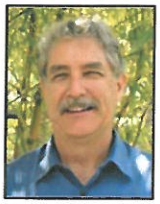
LID Success Stories in Florida



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Introduction

It is becoming increasingly clear to stormwater professionals in Florida that low-impact development (LID) design must become a more frequently used method in approaches to stormwater management. LID techniques expand the range of stormwater management options, can offer greater treatment effectiveness and more natural hydrologic responses, are often a more feasible application to space-constrained retrofit conditions, and provide cost savings over conventional treatment in many situations. Since LID has been practiced only sparsely in Florida in the past, the questions that often arise over its use are the following:

- How effective will it be under hydrologic conditions in Florida?
- How cost-effective is it compared to conventional treatment?
- How do the maintenance requirements for it compare to those for conventional treatment?

This article presents observations from example LID projects from Florida that help to answer those questions.

Town of Melbourne Beach Bioretention Retrofit

The Town of Melbourne Beach discharges a portion of its runoff to the Indian River Lagoon, which has a nutrient Total Maximum Daily Load. As is common in many coastal and urban communities in Florida, significant amounts of undeveloped land that may be available for stormwater retrofit projects are no longer present and have not been for many years. The Town is estimated to be 99% developed, and most of the development occurred before the advent of the State's stormwater treatment rules. Despite the challenges, the Town passed a referendum in 2008 to rehabilitate and improve its stormwater management system through bonding and ad valorem taxation (Town of Melbourne Beach Resolution 2008-13, Bond Referendum).

Figure 1. Curb Cuts with High-Flow Bypass

Figure 2. Energy Dissipaters and Sediment Sumps

Retrofitting the Town's stormwater management system for water quality treatment is a challenge using conventional stormwater treatment technologies since most of them are land-intensive. This led the Town and its consultant, Jones Edmunds, to consider LID practices for retrofit treatment since they can be well-suited for fitting into available spaces as needed.

The highlight project of the rehabilitation and improvements is the Sunset Boulevard Bioretention Park. Before the project, Sunset Boulevard had a crowned median with storm sewers and a raised-grass edging that caused the roadway to be directly connected impervious area that discharged to the Indian River Lagoon without significant treatment or attenuation. With the Bioretention Park design, the street was regraded to an inverted median that was converted into a 1,100-foot-long bioretention area. Curbs were constructed along the median/bioretention area for improved maintenance, safety, and aesthetics. Curb cuts were placed upstream of the storm sewer inlets so that discharge through the storm sewer system would not occur until the bioretention area filled to capacity, as shown in Figure 1. Flumes, energy dissipaters, and sediment sumps were constructed at the curb cuts to ensure that the inflow would not dislodge the mulch and that sediment would not clog the pore space of the bioretention media, as shown in Figure 2. Additionally the Town used pervious pavers at median ends and graded shallow swales along the roadside to eliminate the raised-grass edging to further promote infiltration, as shown in the pre- and post-construction photos in Figure 3. Areas in front lots were also graded for rain gardens at residents' request.

To date, the Town has not conducted any post-construction monitoring on the system. However, in October 2012 an unnamed tropical storm system produced over 8 inches of rain within a 24-hour period in the watershed, and no significant discharge was observed through the storm sewer system for that event. Additionally, the ponding in the bioretention area fully recovered in less than 24 hours. These observations suggest that the average annual capture of runoff volume for this system is nearly 100%. Another observation worth noting is that the mulch in the system after this event was nearly undisturbed, suggesting that frequent maintenance during wet periods will not be necessary to maintain the aesthetics or functionality of the system. Finally, it is possible that the improved aesthetics in the area will increase property values in the vicinity, although this may be difficult to quantify due to other factors that affect property values over time.

The cost of Total Nitrogen removal for this project is estimated to be less than a third of that from conventional treatment. The high cost-effectiveness is a function of the high capture efficiency and the fact that no land purchase was required to construct the treatment facilities.

Continued on page 6

Figure 3. Pre- and Post-Construction

Table 1. Water Quality Results

Constituent	Swale Mean Conc. (mg/l)	Curb and Gutter Mean Conc. (mg/l)	Percent Difference in Mean
Total Nitrogen	1.98	6.17	68%
Total Kjeldahl Nitrogen	1.54	5.62	72%
Nitrate + Nitrite Nitrogen	0.43	0.55	22%
Total Phosphorus	0.77	0.99	22%
Ortho Phosphorus	0.44	0.52	15%
Total Suspended Solids	27.8	127.7	78%
Biochemical Oxygen Demand	4.45	15.35	71%

Continued from page 5

Sarasota County Swale Monitoring

As part of its ongoing activities to manage pollutant loading to its waterbodies, Sarasota County developed a County-wide pollutant-loading model. One of the unknowns that the County wanted to resolve at the beginning of the process was whether there are significant differences within the typically pooled land-use types used for pollutant-loading modeling. The project team (the County, Southwest Florida Water Management District, and Jones Edmunds) decided that potential differences in medium-density residential areas served by curb and gutter versus conveyance swales/ditches was the most worthy of investigation. There are over 50,000 acres of medium-density residential land that are served by conveyance swale drainage in the County and several times that served by curb and gutter. Swale drainage is clearly not a new concept but if functioning properly it encompasses most LID concepts: treat close to source, minimize or disconnect impervious area, promote infiltration, etc.

Site selection was critical to the investigation so that differences in results could be attributed to the type of drainage being used. The site-selection process considered similarities in items such as proximity, soils, age of development, imperviousness, and lawn-care intensity. Two curb and gutter and three conveyance swale sites within the Phillippi Creek watershed were chosen by the County and Atkins after extensive site investigation. Atkins conducted the monitoring over a 7-month period that contained wet and dry periods along with a very heavy oak pollen period (Atkins, 2010). Twenty events were captured with flow-weighted monitoring at each type of site (curb and gutter vs. conveyance swale), and total flow and rainfall were monitored continuously for the full period.

Runoff concentrations between the two types of sites were statistically very different. As shown in Table 1, Total Nitrogen and Total Suspended Solids mean concentrations were nearly 70% and 80% lower, respectively, in the sites served by conveyance swales versus those served by curb and gutter. The high nitrogen values appeared to be affected by the heavy pollen period—once the pollen receded, the values fell to within a more typical range. However, during the heavy pollen period the percent difference in concentrations between the two sites was similar to the rest of the monitoring period without the oak pollen.

The runoff volume generated by the conveyance swale sites (adjusted for differences in impervious area) was less than half of that generated by curb and gutter sites for the events monitored for water quality, and the amount of rain that produced no runoff was approximately four times greater at the curb and gutter sites than at the swale sites. Combined, the total runoff volume on an average annual basis is estimated to be three to five times less at the conveyance swale sites than the curb and gutter sites. An important finding in the runoff response was that the areas served by conveyance swales exhibited a runoff response that is characteristic of areas with no directly connected impervious area, suggesting that the infiltration or percolation occurring in the swales is the primary difference in runoff volume response.

Multiplying the concentration and flow volume results to compute loads produces Total Nitrogen loadings that are 93% lower for direct runoff and 87% lower for total flow, respectively, at the conveyance swale sites than at the curb and gutter sites. Similar differences were computed for Total Phosphorus, with the conveyance swale sites being 82% lower than at the curb and gutter sites. Applying the Total Nitrogen findings across the portion of the County where medium-density residential areas are served by swales results in a reduction of over 500,000 lb/year. A more detailed reporting of these findings will be published in an upcoming issue of the Florida Scientist.

Additionally the age and maintenance of the swales are details worth noting from the study. The areas studied and their associated stormwater management systems are approaching or are over 50 years old. Although there is not a detailed maintenance record for the swales since construction, routine County maintenance activities suggest that typically no more than minor regrading is performed on the swales approximately once every 5 years. Mowing is performed by the homeowners, so the relative maintenance costs to achieve the load reductions reported below are low. The total life-cycle costs of swales from this study are much less than half of what wet detention would be to achieve the equivalent reductions.

Sarasota County Road Corridor Bioretention

A 2.5-mile extension of Honore Avenue—an important north-south thoroughfare in Sarasota County—was an important stretch of roadway missing from the County's transportation network. The corridor where the road was planned to be constructed already had significant development around it, and land in the area is expensive. The County's engineering consultant Stantec, Inc. and their design-build contactor, APAC, chose to use a context-sensitive design that incorporates LID strategies to help achieve the necessary stormwater treatment and attenuation.

The design incorporated bioretention, bioswales, and rain gardens within the existing right-of-way. In addition to providing very cost-effective stormwater treatment, the design achieved several other benefits. Over 75% of the existing high-value trees within the previously dedicated right-of-way were able to be saved by incorporating them into the LID practices. Compared to conventional designs, using LID practices reduced floodplain impacts by over 23 acre-feet—impacts that would have otherwise required costly compensation. Other benefits included eliminating bald eagle zone

encroachments, reducing wetland impacts, and creating over 64 acres of additional neighborhood park space opportunities. Stantec calculated that the cost savings for stormwater treatment and attenuation alone using LID strategies was $3.5 million when compared to conventional stormwater practices.

Conclusion

The projects above, which are a small sampling of a growing number of successful LID implementations in Florida, demonstrate several important findings:

- LID practices can provide high levels of stormwater treatment under Florida's hydrologic conditions. They can often be at least as or more effective than conventional treatment (e.g., wet detention).
- LID practices can be significantly more cost-effective than conventional treatment, in part because of their ability to fit into space-constrained areas.
- The maintenance requirements for LID implementations can be simpler than those required for conventional treatments.

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