

GHG CASE STUDY: REDUCING LANDSCAPE INPUTS

(Lathrop and Associates, Inc., Office Retrofit)

Introduction

Most household actions to reduce our impact on the climate involve changing the type, and lowering the amount, of energy we use to power our homes and vehicles. Yet, there are other important areas where climate-friendly practices can be implemented. For example, the way you manage your yard can also have a positive effect. More specifically, you can help to shrink your household climate footprint by creating a landscape that minimizes the use of the following four major landscape maintenance inputs:

- Water (beyond rainfall)
- Fertilizer (beyond organic compost)
- Pesticides
- Gas-powered equipment

This case study provides one real world example of a residential lot-scale landscape redesign with environmental benefits.

Case Study Quick Facts

- Greenhouse Gas Emissions Avoided by Reducing Landscape Inputs: 79.1 lbs CO₂e / 1,000 ft² / yr

(This equals the combustion of 3.9 gallons of gasoline/year per 1,000 ft² of lawn or 42.5 gallons of gasoline/year for a quarter acre lot.)

Case Study Background

In this case study example, a landscaped area of 11,568 ft² was redesigned to limit these four long-term landscaping inputs. Landscape architects mixed diverse design styles of native species with a “neat/manicured” look planted close to the building and a “native/wild” look planted in the restoration garden. Additionally, the retrofit applied resource-efficient landscaping principles to maximize low impact development (LID) benefits. These applications included: (a) the installation of site-appropriate natives and drought-tolerant ornamentals for 90% of the plant species used; (b) supplementing the existing tree canopy; (c) encouraging biodiversity; and (d) minimizing runoff to manage stormwater quality/quantity using a rain barrel, rain garden, and pervious parking



Figure 1. Before: Bungalow Studio prior to building and landscape improvements. (Image Courtesy: Chris Lathrop)

area.¹ As a result, greenhouse gas (GHG) emissions from landscaping activities have been reduced, as have landscape maintenance costs.

Landscape Retrofit Actions

Dix.Lathrop and Associates, Inc. (DLA) worked with Searl Construction and Howard Glover Landscaping to restore a 1925 Craftsman Bungalow on a 1/3-acre site located adjacent to its office in the Historic District of Longwood, Florida. This building is on the National Register of Historic Places and showcases the integration of historic preservation with resource-efficient design through several distinct garden spaces and multi-function stormwater treatment areas. A permit exemption allowed DLA to retrofit the previously residential structure to a commercial facility for their office expansion. Code-mandated parking was provided through a pervious eucalyptus-mulched² area complementing the pine straw walkways and landscape beds. Site soil examination and watershed pattern analysis prompted DLA to experiment with a mixture of native woody landscape plants and grasses utilizing native perennials as season-changing accents and to re-establish the historical longleaf pine/turkey oak hill habitat adjacent to an upland hardwood hammock.³ Low impact design and site-appropriate species have reduced ongoing maintenance impacts.

Long-Term Maintenance Considerations

For the redesigned area, manual plant maintenance (pruning and weeding) is less frequent (quarterly) than that required for conventional turfgrass landscapes (weekly/monthly). Fertilizer was applied only at the time of original plant installation (April 2008), and no subsequent fertilization has been necessary. Mulch is replenished annually and no gasoline powered equipment is required. In retrospect, low volume micro-jet irrigation for plant establishment could have been shut off earlier than the 18 months (78 weeks) used in the native restoration garden.⁴ One University of Florida study suggests “most shrubs [reach] a point when regular irrigation could be discontinued between 12 and 28 weeks after planting as defined by reaching a root spread to canopy ratio of 1.0 or greater.”⁵

GHG Emissions Analysis Results

Energy use and greenhouse gas emissions are avoided as a result of: (1) reduced on-site irrigation; (2) reduced application of synthetic (i.e., fossil fuel-based) fertilizer; (3) reduced need for pesticides; and (4) reduced need for fossil fuel-based lawn equipment. GHG emissions from landscape maintenance activities were estimated for a conventional turf landscape and the retrofitted Bungalow landscape (*Table I*). Calculations were based on information from various sources including: (1) UF/IFAS recommendations for maintenance of the conventional landscape; (2) literature values for GHG emissions resulting from fertilizers, pesticides and lawn mowing; and (3) an analysis of GHG emissions from irrigation using utility-supplied groundwater. The analysis does not include all of the activities that can contribute to GHG emissions from landscapes, such as lifecycle emissions from growing plants at a

¹ Raingarden species used include *Sabal minor*, *Pityopsis graminifolia*, *Tradescantia virginiana*, *Nolina brittoniana*, *Eragrostis spectabilis* and *Eragrostis elliottii*.

² Eucalyptus is a non-native (and near invasive) exotic species in Florida. Because of the eucalyptus eradication efforts happening around the state, this mulch was available and thus chosen as an alternative to cypress (which is generally not recommended for environmental purposes) or pine bark.

³ Existing *Prunus caroliniana*, and *Quercus laurifolia* were complemented by a new foundation of *Pinus palustris* and accents of *Sabal palmetto*, *Sabal minor*, *Serenoa repens*, *Viburnum dentatum*, *Zamia floridana*, *Callicarpa americana*, and containers planted with colorful ornamentals and *Agave americana*. Grasses, including *Aristida stricta* and *Muhlenbergia capillaris*, were interwoven with herbaceous plants and perennials, including *Liatris tenuifolia*, *Solidago* spp., and *Pityopsis graminifolia*.

⁴ Specifically, drought-tolerant species such as *Aristida stricta* and *Liatris tenuifolia* would have benefitted from less irrigation. However, the *Solidago* spp. has successfully reseeded both seasons, and increased in area, since installation.

⁵ <http://hort.ifas.ufl.edu/irrigation>

nursery, trucking them to the site, etc. Emissions would also be higher if supply sources other than groundwater were used for irrigation. An analysis of Tampa Bay Water data has shown that supplying a blend of groundwater, surface water and desalinated water uses 3 times as much energy (and corresponding GHG emissions) as supplying groundwater alone, while supplying irrigation water exclusively through desalination would use about 18 times as much.⁶

Table 1. Landscape inputs and estimated GHG emissions from conventional and Bungalow Studio (resource-efficient) landscapes.

Landscape area = 11,568 ft ²	Landscape Type		Reduction	
	Conventional turfgrass ⁷	Resource-efficient	%	lbs CO ₂ e/yr
Establishment Period⁸				
Fertilizer (lbs N/yr) ⁹	38.17	11.57	70%	233.67
Irrigation (kgal/yr) ¹⁰	278.79	139.20	50%	197.73
Pesticides (lbs a.i./yr)	0.31	0	100%	5.78
Mowing (gal gas/yr)	4.40	0	100%	86.53
Total GHG Emissions (lbs CO₂e/yr)	822.69	298.98	64%	523.71
Maintenance Period¹¹				
Fertilizer (lbs N/yr)	38.17	0	100%	335.40
Irrigation (kgal/yr)	278.79	0	100%	394.90
Pesticides (lbs a.i./yr)	0.63	0	100%	11.56
Mowing (gal gas/yr)	8.79	0	100%	173.07
Total GHG Emissions (lbs CO₂e/yr)	915	0	100%	915.00
Costs (\$/yr)¹²	\$1,200¹³	\$400	66%	N/A

⁶ Foerste, Eleanor C., M. Jennison Kipp, Dave Bracciano, and Pierce H. Jones. 2010. Accounting for the Carbon Costs of Alternative Water Supplies in Florida. Poster presented at the 2nd UF Water Institute Symposium, February 25, 2010, Gainesville, FL.

⁷ Conventional calculations apply Florida averages to the equivalent size landscaped area as the case study. See *Greenhouse Gas Reduction and Energy Conservation: Development Impacts Under Florida's HB 697*, University of Florida Program for Resource Efficient Communities, Version 2.0, May 2010, available at http://buildgreen.ufl.edu/HB697_Book_Order_Form.pdf, for full details, assumptions, and calculations for average impacts per 1,000 sf of conventional turf landscape.

⁸ The establishment period began in April 2008 and extended for 12 to 18 months, depending on the species. According to (<http://www.wunderground.com/history/>), the precipitation from April 2008 through April 2009 was 41.93 inches for Orlando, Florida (zip code 32801) while the normal average from 1971-2000 has been 48.35 inches (http://www.srh.noaa.gov/mlb/?n=monthly_normals).

⁹ Units used: Kgal = kilogallons. Lbs = pounds. N = nitrogen. a.i. = active ingredient. Mo = month. Yr = year. CO₂e = carbon dioxide equivalent. \$ = dollars. Gal = gallons of gasoline.

¹⁰ Irrigation volume estimates based on UF/IFAS calculations of Florida turf irrigation needs. Assumes groundwater irrigation source and uses GHG emissions coefficients from Tampa Bay Water carbon footprint study: Foerste, Eleanor C., M. Jennison Kipp, Dave Bracciano, and Pierce H. Jones. 2010. *Accounting for the Carbon Costs of Alternative Water Supplies in Florida*. Poster presented at the 2nd UF Water Institute Symposium, February 25, 2010, Gainesville, FL.

¹¹ The maintenance period is ongoing and began between April 2009 to August 2009, depending on the species. According to (<http://www.wunderground.com/history/>), the precipitation from April 2009 through April 2010 was 66.61 inches for Orlando, Florida (zip code 32801) while the normal average from 1971-2000 has been 48.35 inches (http://www.srh.noaa.gov/mlb/?n=monthly_normals).

¹² Costs estimated in 2008 dollars.

¹³ Standard commercial maintenance costs for 1/3 acre based on Central Florida market values. Bungalow Studio maintenance costs include weeding and mulch applications.



Figure 2. After: Front yard planting with structured use of natives and containers to add color.



Figure 3. After: Side yard view of native restoration garden in its first year after planting.

Conclusions

Irrigation using potable water represents the greatest source of GHG emissions due to the energy required to treat and pump the water. The GHG emissions associated with the manufacture and application of synthetic fertilizers represent the second greatest source. By establishing a landscape with greatly reduced water, fertilizer, pesticide and lawn equipment requirements, this retrofit project was able to reduce GHG emissions by about 79 lbs CO₂e/yr for each 1,000 ft² of landscaped area.¹⁴ Overall maintenance costs were reduced by about 2/3. If these practices were applied to a typical subdivision of 1000 homes, each having a landscaped area of 10,000 ft² (approximately quarter-acre lots), then aggregate GHG emissions in that community could be reduced by about 363 metric tons CO₂e/yr through this change in landscaping activities alone. Going forward, the estimated annual GHG emissions avoided by the retrofitted Dix.Lathrop and Associates Bungalow landscape are about 915 lbs CO₂e/year.

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¹⁴ This (79 lbs of CO₂) is equivalent to avoiding the combustion of 3.9 gallons of gasoline as each gallon results in 20.35 lbs of CO₂ (Source: http://www.fueleconomy.gov/feg/content/fncludes/co2_inc.htm).