

A Case Study for the EDGE On-line Tool

[SHADOW WOOD PRESERVE]

Green Roof Evaluation

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INTRODUCTION

Florida was the first state in the country to require the treatment of stormwater from all new developments. With the state's continuing rapid growth and its potential impact on ground and surface waters, innovative technologies such as green roofs are essential to protecting the state's water resources. The first green roof in Florida was installed in August 2003 and monitoring began in October of that year. South Florida's tropical climate presented many design challenges, including the selection of appropriate plants, hurricanes and extended winter dry seasons. This is an ongoing project currently entering its third phase of operation. It is an example of a unique cooperative effort between a private developer, Bonita Bay Group, a state regulatory agency, the Florida Department of Environmental Protection (FDEP), and a private, local consulting firm, Johnson Engineering, Inc., to research and promote sustainable development.

BRIEF

With Florida's long growing season and abundant rainfall, green roofs seemed like an excellent innovative Best Management Practice (BMP) to improve stormwater management and reduce energy needs. As part of a stormwater research partnership with The Bonita Bay Group, a major developer of environmentally friendly communities, and low impact development in Southwest Florida, a golf course maintenance building at the Shadow Wood Preserve community was offered as a site for a pilot green roof. The FDEP entered into a contract with Roofscapes, Inc. to design the green roof and provide technical assistance in its construction and monitoring. One of the first challenges encountered was the lack of information on the plants that could be successfully grown on a green roof in Florida's subtropical climate. The area receives approximately 53 inches of rainfall a year, but has very distinct wet and dry seasons. Daily summer temperatures are in the 90's while freezing temperatures occur infrequently. Winter seasons have moderate temperatures and limited rainfall. However, almost all experience with green roofs has been in temperate and, to a lesser extent, Mediterranean climates in Europe where very different conditions prevail.

The objective was to develop a green roof model for South Florida that shares many of the characteristics of so-called 'extensive' green cover systems developed in Europe. These are veneer systems incorporating 'engineered soil' and synthetic layers which can support a dense ground covering vegetation layer without active irrigation. These systems are currently being adapted for use in a variety of American regions. However, up until now, no attempts have been made to build similar green roofs in sub-tropical climates. The building selected for the green roof project was the maintenance/storage building for the golf course maintenance operations at Shadow Wood Preserve in Lee County, Florida. The building design anticipated the roof top plantings.

Survivability of roof media and plants in the storm prone area of Southwest Florida was a concern of the designers with no real local field data available for green roof installations. During the summer of 2004, there were four hurricanes in Southwest Florida, Charley, Frances, Jeanne and Ivan, which brought high winds. While no storm had a direct hit on the green roof building, hurricane force winds were certainly in the area. Plants and soil media survived well without noticeable damage.

The project has undergone a replanting following the installation of a cistern in early 2006 that collects roof runoff to provide water for a new low volume drip irrigation system. The new plants bedded well and the roof returned to full operational status in the summer of 2006 with resumption of the water quality sampling and roof thermal characteristic monitoring. Since then, the plant viability and stability increased significantly, primarily due to irrigation and a plant selection better matched to hot wet summers and dry winters. New plantings included Beach Purslane, Beach Sunflower, Aloe, Crown of Thorns, Mulhy Grass and Cordgrass.

The green roof has also become habitat for local wildlife as well, with two successful nestings of killdeer, a medium sized American plover with two black neckbands and orange-red eye rings. We also observed a black snake on the roof that had apparently used a nearby cabbage palm to reach the roof level.

SUMMARY

The pilot green roof at the Shadow Wood Preserve project included three test plots, each approximately 800 square feet in area. All of these emphasized good drainage, since the threat posed by the hot humid summer conditions seemed greater than the winter dry season. The growth media used in each case was designed with a volumetric maximum moisture content of 35%. The grain-size distribution was skewed toward fine sand and course silt size particles in order to increase surface area and moisture-holding properties. The mixture included expanded shale, fine vermiculite and compost. The three plots differed in the soil media underdrain characteristics.

The initial plant list was composed of:

Plant species	Number of plants	Plant species	Number of plants
Sedum oxacuanum	36	Spartina spartini	100
Sedum album murale	86	Portulaca spp.	150
Sedum sexangulare	82	Portulaca pilosa	200
Sedum rubrotintum Dwarf	67	Tradescantia Wandering Jew	75
Sedum lineare variegatum	4	TYPE III ZONE ONLY	
Maleophora Tequila Sunrise	96	Sedum tetraactinum	12
Delosperma cooperii	96	Sedum bohmeri (Orostachys)	12
Delosperma herbeau	4	Sedum pachyphyllum	12
Delosperma nubigenum	91	Sedum muscoideum	1
Euphorbia millii Rosey	100	Sedum album micranthum	12
E. millii Short & Sweet	100	Delosperma floribundem	12
Zephyranthes Rain Lily	50	TYPE II ZONE ONLY	
Aloe vera	33	Agapanthus spp.	30

Table 1 List of Plants for the Shadow Wood Preserve Green Roof

The three roof plots were planted during the week of July 12, 2003. A total of 1433 plants were installed, generally with plants of each variety distributed in groups of 1- to 15 across each of the three roof areas. It quickly became apparent that the *Sedum* varieties could not withstand the humid, high moisture summer conditions, and most of the *Delosperma* varieties were not durable. The other plants in the trial, however, thrived, including *Aloe*, *Euphorbia*, and *Portulaca*. Present near the end of the initial phase but less robust were *Tibouchina* and *Agapanthus*.

One important lesson of this trial has been that the type of media used and the green roof profile structure are secondary to the correct choice of plants. Little difference has been observed between the three test plots, despite their varying moisture management approaches. However, based on our observations we would not recommend an unirrigated green roof with media depths less than six inches. Subsequent experience for 2003-2005 indicated the need for some type of low volume irrigation in order for plants to be able to thrive and survive extended dry periods typically experienced during winter seasons.

Sampling and sensor instrumentation was installed and set up by AMJ Equipment of Lakeland, Florida and Johnson Engineering, Inc., of Fort Myers, Florida and is

maintained by Johnson Engineering. Sampling equipment is composed of ISCO automated, programmable refrigerated samplers capable of operating in a flow compositing mode. The samplers are triggered by standard tipping bucket rain gages, flow measurements determined by an arrangement of rain barrel equipped with a pressure transducer and a series of calibrated orifices.

Roof thermal characteristics are recorded from readings produced by a set of sensors installed on and in the roof media and stored in a standard Campbell Scientific datalogger for later analysis.

Although sampling and analysis of the two phases of rain events are complete, the results are currently being reviewed by Florida Gulf Coast University (FGCU) staff, and should be available shortly. The same is true for the roof sensor thermal data.

In the winter of 2009, a cooperative effort between the golf course developer, Bonita Bay Group, FDEP, Johnson Engineering and FGCU, was developed to help ensure long term viability of the green roof following the end of research funding by FDEP. This arrangement will have FGCU staff utilizing the facility for advanced research training for environmental students.

PHOTOGRAPHS



Figure 1-Green Roof Bldg (Golf Course Maintenance Storage) at Shadow Wood Preserve



Figure 2-Roof Plantings Oct 2004



Figure 3-Roof Plantings March 2008



Figure 4-Irrigation Cistern System



Figure 5-Roof Sensor Wiring and Datalogger



Figure 6-ISCO Automatic Refrigerated Sampler