of the basin.
- (2) The roadway cross slope used for this table is 2%.

**Table 14.4-2: Minimum Curb Transition and Apron Length**

Gutter Flow	Road Grade														
	1%	2%	3%	4%	5%	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
0-2 CFS	5 ft	5 ft	5 ft	5 ft	5 ft	6 ft	6 ft	7 ft	7 ft	7 ft	8 ft	8 ft	8 ft	8 ft	9 ft
3-4 CFS	5 ft	5 ft	6 ft	6 ft	7 ft	8 ft	8 ft	9 ft	9 ft	9 ft	10 ft	10 ft	11 ft	11 ft	12 ft
5-6 CFS	5 ft	6 ft	7 ft	8 ft	9 ft	10 ft	11 ft	11 ft	12 ft	12 ft	13 ft	13 ft	14 ft	14 ft	15 ft
7-8 CFS	6 ft	8 ft	9 ft	10 ft	11 ft	12 ft	13 ft	13 ft	14 ft	14 ft	15 ft	15 ft	16 ft	16 ft	17 ft
9-10 CFS	8 ft	9 ft	10 ft	12 ft	13 ft	14 ft	15 ft	15 ft	16 ft	16 ft	17 ft	17 ft	18 ft	19 ft	19 ft
11-12 CFS	9 ft	10 ft	12 ft	13 ft	14 ft	15 ft	16 ft	17 ft	18 ft	18 f	19 ft	20 ft	20 ft	21 ft	22 ft
13-14 CFS	10 ft	12 ft	13 ft	15 ft	16 ft	17 ft	18 ft	19 ft	19 ft	20 ft	21 ft	22 ft	22 ft	23 ft	24 ft

Key: CFS = cubic feet per second | ft = feet

- (d) At sag locations, the capacity of the catch basin shall be determined using the weir equation unless precast boxes with special inlets are used, which may be designed with the orifice equation.
  - (1) Refer to the [Greenville County Technical Design Manual<sup>5</sup>](#) for details for on the Hood and Grate, Type 9, 16, 17, or 18 catch basins.
  - (2) The minimum curb transition/apron length on either side of the basin shall be 6 feet for catch basins open on three sides.
  - (3) Also ensure compliance with [Section 6.5.1.7 of the SMDM](#).
- (e) Catch basins are not allowed in the radius section at intersections, except where flows are very small, road grades are very flat, or the entire intersection is in a sag.

<sup>5</sup> Rather than maintaining technical design standards in the UDO, proposed is to maintain these standards in an administrative manual or in an appendix to the UDO. The name of this administrative manual or appendix is TBD.

- (f) Within a piped drainage system, an adequate number of manholes or inlets shall be constructed to provide for cleaning and maintenance of the stormwater system.
4. *Weir Opening Height.* For catch basins, the minimum allowable weir opening height is 4 inches and the maximum allowable weir opening height is 6 inches.
5. *Offset Hood and Grate Inlets Within the County's Right-of-Way.* Hood and grate inlets must meet the following conditions, as illustrated in Figure 14.4-1: *Hooded Grate Inlet* and Figure 14.4-2: *Sag Offset Inlet*:<sup>6</sup>
- (a) Hood and grate inlets are only allowed where curb and gutter is proposed. Curb must transition to standard curb and gutter if rolled curb and gutter is proposed along street;
  - (b) Proposed hood and grate inlets must meet all flow requirements of proposed location and drainage area. Multiple frame and grates in series are allowed for sag locations;
  - (c) Frame and grate must be rated for heavy duty AASHTO H-20 loading;
  - (d) Front of frame and grate must be offset from gutter flow line by a minimum of 12 inches. Boxes are not to extend under proposed asphalt;
  - (e) Front edge of frame and grate will be set a minimum of 3 inches below grade of flow line or flume must have a 10% to 14% down slope from flow line;
  - (f) Grate must be suitable for location. Vane grates are required for all grade applications, specialty grates that are ADA compliant or have openings designed to function better in areas where handicapped persons, bicycles, and pedestrians may be present are required if pedestrian traffic is expected;
  - (g) In locations along grade the minimum throat length shall be 6 feet along direction of flow and 3 feet on downhill side. In sag locations, a minimum 6 foot throat is required on each side;
  - (h) Catch basin will be standard precast or 8-inch concrete brick;
  - (i) Catch basin will have a minimum width of 36 inches;
  - (j) All catch basins 4-feet deep or deeper will require manhole steps 12 inches on center. Steps must conform to ASTM-C-478 or equivalent;

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<sup>6</sup> These graphics may be relocated to an appendix or an administrative manual.



- (k) For square or rectangular boxes, the minimum clearance from side walls to outside edge of pipe is 6 inches. Round inlets will be required to be sized properly using standard methods taking into consideration size of pipes, number of pipes, and the angle of entry; and
- (l) All castings shall be American-made to maintain standard sizes.

**Figure 14.4-1: Hooded Grate Inlet**

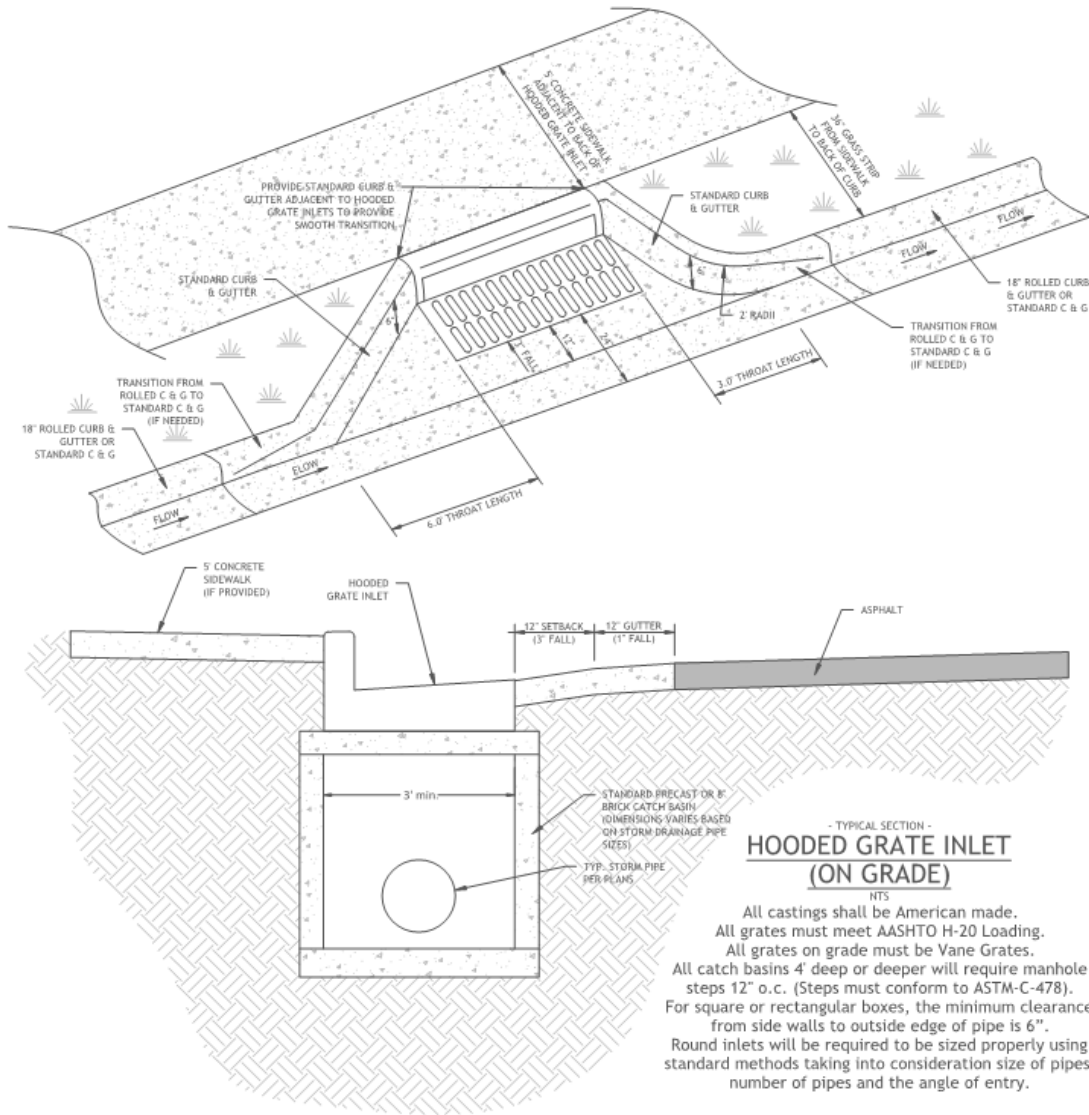
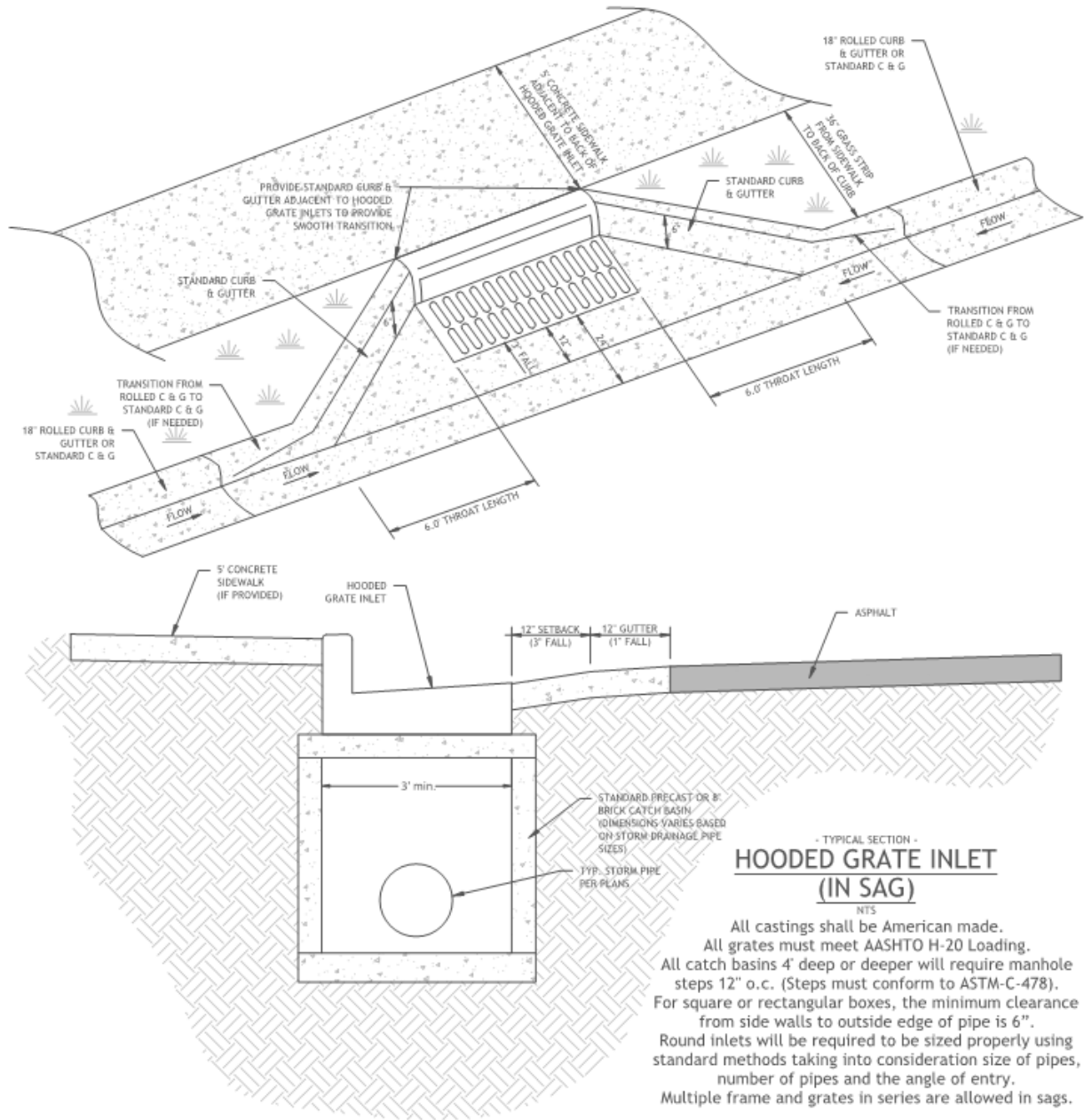


Figure 14.4-2: Sag Offset Inlet



**B. Pipe Design.**

1. The Manning equation shall be used for pipe design, assuming pipe flowing full.
2. The orifice equation shall be used to check the required headwater depths at all catch basins, junction boxes, or pipe inlets along the system to predict and prevent surcharge conditions.

3. Alternatively, a computer model using the Standard Step method or other approved energy-based method may be used to compute the hydraulic profile.
4. For complex systems, the Assistant County Administrator for Public Works may require computation of the hydraulic profile.
5. As a minimum, the Engineer of Record shall submit the following to the Assistant County Administrator for Public Works for review of the proposed system:
  - (a) A drainage map consisting of a topographical map showing the proposed roadways and lots, drainage system with individual structures labeled, and all on-site and/or off-site drainage areas delineated and labeled showing acreages going to each inlet; and
  - (b) Design calculations for piped systems and/or open channels.
6. No pipe less than 15 inches in diameter will be allowed, except for subsurface passive dewatering systems.
7. The pipe layout design should minimize running long sections of pipe diagonally under the pavement.

**C. Outfall Structure Design.**

1. Stabilization is required at the outlet of all outfall pipes.
2. On steep slopes, the last joint of pipe on a plain end outlet shall be a full 8-foot joint.
3. A precast headwall or an approved reinforced concrete headwall is required for all pipe outfalls 36 inches and over.
4. Where a drainage outfall is an appreciable distance above the bottom of a stream or ditch into which it empties, a means to reduce velocity by infiltration or dissipation is required.

**D. Energy Dissipation.**

1. Energy dissipation measures shall be installed at all pipe outlets to prevent downstream channel erosion. Outfall channels shall be designed in accordance with the guidelines in **Sections 6.6 or 8.4.2 of the SMDM**, as applicable, or other approved method.
2. Precast manhole sections may be adapted for use as energy dissipaters at outfalls. The energy dissipater shall be designed so as not to adversely affect the hydraulic capacity of the system.

3. Geotextile protection products may be used in high velocity conditions or where safeguarding of the material is needed. The County may require fabric on steep slopes and/or high velocity conditions.
4. Regenerative Stormwater Conveyances (RSC) are a type of Best Management Practice (BMP) intended to simultaneously convey and treat stormwater runoff, often down a naturally occurring slope.

**E. Roadway Culvert Design.**

1. The design of all roadway culverts shall comply with the requirements of SMDM Chapter 6: *Hydraulics*, or other approved methods.
2. The 25-year average return frequency storm shall be used for the design of all roadway culverts.
3. The permanent impoundment of water on the upstream side of the culvert (i.e., dams) is prohibited.

**F. Open Channel Design.**

1. The design of all open channels shall comply with the requirements of SMDM Chapter 6: *Hydraulics* or other approved methods.
2. Grassed channels shall meet the requirements in SMDM Section 6.6.2: *Vegetated Channel Design*.
3. Where steep slopes, highly erodible soils, or other conditions prevent the proper establishment of grass by seeding and mulching, sod or manufactured erosion control mats may be necessary. Where grassing is required, the work will not be accepted until grass is well established as determined by the Assistant County Administrator for Public Works.
4. For all open channels that cross or border on building lots and where the 1% flow exceeds 50 CFS, the 100-year flood line shall be computed and the lowest floor elevations shall be set at least 4 feet above the base flood elevation.
5. Existing open channels within the development that will carry increased flows as a result of the development may require the installation of proactive stabilization measures to ensure the channel(s) can handle the increased flows without suffering erosion problems.<sup>7</sup>

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<sup>7</sup> Changes the term “subdivision” to “development” for broader applicability.

## LOTS

6. Channels and swales are required when more than two proposed lots concentrate flow to one conveyance point. The swale must meet the requirements outlined in Section 14.4.F.2, above, and [Section 12.8.1.A: Drainage Plan](#).
7. Stormwater from offsite that flows through the proposed development site must also comply with this Section.

## 14.5 STORMWATER MANAGEMENT FOR MINOR SUBDIVISIONS<sup>8</sup>

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### 14.5.1 APPLICABILITY

This Section applies to minor subdivisions, which are subject to the Summary Plat procedure (see [Section 17.4: Summary Plats](#)).

### 14.5.2 STORMWATER POLLUTION PREVENTION PLAN (SWPPP) REQUIRED

- A. Subdividing one parcel (the “parent parcel”) into more than two parcels is considered a part of a larger common plan of development as defined by EPA if, when totally developed, the common plan will result in a cumulative land disturbance totaling one acre or more in area.
- B. The [Greenville County Stormwater Management Ordinance](#) requires stormwater management features if the entire common plan area’s future development’s impervious surfaces result in an increase of one cubic foot per second in runoff from the existing land pervious condition.
- C. Either condition requires the preparation of a SWPPP for the lots created from the parent parcel . Land Development Division staff will review the proposed long term development plans with the subdivider to determine whether a SWPPP is required or whether the Residential LID program will meet the intent of the Clean Water Act.

### 14.5.3 LOW IMPACT DEVELOPMENT BEST MANAGEMENT PRACTICES FOR INDIVIDUAL LOTS

Low impact development best management practices may be used on individual lots in a minor subdivision, as specified in Section 14.6: Low Impact Development Features.

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<sup>8</sup> Carries forward LDR Section 3.5: *Minor Plats*, Subsection 3.5.6: *Stormwater Management* with the following revisions: (1) changes “larger parcel” to “parent parcel;” (2) clarifies the provisions for optional stormwater management procedures; and (3) eliminates the provision allowing 65% of the site to be preserved in a forest or native condition, pursuant to staff input.

**14.5.4 OPTIONAL STORMWATER MANAGEMENT PROCEDURES FOR RESIDENTIAL MINOR SUBDIVISIONS**

- A. **Generally.** When a SWPPP is required pursuant to Subsection 14.5.2: Stormwater Pollution Prevention Plan (SWPPP) Required but the subdivider does not want to provide a SWPPP for the entire parent parcel at the time of recording the Summary Plat, the subdivider may follow one of the two optional procedures specified below.
- B. **Zero Land Disturbance Permit.** When there is no land disturbance associated with the minor subdivision, the subdivider may apply for a Zero Land Disturbance Permit.
  - 1. In this case, the County will place holds on building permits for each of the affected lots until an appropriate Land Disturbance Permit is obtained through the Land Development Division.
  - 2. The subdivider must list this provision on the Summary Plat.
  - 3. As each subdivided lot is sold and the new owner prepares to develop the site, the new owner must apply for a residential lot grading permit or a residential low impact development permit to ensure their proposed development complies with the dispersion requirements.
- C. **Runoff Dispersal.** When there is land disturbance associated with the minor subdivision, the subdivider may disperse runoff into a forested area located on the same lot where the land disturbance occurs, if:
  - 1. The effective impervious surface of the area draining into the forested area is a maximum of 10%; and
  - 2. The minor subdivision maintains ratios proportional to 65% forested conditions and 10% effective impervious area. Examples of such ratios are specified in Table 14.5.4-1: *Example Ratios for Runoff Dispersal Into a Forested Area.*

**Table 14.5.4-1: Example Ratios for Runoff Dispersal Into a Forested Area**

Native Vegetation Preserved (min)	Effective Impervious Area (max)	Lawn/Landscape (max)
65%	10%	35%
60%	9%	40%
55%	8.5%	45%
50%	8%	50% <sup>1</sup>
45%	7%	55% <sup>1</sup>
40%	6%	60% <sup>1</sup>
35%	5.5%	65% <sup>1</sup>

**Table 14.5.4-1: Example Ratios for Runoff Dispersal Into a Forested Area**

Native Vegetation Preserved (min)	Effective Impervious Area (max)	Lawn/Landscape (max)
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**Key:** min = minimum required | max = maximum allowed

<sup>1</sup> Where lawn/landscape areas are established on previous tilled soils and exceed 50% of the total site, these areas should be developed using low impact development (LID) features through the residential LID permit program.

## 14.6 LOW IMPACT DEVELOPMENT FEATURES FOR WATER QUALITY<sup>9</sup>

### 14.6.1 PURPOSE

- A. Low impact development (LID) is used in Greenville County to provide for runoff reduction, infiltration and to manage runoff for improved water quality.
- B. This Section establishes requirements for the use of LID Best Management Practices (BMPs) to:
  - 1. Facilitate the design of drainage systems that are consistent with good engineering practice and design and in accordance with the County’s planning efforts, including stormwater management planning;
  - 2. Minimize the cost of constructing and maintaining engineered stormwater drainage systems by facilitating natural drainage patterns and infiltration of stormwater runoff;
  - 3. Provide a mechanism that allows development with minimum adverse effects to the natural environment.

### 14.6.2 APPLICABILITY

This Section applies to all land disturbing activity, as defined in the current [Greenville County Stormwater Management Ordinance](#), except:

- A. Any development activity expressly exempted by Stormwater Management Ordinance Section 8-57: *Prohibitions and Exemptions*; and

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<sup>9</sup> This Section carries forward portions of LDR Appendix E: *Low Impact Development Features within the Centers and Corridors*. Appendix E was based on the County’s previous Comprehensive Plan, so proposed here is to update the standards and expand their applicability to all development subject to the Greenville County Stormwater Management Ordinance. This Section does not carry forward LDR Appendix E, Section C: *Water Quality Requirements* or Section D: *Water Quantity Requirements* since the Greenville County Stormwater Management Design Manual indicates the appropriate locations for application of the various types of LID BMPs.



- B. Minor subdivisions which may, but are not required to, incorporate LID features.

### 14.6.3 MINIMUM TREATMENT THRESHOLD

- A. LID BMPs are typically used in conjunction with on-site detention. On small sites and in higher density areas, there may be little open area where larger stormwater management features can be placed. The use of LID BMPs is required to ensure developments meet water quality requirements.<sup>10</sup>
- B. All development subject to this Section shall include LID BMPs in the overall stormwater management design to achieve water quality by pollutant of concern reductions. See Chapter 9 of the SMDM.

### 14.6.4 TECHNICAL INFEASIBILITY

An applicant demonstrates technical infeasibility of LID BMPs through a site-specific analysis prepared by a registered professional engineer.

### 14.6.5 LID BEST MANAGEMENT PRACTICES<sup>11</sup>

- A. **Generally.** LID BMPs that may be utilized on a site are limited to those identified in the Greenville County Stormwater Management Design Manual (SMDM).
- B. **Design Standards.** All LID BMPs utilized on a site shall meet the design and construction specifications and details established in the SMDM.
- C. **Applicability of LID BMPs.**<sup>12</sup>
1. The appropriateness of a particular LID BMP depends on a number of factors, including site characteristics, the proposed land use, and the proposed intensity or density of development.
  2. SMDM Appendix F: *Post Construction Water Quality BMP Suggested Uses* identifies appropriate BMPs based on the land area requirement, proposed land use, and

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<sup>10</sup> This Paragraph carries forward portions of LDR Appendix E: *Low Impact Development Features within the Centers and Corridors*, Paragraph A: *Purpose* and revises to require, rather than encourage, the use of LID features.

<sup>11</sup> This Section generally carries forward portions of LDR Appendix E: *Low Impact Development Features within the Centers and Corridors*, Paragraph B: *Low Impact Development Features*.

<sup>12</sup> This Paragraph replaces the table in LDR Appendix E, Section G, *Matrix: Applicability of LIDs* with a cross-reference to a similar (but more recent) table in the Stormwater Management Design Manual.



potential benefits of the BMP. This Appendix shall guide the selection of LID BMPs for a particular development site.

#### 14.6.6 RELATIONSHIP OF LID BMPs TO OTHER GREEN INFRASTRUCTURE

- A. Green infrastructure includes the range of measures that use plant or soil systems, permeable pavement or other permeable surfaces or substrates, stormwater harvest and reuse, or landscaping to store, infiltrate, or evapotranspire stormwater and reduce flows to sewer systems or to surface waters.<sup>13</sup>
- B. Green infrastructure systems include both natural components, such as open spaces and landscaped areas, and engineered components, such as rain gardens and stormwater wetlands. As such, vegetated LID BMPs may be included in required setbacks, buffers, landscape areas, and open space areas as specified below.
- C. If part of an approved stormwater management plan for a proposed development:
  1. Vegetated LID features may be constructed within:
    - (a) Required perimeter buffers; and
    - (b) Required setbacks;
  2. Landscaping used in vegetated LID features may count towards any landscaping required by this UDO; and
  3. Vegetated LID features may count towards required open space, as provided in **Subsection 11.4.4: Amount & Types of Open Space Required**.
- D. In a non-residential, mixed use, or apartment complex development:
  1. To promote multi-functional LID practices and provide incentives for their use, bioretention areas, vegetated swales, planter boxes, rainwater harvesting systems, natural channel design, and other vegetated practices may be used to meet parking area landscaping areas required in this UDO.
  2. These may be constructed in designated landscape areas if part of an approved stormwater management plan.<sup>14</sup>

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<sup>13</sup> This definition of *green infrastructure* is from the Federal Water Pollution Control Act ([33 U.S.C. 1362](#): *Water Pollution Prevention and Control*).

<sup>14</sup> From the U.S. EPA's [Revising Local Codes to Facilitate Low Impact Development](#)

### 14.6.7 RETROFITTING<sup>15</sup>

- A. Retrofitting is a process that involves the modification of existing control structures or conveyance systems, initially designed to safely convey or temporarily store stormwater runoff to minimize flooding.
- B. Redevelopment in areas subject to this Section may require retrofitting existing stormwater control and conveyance systems to meet the current standards for stormwater quantity and water quality. [See the [SMDM](#) and the [Stormwater Management Ordinance](#)]
- C. In areas previously developed and now being retrofitted, installing a new BMP for water quantity and water quality may be required for some existing conveyance systems.

### 14.6.8 LID BMPS WITHIN THE GREENVILLE COUNTY ROAD RIGHT-OF-WAY<sup>16</sup>

- A. **Generally.** LID BMPS may be located in a Greenville County road right-of-way (ROW), if they are part of an approved stormwater management plan for a proposed development.
- B. **Road Design Standards.**
  - 1. All LID BMPS shall comply with the latest edition of the [SMDM](#). In addition, the following standards apply:
    - (a) LID BMPS located within a Greenville County ROW shall not impact the integrity of the road design nor shall they conflict with design criteria of the road requirements;
    - (b) The filling in of a ditch, if that ditch functions as part of a stormwater conveyance system in the ROW, is prohibited; and
    - (c) Retrofitting of existing conveyances systems and installing a new BMP for water quantity and/or water quality may be an option used in areas where the most intensive commercial and highest density residential development is located.
  - 2. For any water quality feature located within the ROW, only runoff from the roadway may be directed into the feature. The Assistant County Administrator for Public Works may make exceptions on a case-by-case basis in areas with intensive commercial and/or medium to high density residential uses.

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<sup>15</sup> This Subsection carries forward LDR Appendix E, Section E: *Retrofitting* with revisions to remove reference to the Centers and Corridors Land Use areas.

<sup>16</sup> This Subsection carries forward LDR Appendix E, Section F: *Allowable LIDs Within the Greenville County ROW* with revisions to replace references to the Center and Corridors Land Use Category, Core Areas, and Transition Areas.

3. All off-site stormwater shall be directed to the storm drain system.
- C. **Allowable LID BMPs.** The following LID BMPs may be used within a Greenville County ROW:<sup>17</sup>
1. *Vegetated Swales.*
    - (a) See SMDM Appendix G: *Post-Construction WQ Specifications and Details*, Technical Specification WQ-19.
    - (b) Vegetated swales:
      - (1) Must meet the minimum design requirement for conveyances, including:
        - (i) Being designed for the 25 year storm; and
        - (ii) Having maximum slope and velocities as outlined in the SMDM.
      - (2) May be used in cul-de-sac center islands and curb extensions if there is adequate space and volume to meet design criteria.
  2. *Pervious Pavement.*
    - (a) See SMDM Appendix G: *Post-Construction WQ Specifications and Details*, Technical Specification WQ-16).
    - (b) Appropriate sub soils must be present; otherwise, underdrains may be necessary.
    - (c) Areas with pervious pavement must be appropriately built to handle pedestrian and automobile traffic (when used in driveways).
  3. *Planter Boxes.*
    - (a) See SMDM Appendix G: *Post-Construction WQ Specifications and Details*, Technical Specification WQ-25.
    - (b) Planter boxes are allowed in the ROW as engineered features to handle road runoff only.
    - (c) Planter boxes may be used in sidewalk areas, curb extensions, and cul-de-sac islands.

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<sup>17</sup> This Paragraph carries forward LDR Appendix E, Section F: *Allowable LIDs Within the Greenville County ROW* with revisions to remove LID BMPs not currently listed in the SMDM (i.e., grass buffers and enhanced grass swales).

- (d) Underdrains should be implemented to ensure that volume in excess of the water quality volume will flow into the storm drain system.

4. *Bioretention Areas.*

- (a) See SMDM Appendix G: *Post-Construction WQ Specifications and Details*, Technical Specification WQ-05.
- (b) Bioretention areas may be used in cul-de-sac center islands, curb extensions, and in the ROW, if there is adequate space and volume for the feature.
- (c) Underdrains should be implemented to ensure that volume in excess of the water quality volume will flow into the storm drain system.

5. *Sand Filters.*

- (a) See SMDM Appendix G: *Post-Construction WQ Specifications and Details*, Technical Specification WQ-06.
- (b) Sand filters may be used in cul-de-sac center islands, curb extensions, and in the ROW, if there is adequate space and volume for the sand filter.

**D. Maintenance of LID Features Within a County ROW.**

1. The property owners (individuals, HOAs, or POAs) who directly benefit from the LID BMP are responsible for maintenance, operation, and repair of all of LID BMPs, other than pervious sidewalk, located in a County ROW.
2. The use of LID BMPs within the Greenville County public ROW requires a maintenance agreement and a hold harmless clause.
  - (a) The purpose of these agreements is to clarify the maintenance responsibilities for certain elements of the public ROW lie with private property owner(s) (individual, HOA, or POA).
  - (b) Approved maintenance agreements become part of the property deed recorded with the Greenville County Register of Deeds Office. The as-built (or record) drawings must be included in the agreement.
3. Maintenance of LID BMPs is critical to the successful functioning of these types of systems and will be included as a project permit condition.
  - (a) Maintenance requirements depend on the LID BMP chosen, but may include on-going sweeping, debris removal, and landscape maintenance.

- (b) Maintenance requirements are described in the specifications for each type of BMP in the [SMDM](#).

**E. Stormwater Concept Plan for features Within a County ROW**

1. The applicant shall present the Stormwater Concept During the preliminary plan Pre-Design meeting (PSM).
2. The purpose of the Stormwater Concept Plan Process is to discuss possible site constraints, existing drainage problem areas, transportation needs, soil conditions, design and accessibility, and maintenance responsibilities.
3. This Concept Plan should focus on the proposed layout and LID features and BMPs for during- and post-construction applications that are unique and require a non-standard approach.
4. Once County staff has agreed to the concept presented, the applicant may proceed to develop the preliminary plan that incorporates the agreed upon concepts.

**14.6.9 MAINTENANCE OF LID FEATURES**

Low impact development features are subject to the ongoing inspection and maintenance requirements specified in the [Greenville County Stormwater Management Ordinance](#), Division 6: *On-Going Inspection and Maintenance of Stormwater Facilities and Practices*.