Putting Urban Landscapes to Work for Water Quality

Evaluating the Benefits and Challenges of Rain Gardens in the Euclid Creek Watershed

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Executive Summary

The Cuyahoga Soil & Water Conservation District conducted a project to evaluate the application of rain gardens within a largely residential urbanized watershed, Euclid Creek. The project installed four gardens and identified the practice, policy and applicability of rain gardens in Euclid Creek and other urban watersheds in the Lake Erie basin. The project examined the challenges and benefits based upon the social, economic and environmental conditions of the watershed and the application of rain gardens as a constructed management practice to improve water quality. While rain gardens provide a simple and valuable public education and outreach tool, more research is needed to determine effectiveness and management to improve water quality within an urban watershed.

Introduction

The efforts to restore and protect the Lake Erie basin within Ohio require multiple efforts within a variety of land uses. While the preservation of the remaining natural systems in the watershed is paramount, the necessity to re-establish infiltration function within our urban areas can begin to balance the services provided by both efforts. This project is intended to examine a constructed management practice that can be applied in very densely populated parts of the watershed and the implications of the practice to improve water quality and the policies and practices within a community for its implementation.

This report provides the results of the implementation of this project. The project scope of work included the research and application of the policy and practice of installing rain gardens within an urban setting. This included two roundtable meetings with practitioners and local policy administrators, the design and installation of four rain gardens in the Euclid Creek watershed, and installation of signage to provide awareness and education on this practice.

This format of the report includes the characteristics of Euclid Creek for it applicability to examine rain gardens, the planning process for the rain gardens, the construction process, and the findings, conclusions and recommendations derived as a result of the project.

Characteristics of Euclid Creek

Rain Gardens were evaluated as a practice based upon the characteristics of the Euclid Creek watershed to determine its use and effectiveness.

Euclid Creek is a direct coastal headwater tributary to Lake Erie within Cuyahoga and Lake Counties. It drains 24 square miles of land within portions of 11 communities, including the northeast portion of the City of Cleveland's North Collinwood and Nottingham Neighborhoods. The following characteristics were used to evaluate the use of rain garden applicability in the watershed.

Population Density

The population of Euclid Creek is 68,000 residents. To place the context of Euclid Creek's population in perspective with other Lake Erie Watersheds, density of population was compared with other non-urban watersheds.

Watershed	Persons per Square Mile
Euclid Creek	2,833
Chagrin	621
Sandusky	116

Information compiled for the Watershed Action Plans of each watershed, based upon U.S. Census Data, 2000.* These are general densities watershed-wide based upon US Census data. Density concentrations may vary in subwatersheds.

Concentration of Single Family Residential Land Use

The watershed is highly developed with only 15% undeveloped land remaining, hence retrofit and redevelopment need to play key roles in restoring the ecological functions in the watershed. The predominant land use is single family residential consisting of 48% of the land cover in the watershed. Hence, finding retrofit practices on single family parcels of land or within neighborhoods, needs to be examined.

High Percentage of Impervious Cover

Due to its highly developed state, the imperviousness is high, particularly in the north and southeast portions of the Euclid Creek watershed. These areas have imperviousness over 25% which greatly limits its ability to operate with adequate water quality functions.

Connection with Nutrient Reduction Needs Identified in TMDL

The Euclid Creek Total Maximum Daily Load conducted in 2005 identified phosphorous exceeding the load capacity of the watershed. Phosphorous sources are attributed to urban runoff, use of lawn fertilizers and sewer outfall issues.

The above characteristics of the watershed provide a baseline of why and where rain gardens could be useful in Euclid Creek and similar type watersheds.

What are Rain Gardens?

A rain garden is "landscaped areas built in depressions that are designed to capture and filter storm water runoff." (*Rain Garden Manual*) They consist of four elements, site placement, size, soils and plants. These four elements combine to create a landscape that provides benefit to the watershed to reduce compaction of turf lawn areas, bring back native wildlife and biodiversity, slow the release of runoff and its associated nutrient loads prior to reaching stream channels.

Rain Garden vs Bioretention

Through this project, a review of rain garden projects and initiatives across the country was conducted. In cooperation with the Cuyahoga Soil and Water Conservation District's (SWCD) technical program implementing Bioretention areas in the Cuyahoga County, Ohio, a distinction needed to made between rain gardens and bioretention areas. Bioretention areas are intended for residential or commercial development projects that can provide water quality management for more than one parcel or larger commercial, industrial and multi-family residential areas. Bioretention typically requires a piping system and engineering associated with site design. They also can be larger than 300 square feet and typically are deeper than 12".

Rain Gardens are considered the little sister of Bioretention Cells. They typically are less than 300 square feet and do not require underground piping system. They also are less than 8" deep.

This distinction is important as communities and developers look at meeting the requirements and goals of the National Pollutant and Discharge Elimination System (NPDES) Storm Water Program. Rain gardens as defined above will not provide the functions required under NPDES Program as part of a common development project.

How to Build a Rain Garden : Our Experience

The great benefit of this project was to learn by doing. The Cuyahoga SWCD utilized the *Rain Garden Manual for Homeowners*, (Rain Garden Maunal) developed by the Northeast Ohio Public Involvement and Public Education Committee (NEO PIPE). Here are the basic tasks

Site Evaluation

Determine a suitable site location to install a garden. For this project, we chose public sites to provide public access to assist with raising awareness to the local community on what rain gardens are and their benefit to Euclid Creek. Due to the small cost of installation, the project chose four sites for installation; South Euclid –Lyndhurst County Library, located in the City of South Euclid, Kiwanis Lodge, located in the City of Richmond Heights, Cleveland Metroparks Welsh Woods Picnic Shelter, located in the City of Euclid, and Brainard City Park, located in the City of Lyndhurst.

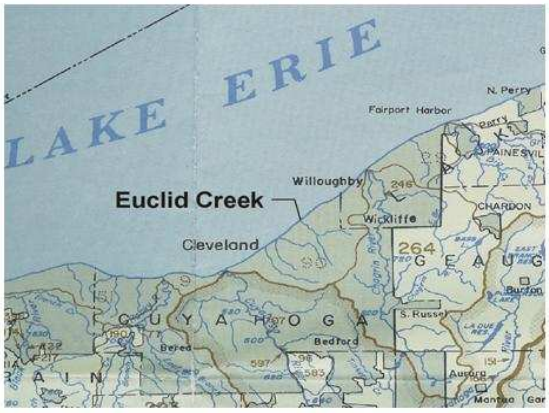
Once the locations were determined, the sites were evaluated with a soil boring and drainage assessment by Natural Resource Conservation Service and Cuyahoga SWCD Technical Staff. NRCS was an active partner as a technical review advisor throughout this project. Since this is was a pilot project NRCS advised the use of the *Rain Garden Manual* developed by the Northeast Ohio Public Involvement Committee as the guide for the installation on these sites. Two of the sites collected water from a roof and two collected water solely from lawn runoff from the drainage area.

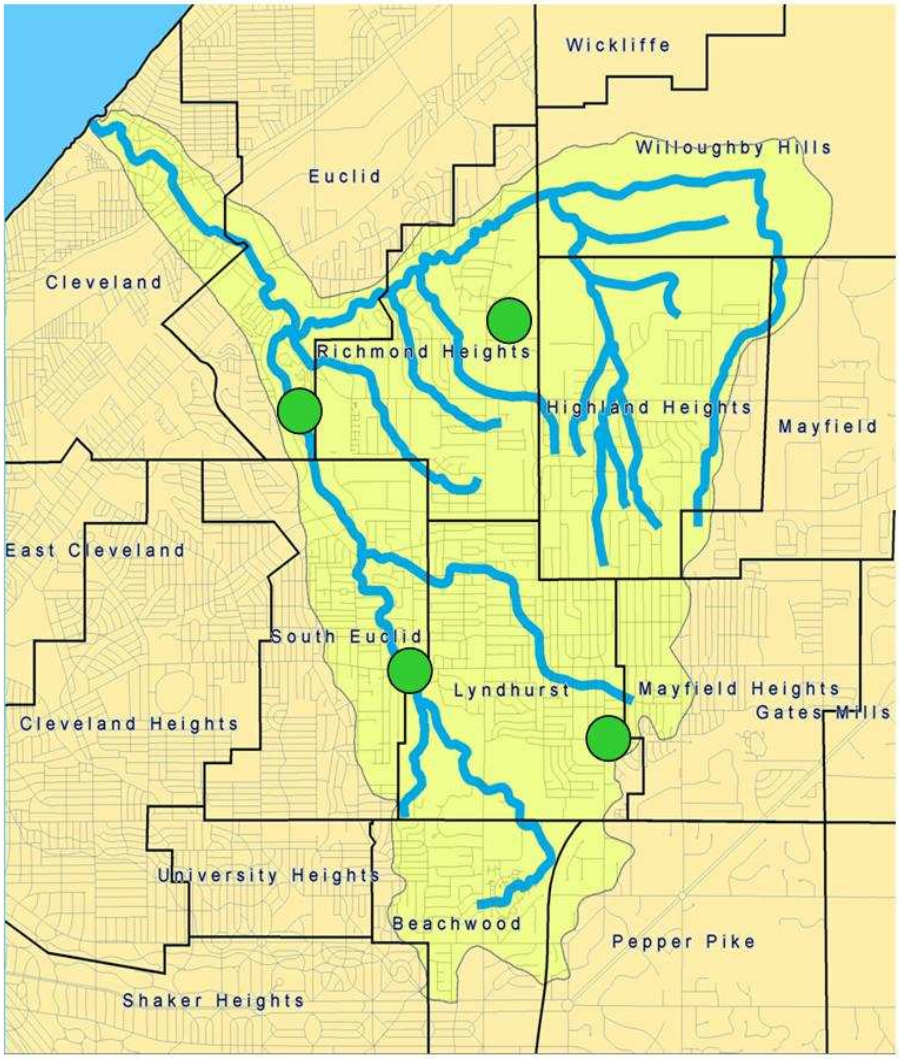
Determination of Garden Size

The Rain Garden worksheet from the *Rain Garden Manual* was used to determine the size of the garden. The rain gardens installed ranged from 100 square feet to 250 square feet based upon the soil type, slope and drainage area for the rain garden.

Euclid Creek Watershed
Rain Garden Locations

Euclid Creek
Watershed Location





Rain Garden
Installation
Locations

NORTH

The soil boring also provided guidance on how deep the garden needed to be and how much clay/silt loam content and it was recommended to remove the existing soil with an amended soil to provide the function that rain gardens are intended for.

Utility Check

Required by state law, a utility check was conducted on each site both in the planning stage and prior to installation. A gas and oil well check was also conducted for each site. Due to the shallow depth of the rain gardens, utilities were not of high concern or an obstruction to the installation process. Cities were also contacted prior to the installation of the rain gardens to ensure collaboration with local codes and ordinances.

Installation

The installation of the rain gardens were relatively simple. Volunteers from various local groups we used for the installation of the gardens. Only one of the gardens installed used large motorized equipment to transport materials. The basic tools of shovel, trowel, and wheelbarrow completed the gardens.

The process as outlined in the *Rain Garden Manual* involved removal of the top 5-6" of lawn area, creation of a shallow depression and loosening of material, placement of bioretention soil mix, installation of a weed barrier, placement of 2" of shredded bark mulch and installation of native plants.

The rain garden installation averaged three hours for each installation with 5-10 volunteers participating and without the use of large equipment.

Disposal of excavated materials was coordinated with the municipal service departments of park management staff to remove off site. This disposal need may pose a problem on residential sites and will need to be coordinated with disposal guidelines in individual communities.

Implementation Evaluation

Markets for Implementation

Two work sessions were conducted in November of 2005 to invite municipalities and trade organizations in the landscape industry to participate in a discussion on the potential of markets for rain gardens. Thirty invitations went out to landscape industry representatives. The participation was low and did not provide any new information on the marketability. However through the work of installing the rain gardens in Euclid Creek, the Cuyahoga SWCD worked with two local suppliers who have developed materials specific to rain gardens that they promote. Kurtz Brothers is a local soil and compost manufacturer. They have developed a Bio-Retention Soil Mix that restores the drainability of the top six inches and reduces the compaction that typically creates the increased runoff rate on non-paved urban lands.

Technical Requirements

After a thorough review with NRCS and Cuyahoga SWCD technical staff, understanding local soils is the critical component to the implementation of rain gardens in the local community. The assistance of NRCS and Cuyahoga SWCD's technical program provided an opportunity to examine the questions to evaluate the best locations to install rain gardens and the criteria to measure soils upon in this evaluation.

Understanding Local Policies

One of the key aspects of rain gardens is the potential to collect rain water from rooftops and dissipate back into the ground rather than transferring it to local streams. The project provided an opportunity to review local ordinances and their relationship to the concept of rooftop drainage collection and disposal. Under the review of the ordinances within Euclid Creek communities, two policy issues were identified. One is that many communities either require the connection of the roof downspout to a storm water sewer system, and or require that positive drainage occurs on a site. Because of the urban nature of the watershed, these policies are important to the overall infrastructure of the communities. These policies related to roof drainage will require additional review and evaluation if rain gardens are to be fully integrated into the storm water management strategies for urban watersheds like Euclid Creek where infrastructure systems are a key component to water management goals.

Water Quality Benefits

A literature review provides some initial evaluations on the benefits to water quality rain gardens provide. However, the research is not defined further between smaller rain gardens and its larger Bio-Retention Cell counterpart. The studies conducted in examining these benefits present the following information;

- Rain Gardens can contribute to the reduction of flow to our local sewer systems and streams. This is important and erosion of stream channels is largely contributed to high velocity flows. In the study developed by Dietz and Clauseen, inflow into the rain garden left the rain gardens as subsurface flow rather than direct runoff.
- Rain Gardens are marginal in their retention of phosphorous and other nutrients if they are not connected to roof drainage. The use of rain gardens to reduce the impacts of the “first flush” (first one-half inch) of rain runoff can be a benefit to their use. Its contribution however is limited due to their size. The effectiveness of rain gardens for nutrient reduction is also attributed to local soil types and conditions and the types of plants that are used.
- Rain Gardens can reduce the imperviousness of lawn areas.
- Rain Gardens can reduce the amount of area needed for fertilizer application.
- Rain Gardens can re-introduce native biodiversity within urban environments.

The studies conducted were not in Ohio and did not take into account the local soils regime of Northeast Ohio. Further understanding the water quality value of these gardens on a neighborhood and watershed scale through monitoring on rain garden sites in Northeast Ohio and other regions of the state is highly recommended to truly understand the benefits of rain gardens to urban runoff impacts to Lake Erie and its local streams. The effectiveness of the larger Bio-Retention Cells for water quality improvements have been documented, especially related to phosphorous and nitrogen load reduction functions. The infiltration of a percentage of runoff from a site is one of the greatest potential benefits of rain gardens within a watershed. This is especially important in urban watersheds like Euclid Creek which are highly flashy and have a high volume of water entering its channels from urban and suburban development.

Costs

The cost to plan and install a rain garden is one of the great benefits of implementing rain gardens. The installation of the rain gardens averaged around $600 for materials for a 250 square foot garden. The installation included the costs for materials including, plants, soil, mulch and weed barrier fabric. Since all of the gardens installed in Euclid Creek were installed by volunteers, the costs for installation were zero. Additional costs to hire a designer and installer through a landscape service and landscape architect will increase the costs of the garden as typically with landscape design and installation costs of traditional gardens. Due to the scale of the garden, large equipment is not needed therefore reducing costs for installation.

Social & Property Issues of Rain Gardens in the Community

As part of this project, the concept of rain gardens across the watershed were examined on a number of issues. One of those issues included the social and personal property impacts of the rain gardens. This section highlights findings both from our experience in Euclid Creek and other studies examining rain gardens in the social context

Turnover of Land Ownership

One concern of rain gardens in the community is the transfer of home ownership and the stewardship of the garden from one property owner to the next. A study conducted in Minnesota on this issue discussed the concern on a demonstration area of multiple homeowners with rain gardens. The study discusses that the first owner is well aware of the garden, but as the transfer of a second or third owner comes into play, an understanding and values (i.e. avid gardener or non-avid gardener) the awareness of the value of the garden is diminished. Further education with the transfer of property will need to be integrated in the home purchasing process.

Demographics of Homeowners

The Minnesota study identified through their survey, age is a contributing factor to a neighborhood or watershed scale rain garden initiative. Older homeowners will largely not want to install the rain gardens due to the maintenance of the rain garden.

Tracking of Progress and Measuring for Water Quality Improvements

Through an interview with one municipal engineer in the watershed, one of the concerns is the monitoring and maintenance of the gardens, related to storm water management. If they are part of a community's storm water management pollution prevention plan, a program will need to be instituted to track and monitor rain gardens in the community and watershed as a valuable tool for measurable improvements. A strategy and use of rain gardens to report measurable water quality benefits will be challenging compared to larger scale constructed management practices such as Bioretention or extended detention basins.

Maintenance on Institutional Lands

While the maintenance of a rain garden on a residential site is largely part of any gardening regime which the homeowner provides, establishing ownership to maintain rain gardens on institutional sites can be challenging. The four sites installed in the Euclid Creek watershed will have different groups maintaining and caring for the gardens in the next year to monitor their progress including local municipalities, regional park agencies and student groups.

Public Involvement /Awareness

While the gardens may be very limited in pollutant load removals and pose homeownership issues, it has been a very successful outreach and public involvement tool to educated people on water quality issues especially related to urban storm water runoff and the impacts to local watersheds. It has also created hands-on involvement of various groups that provides a greater impact on people than receiving information on a practice. Additionally, the local communities were very supportive of this project and also felt this provided a good outreach opportunity through the use of public lands to build awareness of local water quality issues.

Recommendations for the of a Future Rain Garden Program in Euclid Creek and Cuyahoga County

As a result of the completion of this initial project, recommendations of a rain garden program in the Euclid Creek Watershed and Cuyahoga County are provided.

- Expand the monitoring efforts on installed rain gardens to examine and evaluate the water quality benefits better for Northeast Ohio including, infiltration, reduction of impervious cover/compaction in lawn areas, pollutant load reduction functions, ground water recharge and the capacity to remediate nutrients with particular plants. Linking the planning and implementation strengths of Cuyahoga SWCD with the research strengths of local academic institutions should be explored further.
- Evaluation of the effectiveness for water quality improvements. Rain Gardens will need to be evaluated further in addition to other best practices such as bioretention and extended wet detention basins for their water quality improvement effectiveness on a watershed scale as well as their costs and benefits for those costs. The Euclid Creek Watershed partners are developing a strategy to evaluate these practices and their most effective application in terms of land use to improve water quality particularly related to quantity and phosphorous load reductions. Establishing measurement indicators such as the use of the Flashiness Index developed by Heidelberg College to measure rain gardens effectiveness reduce flows in-stream, is needed.
- Evaluation of the desired soil characteristics for implementation should be continued. This will assist in targeting locations in the watershed and across the county where rain gardens can have the greatest impact in infiltration attenuation.
- Continue to provide rain gardens as a public education tool for outreach to the community on the value of backyard stewardship in the community, related to water quality improvements. Installing rain gardens are an effective tool to teach residents of all ages about the impacts of soil, drainage and plants through a hands-on exercise for watershed improvements.
- Continue to evaluate the local maintenance and oversight of rain gardens as part of local storm water pollution prevention planning, including homeownership turnover and reporting of measurable improvements.
- Continue to evaluate the local downspout disconnect policies to further examine how rain gardens can be incorporated into local practice without jeopardizing the need for infrastructure controls.
- Continue to encourage a market-based approach for implementation. Utilizing the skills of landscape designers and material suppliers in the private sector to

service a potentially new landscaping sector is recommended to create a market and demand to implement rain gardens. This is currently being developed by private businesses in Northeast Ohio.

Conclusion

The rain garden project for the Euclid Creek Watershed provided an opportunity to examine the technical, policy and public education issues of a rain garden program. The project was largely successful due to the reduced costs and installation of an additional two gardens and the outreach and interests it has generated on examining practices in the community and watershed. Continued evaluation of their water quality effectiveness on a watershed scale and their long-term maintenance is recommended for further study.

References:

Rain Garden Manual for Homeowners, Northeast Ohio Public Involvement Public Education Committee (NEOPIPE), 2006

Euclid Creek Community Local Municipal Ordinances
(Cleveland, Beachwood, Mayfield Heights, Euclid, Mayfield Village, South Euclid, Lyndhurst, Richmond Heights, Highland Heights)

Dietz and Claussen, *A Field Evaluation of Rain Garden Flow and Pollutant Treatment,* University of Connecticut, June, 2005

Nelson, Nowacek and Petchinik. *Social and Institutional Barriers to Stormwater Infiltration*, Wisconisin Department of Natural Resources, June, 2003

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Firehouse Sign Company

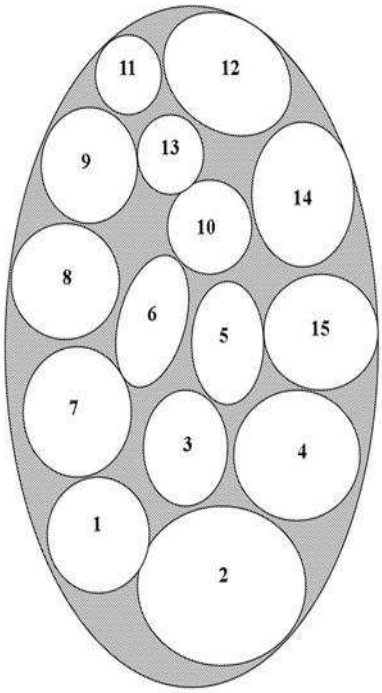
This document was developed by Lynn Garrity, Euclid Creek Watershed Coordinator, Cuyahoga Soil & Water Conservation District.

Appendix: Installation of Euclid Creek Watershed Rain Gardens

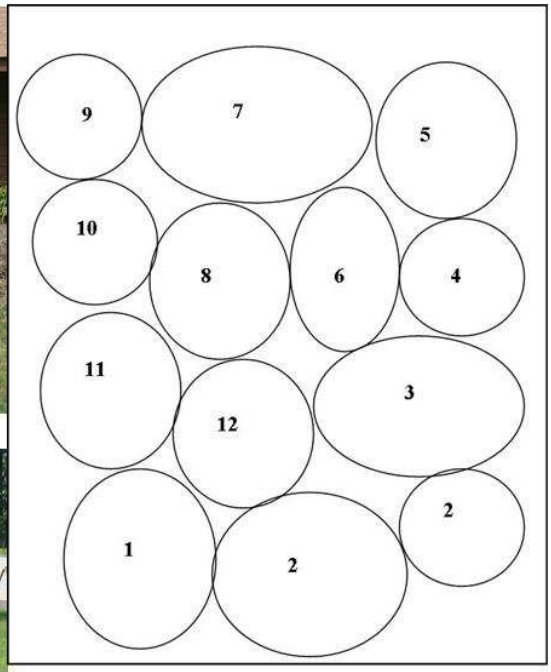
South Euclid-Lyndhurst Library : Installed, July, 2006

Rain Garden Plants

1. Prairie Cord Grass
2. Wild Iris
3. Ohio Goldenrod
4. Swtichgrass
5. Fox Sedge
6. Prairie Dock
7. Purple Coneflower
8. Blazing Star
9. Culver's Root
10. Marsh Milkweed
11. Tall Ironweed
12. Bergamot

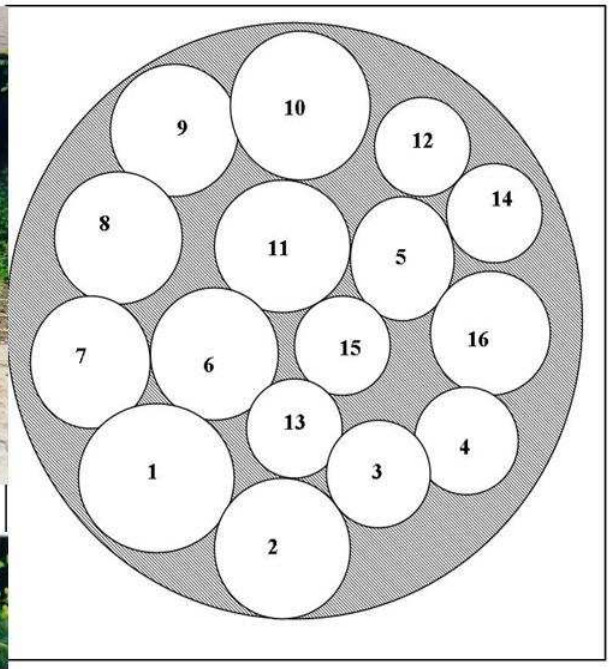


Richmond Heights Kiwanis Lodge: Installed August, 2006



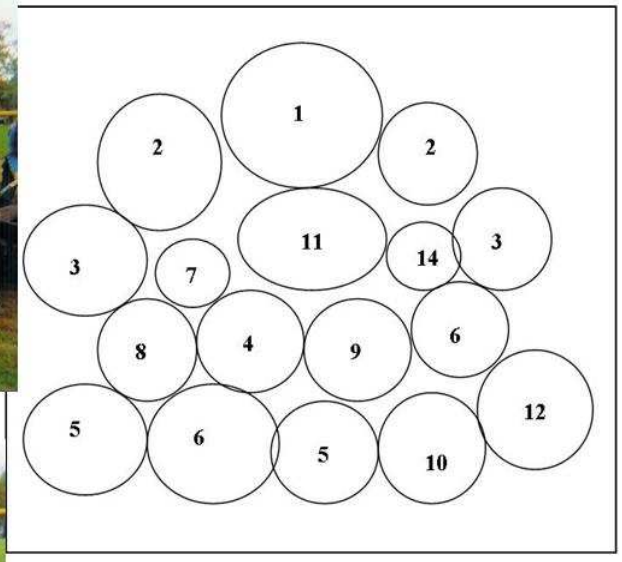
1. Prairie Cord Grass
2. Bergomot
3. Blazing Star
4. Wild Iris
5. Prairie Cord Grass
6. New England Aster
7. White Turtlehead
8. Ohio Goldenrod
9. Culver's Root
10. Queen of Prairie
11. Blazing Star
12. Wild Iris

Cleveland Metroparks Euclid Creek Reservation Welsh Woods:
Installed September, 2006



1. Cardinal Flower
2. Obedient Plant
3. Cardinal Flower
4. Obedient Plant
5. Wild Iris
6. Queen of the Prairie
7. New England Aster
8. Prairie Cord Grass
9. Marsh Milkweed
10. Ohio Goldenrod
11. Purple Coneflower
12. Tussock Sedge
13. Blackeyed Susan
14. Prairie Cord Grass
15. Great Blue Lobelia
16. Woody Sedge

Brainard Park – Installed October, 2006



1. Ohio Goldenrod
2. Wild Iris
3. Tusoock Sedge
4. Great Blue Lobelia
5. Obedient Plant
6. Queen of the Prairie
7. Wooly Sedge
8. Black eyed Susan
9. Purple Coneflower
10. Blue Vervain
11. Prairie Cord Grass
12. Cardinal Flower

Signage for Outreach

Each Rain Garden site will have a weather resistant interpretive sign as shown below to educate residents what a rain garden is and the benefits it provides to Euclid Creek.

Graphic Design provided by: Michael Roach Graphic Design