Greenville County Technical Specification for:

WQ-26 STORMWATER COURTYARD

1.0 Stormwater Courtyard

1.1 Description

Stormwater Courtyards are vegetated stormwater treatment areas that detain stormwater runoff and allow the runoff to filter through a soil media bed. Stormwater Courtyards have a shallow depression that contains aesthetically pleasing, water tolerant plantings and can be designed to include an underdrain system. Stormwater Courtyards are commonly installed to treat stormwater runoff from residential lots and parking areas. Stormwater Courtyards are best suited for relatively flat, low areas that have well drained soils.

1.2 Requirements

1.2.1 General Requirements

Do not construct courtyard areas until all contributing drainage areas are stabilized. Do not use courtyards as sediment control facilities. Do not operate heavy equipment within the perimeter of courtyards areas during excavation, underdrain placement, backfilling, planting, or mulching. The bulleted list below includes design and serviceability requirements for all Stormwater Courtyard installations.

- Drainage areas for courtyards will consist of paved surfaces, buildings, or other impervious surfaces.
- Locate Stormwater Courtyards away from buildings to prevent damage from flooding or standing water.
- Groundwater levels will be at least 2 feet lower than the bottom of the courtyard area.
- Do not install Stormwater Courtyards over septic tanks or leach fields.
- Select areas for Stormwater Courtyards in full or partially sunny locations to facilitate the drying process for plant growth.

1.2.2 Design Requirements

Stormwater Courtyards work best when constructed off-line, capturing only the water quality volume. Divert excess runoff away from the Stormwater Courtyard area or collect excess runoff with an overflow system. Install Stormwater Courtyard to fit around natural topography and complement the surrounding landscape. Stormwater Courtyard areas are any reasonable shape and fit around sensitive areas, natural vegetation, roads, driveways, and parking lots. The following bulleted list includes design requirements for all Stormwater Courtyard installations:

- Stormwater Courtyards will have water depths less than 1.0-ft for the water quality volume.
- Stormwater Courtyards will have a level bed and be constructed in areas where soil conditions will allow for the infiltration of collected stormwater.
- Underdrain systems may be used for soils with low infiltration rates. See the Bioretention Specification for guidance with designing and installing underdrain systems.

- When applicable, the underdrain must drain freely to an acceptable discharge point. The underdrain can be connected to a downstream open conveyance (vegetated swale), to an adjacent courtyard as part of a connected treatment system, or to a stormwater conveyance system.

- Convey stormwater runoff to the courtyard in a non-erosive manner.

1.2.3 Pre Treatment System

Provide a pre-treatment system to trap coarse sediment particles before they reach the courtyard area, which prevents premature clogging. Use pre-treatment systems that evenly spread runoff across the entire width of the Stormwater Courtyard area. Several pre-treatment systems are applicable, depending on whether the Stormwater Courtyards receives sheet flow, shallow concentrated flow or deeper concentrated flows. The following are appropriate pretreatment options:

- **Grass Filter Strips** (for sheet flow): Grass filter strips extend a minimum of 10 feet from edge of pavement to the courtyard and have a maximum slope of 5%.

- **Gravel or Stone Diaphragms** (for sheet or concentrated flow), located at the edge of the pavement or other inflow point, should run perpendicular to the flow path to promote settling. The stone must be sized according to the expected rate of discharge.

- **Pea Gravel or Stone Level Spreaders** (for sheet flow) extend along the top of each bank to pre-treat lateral runoff from the road shoulder to the courtyard. This requires a 2 to 4 inch elevation drop from a hard-edged surface into a gravel or stone diaphragm.

The level spreader option is the most desirable because level spreaders successfully reduce incoming energy from the runoff and convert concentrated flow to sheet flow that is evenly distributed across the entire Stormwater Courtyard area.

1.2.4 Mulch Layer

Provide a uniform 3 inch layer of mulch on the surface of the Stormwater Courtyard area to enhance plant growth, enhance plant survival, suppresses weed growth, reduce erosion of the planting mix, maintain soil moisture, trapping fine sediments, promote the decomposition of organic matter, and pre-treat runoff before it reaches the courtyard.

Provide shredded hardwood mulch that consists of hardwood trees milled and screened to a maximum 4 inch particle size, uniform in texture, free from sawdust, foreign materials, and any artificially introduced chemical compounds detrimental to plant or animal life. Provide mulch that is well aged a minimum of 6-months.

Do not use pine needle, or pine bark mulch due to the ability of floatation.

Use alternative surface covers such as native groundcover, erosion control blankets, river rock, or pea gravel as directed by Greenville County LDD. Use alternative surface covers based on function, cost and maintenance.

Do not use mulch for Stormwater Courtyards that utilize turf grass as the vegetation material.

1.2.5 Overflow System

An overflow system is used to pass runoff volumes greater than the water quality volume away from the Stormwater Courtyards area. Place an overflow structure at the elevation of the maximum ponding depth (12-inches) of the Stormwater Courtyard to carry excess runoff from a 10-yr 24-hr rainfall event to a stormwater conveyance system or stabilized outlet.

1.2.6 Plantings

Use plantings that conform to the standards of the current edition of *American Standard for Nursery Stock* as approved by the American Standards Institute, Inc.

For Stormwater Courtyard applications near roadways, consider site distances and other safety concerns when selecting plant heights. Consider human activities which may damage the plantings, cause soil compaction or otherwise damage the function of the Stormwater Courtyard area when selecting plant species.

Use plant materials that have normal, well developed stems or branches and a vigorous root system. Only use plantings that are healthy, free from physical defects, plant diseases, and insect pests. Symmetrically balance shade and flowering trees. Ensure major branches do not have V shaped crotches capable of causing structural weakness. Ensure trunks are free of unhealed branch removal wounds greater than a 1 in. diameter.

Use plant species that are tolerant to wide fluctuations in soil moisture content. Use plantings capable of tolerating saturated soil conditions for the length of time anticipated for the water quality volume, as well as anticipated runoff constituents.

1.3 Installation

1.3.1 Excavation

Excavate the Stormwater Courtyard area to the dimensions, side slopes, and elevations shown on the Contract Plans. Excavate Stormwater Courtyard area to the required depth based on the plantings utilized.

Ensure excavation minimizes the compaction of the bottom of the Stormwater Courtyard area. Operate excavators and backhoes on the ground adjacent to the courtyards, to excavate the area. Low ground-contact pressure equipment may be used for excavation. Do not operate heavy equipment on the bottom of the Stormwater Courtyard area.

Remove excavated materials from the Stormwater Courtyard site and dispose of them properly.

1.4 Maintenance

Regular inspection and maintenance is critical to the effective operation of Stormwater Courtyard areas. The surface of the ponding area may become clogged with fine sediments over time. Perform light core aeration or cultivate unvegetated areas as required to ensure adequate filtration. Other required maintenance includes but is not limited to:

- Perform pruning and weeding to maintain appearance periodically as needed.
- Replace or replenish mulch periodically as needed.
- Remove trash and debris periodically as needed.

Required Maintenance	Frequency
Pruning and weeding.	As needed
Remove trash and debris.	As needed
Inspect inflow points for clogging. Remove any sediment	Semi-annual (every 6 months)
Repair eroded areas. Re-seed or sod as necessary.	Semi-annual (every 6 months)
Mulch void areas.	Semi-annual (every 6 months)

Required Maintenance	Frequency
Inspect trees and shrubs to evaluate their health.	Semi-annual (every 6 months)
Remove and replace dead or severely diseased vegetation.	Semi-annual (every 6 months)
Removal of evasive vegetation.	Semi-annual (every 6 months)
Nutrient and pesticide management	Annual, or as needed
Water vegetation, shrubs and trees.	Semi-annual (every 6 months)
Remove mulch, reapply new layer.	Annual
Place fresh mulch over entire area.	As needed
Replace pea gravel diaphragm	Every 2 to 3 years if needed

1.5 IDEAL Modeling

The table below shows how to represent this BMP and BMPs similar to this one in the IDEAL model. It lists the parameters needed to successfully run the model and the parameters that affect the trapping efficiency of the BMP.

Stormwater Courtyard Modeling in IDEAL		
What to Model as in IDEAL	Bioretention Cell	
Similar BMPs	Stormwater Alley	
	Green Roofs	
	Planter Box	
	Rain Gardens	
	Natural Infiltration Area/ Basins	
	Bioretention Areas/Swales/Basins	
Specifications Needed for IDEAL	Cell area and number of layers within the cell.	
	If applicable underdrain details such as: - Subgrade infiltration soil texture and degree of saturation. - Underdrain orifice diameter.	
	Type of media and depth of each layer of the cell.	
	Shape and dimensions of the riser.	
	Dimensions, slope, manning's roughness coefficient, and entrance loss coefficient of the barrel.	
	Type, shape, and dimensions of the emergency spillway if applicable.	
	Direct loading of bacteria that will be entering the cell.	
Parameters that Drive Performance	Feature	How Value Affects Sediment Trapping Efficiency (TE)
	Underlying Soil Texture	Soils with higher infiltration capabilities increase TE.
	Area	Increasing area increases TE.
	Amount of Clay in Media	More clay increases TE but decreases infiltration rate.

1.6 References

Clemson University Public Service Activities Carolina Clear, Rain Gardens, A Rain Garden Manual for South Carolina.

NCDENR Stormwater BMP Manual, Chapter 12 Bioretention, Chapter Revised 07-24-09

Prince George's County, Maryland, Bioretention Design Specifications and Criteria, Section 2.0 - Siting and Design Criteria