Chapter 3 – Stormwater Compliance Principles

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3.1 Introduction

The following sections provide detailed design methodology, supporting data, and further guidance on complying with Wake County stormwater design requirements.

3.2 Target Curve Number

Important Notes:

1. Minor and Minor-Limited Residential Subdivisions may elect to limit the proposed subdivision's impervious surfaces to a maximum of 15% in lieu of showing compliance with target curve number requirements. All other applicable stormwater regulations would still apply. Reference UDO 9-12-2.

2. Commercial development projects are not required to show compliance with target curve number requirements. Reference UDO 9-20.

3.2.1 Concept

Wake County UDO Section 9-20 requires that developers must manage residential runoff for post-development to ensure the site will not exceed the designated curve numbers, in accordance with procedures specified in the *United States Department of Agriculture, Natural Resource Conservation Service, Technical Release 55, Urban Hydrology for Small Watersheds* (TR-55). The target curve numbers (TCNs) are provided in Table 3.1 below. If the proposed development does not meet the "target" curve number, then the difference in runoff volume for 3 inches of precipitation between the target curve number and the proposed development curve number must be retained and infiltrated or stored and drawn down over a period of 2 to 5 days.

The Wake County Hybrid Design Tool is required to be submitted for all residential development subject to this requirement. Engineers using the module will input land uses and hydrologic soil groups (HSGs) by drainage area, and the module calculates the target curve number and post development curve number for the site as a whole. The difference between the two numbers translates to a volume that must be detained for the site. The Wake County Hybrid Tool calculates and flags the volume that is the developer's responsibility to detain. The Wake County Hybrid Design Tool is required for TCN calculations and the NCDEQ SNAP Tool is required for Jordan and Falls Lake submittals.

Table 3.1 Wake County Target Curve Numbers

Zoning District	Maximum Composite Curve Number by Soil Group			
	A	B	C	D
R-80W and R-80	37	60	73	79
R-40W and R-40	41	62	75	80
R-30, R-20, R-15, R-10, R-5, Residential Highway, General Business and Office and Institutional	43	63	76	81

The Curve Number (CN) concept was developed by the Soil Conservation Service to estimate runoff volume for specific rainfall events. Curve number values are whole numbers ranging from 30 to 98 – lower values correspond to smaller runoff volumes and higher values correspond to larger runoff volumes. CN is determined using two factors: hydrologic soil group (HSG) and land use.

Soil classifications are divided into four hydrologic soil groups (A, B, C, and D) according to their minimum infiltration rate. Soils that are HSG “A” soils are those which have high infiltration capacity and subsequently low runoff rates. HSG “D” soils are those with very low infiltration capacity and very high runoff rates. The hydrologic soil groups for the soil classifications found in Wake County are listed in Table A-1 In Appendix A.

Land use is the second contributor to determining a curve number. The curve number for wooded area is lower and therefore corresponds to a smaller runoff volume than impervious surface which has a higher curve number. Curve number values for proposed development conditions in Wake County in all four hydrologic soil groups are provided in Table A-2 in Appendix A.

3.2.2 Design Methodology

A composite curve number (CN) is calculated to represent the hydrologic characteristics of the site as a whole. To calculate a composite curve number, the soil types, proposed land uses, and the proposed acreage of each should be known. The land use types listed in Table A-2 are representative of most developments in Wake County. The Wake County Module calculates the CN, TCN and required volume storage for the site. The below examples demonstrate the calculations used in the Module.

Example 3.a Composite Curve Number

The proposed R-40 development is a 10-acre site with the below land uses. Using Table A-2, the curve number can be determined for each area of land use.

Proposed land uses:
Woods, HSG B (CN = 55) = 4 acres
Managed Pervious (Open Space), HSG B (CN = 61) = 1.5 acres
Managed Pervious (Open Space), HSG C (CN = 74) = 2 acres
Roof, HSG B (CN = 98) = 1.5 acres
Roadway, HSG C (CN=98) = 0.5 acres
Grassed ROWs, HSG C (CN=80) = 0.5 acres

Solution:
Multiply the acreage by the curve number and sum the products.
55 * 4 acres = 220
61 * 1.5 acres = 91.5
74 * 2 acres = 148
98 * 1.5 acres = 147
98 * 0.5 acres = 49
80 * 0.5 acres = 40
220 + 91.5 + 148 + 147 + 49 + 40 = 695.5
Divide the sum by the total site acreage to determine the composite curve number.
695.5 / (10 acres) = 69.55
A curve number must be a whole number – therefore the composite curve number is 70.

Based on Table 3.1, this site would have also have a TCN of **66**:
Solution:
*Multiply the HSG acreages by the **Maximum Composite Curve Number by Soil Group**, sum the products, and divide by the total site acreage.*
B Soils = 7 acres => 7*62 = 434
C soils = 3 acres => 3*75 = 225
(434+225) = **65.9**
10
The proposed development CN of 70 is greater than the TCN of 66.

TCN Volume Requirement - SCS Runoff Method

In cases where the proposed development composite CN is higher than the TCN for the site, the additional volume of runoff must be stored. Runoff volumes shall be calculated using the SCS runoff equation as follows:

Q* = Runoff depth (in)
P = Rainfall depth (in)
S = Potential maximum retention after rainfall begins (in)

$$\mathbf{Q= (P-.2S)^2/(P+.8S)}$$
$$\mathbf{S= (1000/CN)-10}$$

Example 3.b Determination of Runoff Volume

In **Example 3.a**, the proposed CN for the site was determined to be 70 and the TCN was determined to be 66. Using the proposed and target curve numbers –determine the volume to be stored on this site. This will be done by calculating the runoff in inches for each curve number and then multiplying the difference between the two runoff values by the acreage of the site.

Runoff for Proposed CN:
Determine the value of S first. Divide 1000 by the composite curve number and subtract 10.
S = (1000 / CN) – 10
S = (1000 / 70) – 10 = 4.29 inches

Now calculate the runoff by using the SCS runoff equation. Per the Wake County rules, P = 3 inches.
$Q^* = (P – 0.2S)^2 / (P + 0.8S)$
$Q^* = (3 – (0.2*4.29))^2 / (3 + (0.8*4.29)) = (2.14)\ 2 / (6.43) = 4.45 / 6.43$
$Q^*_{Proposed}$ = 0.71 inches

Runoff for TCN:
S = (1000 / CN) – 10
S = (1000 / 66) – 10 = 5.15 inches

$Q^* = (P – 0.2S)^2 / (P + 0.8S)$
$Q^* = (3 – (0.2*5.15))^2 / (3 + (0.8*5.15)) = (3 – (0.99))\ 2 / (3 + (3.94)) = (2.01)\ 2 / (6.94) = 4.04 / 6.94$
Q^*_{Target} = 0.55 inches

Runoff Volume to be Stored:
Subtract the runoff produced by TCN by the runoff produced by the proposed CN to determine the runoff in inches that exceeds the allowed amount.
$Q^*_{Proposed} – Q^*_{Target} = 0.71 – 0.55 = 0.16$ inches
Convert the runoff to a volume
0.16 inches * (1/12) feet/inches = 0.01 feet
Multiply the site acreage by the runoff to determine the volume required to be stored.
10 acres * 0.01 feet = 0.10 acre-feet

Convert volume to cubic feet.
0.10 acre-feet * 43,560 square feet = 4,356 cubic feet

Therefore, the volume required to be stored by the Wake County Stormwater Ordinance is 4,356 cubic feet.

Note: The total volume required is for the site and can be spread across multiple drainage areas.

3.2.3 Stormwater Crediting

Land use practices involve stormwater management strategies to reduce the volume of runoff without the use of structural controls. Practices such as wooded area preservation and disconnected impervious area increase opportunities for infiltration and stormwater runoff absorption. Land use practices help to decrease the proposed curve number of a site therefore reducing hydrological impacts, as well as achieving additional environmental benefits.

3.2.3.1 Preservation of Wooded Areas and Reforestation

The preservation of wooded areas or creation of woods by reforestation is an important management tool to lower the proposed curve number of a site. Wooded areas are assigned a lower curve number than any other land use (See Table A-2). Therefore, when determining a composite curve number for a proposed site, increasing the area of woods decreases the proposed curve number. Preserving existing wooded areas is recommended over creation of woods by reforestation. Effort should be made to maintain existing woods in a proposed subdivision.

3.2.3.2 General Design Criteria

In order for a wooded area to be considered as "woods" in the calculation of the proposed site curve number, it must be designated as preserved woods or reforested area, a Neuse River Riparian Buffer (Zone 1) or Wake County Water Supply Watershed Buffer. This concept is consistent with the NCDEQ SNAP Tool designation of "*protected forest*", and the area designated as such should match in the Wake County Hybrid Design Tool and the NCDEQ SNAP Tool.

Protected Forest

A protected forest any wooded/forested area that is neither periodically/regularly mowed nor fertilized, is not managed according to a deferment for use value under forestry or a forest management plan, and where understory and groundcover are allowed to develop. Such areas tend to have minimal use (such as pervious-surface trails) and little management other than control of invasive species and disease. These areas are protected by covenants, easements, or other regulations that prevent their conversion to other pervious uses. This includes forests with conservation easements, Riparian Buffer Zone 1, forested riparian zones protected by other regulations, and protected wetlands.

The areas claimed as "woods" or "protected forest" on the lots must be designated by a boundary on the construction plan and recorded plat. This is required so that the developer, builder, and homeowner are all aware of the area that cannot be disturbed and must remain forested. This boundary may be moved by the builder or homeowner provided that an equivalent area of existing woods or reforested area is provided, and the plat is modified and recorded to reflect the new boundary.

3.2.3.3 Reforestation Design Criteria

In areas that are not naturally wooded, the creation of wooded areas by reforestation is allowed. The reforested area counts as "woods" in the proposed curve number calculation. Areas that are reforested must be planted with trees and/or shrubs and mulched properly as specified in the following standards.

Tree/shrub Density and Spacing

Planted trees or shrubs must meet the minimum density and spacing standards of the Natural Resources Conservation Service. Existing trees or shrubs may be used towards meeting the planting standard. Standards regarding seedling quality and planting instructions and considerations are included in the Field Office Technical Guide, Standard 612 published by the Natural Resources Conservation Service.

Mulching

An initial application of mulch is required for the area designated for reforestation. Existing groundcover may be used towards meeting the mulching standard. The site should be prepared and mulch spread and anchored per the standards included in the Field Office Technical Guide, Standard 484 published by the Natural Resources Conservation Service.

In addition, the reforested area must also meet the definition of "protected forest" from NCDEQ's SNAP Tool as described in the section above to qualify for this credit.

3.2.3.4 Disconnected Impervious

> Important Note:
>
> Information from the section below is intended for use in the Wake County Target Curve Number module only. For these calculations, the disconnected impervious surface (DIS) is NOT considered a stormwater control measure when the credit taken is 50% or less. To receive additional disconnected credit, the designer must comply with all NCDEQ Minimum Design Criteria and additional County SCM requirements (refer to Chapter 5 of this manual). Disconnected impervious surface as a SCM is considered a secondary device and cannot be used within a "shared" stormwater management plan, such as a regular subdivision as a stand alone measure

Disconnected impervious is a term used to describe runoff from an impervious area that has been directed over a pervious surface, such as lawn or woods, as sheet flow to allow infiltration. Connected impervious describes an impervious area in which the runoff is directed on to another impervious surface, a pipe, or a channel without an opportunity for infiltration or absorption. TR-55 recognizes that disconnected impervious areas produce less runoff than connected impervious area when the total impervious area is less than 30 percent. Once over 30 percent impervious, the absorptive capacity of the remaining pervious areas will not significantly affect runoff. TR-55 gives credit for this practice by reducing the composite curve number and provides an equation to determine the composite curve number when using disconnected impervious:

$$CN_{adjusted} = CN_p + [(P_{imp}/100)*(98-CN_p)*(1-(0.5*R))]$$

Where:

$CN_{adjusted}$ = Composite Curve Number
CN_p = Pervious runoff curve number
P_{imp} = Percent Imperviousness % (expressed as whole number)
R = ratio of unconnected impervious area to total impervious area (decimal)

This equation reduces the curve number by counting half of the disconnected impervious area as pervious. Therefore, if considering the effects on a single lot in which the entire roof was disconnected impervious, half of the roof would be assigned a curve number of 98 and half of the roof would be assigned the curve number for the pervious portion of the lot.

Each subdivision has a maximum allowable assumption of disconnected impervious for the whole site based on zoning as shown in Table 3.2. The maximum assumption is the percent of the total impervious surface of the site that is considered disconnected.

Table 3.2 Maximum Allowable Assumption of Disconnected Impervious Surface

Zoning District	Maximum Assumption of Disconnection without Designation
R-80W, R-80, R-40W, R40, R-30	50%
R-20, R-15, R-10, R-5, Residential Highway, General Business and Office and Institutional	25%

If this maximum allowable assumption is exceeded, disconnected impervious surface will be considered an SCM and details must be provided showing that each impervious surface that is considered disconnected meets the design criteria as described below. Stormwater and Maintenance Agreements will be required.

Rooftop Disconnection Design Criteria:

- No more than 500 square feet of roof area should contribute to one downspout.
- Downspout must be installed with a splash block or equivalent length and width of gravel to establish sheet flow.
- From downspout, a minimum of 50 feet should be provided in the direction of flow across a vegetated surface before intercepted by a grassed channel, pipe, or another impervious surface.

Non-Rooftop Disconnection Design Criteria:

- Maximum length of flow across the impervious surface is 75 feet.
- A flow length across a vegetated surface should be provided that is equal to or greater than the flow path across the contributing impervious surface.
- The maximum slope for the vegetated surface is 5%.
- Pervious pavers are automatically disconnected and do not need to meet the additional criteria above.

3.3 Nutrient Loading

Important Note:

Wake County currently applies the Neuse Stormwater Rules for nutrient loading County-wide, except in those areas subject to Falls Lake Stormwater Rules. Once the Jordan Lake Rules for new development are no longer legislatively delayed, they will be applicable within the Jordan Lake watershed.

3.3.1 Nutrient Loading Targets

Nutrient loading requirements and targets vary depending on the project location within Wake County's jurisdiction.

Table 3.3 Current Nutrient Targets (2023) for Nitrogen and Phosphorous

Nutrient Strategy Area	Nutrient Reduction Target	Thresholds (future)
Neuse and Cape Fear River Basins	3.6 N lb/ac/yr & No P target	Low density (≤ 24% Cumulative Impervious): Projects may meet nutrient rate targets entirely by nutrient offsets (no SCMs required), but must also meet low density stormwater requirements of 02H .1003 High density (> 24% Cumulative Impervious): onsite SCMs required to treat for all cumulative impervious if the project density, and meet other low-density, high-density and other stormwater requirements of DEMLR's 02H .1003 Projects meeting the definition of runoff volume match do not need to address nutrient export further
Jordan Lake Watershed Upper New Hope Lower New Hope Haw River	3.6 N lb/ac/yr & No P target (Neuse requirements must be met while Jordan Lake Rules are delayed)	
Falls Lake Watershed	2.2 N lb/ac/yr & 0.33 P lb/ac/yr	30% of N & P reduction must be provided onsite for projects less than one acre or expansions; 50% of N & P reduction must be provided onsite for projects disturbing one acre or more

Projects within the Cape Fear River basin (including Jordan Lake) will need to plan to treat down to the targets listed above, as there will likely not be mitigation credits available for purchase in this area.

3.3.2 Nutrient Loading Calculations

Applicants shall submit nutrient loading calculations using the current version of the NCDEQ SNAP (Stormwater Nitrogen and Phosphorus) tool or the Wake County Hybrid Design Tool. The SNAP Tool, user manual, and additional guidance may be found on NCDEQ's website. In local jurisdictions (such as Wake County) where older Neuse or Tar-Pamlico Stormwater Rules are still in effect, developers should continue to use the calculation method laid out in the Neuse Model Program.

3.3.2.1 SNAP Tool Guidance for Wake County

In addition to the general NCDEQ guidance for the SNAP Tool, the following specific information is provided for Falls Lake submittals. If a field or worksheet is not directly referenced below, that does not imply that it is not required to be completed. The information provided here is intended to give guidance on certain specific expectations for completion of the SNAP tool.

SNAP Project Info Worksheet (Required)

- Project Name: Should match Part A-1 of Financial Responsibility/Ownership Form
- Parcel ID: Complete with all PINs
- Project Latitude/Longitude: Provide in decimal degrees
- Nitrogen Delivery Zone: If your project is in the Cape Fear River Basin, enter xxxx
- Local govt cutoff date for Existing BUA: Enter xx/xx/2024 (Neuse/Cape Fear); xx/xx/xxxx (Falls Lake)
- Nitrogen Export Rate Target: Should be 3.6 lb/ac/yr for all locations other than Falls Lake; Should be 2.2 lb/ac/yr for Falls Lake
- Phosphorous Export Rate Target: Should be blank for all locations other than Falls Lake; should be 0.33 lb/ac/yr for Falls Lake

SNAP Land Cover Characteristics Worksheet

- Precipitation Station: Should be "Raleigh", "Neuse", or "Zebulon", depending on the closest location to your project. Refer to the map linked in this worksheet.
- The category of "Roof" shall be used for any impervious surface elevated above the surrounding ground. For example, the roof of a home, or the roof of an accessory structure like a garage or shed.
- The category of "Roadway" shall be used for any public or private road surface (not including a personal or shared driveway).
- The category of "Parking/Driveway/Sidewalk" shall be used for impervious surfaces at ground level and miscellaneous uses. These would include parking pads, driveways, sidewalks, graveled areas, patios, retaining walls, and HVAC pads. Note that permeable pavement designed as an SCM for infiltration will be entered under "Land Taken Up By SCM" in the SNAP Tool.
- The category of "Protected Forest" may be used for the following:
  - Zone 1 of the Neuse Riparian Buffer
  - Areas designated as preserved woods or reforested area on both the construction drawings and recorded plat
  - May be used for Wake County Water Supply Watershed Buffers and Tree & Vegetation Protection Zones, but labeled separately

- The category of "Managed Pervious/Landscaping shall be used for all pervious area that is not designated as Protected Forest".
- Pools and open water (ponds, lakes, etc.) shall be entered as a Custom Land Cover with values of Impervious – 0, TN EMC (mg/L) = 1.18, TP EMC (mg/L) = 0.11.

SNAP SCM Characteristics Worksheet

- The "Hydrologic soil group (HSG) at SCM location" shall be the HSG specifically at the location of the SCM – not the overall HSG of the site. If the SCM is located between two HSGs, then the one with the lower infiltration rate shall be used.
- The "SCM description" should be the name of the SCM and should match the submitted plans and Stormwater Impact Analysis (SIA) for the project. For example, "Dry Pond #1".
- The "Design Storm Size (inches/24 hours)" shall be 1 inch for the purposes of the SNAP tool's nutrient calculations. Note that the SCM may also be required to comply with the County's Target Curve Number Requirements, and the Wake County Target Curve Number Module will be used for that calculation.
- The "Percent of Full Size" field should be 100% for any SCM being used for regulatory compliance with State Stormwater Rules.

3.3.2.2 Nutrient Loading Calculation Guidance for the Neuse Stormwater Rule

Detailed guidance on the use of the SNAP Tool may be found on the NCDEQ website here and above. The following overview is intended as general guidance on concepts for the calculations subject to the Neuse Stormwater Rule. Additional information may be found in Appendix B of the Neuse and Tar-Pamlico Local Program Development Guide. In cases where there may be conflict in terms or requirements between NCDEQ and Wake County, the more stringent shall apply. Impervious surface is defined in UDO 21-11. Note that the terms impervious and built upon area (BUA) are used interchangeably below.

Existing Impervious (AKA "existing development"): Impervious built/vested prior to xx/xx/2024. To qualify as existing impervious, any built impervious must have been properly approved and permitted under the applicable stormwater regulations at the time it was installed (or met an available exemption). **Note: Impervious/BUA is considered "still present" if demolished but still remains impermeable (such as reduced to a gravel parking area). Impervious can be permanently removed in one area and replaced in another area for no net change in impervious. Impervious is permanently removed from the total area of Existing Impervious if demolished/removed and followed up with planting, seeding and strawing, or other work to restore rain infiltration, such as deep soil ripping.*

New Impervious: New impervious/BUA the applicant is seeking a permit to install. This can include replacement of Existing Impervious. This area is part of the total Disturbed Area.

Net Increase Impervious: New Impervious minus any impervious that is demolished and replaced with impervious anywhere onsite. Net Increase in impervious must be > 0 for the Neuse Nutrient Stormwater Rules to apply.

Cumulative Impervious: Includes all Existing Impervious and Net Increase Impervious – Cumulative Impervious is used for calculating Project Density (% Impervious/BUA) for Neuse stormwater compliance, and is subject to Stormwater Rules and Nutrient Targets, depending on provided stormwater treatment, nutrient offsets, and other exemptions and exceptions that may apply.

NCGS 143 214.7D. Limitations on built upon area requirements:

A. As used in this section, the term "built upon area" means impervious surface and partially impervious surface to the extent that the partially impervious surface does not allow water to infiltrate through the surface and into the subsoil.

B. For the purposes of implementing State or local government stormwater programs, none of the following surfaces shall be considered "built upon area" or an impervious or partially impervious surface:
    1) A slatted deck
    2) The water area of a swimming pool

3) A surface of number 57 stone, as designated by the American Society for Testing and Materials, laid at least 4 inches thick over a geotextile fabric.
4) A trail as defined in G.S. 113A 85 that is either unpaved or paved as long as the pavement is porous with a hydraulic conductivity greater than 0.001 centimeters per second (1.41 inches per hour).
5) Landscaping material, including, but not limited to, gravel, mulch, sand, and vegetation, placed on areas that receive pedestrian or bicycle traffic or on portions of driveways and parking areas that will not be compacted by the weight of a vehicle, such as the area between sections of pavement that support the weight of a vehicle.
6) Artificial turf, manufactured to allow water to drain through the backing of the turf, and installed according to the manufacturer's specifications over a pervious surface. Note: artificial turf requires land use approval from the Planning Department

An additional Item (7) is included in the Wake County UDO: Stormwater Control Measures, excluding underground detention stormwater control measures, designed in accordance with the Wake County Stormwater Design Manual.

Stormwater Control Measures means permanent structural devices that are designed, constructed, and maintained to control flow from stormwater runoff before the water reaches downstream bodies of water. These devices remove pollutants from stormwater and help reduce flooding and erosion to downstream properties when designed in accordance with the Wake County Stormwater Design Manual

NCGS 143-214.7 bars the State or local governments from requiring stormwater treatment for existing development. It also establishes that the area of Existing Impervious, or the equivalent amount if it is rebuilt, is to be removed from calculations of project area and project density with respect to stormwater requirements.

Note that the total impervious surface coverage (including existing impervious surfaces) must be considered when meeting Wake County zoning requirements, which is a separate regulation.

3.3.3 Neuse (outside of Falls Lake) and Cape Fear Requirements

Refer to Sections 3.3.2.1 and 2 of this Manual for guidance on nutrient loading calculations for the Neuse River Basin. Wake County implements the Neuse Stormwater Rules Countywide (outside of Falls Lake), including within the Cape Fear Basin. The Jordan Lake Stormwater Rules for new development are currently under legislative delay but will become effective and enforceable upon the end of all applicable legislative delays (UDO 9-21-3). At that time, other areas of the Cape Fear Basin, outside of Jordan Lake, will continue to demonstrate compliance with the Neuse Stormwater Rules.
The tables below provide a high-level summary of Neuse Stormwater requirements for various scenarios. All scenarios assume that there is a net increase in impervious surface (or built upon area, BUA). A greenfield development is assumed to have no impervious surface or built upon area, whether existing or regulated. Where low- or high-density stormwater design is required for compliance with the Neuse Rules, this design shall be based on all Cumulative Built Upon Area (Cumulative BUA).

Please note that additional County stormwater requirements, including downstream assessments and target curve number for residential developments, will also apply. These additional requirements may require a stormwater control measure to be proposed onsite, even if the Neuse Stormwater Rules do not.

Some key items to understand include:

- Required stormwater treatment must be installed onsite or using regional offsite SCMs, treating runoff volume from all Cumulative BUA or equivalent volume. This is regardless of already-acquired nutrient offsets.
- Treatment of runoff volume from Existing BUA can be used in place of treatment of runoff volume from Cumulative BUA.
- New or redesigned stormwater control measures (SCMs) must be sized for the total volume draining to them. This may include more than the required volume.
- Nutrient offsets may be used to meet remaining nutrient reduction need after determining reduction provided by stormwater treatment and any previous offsets.
- It is recommended to contact the NC Division of Water Resources for guidance on nutrient calculation, especially if existing SCMs are present or previous nutrient offsets exist.

Note also that a minor or minor-limited subdivision will be required to show compliance with the Neuse Stormwater Rules at the time of subdivision if it is determined to be a common plan of development (refer to definition below, and in Appendix B). If a minor or minor-limited subdivision has shared elements – for example, a road – or otherwise meets the definition below, then it will be determined to be a common plan of development.

Common plan of development (from 15A NCAC 02H .1002): means a site where multiple separate and distinct development activities may be taking place at different times on different schedules but governed by a single development plan regardless of ownership of the parcels. Information that may be used to determine a "common plan of development" include plats, blueprints, marketing plans,

contracts, building permits, public notices or hearings, zoning requests, and infrastructure development plans.

DEQ's Operational application: We interpret "proposed development activity" (from the .1002 definition of "project") to include the entirety of a common plan of development, whether different builders implement individual lots or phases, or an institutional/campus situation where there may be ongoing development expansion over a long period of time. A construction or land disturbing activity is part of a larger common plan of development if it is completed in one or more of the following ways: in separate stages, in separate phases, or in combination with other construction activities.

Table 3.4 Neuse Stormwater Compliance for Isolated Single-Family Residence/Duplex, not part of a Common Plan of Development (future)

Isolated Single-Family Residence/Duplex, not part of a Common Plan of Development					
	Disturbed Area	**Cumulative BUA**	**SNAP Calculations Required**	**SCM Treatment Required**	**Comments**
Greenfield/ No Existing BUA	< 1 ac	Any	Exempt		
	≥ 1 ac	≤ 5%	Exempt		Final as-built impervious survey may be required to verify exemption
		> 5% but ≤ 24%	Yes	No	Low Density Stormwater Design; Buydown Only Allowed; Low density as-built certification required; Final as-built impervious survey may be required to demonstrate compliance
		> 24%	Yes	Yes	High Density Stormwater Design, SCM Treatment or Runoff Match Required
Existing BUA Present	< 1 ac	Any	Exempt		
	≥ 1 ac	≤ 5%	Exempt		Final as-built impervious survey may be required to verify exemption
		> 5% but ≤ 24%	Yes	No	Low Density Stormwater Design; Buydown Only Allowed; Low density as-built certification required; As-built impervious survey may be required to demonstrate compliance
		> 24%	Yes	Yes	High Density Stormwater Design, SCM Treatment or Runoff Match Required

Note: Notwithstanding the cumulative built upon area (BUA) thresholds above, the total impervious surface coverage or BUA of any residential lot may not exceed 30%, per Wake County's UDO. More stringent limitations may apply in specific watershed areas within the County. If maximum impervious surface area limitations (MISAs) are recorded on the plat for a lot (or lots), those MISAs shall not be exceeded unless the property is eligible for a stormwater deviation.

Table 3.5 Neuse Stormwater Compliance for Residential Development within a Common Plan of Development (future)

Residential Development, Part of a Common Plan of Development					
	Disturbed Area*	**Cumulative BUA***	**SNAP Calculations Required**	**SCM Required**	**Comments**
Greenfield/ No Existing BUA	< 1 ac	Any	Exempt		
	≥ 1 ac	≤ 24%	Yes	No	Low Density Stormwater Design; Buydown Only Allowed; Low density as-built certification required; As-built impervious survey of lots may be required to demonstrate compliance
		> 24%	Yes	Yes	High Density Stormwater Design, SCM Treatment or Runoff Match Required; SCM as-built certification required
Existing BUA Present	< 1 ac	Any	Exempt		
	≥ 1 ac	≤ 24%	Yes	No	Low Density Stormwater Design; Buydown Only Allowed; Low density as-built certification required; As-built impervious survey of lots may be required to demonstrate compliance
		> 24%	Yes	Yes	High Density Stormwater Design, SCM Treatment or Runoff Match Required; SCM as-built certification required
Incremental Increase in BUA within Existing Developments	Incremental Expansion on Existing Lots within a Common Plan of Development will be limited to the BUA limits recorded on the associated plat. Parcels with a recorded perpetuity statement on the plat will be held strictly to those recorded limits. Lots without a recorded perpetuity statement may be eligible for a stormwater deviation to increase BUA up to 30% Total Proposed Built Upon Area with additional stormwater treatment measures, but in no case shall be allowed to exceed the zoning limitations on impervious area within the Wake County UDO.				

Note: Notwithstanding the Cumulative Built Upon Area (BUA) thresholds above, the total impervious surface coverage or BUA of any residential lot or project may not exceed 30% (or its recorded MISA), per Wake County's UDO. More stringent limitations may apply in specific watershed areas within the County.

*Disturbed Area and Cumulative BUA of the Entire Common Plan of Development

Table 3.6 Neuse Stormwater Compliance for Commercial/Non-Residential Development (future)

Commercial/Non-Residential Development					
	Disturbed Area*	**Cumulative BUA***	**SNAP Calculations Required**	**SCM Required**	**Comments**
Greenfield/ No Existing BUA	< 0.5 ac	Any	Exempt		
	≥ 0.5 ac	≤ 24%	Yes	No	Low Density Stormwater Design; Buydown Only Allowed; Low density as-built certification required; Final as-built impervious survey may be required to demonstrate compliance
		> 24%	Yes	Yes	High Density Stormwater Design, SCM Treatment or Runoff Match Required; SCM as-built certification required
Existing BUA Present	< 0.5 ac	≤ 24%	Exempt		Final as-built impervious survey may be required to verify exemption
		> 24%	Yes	Yes	High Density Stormwater Design, SCM Treatment or Runoff Match Required; SCM as-built certification required
	≥ 0.5 ac	≤ 24%	Yes	No	Low Density Stormwater Design; Buydown Only Allowed; Low density as-built certification required; Final as-built impervious survey may be required to demonstrate compliance
		> 24%	Yes	Yes	High Density Stormwater Design, SCM Treatment or Runoff Match Required; SCM as-built certification required

Note: Notwithstanding the cumulative built upon area (BUA) thresholds above, the total impervious surface coverage or BUA of any residential lot or project may not exceed the specified limits for the associated zoning districts per Wake County's UDO. More stringent limitations may also apply in specific watershed areas within the County.

*Disturbed Area and Cumulative BUA of the Entire Common Plan of Development

3.4 Downstream Impact Analysis

Important Note:

All projects which must demonstrate compliance with the Neuse, Jordan, or Falls Lake Stormwater Rules shall also perform the required downstream impact analysis. Minor subdivisions are not required to perform the downstream impact analysis at the time of subdivision if they limit their overall impervious to 15% AND are not considered part of a common plan of development. However, if individual lot disturbances trigger compliance with State Stormwater Rules, the downstream assessment will be required to be performed as part of those development plans.

All SCMs shall discharge to field verified public conveyances, i.e. an adequately sized pipe network or Waters of the State.

Per Wake County Unified Development Ordinance Article 9-22, a Downstream Impact Analysis must be performed in accordance with the "ten percent rule" using the steps set forth below. A copy of the analysis must be provided with the permit application. The purpose of the Downstream Impact Analysis is to determine if the project will cause any unintentional additional impacts of flooding or channel degradation downstream of the project site.

The timing of flows is a critical consideration in the placement of stormwater control measures for water quantity. If not considered during planning, then the stormwater control measure may increase the peak flows downstream, making downstream flooding worse than if no detention had been performed. In Figure 3.1 below, the peak flow from the site is reduced appropriately, but the timing of the flow is such that the combined detained peak flow (the larger dashed triangle) is higher than if no detention were required.

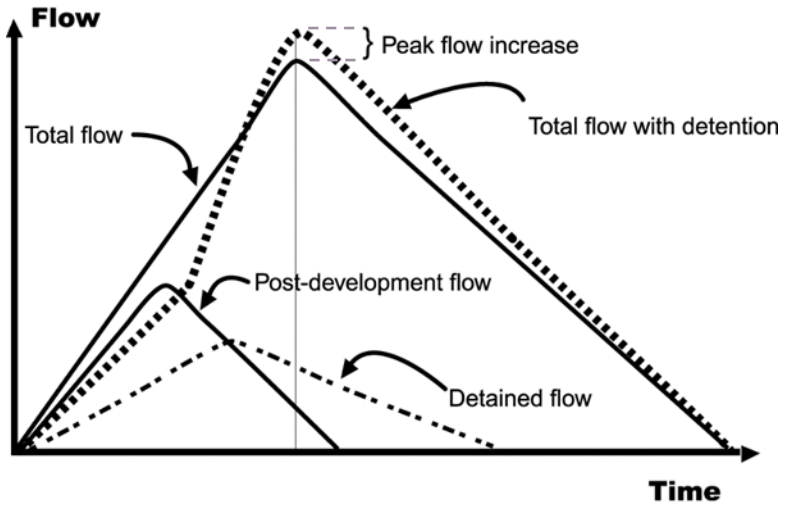

Figure 3.1: Detention Timing Example; Reprinted with permission from the North Central Texas Council of Governments iSWM™ Technical Manual – Hydrology

In this case, the shifting of flows to a later time brought about by the detention measures makes the downstream flooding worse than if the post-development flows were not detained. This is most likely to happen if detention is placed on tributaries toward the bottom of the watershed, holding back peak flows and adding them as the peak from the upper reaches of the watershed arrives.

Another important impact of new development is an increase in the total runoff volume of flow. Thus, even if the peak flow is effectively attenuated, the longer duration of higher flows due to the increased volume may combine with downstream tributaries to increase the downstream peak flows.

Figure 3.2 illustrates this concept. The figure shows the pre- and post-development hydrographs from a development site (Tributary 1). The post-development runoff hydrograph meets the flood protection criteria (i.e., the post-development peak flow is equal to the pre-development peak flow at the outlet from the site). However, the post-development combined flow at the first downstream tributary (Tributary 2) is higher than pre-development combined flow. This is because the increased volume and timing of runoff from the developed site increases the combined flow and flooding downstream. In this case, the detention volume would have to have been increased to account for the downstream timing of the combined hydrographs to mitigate the impact of the increased runoff volume.

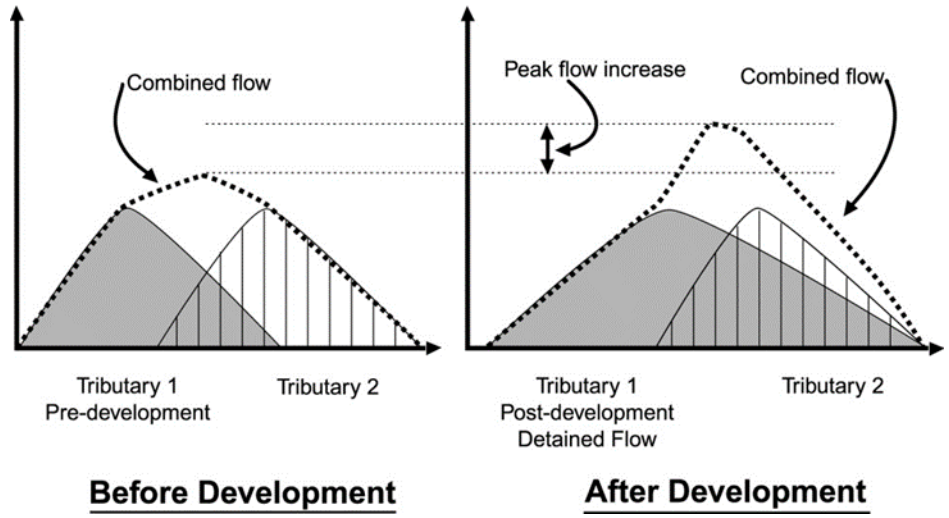

Figure 3.2: Effect of Increased Post-Development Runoff Volume with Detention on a Downstream Hydrograph, Reprinted with permission from the North Central Texas Council of Governments iSWM™ Technical Manual – Hydrology

The downstream impact analysis must include the assumptions, results and supporting calculations to show safe passage of post-development design flows downstream for the 10-year design storm. This analysis shall be performed at the outlet(s) of the site, and downstream at each tributary junction to the point(s) in the conveyance system where the area of the portion of the site draining into the system is less than or equal to ten percent of the total drainage area above that point. A summary table with the pre-and post-development flows for each analysis point is required. The general procedure is as follows:

1. Determine all points of discharge from the site. These points will be used as the first point(s) of analysis for the downstream impact assessment. Identify pre- and post-development site conditions.

Note that if the discharge point(s) from the site do not have a clearly defined cross section, they shall be considered as either shallow concentrated flow or channelized flow. Sheet flow discharges will not be accepted for analysis purposes. Field verify the path of discharge to public conveyances, i.e. an adequately sized pipe network or Waters of the State. Obtain drainage easements as needed.

2. Using a topographic map, determine the point(s) downstream where the proposed site area – or the portion of the site area in that drainage area - equals ten percent of the total drainage area, called the 10% point (or "zone of influence"). Identify all tributary junctions between the downstream site boundary/site outlet(s) and the 10% point. All points identified, as well as the outlet(s) of the site, are known as 10% rule comparison points.

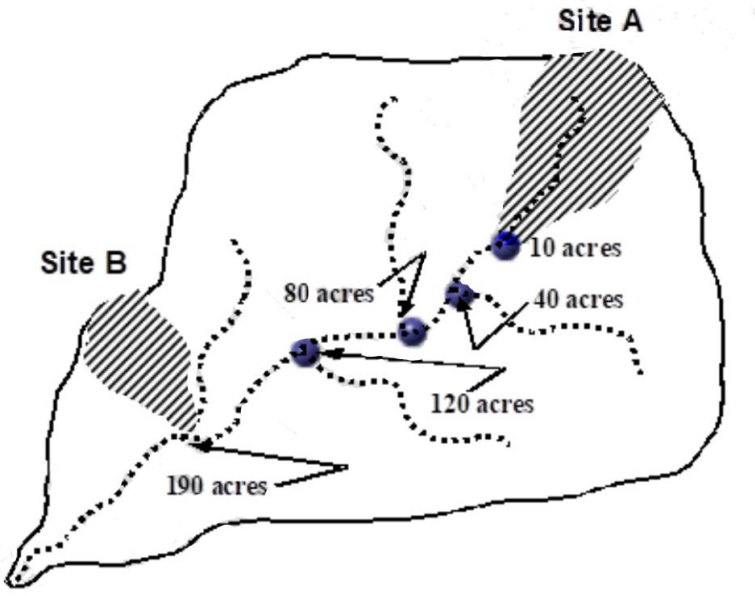

Figure 3.3: Example of the 10% Rule, Reprinted with permission from the North Central Texas Council of Governments iSWM™ Technical Manual – Hydrology

In the figure above, Sites A and B are located within a 250 acre watershed. Site A is a 10-acre development which discharges to a tributary. The 10% point would be the point at which the total drainage area which includes the project is 100 acres. This would be located somewhere between the 80- and 120-acre junction points of the tributary. In this case, the downstream analysis would need to end at the junction labeled 120 acres, which is the closest junction past the 10% point. The 10% rule comparison points would include the site outlet, the 40-acre junction, the 80-acre junction, and the 120-acre junction.

Site B is a 6-acre development which is located further downstream. Its outlet is to the tributary at the point where the total drainage area of the watershed is 190 acres. The 10% point (or "zone of influence") of Site B would be the point at which the total drainage area that includes the development is equal to or greater than 60 acres. Since the outlet of the site includes a total drainage area of much greater than 60 acres, the only 10% rule comparison point would be the outlet of Site B.

3. Using a hydrologic model with existing land uses, determine the pre-development peak runoff rate (cubic feet per second) for the 10-year, 24-hour design storm event at each comparison point. Note that the same hydrologic analysis method shall be used for both pre- and post-development discharge calculations.

    - Offsite areas should be modeled as "full build-out" for both the pre-and post-development cases.
    - An accurate estimation of the time of concentration is key in the downstream impact analysis. Large detention structures (including stormwater control measures) within the drainage area will impact the time of concentration and should be considered in the analysis. For projects that discharge directly into a FEMA studied stream, these structures should already be accounted for in the hydrologic models used by those studies. For projects that do not discharge directly to a FEMA studied stream, the engineer performing the analysis will need to use best available information (aerial topography information, field visits, surveys, or existing plans) to model and account for these structures within the watershed.
    - An approximate curve number is used because the actual peak flow is not key for initial analysis. Only the increase or decrease is important. The accuracy in CN determination is not as significant as an accurate estimate of the time of concentration.

4. Insert the proposed site design and proposed stormwater control measures (SCMs) for the project into the land uses and determine the post-development peak runoff rate for the 10-year, 24-hour design storm at each comparison point.

5. If the post-development peak discharge rate is equal to or less than pre-development conditions at all comparison points, no further analysis is required.

6. If the 10-year, 24-hour post-development peak discharge rate is greater than the pre-development peak discharge rate at any comparison point, then one of the following actions must be taken:

    a. Revise the site plan for the proposed site to incorporate better use of natural features, design additional structural control facilities, reduce impervious cover, or alter the timing of peak flows to lower post-development flows at each comparison point to pre-development levels; or
    b. Obtain a flow easement from downstream property owners through the ten percent point where the post-development peak discharge rate is higher than the pre-development peak discharge rate. See Section 7.4.4 Flow Easements.

Example scenarios for finding the 10% point and points of analysis for a downstream impact analysis may be found in Appendix C of this manual.

3.5 Peak Flow

Important Note:

Wake County currently operates under the .0235 Neuse Rules. All projects are subject to peak flow control. The peak flow control for the 1 year 24 hour storm and the downstream analysis of the 10 year storm are two separate ordinance requirements.

3.5.1 Concept

The Falls Rules [15ANCAC 02B .0277, Section 4(f)] state " and the Neuse Rules 15 NCAC .02B .0235, state "new development shall not result in a net increase in peak flow leaving the site from the pre-development conditions for the 1-yr, 24-hr storm event." The purpose of peak flow control for stormwater runoff from new development is to ensure that the integrity and nutrient processing function of receiving waters and associated riparian buffers are not compromised by erosive flows.

The Design Engineer must calculate the pre- and post-development discharges for each point of discharge from the site (i.e., by drainage area) based on the site boundary to determine whether a stormwater control measure is needed to attenuate an increase in peak flow. If runoff leaves the site at several locations, the engineer must conduct a separate analysis for each point. Engineers are required to provide drainage area maps, stormwater model, and supporting calculations to demonstrate peak flow compliance.

The initial peak flow analysis to determine whether a measure is needed is based on the drainage area(s) within the site limits; however, if a measure is needed in a particular drainage area it must be designed and sized for the entire drainage area (including offsite drainage). The development will need to demonstrate no net change in peak flow for the total drainage area to the SCM and its bypass areas (pre- to post-development with SCM).

In the cases where stormwater runoff discharges into a stream, the design engineer must also ensure that these streams are protected from erosive flows.

If a stormwater control measure (SCM) is required, the SCM must be designed for the actual drainage area coming to the device (which includes existing conditions for offsite run on):

- If an SCM is designed to treat offsite drainage as well, the engineer must provide calculations for Pre-, Post-, and Post-SCM peak flow for the entire drainage area (including offsite).
- Post-SCM peak flow must be equal or less than pre-development peak flow.

3.5.2 Design Methodology

Time of Concentration

Time of concentration (Tc), as described by TR-55, is the time required for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. A higher Tc corresponds to a lower peak flow since the longer flow time stretches out the hydrograph and a lower Tc corresponds to a higher peak flow. Tc is computed by calculating the travel time for each type of flow (sheet, shallow, or channel) separately and then summing the calculations. As stated in TR-55, any flow over a lake or reservoir can be neglected since the travel time is very close to zero. The minimum value for a time of concentration is 5 minutes. There are multiple methods which may be used to calculate time of concentration. One example method (from TR-55) is provided below.

Tc = Tt Sheet + Tt Shallow + Tt Channel

Sheet Flow

Sheet flow occurs as flow over plane surfaces. Calculation of the travel time for sheet flow requires that the flow length, slope, and Manning's roughness coefficient for sheet flow be determined. The maximum flow length for sheet flow is 100 feet. The Manning's roughness coefficients (n values) are in Table 3.7.

Table 3.7 Manning's Roughness Coefficients for Sheet Flow (flow depth generally ≤ 0.1 ft)

SURFACE DESCRIPTION	Manning's roughness coefficient n
Smooth Surfaces - Paved, Gravel, or Bare Soil	0.011
Fallow (no residue)	0.05
Cultivated Soils	
Residue Cover ≤ 20%	0.06
Residue Cover > 20%	0.17
Grass	
Short grass prairie	0.15
Dense grasses*	0.24
Bermuda grass	0.41
Range (natural)	0.13
Woods**	
Light underbrush	0.40
Dense underbrush	0.80

* Dense grasses include species such as weeping love grass, bluegrass, buffalo grass, blue gamma grass, and native grass mixtures.

** When selecting an n-value from the table, consider the cover to a height of about 0.1-foot since this is the only part of the plant that will obstruct sheet flow.

$$T_t = \frac{0.007(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$$

T_t =travel time (hr)
n = Manning's roughness coefficient
L = flow length (ft)
P_2 = 2-year 24-hour rainfall (in)
s = slope of the land surface (ft/ft)

Shallow Flow

After a maximum of 100 feet of sheet flow, the runoff usually becomes shallow concentrated flow. The average velocity of this flow should be determined using the equations below.

Unpaved: $V = 16.1345(s)^{0.5}$

Paved: $V = 20.3282(s)^{0.5}$

V=Average Velocity (ft/s)
s = slope of hydraulic grade line (watercourse slope, ft/ft)

$$T_t = \frac{L}{3600V}$$

T_t =travel time (hr)
L = flow length (ft)
V = average velocity (ft/s)
3600 = conversion factor from seconds to hours

Channel Flow

Open channels include, but are not limited to, channels that are assumed to begin where surveyed cross section data has been obtained, where channels are visible on aerial photographs, or where blue lines appear on the United States Geological Survey (USGS) quadrangle sheets. Manning's equation should be used to estimate average flow velocity. Average flow velocity is usually determined for the bank-full elevation.

Manning's equation is:

$$V = \frac{1.49 r^{2/3} s^{1/2}}{n}$$

V=Average Velocity (ft/s)

r = hydraulic radius (ft)

s = slope of hydraulic grade line (channel slope, ft/ft)

n = Manning's roughness coefficient for open channel flow

$$r = \frac{a}{p_w}$$

a = cross sectional flow area (ft2)

p_w=wetted perimeter (ft)

$$T_t = \frac{L}{3600V}$$

T_t =travel time (hr)

L = flow length (ft)

V = average velocity (ft/s)

3600 = conversion factor (sec-hrs)

Table 3.8 Representative Manning's Roughness Coefficients for Open Channel Flow

CHANNEL LINING	n
Asphalt	0.016
Concrete, finished	0.012
Concrete, unfinished	0.014
Grass	0.035
Gravel Bottom/riprap sides	0.033
Weeds	0.040

3.5.3 Peak Flow Calculations

Design engineers shall provide sealed calculations to demonstrate pre-development, post-development (without SCMs), and post-development (with SCMs) peak flow rates from each point of discharge from the site using an acceptable methodology.

The Rational Method and the SCS (NRCS) Unit Hydrograph method may be used for hydrologic analyses. Design engineers should be aware of the limitations for each methodology and select one which is appropriate to use in the hydrologic analysis for a particular site. It should be noted that the Rational Method cannot be used for any application requiring storage design – including the routing of flows through stormwater control measures.

Rainfall intensity data shall be obtained for the specific location of the project site from NOAA Atlas 14. Peak flow calculations shall be accompanied by pre-and post- drainage area maps.

The following programs are acceptable to be used and submitted for hydrologic analysis:

- HEC-HMS
- Hydraflow by Autodesk
- WinTR-55
- HydroCAD
- PondPack
- XP SWMM
- EPA SWMM
- PC SWMM
- Infoworks ICM
- Civil Storm

Other programs not listed above may be requested on a case-by-case basis at the discretion of Watershed Management plan review staff; however, the Chainsaw Routing Method is not an accepted method for hydrologic analysis.

Regardless of the program chosen for routing of flows, the sealed calculation package shall include all model assumptions and inputs used for the calculations.

When setting up the hydrologic model and evaluating the site for peak flow requirements, the designer should also consider the project's compliance with the required Downstream Impact Analysis (Section 3.4 of this manual) as well as requirements for stormwater outlet protection (UDO 10-21).

- Development with a net change in peak flow in excess of 10% the pre-development peak will be required to provide mitigation in the drainage area showing an increase. Note: An increase in runoff rates less than 10% does not automatically mean that a project will not be required to provide detention or make drainage improvements.

- If an SCM is required, the SCM must be designed for the actual drainage area coming to the device (existing conditions for offsite).
  - If the SCM is designed to treat offsite as well, the engineer must provide calculations for Pre, Post, and Post SCM peak for the entire drainage area (including offsite).
  - Post SCM peak flow must be equal or less than Pre peak flow

While discharge points generally should be placed at the low points on the project, if there is not an existing conveyance care shall be taken in discharging concentrated flows to avoid negative impacts on downstream property owners. Any disputes over runoff shall be worked out between the downstream property owner and the developer.

3.6 Stormwater Control Measures

Stormwater Control Measures (SCMs) are devices used to control and treat stormwater runoff that flows onto a property when it rains. These devices remove pollution from stormwater and help reduce flooding and erosion to downstream properties.

Because they are permanent features, choosing the correct SCM or group of SCMs for a site is an important decision that should be thoroughly and carefully considered at the outset. Because every site is unique and has its own challenges, there is no one SCM solution that is best suited for every site.

When selecting a SCM for a site, it is important to:

- Understand which SCMs will work within the physical constraints of the site,
- Evaluate how the possible SCMs address the regulatory requirements relevant to the site, including pollutant removal and water quantity control, and
- Consider other factors such as construction costs, maintenance and access, ownership issues, safety, aesthetic, and environmental factors (buffers, floodplain, depth to water table, etc.) at the site.
- Field verify the discharge points and downstream structures which may be impacted

Please refer to Section A-8 of the NCDEQ Stormwater Design Manual for additional guidance on SCM selection.

Note that primary SCMs may be used as stand-alone measures to treat a new development site (when 100% sized), or as a retrofit. Secondary SCMs may be used in series with a primary SCM – either to provide pretreatment for the primary SCM or to reduce the volume of runoff (and therefore the size) of the primary SCM. Secondary SCMs may also be used as a retrofit, or in series with another secondary SCM to treat the design storm IF that "treatment train" can be shown to meet or exceed the required performance standards.

Stormwater Control Measure Designations	
Primary SCMs	**Secondary SCMs**
Bioretention Cell	Disconnected Impervious Surface
Infiltration System	Dry Pond
Permeable Pavement	Green Roof
Rainwater Harvesting*	Level Spreader-Filter Strip
Sand Filter	Treatment Swale
Stormwater Wetland	
Wet Pond	

** To be considered a primary treatment SCM, a rainwater harvesting measure must be sized to capture a minimum of 85% of the total annual runoff volume as demonstrated through water balance calculations.*

Requirements for primary and secondary SCMs apply to compliance with state stormwater rules. Any appropriate SCM may be used to meet county stormwater volume requirements for Target Curve Number or deviations.

3.6.1 General Design Criteria

Stormwater control measures (SCMs) in Wake County may be designed to meet multiple requirements including but not limited to target curve number, downstream assessments, peak flow, and/or nutrient loading.

Design Storm Requirements	
Compliance Goal	**Design Storm**
Target Curve Number	3-inch rainfall
Peak Flow	1-year, 24-hour
Downstream Assessment	10-year, 24-hour
Water Quality Volume (Nutrient Loading)	1-inch rainfall (1st flush)
Stormwater Deviation	3-inch rainfall*

**The Swift Creek requirements apply for the portion of impervious between 12% and 15%. Above 15% impervious surface area, the 3-inch design criteria shall apply.*

SCMs shall be designed according to the latest version of NCDEQ Minimum Design Criteria (MDC) and must comply with the entirety of the NCDEQ Stormwater Design Manual and requirements, including but not limited to locating devices in proper soil types and meeting the required depth to seasonal high water table (SHWT). In the case of any conflict between State and County requirements, the more stringent shall apply.

All stormwater control measures within Wake County must also comply with the following general criteria:

General Minimum Design Criteria and County Clarifications/Requirements:

- All SCMs shall comply with Chapter C-0 "Minimum Design Criteria for All SCMs" of the NCDEQ Stormwater Design Manual.
    - General MDC 3: Vegetated slopes shall not be steeper than 3:1.
    - General MDC 5: Stable bypass shall be provided for SCMs, and this bypass shall not be directed straight toward a downstream structure.
    - General MDC 5: All stormwater control measures with a drainage area of 4 acres or more shall perform a backwater analysis to determine the 100-year backwater. This backwater must be entirely contained within the stormwater control measure or its associated easement unless a backwater easement is recorded on a record plat. Upstream properties shall not be inundated due to the SCM's failure to pass storms greater than the design storm.
- All SCMs shall comply with Chapter A-5 "Common Structures & Materials" of the NCDEQ Stormwater Design Manual, including the following requirements for embankments:
    - Embankments of all stormwater control measures shall comply with State Dam Safety Regulations.

  - The height of an embankment dam must consider freeboard and compensation for settlement. The basin's freeboard should be a minimum of 1 foot above the elevation of the highest stage calculated based on the 100-year storm.
- Permanent stormwater conveyances shall be designed to safety pass the 10-year storm event (25-year storm event in Water Supply Watersheds) without causing scour, rills, gullies, or other reasonably expected failure, unless otherwise specified in this manual or the County UDO.
  - The maximum side slopes for vegetated conveyances shall be 3:1, with a minimum longitudinal slope of 1%.
- All SCMs, with the exception of underground rainwater harvesting measures, shall flow by gravity and not require a pump to function.
- Structures such as docks, piers, diving platforms, or bridges shall not be allowed in a stormwater control measure.
- Plans for projects with stormwater control measures shall include a separate sheet(s) that includes a site specific, detailed construction or conversion sequence, plan and profile construction details with elevations of applicable storm events, and a landscape plan/planting plan for each stormwater control measure.

Location of Stormwater Control Measures:

- Stormwater control measures that are proposed for the "shared" compliance of a subdivision or development shall be located in a common area/open space lot of the development and shall be maintained by a property owners' or homeowners' association. SCM access and maintenance easements shall also be in common areas/open space to the maximum extent practicable.
- Stormwater control measures shall not be located in a required landscape buffer (UDO 16-10-2(j)).
- All measures shall be located a minimum of 10 feet from any structure. The only exception to this requirement will be rainwater harvesting devices located on a single-family residential lot.
- All stormwater control measures shall be setback from septic systems (including repair areas) in accordance with the requirements below:

Stormwater Control Measure (SCM) Required Setbacks from Septic Systems	
SCM Type	**Minimum Setback**
Bioretention Cell	25 ft**
Cistern	Contact Wake County Environmental Services
Dry Pond	25 ft**
Infiltration System	25 ft**
Permeable Pavement	25 ft**
Sand Filter	25 ft**
Stormwater Wetland*	50 ft
Wet Pond*	50 ft

* Indicates that the SCM will have a permanent pool

** Indicates a Wake County requirement

- Locating SCMs in flood hazard areas is discouraged, as these areas will likely have high water tables. Any SCM proposed within a flood hazard area will require a flood study permit. Modeling will be required to demonstrate no impact to flood levels, in accordance with UDO Article 14.
- SCMs shall not be located in stream channels; clean water diversions shall be installed as needed.
- All SCMs shall discharge to field verified public conveyances, i.e. an adequately sized pipe network or Waters of the State, riparian buffers, wetalnds, etc.

The pages below identify common stormwater control measures and their specific design requirements. Although not discussed below, the County does accept the "New Stormwater Technologies" identified in the NCDEQ Stormwater Design Manual. Designs and crediting for those measures shall conform to NCDEQ standards, as well as the general County criteria above. Minimum septic setbacks for these measures shall be evaluated on a case-by-case basis.

3.6.2 SCM Specific Design Criteria

3.6.2.1 Infiltration System

Description
Infiltration systems are designed to capture stormwater runoff and allow it to infiltrate into the soil over a specific period of time. There are two major types of infiltration systems – infiltration trenches and infiltration basins. These systems work best for smaller, highly impervious drainage areas. Pervious surfaces within the drainage area can contribute fines that will clog the soil and remove infiltration capabilities. Infiltration systems are generally installed at a shallow depth and require specific media (either stone or an engineered soil mix).
NCDEQ Design Criteria
NCDEQ MDC C-1: Infiltration System
Additional County Requirements
• Infiltration SCM construction shall avoid the use of heavy equipment on the bottom of the basin, or any areas of the SCM where infiltration is a design component. • For infiltration trenches, medium or coarse sand, or crushed stone (i.e., uniformity coefficient of 2 or smaller) is required as a drainage medium. Trench media shall be hard, durable, inert particles, free from slate, shale, clay, silt, and organic matter. • For infiltration basins, drainage media shall be enclosed on all sides by a geotextile filter. The top surface of the geotextile shall be 6 to 12 inches below the upper surface of the drainage media. The other surfaces of the geotextile shall be in contact with the in-situ soil. • Infiltration SCMs shall meet a minimum 25 ft setback from any existing or proposed septic system or repair area. • Infiltration SCMs shall not be located in flood hazard areas.

3.6.2.2 Bioretention Cell (or Rain Garden)

Description

Bioretention cells are excavated areas that are filled with specialized soil media and plants, or grass/sod. They are designed to temporarily pond and filter stormwater runoff. Bioretention cells are highly effective at removing pollutants and can be installed in a wide variety of soil types from clay to sand.

Rain gardens are generally smaller versions of a bioretention cell and are allowed to be installed as part of a stormwater deviation on eligible single family residential lots. Rain gardens proposed for stormwater deviations will be designed to capture the required volume, and typically do not have an underdrain and shall be less than 12 inches deep.

NCDEQ Design Criteria

NCDEQ MDC C-2: Bioretention Cell

Additional County Requirements

- Flow should enter a bioretention cell via disperse flow or an energy dissipater at a velocity of less than 1 ft/s for mulched cells or 3 ft/s for grassed cells to prevent erosion. Dispersed flow can be provided via a gently sloping parking lot that drains toward a bioretention cell. If the inflow to the cell is concentrated in a swale or pipe, then a riprap lined entrance, a forebay, or other energy dissipating device should be used. If a forebay is used, it can both dissipate energy and provide pre-treatment.
- Bioretention cells shall have a pretreatment area which can be a forebay or grass/gravel combination as described in the NCDEQ Recommendation #2 in the Stormwater Manual section linked above.
- Bioretention cells shall meet a minimum 25 ft setback from any existing or proposed septic system or repair area.
- Bioretention cells shall not be located in flood hazard areas.
- Plants and spacing shall be denoted on SCM construction plan

3.6.2.3 Wet Pond

Description

Wet ponds are designed to capture the design storm and release it slowly over a period of two to five days via a properly designed outlet structure. The first outlet in the structure is designed to be above the bottom of the pond, thus creating a permanent pool of water. The captured runoff shall have an adequate flow path to bring about the removal of TSS through dilution and settling.

NCDEQ Design Criteria

NCDEQ MDC C-3: Wet Pond

Additional County Requirements

- Measures shall be provided along the principal spillway to prevent piping.
- Durable materials, such as reinforced concrete, are required.
- An emergency spillway shall be provided to prevent failure of the embankment structure during large storm events.
- Embankments shall comply with State Dam Safety regulations.
- The permanent pool elevation shall be at approximately the same elevation as the SHWT elevation. When a wet detention basin is to be located in highly permeable soils like gravelly sands or fractured bedrock, or when the permanent pool elevation proposed is greater than six (6) inches above the SHWT, the designer may need to incorporate a liner to sustain a permanent pool of water. A liner shall be constructed or compacted such that the infiltration rate is no more than 0.01 in/hr. When a liner is proposed, topsoil for vegetation must be placed on top of the liner.
- A permanent pool shall be maintained; a minimum depth of 3 feet is recommended
- Wet ponds shall meet a minimum 25 ft setback from any existing or proposed septic system or repair area.
- Compliance with MDC 11: Drought tolerant wetland vegetation required as needed based on field conditions

3.6.2.4 Stormwater Wetland

Description
Stormwater wetlands are manmade systems designed to mimic the function of a natural wetland by temporarily storing water in shallow pools that support specific wetland/riparian vegetation. The mix of physical, chemical, and biological processes in a constructed stormwater wetland provide significant stormwater treatment and pollutant removal. Stormwater wetlands are designed with an outlet structure that will release temporarily ponded water over a period of two to five days.
NCDEQ Design Criteria
NCDEQ MDC C-4: Stormwater Wetland
Additional County Requirements
• Landscape/planting plans for stormwater wetlands shall specify any unacceptable months for planting wetland plants. • Stormwater wetlands shall meet a minimum 50 ft setback from any existing or proposed septic system or repair area.

3.6.2.6 Sand Filter

Description
Sand filters can be located above or below ground, and they primarily function by sending stormwater through a sand media which filters out pollutants. Treatment and pollutant removal can occur through settling, filtering, and adsorption processes in the sand filter. Since water drains through the sand media so quickly, the stormwater is treated by the sand filter while the storm event is occurring. For this reason, NCDEQ allows them to be designed to treat 0.75 times the design volume to receive nutrient removal credits. Underground sand filters may be considered built upon area.
NCDEQ Design Criteria
NCDEQ MDC C-6: Sand Filter
Additional County Requirements
• Pervious areas in C and D soils shall be graded to drain away from the sand filter to prevent clogging of the measure. • Sand filters shall meet a minimum 25 ft setback from any existing or proposed septic system or repair area. • Sand filters shall not be located in flood hazard areas.

3.6.2.7 Rainwater Harvesting

Description

Rainwater harvesting devices include many different types of measures designed to collect, store, and use rainwater. These measures typically collect rainwater from the roof of structures but may be used to collected runoff from other impervious areas, including parking lots.

Rainwater harvesting, in the form of rain barrels or underground tanks, is one of the most commonly used measures installed on eligible residential lots as part of an approved stormwater deviation. These may range from 55-gallon rain barrels to 1500-gallon above ground tanks to 2500-gallon underground cisterns. When these measures are approved as part of a stormwater deviation, they are designed for capture of a particular volume of water (rather than State Minimum Design Criteria) which must be captured and then drawn down over a specific period of time. Underground rain water harvesting placed under impervious area may be considered built upon area.

NCDEQ Design Criteria

NCDEQ MDC C-7: Rainwater Harvesting

Additional County Requirements

- Rainwater harvesting measures used for stormwater deviations are not required to meet NCDEQ Minimum Design Criteria. Drawdown of the required volume is required to provide for storage for the next rain and may be accomplished through a programmed irrigation system, passive drawdown, etc. Maintaining many rain barrels on an individual site can be cumbersome as each will need to be cleaned out after pollen season.
- Rain barrels installed on single family lots as part of a stormwater deviation do not have a required minimum setback from any existing or proposed septic system or repair area. However, discharge from the rain barrels must be directed away from the septic areas.
- If other forms of rainwater harvesting are proposed, Environmental Services Wastewater staff shall determine the required setback from septic systems and repair areas. A wastewater information specialist may be contacted at wastewater@wake.gov or 919-856-7434.

3.6.2.8 Green Roof


Description
A green roof consists of low growing plants with shallow root systems that are grown in a shallow (3-4 inch) layer of light-weight media. During small rain events, there is very little runoff. During larger events, rainwater will first saturate the growing media, and once its capacity is filled the green roof will begin to drain water as runoff through gutters, drains, and spouts. Green roofs are considered secondary SCMs.
NCDEQ Design Criteria
NCDEQ MDC C-8: Green Roof
Additional County Requirements
• Discharge from the green roof shall be directed away from septic areas.

3.6.2.9 Level Spreader-Filter Strip

Description

A level spreader-filter strip (LS-FS) consists of a hardened (typically concrete) level lip and a filter strip that is graded and vegetated so that it filters and allows infiltration of stormwater. The level spreader itself disperses and diffuses flow, and the filter strip performs the pollutant removal function of the system. Level spreader-filter strips are considered secondary SCMs.

NCDEQ Design Criteria

NCDEQ MDC C-9: Level Spreader-Filter Strip

Additional County Requirements

- Level spreader-filter strip systems shall be provided pretreatment via a forebay when it receives flow directly from the drainage area. Refer to Recommendation 1 in the NCDEQ manual section linked above.
- Non-clumping, native, deep-rooted grasses shall be specified in the filter strip. For the Piedmont, appropriate grasses include tall Fescue or Common Bermuda.
- Sod used for the filter strip shall be washed or grown in non-clayey soils. Frequent watering shall be provided during the first three weeks after sod installation to ensure that the first 1.5 inches of soil is kept moist.
- Discharge from the level spreader-filter strip shall be directed away from septic areas.

3.6.2.10 Disconnected Impervious Surface

Description

Disconnected impervious surface (DIS) is a practice of directing stormwater runoff from impervious/built upon areas to properly size, sloped, and vegetated pervious areas. This is a low-cost stormwater control measure that can help to restore hydrology of streams and reduce pollutants in stormwater runoff.

The vegetated receiving areas cannot be installed until the impervious areas that drain to them are completed. Downspout systems must be installed correctly, and their drainage areas verified not to exceed the approved design. It is extremely important that the vegetated receiving area is uniformly graded with no gullies, low spots, or lateral slopes. A one-time fertilizer application and regular watering should be provided to help to establish the vegetated area of the DIS system.

Disconnected impervious surface areas are considered secondary SCMs. O&M agreements are required per the NC MDC Manual.

NCDEQ Design Criteria

NCDEQ MDC C-10: Disconnected Impervious Surface

Additional County Requirements

- Discharge from the downspouts of these measures shall be directed away from septic areas.
- Disconnected impervious surface credit over 50% will be tracked as a SCM and annual inspections required.

3.6.2.11 Treatment Swale

Description

Treatment swales are designed to filter pollutants as stormwater runoff moves through the grass in the swale. Note that swales designed primarily to convey stormwater from a project (rather than to remove nutrients) do not have to meet the NCDEQ minimum design criteria below. Instead, they must be designed per the minimum requirements of Rule .1003(2)(c). Setbacks from septic areas apply to all swales, regardless of whether designed to remove pollutants.

Treatment swales are considered secondary SCMs.

NCDEQ Design Criteria

NCDEQ MDC C-11: Treatment Swale

Additional County Requirements

- A minimum freeboard of 6 inches for the 10-year storm shall be provided.
- Treatment swales shall meet a minimum 25 ft. (measured from the center of the swale) setback from any existing or proposed septic system or repair area.
- **Recommend fencing to prevent vehicle encroachment**

3.6.2.12 Dry Pond

Description

Dry ponds are primarily designed to attenuate and delay peak flows from stormwater runoff. They are designed to pond and hold water immediately after a storm event, draining down over a specified amount of time. Dry ponds should not hold a permanent pool of water but should instead remain dry between storm events. Dry ponds receive very little nutrient removal credit and are considered a secondary SCM.

NCDEQ Design Criteria

NCDEQ MDC C-12: Dry Pond

Additional County Requirements

- A minimum freeboard of 1 foot shall be provided between the design elevation and the emergency spillway elevation to minimize overtopping of the dam and to protect the structural integrity of the pond.
- Dry ponds shall be provided with permanent vegetation. Shrubs, trees, and other landscaping of the dry pond shall not be allowed.
- Dry ponds shall meet a minimum 25 ft setback from any existing or proposed septic system or repair area.
- Dry ponds shall not be located in flood hazard areas.

3.6.2.13 Permeable Pavement

Description

Permeable pavement is designed to control quality and/or quantity of stormwater runoff while still allowing for parking, foot traffic, or other uses. It captures stormwater through voids in the pavement and then filters that water through an underlying aggregate reservoir which ultimately allows infiltration into the soil subgrade. If the underlying soils are not suitable for infiltration, permeable pavement may be designed to meet detention requirements. However, only permeable pavement designed for infiltration per NCDEQ standards is eligible to receive built upon area (BUA) credit.

NCDEQ Design Criteria

NCDEQ MDC C-5: Permeable Pavement

Additional County Requirements

- Permeable pavement designed for infiltration may receive a built upon area credit of 100%
- Permeable pavers must adhere to the following required setbacks:
    - Permeable pavement shall meet a minimum 25 ft setback from any existing or proposed septic system or repair area.
    - If there is no foundation drain on a structure, then a 5 ft setback is required from a structure. If there is no foundation drain, then the setback is determined by slope.
        - A 10 foot setback is required if the SCM is downslope from the structure.
        - A 15 foot setback is required for an even slope between the SCM and structure.
        - A 25 foot setback is required if the SCM is upslope of the structure.
- *Geogrids, geotextiles, and geomembranes shall not be allowed over the subgrade on permeable pavers designed for infiltration.*
- An engineer must certify that the pervious pavement does not affect structural foundations.
- All permeable pavement systems shall be reviewed and permitted as stormwater control measures and require annual 3rd party inspections by a qualified professional. For pavers designed for infiltration, these annual inspections shall include verification (via acceptable testing methods) that the pavement still meets minimum infiltration rates to qualify for BUA credit.

3.6.3 SCM Easements

Easements are required for all other stormwater control measures in accordance with UDO 9-20-4(B) and the NCDEQ Stormwater Manual and its associated minimum design criteria. In the case of any conflicts, the more stringent requirements shall apply. These stormwater access and maintenance easements are permanent easements that must be recorded on the record plat for the project or development. For projects which do not otherwise require a final plat, an exempt plat may be used to record the required easements.

These easements will be labeled as "*Stormwater Access and Maintenance Easement*" and shall:

- Include the width(s) of the easement
- Extend to the nearest public right of way
- Include a minimum width of 20 feet for any access from the public right of way (note that DEQ recommends 25 feet for maintenance access for measures that require larger equipment, such as wet ponds)
- Show and identify the stormwater control measure (show the entire footprint of the SCM and label it to match plans, i.e., "Dry Pond #1")
- Include the entire footprint of the stormwater control measure system including side slopes, forebay, riser structure, stormwater control measure, outlet, dam embankment, emergency spillway, etc.
- Provide a minimum of 10 feet around the footprint of the stormwater control measure system to provide enough room to complete maintenance tasks
- Not include lateral or incline slopes that exceed 3:1 (horizontal to vertical)
- Include direct maintenance access to any forebay for any measures utilizing a forebay
- Include access for cleaning underdrain piping for any measures which utilize underdrains
- Be granted in favor of the party responsible for enforcing the stormwater program under which the SCM is being approved (i.e., Wake County)
- Be protected for SCM access and maintenance and not include development

For stormwater control measures installed as part of an approved stormwater deviation (residential lot), no access and maintenance easement is required to be recorded. Note that stormwater control measures located on individual residential lots (for isolated lots not within a common plan of development) have additional requirements. Plats for these residential lots that contain a stormwater control measure shall also include:

- The specific location of the stormwater control measure on the lot
- A typical detail for the stormwater control measure to be used
- A note that the stormwater control measure on the property has been required to meet stormwater regulations and that the property owner may be subject to enforcement actions if the stormwater control measure is removed, relocated, or altered without prior approval.

3.6.4 Stormwater Agreement

All stormwater control measures shall complete and submit for review a copy of the required Stormwater Agreement. This agreement:

- Acknowledges that the maintenance of the stormwater control measure(s) is the sole responsibility of the owner;
- Indicates that this responsibility for maintenance of the measure(s) passes in the chain of title to any future owners;
- Grants access to Wake County to inspect the stormwater control measure(s); and
- Acknowledges that the owner of the stormwater control measure(s) shall provide an annual inspection report for each measure to the County by June 30th of each year.

County staff shall review the completed draft signed and notarized stormwater agreement prior to recordation. Once approved by staff, the agreement can be recorded with the Register of Deeds. The stormwater agreement, and its book and page, shall be referenced on any recorded plat for the project.

3.6.5 Operations and Maintenance Agreement and Plan

All owners of stormwater control measures shall enter into a binding Operation and Maintenance (O&M) Agreement with Wake County that complies with 15A NCAC .02H .1050(11) and County requirements (reference UDO 9-32-4). This O&M Agreement requires the owner to maintain, repair, or reconstruct the stormwater control measure(s) in accordance with the approved design plans and the O&M Plan.

This O&M Agreement shall be referenced on the recorded plat for the development/project and shall be recorded with the Register of Deeds. For measures installed as part of a stormwater deviation (which do not require a plat), the O&M Agreement shall be recorded with the Register of Deeds to that it appears in the chain of title for subsequent purchasers of the property.

Excepting those measures installed as part of a stormwater deviation, all owners of stormwater control measures shall also record an Operations and Maintenance Plan that complies with 15A NCAC .02H .1050(12) and County requirements (reference UDO 9-32-3).The Operations and Maintenance Plan shall specify all operation and maintenance work necessary for the function of all stormwater control measure components, including the stormwater conveyance system, perimeter of the device, inlet(s), pretreatment measures, main treatment area, outlet, vegetation, and discharge point. The Operations and Maintenance Plan is a separate document from the aforementioned O&M Agreement.
More information on SCM Operations and Maintenance may be found in Section A-7 of the NCDEQ Stormwater Design Manual.

3.6.6 As-built Certifications and Surveys

Upon project completion, the County shall require submitting as-built documentation to verify compliance with all applicable stormwater regulations. A field inspection of all stormwater device(s) and conveyances shall be completed and sealed by the design engineer and/or a certified 3rd party SCM inspector.

Before an as-built stormwater improvement submission may be made to the County, the County field consultant shall verify, via inspection, that:

- any temporary erosion control measures (skimmer, etc.) have been removed,
- the stormwater control measure has generally been converted to its final form and is stabilized and non-erosive, and
- that the permanent conveyances to the measure(s) are stabilized, non-erosive, and generally in the correct locations.

Once verified, the Wake County field consultant shall provide a completed form to the applicant which shall be submitted with the as-built package. The as-built stormwater submittal checklist may be found here.

3.6.6.2 Stormwater Control Measures and Other Improvements

As-built plans are required to be submitted, along with an Engineer's Certification and 3rd party field inspection, to verify that all stormwater improvements have been completed in accordance with the approved plan and County regulations.

Refer to the as-built checklist for general submittal requirements. Sufficient information must be provided to ensure that:

- Target Curve Number Volume requirements have been met (for residential projects only)
- Peak Flow requirements have been met
- Required Nutrient treatment has been provided
- Assumptions of any downstream assessments have been met
- Stormwater control measures are installed per the approved plans (design vs. as-built elevations for water quality, 1-year, 10-year, and 100-year storms shall be provided on cross section)
- Permanent pool elevation (design vs. as-built elevation) for applicable SCMs
- All Minimum Design Criteria have been met for each stormwater control measure
- Required plantings/stabilization has been provided
- Stormwater conveyances and drainage facilities are installed per the approved plans and capture the required drainage areas
- All stormwater improvements (including drainage facilities and stormwater control measures) are located within the recorded stormwater access and maintenance or drainage easements
- All backwater from the stormwater system is contained within the recorded stormwater, drainage, or backwater easements
- Any other project specific requirements have been met

As-builts shall not be submitted for County review and approval until the stormwater control measures and all of their conveyances have been permanently stabilized. Any and all temporary erosion control measures within the SCMs shall be removed including skimmers and baffles, and permanent stabilization and/or landscaping of the SCM completed. When ready, the as-built submittal and associated Engineer's Certification shall be uploaded to the stormwater permit through the Wake County Permit Portal. If the submittal is complete, the Watershed Management plan reviewer shall request an as-built inspection be performed by the post-construction staff and will begin the 10-day initial review cycle.

When the initial review is complete, the Watershed Management plan reviewer shall provide a Stormwater As-built Review Checklist to the responsible party and certifying engineer which either notes approval or rejection of the as-built submittal. If the as-built submittal is not approved, specific comments shall be provided which must be addressed before resubmittal through the Portal. Upon approval of the as built submittal, including inspection approval, the responsibility of the device transfers to the permanent owner, homeowners' association, etc. The permanent owner shall register in the Wake County Permit Portal to enable submission of the annual inspection through the Permit Portal.

3.6.6.3 Impervious Surveys

As-built impervious surveys are not required for every project but may be required as a condition of a project's approval to verify that the actual constructed project complied with any maximum impervious limitations, specific design assumptions, certain exemptions (no increase in BUA) or thresholds (low-density) that were critical to the plan approval.

For example, if disturbance thresholds for a project subject to the Neuse or Falls Lake Rules were met, then a stormwater management plan and permit are required to verify compliance with the Rule. If compliance was shown via no increase in impervious, then no calculations or SCMs are required BUT an as-built impervious survey may be required to verify that the completed project did not in fact increase impervious.

If an as-built impervious survey is required as a condition of approval, the submitted survey must be sealed by a North Carolina licensed surveyor. The as-built impervious survey shall be uploaded to the stormwater permit through the Wake County Permit Portal.

As-built impervious surveys may also be required by Wake County Planning, Development, and Inspections staff as part of their reviews in specific watersheds, particularly in Swift Creek.

3.6.7 Post-Construction Owner Requirements

Stormwater improvements include not only any stormwater control measures, but also drainage facilities (ex: conveyances) and easements. While the developer is responsible for the initial completion of stormwater control measures and any other stormwater improvements, the responsibility for long-term maintenance passes to future owners – which may be a homeowners' or property owners' association. All stormwater improvements are required to be maintained into perpetuity so that they continue to function and meet the purpose and requirements of the County's stormwater ordinance. It is the responsibility of the developer to provide the approved as built package, construction plan and maintenance documents including the O&M manual to the HOA, management company or property owner.

All owners should familiarize themselves with any Operations and Maintenance Plan and/or Maintenance Agreement for the measures for which they are responsible. It is also important for owners of stormwater improvements to ensure that they have budgeted appropriately to pay for annual third-party inspections as well as routine and future maintenance needs. Owners shall register in the County Permit Portal and notify the County when there are changes in the ownership of a stormwater control measure.

Wake County Watershed Management staff have the right to inspect sites to determine whether the stormwater improvements have been installed and are being properly maintained (Refer to UDO Article 9, Part 6). Enforcement actions, including but not limited to Notices of Violation or civil penalties, may be issued for failure to submit annual inspections, failure to maintain SCMs, removal of SCMs, or any other violations of Wake County's UDO.

Owners may wish to view additional information, including videos, regarding operation and maintenance of specific types of stormwater control measures at NCDEQ's website here.

Annual Inspections

Owners of stormwater control measures are required to submit an annual inspection report for each measure by June 30th of each year.

- Annual inspections for stormwater control measures that were installed as part of a stormwater deviation approval to increase the maximum impervious surface area (MISA) limitation on an individual lot are not typically required to be performed by a qualified professional. These inspections may be performed by the individual property owners. The exceptions to this are underground devices and permeable pavement, which both require a qualified professional to inspect and certify each year.
- All other annual inspections for stormwater control measures shall be performed by a qualified professional working within their area of competence. These professionals may include: a licensed North Carolina Professional Engineer, Surveyor, or Landscape Architect; soil scientist; aquatic

biologist; or other person certified by the North Carolina Cooperative Extension Service for stormwater control measure inspection or maintenance.

- The inspection report(s) shall be submitted via the Wake County Permit Portal by uploading it to the associated stormwater permit via Attachments
- To upload documents to the Portal, owners and their representatives must register for an account and be linked to the appropriate permit(s) in the system. Please contact Watershed Management at watershedmanagement@wake.gov to request access to your permit case files (Subject Line: Add Case Contact). The Watershed Management Contact Change Request Form must be attached to this email request. This form is available through the Permit Portal.
- All inspection reports shall be on a form provided by or approved by Wake County. Current approved annual inspection forms may be downloaded from the County's website under "Stormwater Management" here.

Records of Maintenance

The owner of the stormwater control measure(s) is responsible for maintaining it so that it continues to serve the intended functions. Specific operation and maintenance requirements, including inspections at certain timeframes or after rainfall events, for each measure are identified in the Operation and Maintenance Plan(s) for the SCMs. Owners of SCMs shall keep all maintenance records for a minimum of 5 years, and these records shall be made available to the County upon request. Reference UDO 9-32-1.

Operation and Maintenance Plans

The owner of an SCM (lot owner/home owners association/property owners association) is required to update the operations and maintenance plans for stormwater control measures at least once every 10 years (UDO 9-23-3(B)). This provision does not apply to measures installed as part of an approved stormwater deviation.

Change of Ownership

While legal responsibility for the maintenance of SCMs automatically transfers to successive owners with property transfer in accordance with the recorded Stormwater Agreement, the County requests notification of any change in ownership. The County requests to be notified in writing within 30 days of any change in ownership/responsibility for stormwater control measures. Contact information for the new owner should be included within the notification.