LID-EZ USER'S MANUAL

Developed for the Towns of Cedar Point and Cape Carteret as part of the Section 319 Grant funded by the NC Department of Environment and Natural Resources

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Introduction

This manual outlines the process for filling out and completing the calculations form, as well as providing a framework for the calculations used within the spreadsheet. This manual may not include support and explanation for every possible permutation and combination of calculations and methodology used to reach the final answers reported in the spreadsheet. If a specific scenario is not adequately explained, additional assistance is available from the developers. Please contact Town officials to obtain additional project support.

The manual is organized in a way which follows the typical data entry process for the spreadsheet, and subject headings match those shown on the spreadsheet.

The references to current regulations included herein are based on the developer's current understanding of NCDWQ Coastal Stormwater permitting policies and guidance and are subject to change. Project Applicants are asked to verify current stormwater regulations and policies at the time of submittal, as they may have changed subsequent to development of this spreadsheet.

General Project Information

The top portion of the spreadsheet includes five free entry fields where the user can list the project name, project number (this may also be used to reference Town issued permit or application numbers), firm name of the lead design firm, project contact person, and revision date. This information is for administrative purposes only and is not used anywhere else in the spreadsheet.

Site Data

- **Jurisdiction -** the town issuing the permits for the project
- **Receiving Stream Class –** This pull down list is used to select the receiving stream classification. If the project is within ½ mile of, and drains to a stream classified as SA, then SA should be selected. Otherwise Non-SA should be selected. Depending on the classification of the receiving stream and the distance the stream is from the project site, stormwater management requirements vary. Once selected, the spreadsheet will report stormwater requirements based on the applicable regulation.
  For additional assistance in determining the appropriate stream classification, contact Town officials or the NCDWQ Wilmington Regional Office.

- **Default WQ Volume –** This is an automatically seleted value based on the stream classification selected above. Projects within a half mile of SA waters (and draining to them) are required to control and treat the change in runoff volume expected during the 1-yr 24 hour storm, reprenseted by "Delta 1-yr Storm". All other projects are required to control and treat the stormwater runoff resulting from 1.5 inches of rainfall, represented by "First Flush" (see "Rainfall Depth" explanation below).
- **Override WQ Vol –** the user has the ability to override the default value and use any one of three options. The first two options are described above. The third option, "Low Density" should only be used if the project complies with the NCDWQ requirements for Low Density projects. Low Density projects do not have a volume control requirement, but are held to impervious area limitations and higher conveyance design standards. *Note: This spreadsheet does report total project % impervious, but there are no error messages to report non-compliance with Low Density project requirements.*

Rainfall Depth

- **First Flush -** the rainfall depth to be used for first flush calculations (where applicable). The default value for this is set at 1.5" to match current permitting requirements, however due to vested rights or other Town requirements, this value may be modified.
- **1-yr & 10-yr 24-hour** - Rainfall depths for the referenced storm events based on NOAA Atlas 14 rainfall data for the Cedar Point area, as of June 2011.

Site Summary

- The three results listed here are calculated from the post development land use data entered later in the spreadsheet. Impervious are and built upon area are adjusted to account for the allowable credits provided for Permeable Pavement as described in the NCDWQ BMP Manual.

Storage Requirements

- The 2 results here show the minimum total volume of runoff which must be controlled and treated. Data is shown for both possible rule requirements.

Permeable Pavement

- This section follows the NCDWQ Guidance for calculating the benefits of Permeable Pavement systems as a runoff reduction BMP. The use of Permeable Pavement, installed per the DWQ BMP Manual minimum standards, results in a reduction in Built Upon Area, and a corresponding reduction in Curve Number (explained below).
- **Input Parameters**
    - **Pavement Type –** choose from one of the 5 options. These are based on the approved pavement types and installation standards outlined in the NCDWQ BMP Manual
    - **Soil Infiltration Rate –** input the average infiltration rate of the underlying soil Note – 0.52 in/hr minimum required for credit, and information should be supported by soil tests completed by registered soil scientist or other qualified professional.
    - **Soil Type –** choose the appropriate Hydrologic Soil Group. The HSG is based on typical soil qualities. A listing of soil names and the corresponding HSG, and more information on Soil Groups, can be found in "Urban Hydrology for Small Watersheds" Appendix A
- Note: The inputs here are used to compute an adjusted curve number for the permeable pavement areas in the post-development t land use conditions. If any of the minimum requirements (as defined by DWQ) are not met, then the CN will default to 98, and no BUA or runoff volume reduction will be credited.

<u>Project Specific Information – Land Use and BMP Data</u>

In this section of the spreadsheet, the user enters the site specific variables needed to complete the stormwater assessment and show compliance with State and Local stormwater control regulations.

Pre & Post Development Land Use

- All existing condition reports and post development land use plans can be broken down into land uses comprised of a soil type and a ground cover. Soil Types can be gathered from the most recent Carteret County soil survey, published by USDA, or from site soils reports completed by a licensed soil scientist. Each soil type is classified into one of 4 Hydrologic Soil Groups. A list of soils types and their corresponding HSG can be found in "Urban Hydrology for Small Watersheds" Appendix A

Land use simply represents the type of land cover present (or proposed) for that area. For this spreadsheet the list of Land Uses presented in TR-55 has been pared down for simplicity and consistency. Generally, land use is divided into Woods, Open Space (or landscaped areas), and impervious cover. For the post development section Impervious Areas are further broken down into the following 3 types:

- **Connected impervious Area** – Impervious cover which is connected to a defined stormwater conveyance (ditch, gutter, pipe, etc). The runoff from this area has little or no opportunity to infiltrate into the ground prior to reaching an analysis point or the site boundary.
- **Disconnected Impervious Area** – impervious cover which is constructed in a manner which allows the runoff from the impervious area to infiltrate into adjacent pervious areas such as woods or landscaped areas. Note that if the impervious area is connected to a defined structural stormwater BMP such as an infiltration area or grass swale, then the area should be considered to be "Connected impervious" area.

  Note: Justification of all impervious areas claimed as 'Disconnected" is required. The pervious areas adjacent to the impervious area must be capable of infiltrating the design rainfall event based on the area available for infiltration, soil properties, and slope.

- **Permeable Pavement** – as described above – a pavement system which allows stormwater to flow through the pavement and infiltrate into the underlying soil. These systems are subject to NCDWQ Design Standards.

- For each combination of ground cover and soil type, the spreadsheet will automatically enter the corresponding SCS Curve Number. The user must also enter the total area covered by that combination of soil type and land use.

IMP / BMP Devices (Storage Input)

- This section allows the user to input structural stormwater Integrated Management Practices (IMP) or Best Management Practices (BMP). The practices are used to control and treat stormwater runoff. The input parameters include 4 parameters
  - **Location -** this is a user entry, free text field, used to help correlate this calculation sheet to site plans. The location listed should be identifiable on the accompanying site plans.
  - **Type of Device –** from the pull down list, choose the type of BMP proposed in this location
  - **Storage Volume –** enter the storage volume (in cubic feet) available in the device to contain and control stormwater runoff. All volume claimed should be designed to allow the stormwater to infiltrate or, where allowable by NCDWQ BMP design standards, drawdown over 2-5 days.

    Note: Selected BMPs have no storage volume component; this field should be left blank for those BMPs

  - **Impervious Area –** Enter the impervious area which is treated by this device. If permeable pavement drains to the device, the user should calculate the net impervious area after taking the allowable NCDWQ reduction.

Calculations

SCS Curve Number Method

The majority of calculations completed by the spreadsheet reference "Urban Hydrology for Small Watersheds" also known as "TR-55" first published by USDA in 1975. The equations listed herein were adapted from version "210-VI-TR-55, Second Ed., June 1986." The references to TR-55 are also referred to, in general terms, as the Curve Number Method.

Runoff Volume Management

Runoff volume control is a guiding principle of Low Impact Development and is applicable to all new developments. Regardless of regulations, the effort to control and treat the increase of stormwater runoff volume caused by changes in land cover is a sustainable approach fostering environmental stewardship. Volume management can be achieved using the LID techniques discussed in the Town's LID Manual.

Composite CN Calculation

To determine the pre and post development runoff volumes, a composite curve number must be calculated from the combination of soil types and land uses. The composite curve number is reported in the **Curve Number Summary**

Example: Determination of the Curve Number

The proposed development is a 1.1-acre site in which the soil and proposed surface cover types have been determined. The acreage of each of these areas is known. Using the curve number (CN) table from TR-55, the soil type, and the surface cover types, the curve number has been determined for each area. Determine the proposed curve number for the site.

Proposed Site Composition:
Proposed Woods, HSG B (CN = 55) = 0.25 acres
Proposed Open Space, HSG B (CN = 61) = 0.45 acres
Proposed Impervious (CN = 98) = 0.40 acres

Solution:
Multiply the acreage by the curve number and sum the products.
55 * 0.25 acres = 13.75
61 * 0.45 acres = 27.45
98 * 0.40 acres = 39.20
13.75 + 27.45 + 39.20 = 80.40

Divide the sum by the total site acreage to determine the composite curve number.
80.40 / (1.1 acres) = 73.09

A curve number must be a whole number – therefore the composite curve number is 73.

Disconnected Impervious Area CN Calculation

TR-55 gives credit for disconnected impervious surfaces by reducing the total composite curve number for the site. The adjustment is based on the percent of disconnected impervious area to total impervious area, as well as the CN of the pervious areas. The CN of the pervious areas is important because it impacts the degree to which we can expect runoff to infiltrate into the

natural soils. Note that this CN adjustment is only reflected in the **Curve Number Summary** and that the CN listed for the disconnected area in the land use input table will always be 98.

TR-55 provides an equation to determine the composite curve number when using disconnected impervious. This equation is:

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

Where:
CN_c = Composite Curve Number
CN_p = Pervious runoff curve number
P_{imp} = Percent imperviousness
R = ratio of unconnected impervious area to total impervious area

Runoff Volume Calculation

The SCS Runoff Curve Number Method was developed to determine runoff for a particular rainfall event, neglecting storm intensity, for a specific curve number. The runoff represents the amount of rainfall that is not retained in surface depressions, intercepted by vegetation, evaporation, and infiltration. The total runoff volume for a site is based on the total site area, the composite CN for that site, and the design rainfall depth. The SCS runoff equation is:

$$Q^* = (P – 0.2S)^2 / (P + 0.8S)$$

Where:
Q* = runoff in inches
P = Precipitation Depth in inches
S = Potential maximum retention after runoff begins in inches

$$S = (1000 / CN) – 10$$

Once the runoff depth is determined, it is multiplied by the total area to determine total runoff volume.

Determining Required Treatment Volumes

If the project is required to control and treat the difference in runoff volumes between pre and post development conditions, then the spreadsheet will compute pre and post development composite CN's and then compute the corresponding runoff volumes based on a 3.57" rainfall depth. The minimum required treatment volume is the difference between those two values. This value is reported under the **Storage Device Results** section, as "Total Volume Required"

Using Storage Devices to Reduce the CN

On many sites, land use practices (site fingerprinting, disconnected impervious areas, pervious pavements, etc) may not be sufficient to meet all stormwater permitting requirements. In this case BMPs should be used to control the remaining difference in stormwater volume.

Determining the required storage volume or an individual BMP

- Runoff volume is heavily influenced by impervious cover. Using the data entered for total impervious on site, and impervious area treated by the BMP, the spreadsheet

calculates the % of total impervious area treated by this BMP. That percentage is then multiplied by the total volume required to determine the volume required for the individual BMP.

Computing the CN reduction

TR-55 provides an equation to compute the adjusted CN resulting from the implementation of storage and infiltration devices within the contributing watershed (site). The process was developed in order to model infiltration devices and other storage devices that the NRCS TR-20 software could not model. It is essentially the reverse of the runoff volume calculation process shown above – in this process the spreadsheet starts with the runoff volume, removes the storage volume and then uses the net volume computes the CN rather than using the CN to determine the runoff volume. The equation to adjust the CN based on provided storage is:

$$CN_{adjusted} = 200 / [(P+2(Q)+2) – (5PQ+4(Q^2))^{1/2}]$$

Where:

P = Rainfall Depth (inches)

Q = (Runoff Depth for Proposed unadjusted CN – Volume Provided) (inches)

So in this equation, the spreadsheet converts the total volume provided in the storage devices to an equivalent rainfall depth by dividing the volume provided by the site area.

Pollutant Removal

Pollutant removal rates for individual BMPs are based on the current version of the NCDWQ BMP manual. Composite pollutant removal rates are calculated using a weighted average based on BMP characteristics and the % of total area treated.