Greening Croasdaile Retirement Community

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September 2011

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Abstract:

Croasdaile Village (CV) is a 100 acre retirement community located within the Croasdaile Farm area of Durham, North Carolina. CV strives to create beautiful and sustainable outdoor spaces for its residents, and would like to follow the example of several sustainable landscaping initiatives in North Carolina. The facility has partnered with Duke University to identify areas in need of improvement and obtain recommendations that, when implemented, would help achieve their goal. A set of criteria allowed for the evaluation of CV's current landscaping and maintenance practices. Further research on sustainable landscaping methods and best management practices (BMPs) aided in the development of recommendations for the campus. Review of other local and national initiatives ensured that CV was in line with universal standards on sustainable landscaping. Results provide a comprehensive set of water use, maintenance and erosion control recommendations.
Introduction:

Croasdaile Village (CV) is a not-for-profit\(^1\) United Methodist retirement community that offers a continuum of personal care and services, with an overall goal of upholding the greatest level of individual resident independence\(^2\). Currently, CV strives to integrate more sustainable operations and has partnered with the Duke University client centered masters project program to accomplish this goal.

The commonly accepted definition of sustainability was developed by the Brundtland Commission in the 1987 Tokyo Declaration\(^3\). Sustainability is “defined as an approach to progress, which meets the needs of the present without compromising the ability of future generations to meet their own needs.”\(^4\) This started the idea of giving the future more thought and weight when decision-making, and has been applied to industries across the board. Recently, sustainability has taken on a more systematic approach with the creation of the “triple bottom line”, also known as the 3 P’s: profit, people, planet. The term was first coined by John Elkington, a British businessman, and founder of SustainAbility, a British consultant group. It is the concept that there are three different bottom lines that exist in every business: the traditional economic bottom line, a social bottom line and lastly, an environmental bottom line. When a business chooses to evaluate based on all three bottom lines, it ensures that they have taken into account the true costs associated with their practices. The economic bottom line is the most traditional measure of profit and measures the total profit and loss of money. The environmental bottom line focuses on the environmental


accountability of the company. The social bottom line focuses on the people within the organization and how socially responsible the operations are. Using the triple bottom line concept as a guide for an organization gives an accurate and comprehensive measure of their performance on all three levels. It allows the organization to quantify non-market value achievements or faults and figure them into the businesses plan.

The triple bottom line highlights the objectives that CV would like to achieve through their creation of a sustainable facility. CV aims to implement cost effective measures that help to keep their nonprofit organization running while minimizing the costs for residents. Additionally, they aim to maintain a clean and healthy environment where their employees and residents may live, work, learn and socialize. CV also wants to achieve a smaller environmental footprint through sustainable and environmentally friendly operations. Analysis of their current operations shows that there are areas in which change would bring them closer to achieving their goal of sustainability through the concept of the triple bottom line.

**Facility Background:**

CV is a 100 acre retirement community located within the Croasdaile Farm area of Durham, NC (Figures 1,2). While it was once a dairy farm, in 2000 it became what is now a flourishing retirement community. CV hosts a very active community and over 300 activities per month for residents to take part in. Many of the activities are centered around their beautiful campus; including, walking trails, birding, a butterfly garden, and fishing in the 10 acre lake. The beautiful campus and easy accessibility to Durham city are drawing points for CVs new residents.

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Figure 19: CV map and layout

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Following in the footsteps of many other local landowners and sustainable landscaping initiatives (see appendix A), CV would like to incorporate sustainable operations methods to their facility, while maintaining their mission and values (see below). While in the future they would like to have sustainable operations throughout their facility, particularly renewable energy sources, they have decided to begin the transformation by employing sustainable practices throughout their landscaped campus. They plan to accomplish this by gaining a set of recommendations that will guide them through the process of becoming a sustainable campus.

Mission: “Croasdaile Village is a partnership of residents, staff and friends that ensures dignity and premier life care.”

Values: “Human dignity, ethical practices, financial integrity, benefvolent care, work force excellence, continuous quality improvement, governance accountability, public disclosure and accountability, community involvement/collaboration, and education.”

Objective:

To provide Croasdaile Village with a comprehensive set of water use, maintenance and erosion control recommendations based on analysis of the current campus, operations and maintenance.

Greening Croasdaile Village is closely aligned with CV’s mission and values. Creating a sustainably managed campus will help them achieve economic, environmental and social benefits not only for themselves, but for the residents of CV.

CV highly values financial integrity which directly links to the economic benefits of sustainable management. The cost savings gained through reuse of green waste, elimination of potable water use and minimization of pesticide and fertilizer use all aid CV to maintain their attempts to eliminate wasteful spending and maintain ethical practices and workforce excellence. While these sustainable management methods help to save money, they also help maintain a healthy and clean environment for the residents of CV, particularly through the reduction of pesticide use and added ecosystem services of naturalized environments. This quality improvement adds to the benevolent care that CV sets as a priority. Additionally, maintaining the campus as a beautiful and natural environment provides for recreational areas and opportunities to further instructive programs that promote community involvement and education.

12 Linda Davis, Croasdaile Village. Correspondence, 4 April 2011.
Methods:

In order to accomplish the objective, I analyzed current CV landscaping and associated practices and completed extensive research on sustainable landscaping methods. This research was used to create detailed recommendations that, when employed at CV, will reduce minimize non-point source pollution, reduce potable water use, prevent erosion, educate its residents and achieve sustainability, all while minimizing maintenance and utility costs.

First, I collected information on CV's landscaping issues and current practices, including area uses, green waste practices, areas with erosion issues and stormwater controls. After an initial analysis of the CV campus, I met with Melissa McCullough, of the United States Environmental Protection Agency, and Michelle Wallace of Durham NC Cooperative Extension to create a comprehensive set of sustainability goals, purposes, and corresponding metrics that when fulfilled would ensure attainment of each goal. CV will be considered sustainable when all goals are fulfill through realization of each metric.

The six goals to fulfill to achieve sustainability are:

1. Stormwater managed onsite
2. Green-waste composted for reuse
3. Integrated Pest Management (IPM) employed
4. Low-maintenance landscaping present in undefined plots of land
5. Sedimentation of storm sewers and receiving streams is prevented
6. Outdoor activities are maintained or enhanced throughout the campus
Further analysis of the CV campus and discussions with James Sanes, Director of Facility Services at CV allowed for the identification of problem areas on CV’s campus and sustainability goal metrics that were unfulfilled/partially fulfilled. Recommendations were made in regard to those unfulfilled/partially fulfilled metrics that, when employed, would fulfill the metric and achieve the overlying sustainability goal.

Criteria:

Criteria were developed through discussions with Melissa McCullough and Michelle Wallace. Additionally, information was on project organization and comparisons of quality were gained through the similar project literature review.

Criteria are organized as follows:
Overarching goal of a sustainably managed campus for CV:

1. Stormwater Managed Onsite: Minimize non-point source pollution and flooding
   - Stormwater retention ponds/rain gardens present
   - Stormwater retention ponds/rain gardens maintained properly
   - Buildings equipped with rain barrels/cisterns
   - Impervious surface limited to roads, roofs, parking lots and walkways

2. Green Waste Composted for Reuse: Minimize costs of disposal and need for additional purchased product
   - Waste not sent offsite for disposal
   - Composted materials used onsite in maintenance practices

3. Integrated pest management employed: Minimize costs of fertilizer and pesticide, reduce run-off and eliminate health risks in the community
   - Targeted application of pesticides and fertilizers
   - Lowest environmental impact pesticides and fertilizers used

4. Low-maintenance landscaping present in undefined plots of land: Minimize costs and labor and maximize ecosystem services and aesthetic qualities of the campus
   - Required 30ft. grass boundaries existent
   - Large undefined converted to managed prairie/woodland
   - Managed prairie/woodland maintained to remain aesthetically pleasing
   - Use of water-wise, naturalized landscaping

5. Sedimentation of storm sewers and receiving streams is prevented: Ensure the floodplain functions are protected
   - Erosion and soil loss prevented through use of landscaped areas (0% unlandscaped)
   - 10 ft. riparian area buffers existent

6. Outdoor activities are maintained or enhanced throughout the campus: Create a pleasant campus atmosphere that meets the needs of the residents
   - Natural areas that provide a recreational activity present
   - Outdoor environmental educational opportunities available for resident involvement.
1.

**Goal: Stormwater managed onsite.**

**Purpose:** Minimize non-point source pollution and flooding

**Metrics:**

*Stormwater retention basin & rain gardens present*

Fulfilled. Two stormwater detention basins and one stormwater retention basin are present above Boles Lake that feed into Boles Lake (Figure 3). These adequately provide for the stormwater present on the campus. The two detention basins catch all stormwater from drains throughout the campus, and allow for sedimentation and flood protection during a storm. While primarily protecting against flooding, sedimentation of the stormwater helps water quality overall. Additionally, the retention basin located above Boles Lake serves as a place for percolation and nutrient absorption. A rain garden is present in butterfly garden area to provide for additional percolation and absorption, as well as an aesthetically pleasing place for recreational purposes (Figure 4).
Figure 3\textsuperscript{13}: Retention and Detention Basins highlighted

Figure 4\textsuperscript{14}: Rain garden highlighted

Stormwater retention ponds/rain gardens maintained properly to ensure percolation and filtration

Fulfilled. Proper vegetation, including naturalized aquatic plants and grasses, is present in upper stormwater retention pond and in the lower Boles Lake. Grasses are maintained at four to six inches, and provide for percolation, filtration and nutrient absorption of stormwater. Detention basins are periodically dredged to remove excess sediment and maintain appropriate volume for storm events.

Each cottage (49) and each larger building (6) equipped with rain barrels/cisterns used to maximize use of roof runoff

Partially fulfilled. Previously, residents were able to buy rain barrels for their cottages through a CV contact person. Only six residents did so. Recently, maintenance has had great success using the water from the rain barrels instead of potable water. This has encouraged them to use approximately eight rain barrels as a water source around the campus (six from the previous residents, two from maintenance, totaling eight). Currently, large cisterns are not present or in use on campus.

Recommendation:

It is recommended that CV equip its large buildings with cisterns and encourage the use of rain barrels on each of the 49 individual cottages. In addition to cost savings due to reduced potable water use, rainwater contains nutrients, such as nitrogen and phosphorous, that helps to feed the vegetation. Furthermore, potable water has added fluoride to promote dental health and chloramines used to control microbes\(^\text{15}\), which in some cases harms the vegetation.

Equipping the large buildings with cisterns will help to harvest the largest volume of rainwater, however, it is also the most expensive option. Cisterns have much larger holding

capacity (roughly 5,000 gallons) and will greatly supplement or eliminate any need for potable water use in landscaping maintenance throughout the campus. Rain cisterns are usually custom built for the building that they are connected to, so prices can range dramatically from thousands to tens of thousands of dollars. A smaller scale alternative would be to opt for rain barrels instead of large cisterns.

Encouraging the use of rain barrels on each of the individual cottages will also cut down on potable water use for outdoor landscape needs. This could be done through an educational workshop highlighting the benefits of rain barrels, financial incentives for residents who choose to purchase or install rain barrels, or through a CV homeowner regulation. If required by CV homeowners association, funding or grants for the rain barrels would be necessary from CV (rain barrels start at roughly $80 each for a 54 gallon rain barrel). It is recommended to have a rain barrel that holds at least 55 gallons.

Each year Durham gets an average of roughly 48 inches of rain. This means that for each cottage a total of 38,796 gallons of water can be saved and used each year. However, it is unreasonable and unnecessary to maintain a rain barrel with a large enough capacity to hold that much water, since most of it will go unused by the resident. Based on the recommended rain barrel capacity of 55 gallons, a storm measuring 0.068 inches of rain will fill the barrel (Using the equation captured water(gal) = rain(inches) x 0.6 x building footprint(sqft), and an average

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cottage building footprint of 1,346sqft\textsuperscript{23}. Since the lowest average rainfall during any time of year is 3.4 inches\textsuperscript{24}, filling the rain barrel to capacity will prove to be no problem. When translated into cost savings, filling up one 55 gallon rain barrel once a month would equate to $152.64 in savings each year, based on the current FY 2012 Durham City potable water rate of $1.73 per ccf\textsuperscript{25} at the lowest tiered price. Realistically speaking, rain barrels will be filled to capacity more than once each month. This will greatly increase the saving in potable water use to double or even triple the base $152.64 each year. Additionally, the base savings in potable water will cover the cost of the rain barrel within the first year of use.

**Impervious surface limited to roads, roofs, parking lots and walkways (perVIOUS substitutes elsewhere)**

Fulfilled. There are no extraneous impervious surface areas.

2.

**Goal: Green waste composted for reuse.**

**Purpose:** Minimize costs of disposal and need for additional purchased product

**Metrics:**

**Waste is not sent offsite for disposal.**

Unfulfilled. Green waste is sent offsite for disposal. Previous attempts to compost green waste were considered unsuccessful and have prompted the sending of waste offsite for disposal. Primary concerns and reasons for elimination of large scale composting were nuisance issues,

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particularly location and aesthetics. Some residents individually compost for their own personal
gardens and for small supplements to specialized gardens around campus, however, CV landscape
and maintenance as a whole no longer composts green waste.

**Recommendation:**

Create an area for composting that is sheltered from eyesight to maintain the aesthetics of
the campus. If there is no such location available, use methods to help beautify the large bin, such
as covering with vines, or surrounding with shrubbery. It may also be helpful to have several
smaller composting bins, as opposed to one large one. While compost bins may be purchased,
considering the volume of green waste that CV has, it would be most cost effective to build a custom
compost bin (this may be unnecessary if the previous compost bin still exists, at which there will be
no additional cost to CV).

**Composted materials used onsite in maintenance practices.**

Unfulfilled. Composted materials from CV are currently unavailable. All supplemental soil
and maintenance products are purchased from outside sources. While there is some composted
material available from individual residents, the volume is negligible in terms of maintaining CVs
campus.

**Recommendation:**

Once compost bin(s) for the facility are in operation, use compost product to supplement
landscape soils and mulches. This provides additional nutrients for the vegetation and can be used
with IPM to limit use of chemical fertilizers. Additionally, composted material will help to eliminate
the costs of additional soil supplements purchased by CV, which run at roughly $4 per cubic foot.

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3.

**Goal:** Integrated pest management (IPM) employed

**Purpose:** Minimize costs of fertilizer and pesticide, reduce runoff and eliminate health risks in the community

**Metrics:**

- **Targeted application of pesticides and fertilizers**
  
  Unable to obtain information.

- **Lowest environmental impact pesticides and fertilizers used**
  
  Unable to obtain information.

**Recommendation:**

It is recommended that CV begin a contract with an IPM company, as opposed to independent contracts with Freedom Landscaping for weed control and Steri-Tech for pest control. IPM is an environmentally and human health friendly mechanism for pest prevention. It uses prior knowledge of pest resistant species, pest life-cycles and natural pest solutions (such as natural predators) to create solutions to pest problems\(^27\). This approach helps to minimize the use of synthetic fertilizer, herbicides and pesticides through avoidance or, in extreme cases, targeted application, which ultimately minimizes chemical runoff and health risks associated with the synthetic products\(^28\). This is particularly important for a retirement community that is home to a more sensitive demographic. Contracting out an IPM company will ensure that IPM is properly done for CV, and holding one contract for all pest management will help to minimize costs incurred by CV. In the Triangle there is a company that does commercial and residential IPM called Integrated Pest Management, Inc.\(^29\).

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\(^28\) Michelle Wallace correspondence. 20 April 2011.

4.

Goal: Low-maintenance landscaping present in undefined plots of land.

Purpose: Minimize costs and labor and maximize ecosystem services and aesthetic qualities of the campus

Metrics:

- **Required 30 ft. grass boundaries are existent**
  
  Fulfilled. 30ft. grass boundaries are existent around all structures.

- **Large undefined areas are converted to managed prairie/woodland**
  
  Fulfilled. Current planned, but unconstructed, residential area is maintained as forested area. Large riparian area was converted from mowed grass lawn to natural managed prairie. Areas along roads have been converted to managed woodland areas.

- **Managed prairie/woodland maintained to remain aesthetically pleasing**
  
  Partially fulfilled. The riparian area prairie was trimmed once or twice a year, proper maintenance for a managed prairie; however, there are currently plans to transform the area from managed prairie to managed woodland. This transformation includes less management and maintenance of the current prairie state, as it succeeds to woodland. Other natural areas are maintained; although, residents disagree on the fact that it is “aesthetically pleasing.” The largest problem with the areas is the different views on what is aesthetically pleasing.

**Recommendation:**

Use educational opportunities to achieve acceptance of managed prairie and woodland areas; for example, leading a nature walk near the sites identifying natural vegetation and wildlife. These courses or activities may be incorporated into the present resident education program at no
to little additional cost. Further detail on cost estimates provided under “Outdoor Activity” goal recommendations.

Provide additional maintenance on the perimeters of the sites. This will allow the site to still exist in its natural state, while appeasing residents who are concerned about their views. This can be done using the current landscape maintenance labor for minimal additional labor costs initially. After the initial clean-up of the perimeters, maintenance will become part of normal operations at CV.

**Use of water-wise, naturalized landscaping**

Fulfilled. No presence of exotic invasives and use of naturalized vegetation is maximized throughout the campus. Naturalized, water-wise vegetation is used around the campus due to the absence of irrigation systems. In particular, the butterfly and bird gardens, use native flowering vegetation to attract native wildlife. This supports the recreational activities surrounding these areas of the campus as well as the local wildlife.
Figure 5:
Managed prairie and woodlands highlighted.

5.

Goal: Sedimentation of storm sewers and receiving streams is prevented.

Purpose: Ensure the floodplain functions are protected

Metrics:

   Erosion and soil loss prevented through use of landscaped areas (0% unlandscaped)

   Fulfilled. All areas are landscaped. Grass lawn covers most of the campus in addition to the
managed prairie and woodland areas and vegetation surrounding buildings and as view and noise
pollution prevention. Some efforts have been taken to transform some of the steeper grass lawn
slopes supplementing them with shrubbery and trees to help hold soil more effectively and prevent
erosion. While landscaped slopes require less maintenance than grass lawn slopes, both are
effective at holding soils to prevent erosion.

   10 ft. riparian area buffers existent

   Fulfilled. Each of the two riparian areas is protected by the required 10 ft. of vegetative
buffer. These buffers help to increase surface roughness, decrease sedimentation and erosion and
provide for infiltration, all of which are essential to help maintain water quality\textsuperscript{31}.

\textsuperscript{31} Hawes, Ellen; Smith, Markelle. Eightmile River Wild and Scenic Study Committee. \textit{Riparian Buffer Zones: Functions and Recommended Widths}. April 2005.
6.

Goal: Outdoor activities (physical activity, mental restoration and social interaction) are maintained or enhanced throughout the campus.

Purpose: Create a pleasant campus atmosphere that meets the needs of the residents

Metrics:

Natural areas that provide a recreational activity present.

Fulfilled. Currently there is a bird and a butterfly garden present on the CV’s campus, providing for recreational bird and butterfly watching. While the campus itself does not include Boles Lake, residents have access to the lake for fishing and additional bird watching. Walking trails are available throughout the campus for exercise and leisurely walks/runs.

Outdoor environmental educational opportunities available for resident involvement.

Partially fulfilled. Some signage is available to identify vegetation. CV also has several groups that regularly bird and butterfly watch.

Recommendation:

Provide workshops through CV that encourage outdoor activity and interest in the environment of Durham, NC. This could be done as a series and include topics such as starting a vegetable garden, native wildlife, naturalized flowering plants, rain barrel installation and use and sustainability. Additionally, this program could include the prior recommended educational workshops aimed to achieve acceptance of managed prairie and woodland areas. Costs of the workshop series could be budgeted into the existent education budget to minimize additional costs for CV. Information on all topics in widely available for free online. If warranted, a specialist could be hired/volunteer to host the workshops.
Advertise outdoor activity groups, such as the bird watching group, and workshops throughout CV. CV has many ways to reach its residents, and advertising can be done fairly cost free. Information about current outdoor activity groups can be included in “The Villager” newsletter that is uploaded to the CV website32 or through CV’s Facebook page. Fliers may also help to advertise in which minimal printing costs would incur.

Conclusions:

CV is not far from reaching sustainability. Campus operations would benefit greatly once problem areas are addressed. Effective use of stormwater has the potential to save CV significant money each year. Installation of rain barrels and cisterns on facility buildings has the potential to eliminate the need for any potable water use for landscaping. Rain barrels can be purchased for as cheap as $80 and can save hundreds of dollars a year in potable water costs for residents and the facility. Captured stormwater also has beneficial effects for the vegetation that potable water does not provide.

Additionally, composting green waste will help to minimize costs for offsite disposal and provide free, organic and nutrient rich soil supplement that can be used around campus instead of purchasing additional products to supplement soil. Composting has been done before at CV and can easily be reincorporated to address the issues of aesthetics and location nuisance. Constructing the compost bin in a location hidden from main roads and homes, or beautification of the bins itself using vines or shrubbery can easily solve the aesthetics and location nuisance issues.

Introducing IPM to the campus will also help to maintain the health of the environment and CV residents while minimizing waste and cost. CV currently has two separate contracts for weed and pest control. A contract with a company that employs IPM practices will address both weed and pest control. IPM uses biological knowledge to balance the natural environment in the area

with limited use of chemical pesticides, herbicides and fertilizers. Limiting the use of expensive and potentially dangerous chemicals cuts costs and allows for a safe and clean environment around CV’s campus.

CV has been working hard to transform highly maintained grass lawns to managed prairie/woodland. They have succeeded at their transformations, but many residents feel that the managed areas are not aesthetically pleasing. Creation of educational opportunities for residents to participate in, such as a guided nature walk, can help to achieve acceptance of the areas within the community. CV currently has a vibrant educational program that could easily incorporate a new workshop or activity. Furthermore, added maintenance on the perimeter of the areas will help appease residents concerned about their views while maintaining the natural ecosystem.

Acceptance of managed prairie and woodland areas is not the only goal that will benefit from additional educational opportunities for residents. Providing workshops for resident that encourage outdoor activity and interest in the environment of Durham, NC will help to maintain the lively community that CV is so proud of. A workshop series centered around nature and sustainability will add a new dimension to the current educational program and possibly bring new interests and hobbies to curious residents.

Following through on the implementation of recommended changes will help CV to achieve their goals of a sustainably managed campus. Areas that need changes require only small, inexpensive changes. This makes sustainability a fairly easy task for CV to accomplish. After achieving a sustainable campus, CV may move onto their next goal, creating a sustainable facility.

Thank you to: Ken Reckhow, Linda Davis, Howard Dewitt, James Sanes, Boyd Strain, Melissa McCullough, Michelle Wallace
Appendix A:

Landscape greening projects in NC:

Many sustainable landscape initiatives have taken place locally in the Triangle, as well as nationally. Specifically, Durham County hosted a “Sustainable Landscape Series” workshop in 2009. The series was designed to help members of the public learn more about managing their personal landscapes. Year-round sustainable landscape management and environmental accountability were the highlight of the course. It was broken up into three themed days: soil management, smart watering and sustainable management and covered a variety of strategies including water conservation, rain gardens, xeriscaping, plant selection and pest management.

The city of Durham is not the only contributor to sustainable landscaping education in the area. Private groups in Durham have also begun to support the idea of sustainable landscaping and educate the public through workshops. Notably, the Sara P. Duke Gardens holds a “Landscape Plants for North Carolina Gardens” class each season. Attendees learn about different seasonal plants suitable for North Carolina’s environment, and how to incorporate the plants into their own landscape designs.

Additionally, the city of Durham awards those best contributors to Durham’s appearance with the annual Durham Golden Leaf Awards. The awards were created to acknowledge people and businesses community-wide that were making positive contributions to Durham as a whole. The

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awards are co-sponsored by the Durham City-County Appearance Commission, a volunteer advisory board that “provides leadership, expertise, and oversight in the promotion of design excellence, visionary planning, and preservation of the best and most livable community standards,”36 and Keep Durham Beautiful, Inc., a nonprofit, volunteer-based organization that works to inspire the public to take greater responsibility for their community environment. There are eight categories of awards for design and maintenance additions that enhance the beauty and sustainability of Durham. Nominations are taken from the public and a jury of design professionals assesses the sites based on the criteria (Selection criteria included excellence in design of a new development and/or improvement of an existing structure; raising community awareness of the value of good appearance and stewardship; improving character, environment, or livability of an area; and a commitment to ongoing property maintenance in landscaping, signage, and general upkeep)37,38. Two categories of note are the Landscaping & Maintenance category and the Keep Durham Beautiful category.

On a national level, the Environmental Protection Agency (EPA) has designed a program called GreenScapes to help provide cost-efficient and environmentally friendly solutions for landscaping. The program provides information and resources for commercial and individual landscapers (with an emphasis on large-scale landscapes). The information helps to educate the public on the benefits of sustainable landscaping and includes information on plant choice and needs by region, success stories and guidance on planning and completing a sustainable landscape

project. The program encourages holistic decision-making about landscape practices and their impact on land, water, air and energy usage\textsuperscript{39,40}.

Sustainable Sites Initiative (SITES) is another national initiative aimed at making sustainable landscaping the norm. SITES has developed a list of benchmarks that individual facilities can voluntarily implement in order to be deemed a sustainable site\textsuperscript{41}. Many of the pilot projects are here in North Carolina. Notably, The Prairie Ridge Ecostation, The Education Center Site at NC Botanical Garden and The Charlotte Brody Discovery Garden.

The Prairie Ridge Ecostation is located in Raleigh, North Carolina. Serving as the field station for the North Carolina Museum of Natural Sciences, the ecostation currently consists of 45 acres of land, primarily restored prairies, forests and riparian areas. The conversion of the once abandoned land to an outdoor laboratory allows students and the public to learn about nature and take part in field research\textsuperscript{42}.

The Education Center Site at NC Botanical Garden, located in Chapel Hill, North Carolina, is a great example of the SITES project in an open space environment. The project aims to gain LEED platinum certification and is using the SITES criteria for its new Education Center to do so. They plan to install water-wise vegetation, capture stormwater in cisterns and create bio-retention areas for stormwater. Additionally they will divert 95% of their construction debris from landfills and salvage their trees for material reuse\textsuperscript{43}.

\textsuperscript{40} Environmental Protection Agency. Large-Scale Landscapes. 30 June 2011. http://www.epa.gov/epawaste/conserve/rrr/greenscapes/lrgscl.htm
\textsuperscript{41} The Sustainable Sites Initiative. 2010. http://www.sustainablesites.org/
\textsuperscript{42} The Sustainable Sites Initiative. Pilot Projects. 2010 http://www.sustainablesites.org/pilot_projects/
\textsuperscript{43} The Sustainable Sites Initiative. Pilot Projects. 2010 http://www.sustainablesites.org/pilot_projects/
Additionally, the Charlotte Brody Discovery Garden, located on Duke University’s campus in Durham, North Carolina, has shifted its focus towards more sustainable practices. Rainfall and stormwater are handled onsite at all outdoor classroom areas through the use of rain gardens, green roofs, water collection cisterns and a comprehensive greywater system. A comprehensive collection of small scale projects was implemented to demonstrate sustainability for the average homeowner.\textsuperscript{44}

\textsuperscript{44} The Sustainable Sites Initiative. \textit{Pilot Projects}. 2010 http://www.sustainablesites.org/pilot_projects/
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