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# Rain Garden Installation: Site and Soil Conditions

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**Rain gardens have the potential to lower the impact of stormwater coming from impervious surfaces in urban areas and to mitigate non-point source polluted runoff. Rain gardens are easy to install, inexpensive, sustainable, and are aesthetically pleasing. The site and soil conditions of a rain garden installed in Spring 2006 on the campus of Florida A&M University, Tallahassee, Leon County, are described. The soil at the rain garden site is composed of three types: Orangeburg, Plummer, and Urban land. Data for soil leaching and runoff potential for pesticides indicate that all three soils have a medium soil leaching potential to leach to groundwater, with the Plummer and Urban land soil types having a high runoff potential. Soil fertility testing of the rain garden site for phosphorus, potassium, magnesium, and calcium indicates that the soil is high in phosphorus, medium-high in potassium, and very high in magnesium.**

Rain gardens are relatively small, maintained landscapes that serve to capture runoff water. They have been recommended as a best management practice for homeowners to treat stormwater runoff and have the ability to filter runoff pollution, recharge local groundwater, conserve water, improve water quality, protect rivers and streams, remove standing water, create habitat for birds and butterflies, and survive drought seasons (Lloyd et al., 2002). Rain gardens are usually located in low areas of the landscape where water naturally collects after a rain event that would otherwise flow into natural waterways or storm sewers. Because of water's natural ability to dissolve more substances than any other liquid, it can dissolve or carry excessive nutrients and hazardous waste (pesticides, paint, solvents, and motor oil) as it flows off building rooftops, driveways, and walkways. These stormwater pollutants can poison aquatic organisms and negatively impact their environment (USEPA, 2003).

In combination with other alternative stormwater strategies such as utilization of rain barrels and redirection of stormwater to allow its flow into a remediation site, rain gardens can serve as a localized on-site stormwater management practice that is applicable for residential, governmental, institutional, recreational, and agricultural landscapes. Wherever stormwater is of concern, rain gardens can help to mitigate off-site drainage issues and improve water quality by allowing the chemical, biological, and physical properties of plants, microbes, and soils to remove pollutants from stormwater runoff. The objective of this paper is to describe the characteristics of a rain garden site and the existing soil conditions.

## Materials and Methods

**Rain garden site.** In Spring 2006, a rain garden was installed on the campus of Florida A&M University–Cooperative Extension Service University Teleconference Center at 2010 Pinder Drive, Tallahassee. A preexisting stormwater runoff impoundment was selected for the rain garden site. The site receives stormwater runoff mainly from the Teleconference Center's rooftop, parking lot, and walkways, an area that is ~21,560 square ft. The rain garden is ~12 ft lower than the Teleconference facility foundation, parking lot, and impervious areas, with a slope of ~40°. A constructed cinder block retention wall, approximately 60 ft long on the north side and 70 ft long on the west side, delineates the northern and western boundaries of the rain garden. A single 12-inch stormwater drainage pipe delivers rainwater runoff to the rain garden site. The site was previously supplemented with builder's sand to facilitate drainage and percolation.

In preparation for the rain garden installation, the drainage area was measured and a design was conceptualized. The design plan depicted the location of the rain garden, an area that is ~2100 square ft, and the layout of the plant materials to be used. Table 1 contains a list of plants used in the rain garden. Creeping fig was planted on the northern and western walls to provide vegetative cover and annual pansies were used for a show of color. Site preparation consisted of weed removal, amending the soil with mushroom compost (Quincy Farms, Quincy, FL), and placing a weed barrier (WeedBlock, Easy Garden Product Ltd., Waco, TX) for weed suppression. Plants were installed and mulched with pine straw (Fig. 1). The plants were watered initially and then as needed to get them established. The site receives partial sunlight since trees on the north and east side of the rain garden site partially shade it.

**Soil test.** To ascertain the nutritional status of the soil in the rain garden, soil samples were collected, one pooled inside the

Table 1. List of landscape plants used in the rain garden installation.

| Genus and species | Common name |
|---|---|
| *Hydrangea quercifolia* | Oak-leaf hydrangea |
| *Cornus florida* | Florida dogwood |
| *Serenoa repens* | Saw palmetto |
| *Ficus pumlia* | Creeping fig |
| *Viola tricolor hortensis*[z] | Multi-colored pansy |

[z]Annual bedding plant.

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Fig. 1. Plants in the rain garden were mulched with pine straw.

rain garden site and one outside the rain garden boundary. The soil samples were obtained by collecting 12 soil cores from the upper 6 inches of the soil surface from each area. The samples were air dried for 48 h and a pint of soil was individually bagged per area and shipped to the Soil Testing Laboratory at the University of Florida, IFAS, in Gainesville. A standard fertility test was performed to determine pH, lime requirement, phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg). The soil test does not determine nitrogen in the soil because it is highly mobile and its soil status varies with rainfall or irrigation events (UF/IFAS ESTL, 2004).

## Results and Discussion

The US Natural Resource Conservation Service (NRCS) cooperatively investigates, inventories, documents, classifies, and interprets soils of the United States for land-use management decisions. A search of the NRCS Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/) for soil types at the Teleconference Center showed that that it contains Orangeburg, Plummer, and Urban land soils. Descriptively, Orangeburg soils are very deep, well drained, moderately permeable that formed in loamy and clayey sediments of the coastal plain. Plummer soils are very deep, poorly drained, moderately permeable, loamy and found on the lower and upper coastal plain. Urban land soils are generally characterized as land covered with buildings, streets, houses, schools, and downtown areas.

These soils have been previously rated for their leaching and runoff potential to assist pesticide applicators in determining pesticide loss potential to groundwater and surface water bodies (Hurt et al., 1999). The rain garden soils' leaching and runoff potential ratings are listed in Table 2. The three soil types present at the Teleconference Center were all rated medium for their ability to leach to groundwater. The use of a weed barrier, designed with micro-funnels, allowed air and water to move through and did not impede stormwater from moving into the soil. Cut-out openings in the weed barrier that were similar in size to the container plant root ball allowed for facilitated drainage and percolation into the soil. The rain garden site has a considerable amount of builder's sand, which also allows the site to drain quickly, even though the site is considered to have a medium-high runoff potential as indicated above. The north and west walls help to retain the stormwater, providing time for percolation to occur.

Table 2. Rain garden soils leaching and runoff potential rating[z] of Orangeburg, Plummer, and Urban soils at the FAMU Teleconference Center in Leon County, FL.

| Soil type | Soil leaching | Soil runoff |
|---|---|---|
| Orangeburg | Medium | Medium |
| Plummer | Medium | High |
| Urban land | Medium | High |

[z]For leaching, soils rated "medium" have a medium potential for pesticides to leach to groundwater (Hurt et al., 1999). For runoff, soils rated "high" have a high potential for pesticide runoff and soils rated "medium" have a medium potential for pesticide runoff.

Results from the soil fertility test indicted that P (37.36 ppm) was twice as high in the rain garden site as compared to the areas outside the rain garden (18.87 ppm) (Table 3). The higher levels of P could be attributed to the supplemental soil amendment with mushroom compost. The levels of K, Mg, and Ca were about one-third higher outside the rain garden compared to the area inside the rain garden and maybe due to the variability of soil types. Further testing will be conducted to determine soil nutrient composition. The soil sample results also indicated that the soil pH is somewhat alkaline and falls just within the optimum range for most terrestrial soils.

The rain garden at the FAMU Teleconference Center has the potential to mitigate stormwater runoff, improve water quality, and enhance the campus landscape aesthetic experience. Future studies will be conducted to evaluate plant performance, water quality parameters, and soil biological activities.

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Table 3. Landscape garden soil test results for pH, lime requirement, phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) at the FAMU Teleconference Center Rain Garden, Tallahassee, FL.

| | pH[z] | Lime | P (ppm) | K (ppm) | Mg (ppm) | Ca (ppm) |
|---|---|---|---|---|---|---|
| Inside rain garden | 7.6 | None | 37.36 | 67.96 | >939.2[y] | >2524 |
| Outside rain garden | 7.8 | None | 18.87 | 91.08 | >1536[y] | >3.600 |

[z]The pH of the soil is quite high and it is recommended to use plant species that are tolerant of high soil pH.
[y]Soil test values noted with a ">" sign exceeded the normal working range of laboratory extraction method and are interpreted as high or very high. No positive plant response to addition of the nutrient is likely.