A Citizen-Based Approach to Stormwater Management:

Raingardens to Improve Impaired Waters

Final Report

Powderhorn Lake
Minneapolis, Minnesota

LCCMR Project 09-05e

June 29, 2012

Metro Blooms

In Association with:

SEH

Minneapolis Park & Recreation Board

MCC
Minnesota Conservation Corps

Minneapolis
City of Lakes

Minnehaha Creek Watershed District

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Final Report
Powderhorn Lake Minneapolis, Minnesota

Prepared for:

Legislative-Citizen Commission on Minnesota Resources

Prepared by:

Metro Blooms
P O Box 17099
Minneapolis, MN 55417
651.699.2426

In Association with:

Short Elliott Hendrickson Inc.
3535 Vadnais Center Drive
Saint Paul, MN 55110-5196
651.490.2000

City of Minneapolis, Minneapolis Park & Recreation Board,
Minnesota Conservation Corp and Minnehaha Creek Watershed District

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Acknowledgements

This study was conducted by Metro Blooms, a private nonprofit volunteer-based educational organization which seeks to partner with other organizations, businesses, professional associations, local governments and watershed districts to promote environmentally sound gardening and landscaping practices to improve the health of our land and water resources. Funding for this project was recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR) from the Environment and Natural Resources Trust Fund.

This project was delivered by numerous partners, many with in-kind contributions. Metro Blooms wishes to acknowledge and thank the following organizations for participating in this study:

Minneapolis Park and Recreation Board – stormwater monitoring and in-kind contributions related to management for monitoring and Mississippi River Green Team (youth worker) and technical review

City of Minneapolis – in-kind contributions for monitoring, technical review, and GIS services

Minnesota Conservation Corps – excavation

Short Elliot Hendrickson – paired watershed analysis, partner meeting facilitation, and report preparation

Minnehaha Creek Watershed District– in-kind contributions for technical review

Minnesota Pollution Control Agency– in-kind contributions for technical review

Mark Pedelty, University of Minnesota (and students) – in-kind contributions for documentary production and promotions

Mississippi River Green Team - youth in summer jobs program cared for and planted raingardens

Hennepin County Master Gardeners and many volunteers - participated in door-knocking, installation and maintenance activities

Ecoscapes – excavation and installation (pavers, drains, gutter realignments)

Dragonfly Gardens - contributions of native and other perennial plants

Patio Town - contribution of permeable pavers

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Education and action influenced community members to improve Powderhorn Lake water quality.

- The Powderhorn Lake neighborhood implemented best management practices to reduce stormwater runoff to Powderhorn Lake by directing 70,000 square feet of impervious area to bio-infiltration basins (raingardens).
- 230 community members were involved in activities related to implementation of water quality protection practices.
- 125 raingardens were installed through a fast-track design and construction process.
- Multiple community cleanup events were held which resulted in over 130 large bags of leaves and debris from entering the lake.

fast facts

125 raingardens installed

230 community members involved

50% property owners (non-rentals) participated in test area

> 70,000 square feet of impervious area redirected

> 15,000 native perennials planted

how? Citizen Engagement Methods Key to Successful Outcomes

- Enlist local champions of stormwater management to reach out to community members.
- Use a combination of outreach methods: workshops, mass mailings, door knockers, neighborhood home meetings, and canvassing.
- Include multi-lingual staff and community members to engage non-english speaking community members.
- Use a non-profit organization for outreach and implementation to offset skepticism associated with a private firm or city-led effort.
- Provide an economic incentive and a well-crafted, educated message.

why? Project Vision

The long-term success in reducing impairments to urban lakes and waterways will require better citizen-based approaches to increase public awareness and effect behavior change. A coordinated plan is also required that focuses efforts on areas and stormwater management practices providing the best benefits to the impaired receiving waters. This project evaluated community outreach approaches through a pilot study of the fast-tracked installation of over 100 raingardens in a 28-acre sub-watershed draining to Powderhorn Lake, Minneapolis. Stormwater best management practices (BMPs) were restricted to installations on private property. Stormwater monitoring was also integrated into the project to assess whether reductions in pollutant loadings or volume could be detected and provide support for future water quality improvement plans for Powderhorn Lake.

Citizen-Based Approach to Stormwater Management – Neighborhood of Raingardens

The term "Neighborhood of Raingardens" was created to define the collective approach to implementing stormwater management practices clustered in neighborhood areas. The goal is to educate citizens on the ways they can have a positive effect on the local water quality through a variety

of methods such as: raingardens, permeable pavers, green roofs, rain barrels, native plantings, boulevard plantings and yard maintenance. Raingardens serve as a visible tool and 'hook' to gain citizen interest and encourage neighbor participation. The large-scale community participation process not only teaches participants about water quality protection, but it also builds a stronger and more beautiful community through increased community outreach.

methods

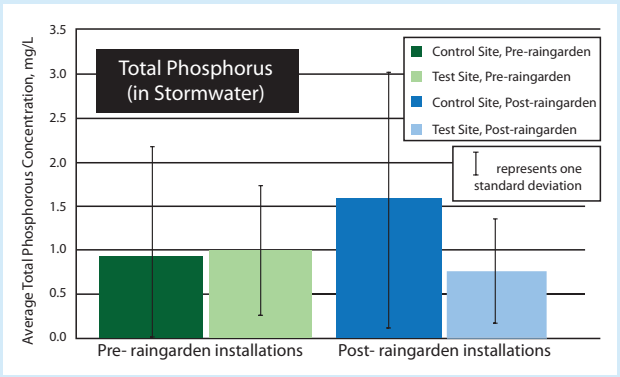
The project was developed through three phases: citizen engagement, design, and installation. Measurement activities preceded and occurred throughout the project.

Participant Process

Metro Blooms' general approach to citizen-based stormwater management projects involves the property owner throughout the process. For this project, the property owners were presented the large incentive of free design and installation services, as well as free garden plants and materials. Because this was a fast-paced project, it was difficult for most property owners to be involved in the installation process, but local youth teams assisted and institutional properties held events that engaged numerous community members.

Measurement

Performance was measured by monitoring the water quality and quantity of stormwater discharged to Powderhorn Lake from the area with raingardens (test site) and a neighboring watershed without raingarden installations (control site) and comparing the results from the two sites. Minneapolis Park and Recreation Board (MPRB) installed and maintained equipment for three years to provide stormwater runoff characteristics before and after the raingardens were installed. Surveys, site assessments, and maintenance activities were also used to evaluate the effectiveness of the Neighborhood of Raingardens in improving Powderhorn Lake water quality.



results

Monitoring in urban storm sewers has its challenges and coupled with the climatic conditions for the project period, fewer water quality samples were collected than planned. While the paired watershed analysis results do not show a statistically significant outcome, the few water quality samples collected in 2011 provide promise that the test neighborhood efforts could have reduced pollutant loadings when compared to the control area.

Other project measurements demonstrate that education and action influenced community members to improve Powderhorn Lake water quality. Over 230 people participated in project events and over 130 large bags of debris were collected in maintenance activities. In addition, post-survey results of participating property owners indicated that 76% enhanced their garden with additional plants, landscape materials or art. Over 50% implemented additional BMPs in their yard, such as adding a rain barrel or additional raingardens.

future plans

- Continue stormwater monitoring (City of Minneapolis is funding 2012 monitoring by MPRB).
- Further develop Metro Blooms' volunteer-based, raingarden evaluation program to provide added incentive for continued maintenance of raingardens.
- Focus new urban projects on maximizing backyard runoff capture with multiple types of BMPs.

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List of Abbreviations

BMP	Best Management Practice
cf	Cubic Feet
ft	Feet
LCCMR	Legislative-Citizen Commission on Minnesota Resources
LDA	University of Minnesota Landscape Design & Architecture Student
MCC	Minnesota Conservation Corps
MCWD	Minnehaha Creek Watershed District
MPRB	Minneapolis Park and Recreation Board
sf	Square Feet
SWMP	Stormwater Management Plan
TP	Total Phosphorus
TSS	Total Suspended Solids

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Prepared for Legislative-Citizen Commission on Minnesota Resources

1.0 Introduction

1.1 Project Vision

The long-term success in reducing impairments to urban lakes and waterways will require better citizen-based approaches to increase public awareness and effect behavior change. A coordinated plan is also required that focuses efforts on areas and stormwater management practices providing the best benefits to the impaired receiving waters.

This project evaluated community outreach approaches through a pilot study of the installation of over 100 raingardens within a five-week period in a 28-acre sub-watershed draining to Powderhorn Lake, Minneapolis. Stormwater best management practices (BMPs) were restricted to installations on private property. Stormwater monitoring was also integrated into the project to assess whether reductions in pollutant loadings or volume could be detected and provide support for future water quality improvement plans for Powderhorn Lake.

The study results have direct benefits to Powderhorn Lake, a water body in Minneapolis and within the Minnehaha Creek Watershed District (MCWD). In addition to directing over 70,000 square feet (sf) of runoff from impervious areas to bio-infiltration areas (raingardens), the project engaged 230 community members and increased their awareness of how their actions affect the water quality of their neighborhood lake. Community members were involved at various levels of commitment, including: reading literature distributed as part of the project, attending or hosting a workshop, meeting with a designer, and participating in installation and maintenance activities.

The study results will be used by the City, Minneapolis Park and Recreation Board (MPRB), and MCWD for various watershed management strategies. In addition, the findings of this project can be applied to similar urban areas and provide a basis to target citizen-based improvements of highest benefit to our water resources.

1.2 Citizen-Based Approach to Stormwater Management – Neighborhood of Raingardens

The term “Neighborhood of Raingardens” was created to define the collective approach to implementing stormwater management practices clustered in neighborhood areas. The goal is to educate citizens on the ways they can have a positive effect on the local water quality through a variety of methods such as: raingardens, permeable pavers, green roofs, rain barrels, native plantings, boulevard plantings and yard maintenance. Raingardens serve as a visible tool and ‘hook’ to gain citizen interest and encourage neighbor participation. The

large-scale community participation process not only teaches participants about water quality protection, but it also builds a stronger and more beautiful community through increased community outreach.

The Powderhorn Lake Neighborhood of Raingardens project specifically explored several different techniques to recruit residents and institutional property owners to install raingardens and implement other stormwater management practices on their private property. For example, one method is to have a resident host a neighborhood raingarden party, as shown in Figure 1. A small workshop-style presentation introduces stormwater and water quality concepts, and residential practices to improve water quality. In the case of this project, significant incentives included free consultation, design, installation and plantings funded by this project. In addition to citizen engagement, this project required specific design and installation processes, which are also documented in this report.

Figure 1 – Neighborhood Raingarden Party Used to Introduce Stormwater Management Practices

The Powderhorn Lake Neighborhood of Raingardens project was developed to reach several goals. Foremost was to evaluate methods of citizen engagement and maximize community involvement. Given the "free" incentive of a raingarden, the focus of the best management practices was on the installation of a raingarden and education about water quality protection. In most cases, a raingarden provided a BMP with a high runoff capture volume for a specific property. For some properties, other practices may have been more effective, but were not implemented because of site, budget, and homeowner constraints, except at institutional and specific properties during the second year.

Another project goal was to maximize runoff capture. This goal was restricted by the requirement to install raingardens and other stormwater management practices exclusively on private property. The inability to capture runoff from sidewalks and streets limited the stormwater runoff pollutant load and volume reduction possible with this project.

1.3 Project Team

This study was conducted by Metro Blooms, a private nonprofit organization which seeks to partner with other organizations, businesses, professional associations, local governments and

watershed districts to promote environmentally sound gardening and landscaping practices to improve the health of our land and water resources. Funding for this project was recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR) from the Environment and Natural Resources Trust Fund.

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- Mark Pedalty, University of Minnesota (and students) – in-kind contributions for documentary production and promotions
- Mississippi River Green Team (youth in summer jobs program) – cared for and planted raingardens
- Ecoscapes – excavation and installation (pavers, drains, gutter realignments)
- Dragonfly Gardens - contributions of native and other perennial plants
- Patio Town - contribution of permeable pavers
- Numerous volunteers including: Hennepin County Master Gardeners, University of Minnesota students, residents from the Powderhorn Park Neighborhood & many others

1.4 Study Area

1.4.1 Powderhorn Lake and Watershed Characteristics

Powderhorn Lake is located in an urban residential area south of downtown Minneapolis, Minnesota, as shown in Figure 2. It is a small 11-acre lake within a 77-acre park. Originally a wetland area, it was dredged in the early 1900s to create the lake and park. It is shallow, averaging under 4 feet (ft) in depth with one area around 20 ft deep. It has a watershed of 286 acres (26:1 ratio) and five separate stormwater outfalls discharging to the lake (Figure 3), with no natural open channel tributaries. Water leaving Powderhorn Lake is pumped directly to the Mississippi River, when authorized. Other than the park area surrounding the lake, the watershed is a built-out urban area that is primarily residential, with institutional and commercial properties mixed throughout.

Figure 2 – Powderhorn Lake Location Map

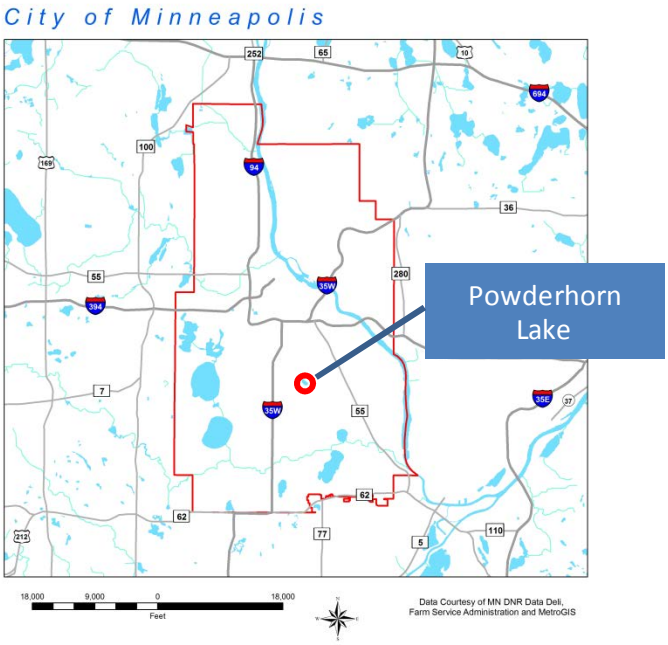
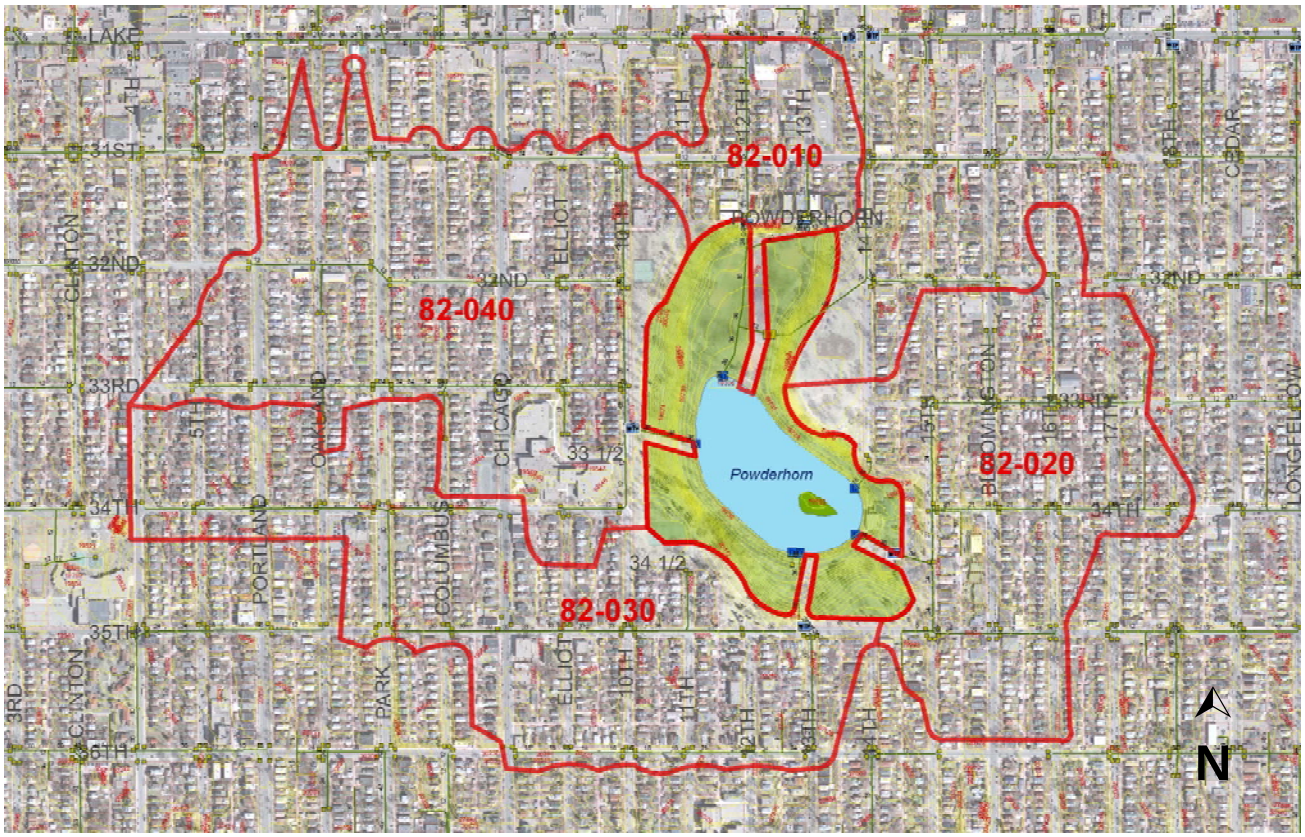


Figure 3 – Powderhorn Lake Sub-Watersheds



1.4.2 Powderhorn Lake Water Quality and Past Improvement Projects

Powderhorn Lake was previously listed by the State of Minnesota as impaired for "nutrient/ eutrophication biological indicators". It was removed from the list of impaired waters in 2012. Several City and MPRB improvement projects and City-wide programs targeted Powderhorn Lake for water quality improvements and include:

- Installation of five Continuous Deflective Separation (CDS) grit chamber units in 2002. These units remove floatables like leaves and garbage and heavier solid particles, such as sand.
- A shoreline restoration and retaining wall construction was completed in 2002. This included removal of concrete sluiceways and planting of native aquatic and shoreline vegetation (Figure 4).
- Alum treatment in 2003. Alum is a chemical that is added to remove soluble phosphorus which forms a precipitant that settles to the lake bottom.
- Aeration during summer and winter since 2003.
- Annual barley straw treatment since 2004. This approach targets microbial communities in the lake, to increase their take up of nutrients as they grow making the nutrients unavailable to algae (Figure 5).
- Implementation of ongoing practices including:
  - Street sweeping during the spring, summer and fall. Winter sweeping is also conducted as weather permits. The Powderhorn Park parking lots are also swept on an approximately 15-day cycle.
  - Goose reduction programs.
  - City stormwater utility program which credits property owners who employ on-site stormwater management practices.
  - Public education programs.

Figure 4 – Shoreline Restoration

Figure 5 – Barley Straw Treatment

1.4.3 Neighborhood of Raingardens Study Area

In 2008, Metro Blooms was working with the City on education programs for residential stormwater management. Metro Blooms was interested in expanding its existing raingarden workshop program to focus on specific areas for engagement. With interest and planning assistance from multiple partners, the concept evolved to this pilot study of methods for fast-tracked installation of residential and institutional property raingardens. The partner team also wanted to measure performance of this collective stormwater management approach and incorporated water quantity and quality monitoring into the project. The Powderhorn Lake area was selected as the site for the study. Additionally, there were residents in the area with interest in raingardens based on previous workshops and outreach activities.

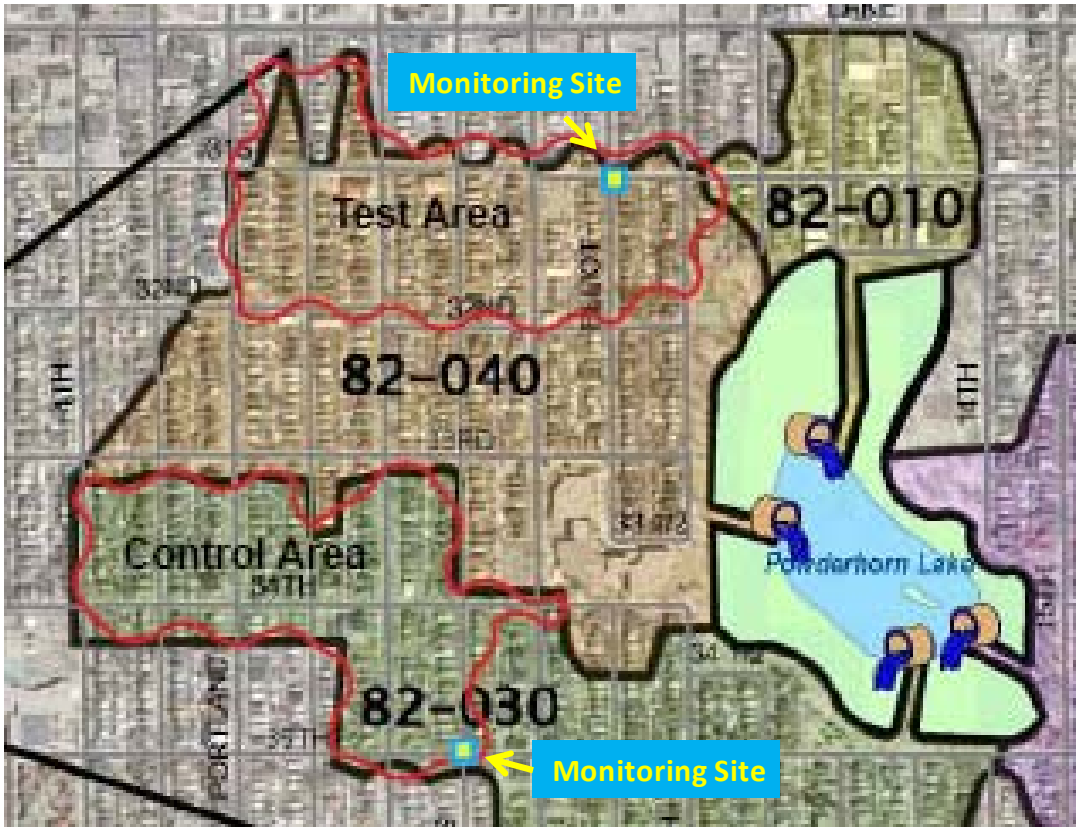
The study was set up to assess the performance of a Neighborhood of Raingardens with a paired watershed analysis. In this analysis, stormwater monitoring is required in both a test and control area. The watershed area with newly installed raingardens and other BMPs is the test area and the one without the accelerated raingarden program is the control area. A review of watershed land use identified two subwatersheds, 82-030 and 82-040, on the west side of the lake with similar characteristics as shown in Table 1. Figure 6 shows the areas of each of these subwatersheds selected for this study.

Table 1 - Powderhorn Lake Watershed Land Use

	Drainage Area 82-040 (Test)				Drainage Area 82-030 (Control)			
Type	Count	Total Area (sf)	Estimated Impervious Area (sf)	% Impervious	Count	Total Area (sf)	Estimated Impervious Area (sf)	% Impervious
Residential Parcels	435	2,261,064	852,059	38%	396	2,069,998	746,954	36%
Non-Residential Parcels	20	388,864	253,773	65%	20	201,254	129,333	64%
Public Right-of-Way	na	1,640,732	1,394,623	85%	na	1,650,891	1,403,257	85%
Total		**4,290,660**	**2,500,455**	58%		**3,922,143**	**2,279,544**	58%

Source: City of Minneapolis GIS database
na = not applicable

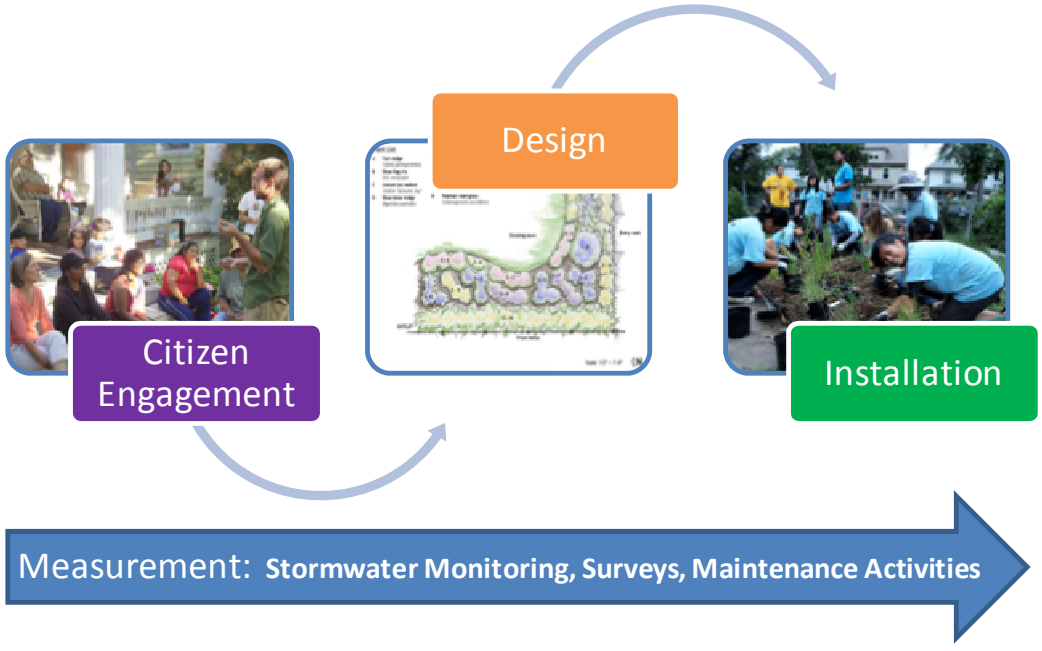
Figure 6 – Test and Control Sub-Watersheds



1.5 Methods

The project was developed through three phases: citizen engagement, design, and installation. Measurement activities preceded and occurred throughout the project, as depicted in Figure 7.

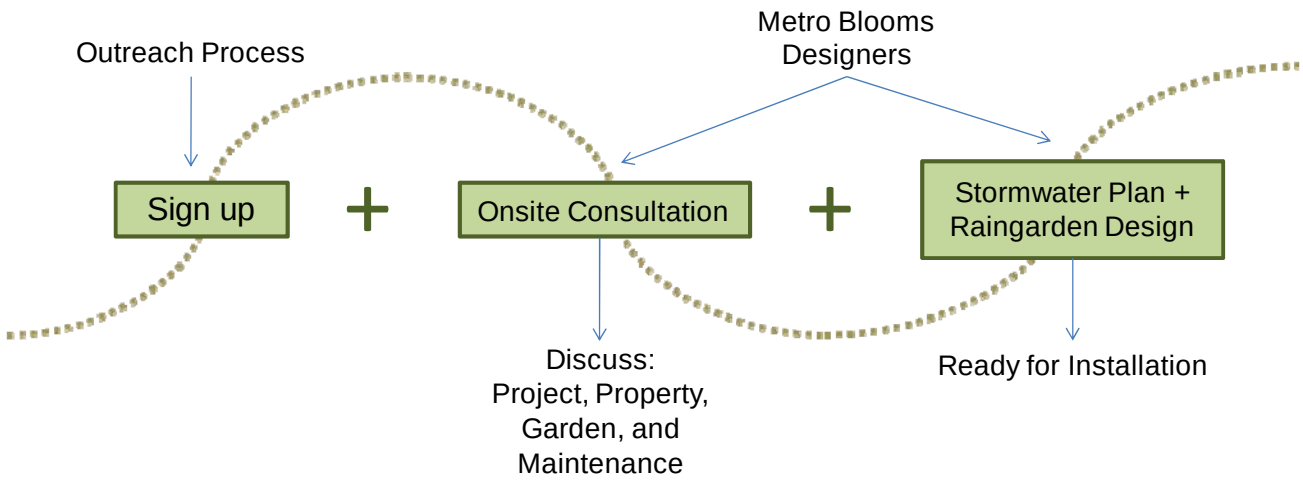
Figure 7 – Project Phases



1.5.1 Participant Process

Metro Blooms' general approach to citizen-based stormwater management projects involves the property owner throughout the process. Figure 8 presents the process and interaction with the participant. For this project, the property owners were presented the large incentive of free design and installation services, as well as free garden plants and materials.

Figure 8 – Participant Process



1.5.2 Project Specific Process Features

The Powderhorn Neighborhood of Raingardens used multiple outreach methods and a fast-tracked design and installation process. The initial plan was to involve property owners throughout the process including installation. Past experience has shown there is more commitment to the cause and longer-term success in maintenance of the garden and other stormwater management practices with involvement. Because the schedule was compressed to accommodate issues with the stormwater monitoring, the gardens needed to be installed in a short period of time. It was too difficult to plan schedules with each property owner to coordinate their involvement in the planting. However, there were some individual and several community and institution property group installations.

1.5.3 Measurement

1.5.3.1 Stormwater Monitoring

A significant part of this project was monitoring the water quality and quantity of stormwater to see if there was a measurable difference in the pollutant loadings going to Powderhorn Lake. The monitoring activities dictated the schedule and selection of the study area and required continual adjustments for the team in all project phases.

Stormwater monitoring to test the performance of a BMP involves:

- Selection of the proper sites to characterize similar drainage areas for test and control watersheds and for optimum monitoring equipment performance.

- Use of equipment that is installed correctly and maintained to ensure accurate data collection.
- Data analysis that involves quality control procedures to report results with statistical confidence.
- Adequate monitoring of watershed storm events before (pre-test or calibration period) and after (post-test or treatment period) the BMP installation, in both the test and a control watershed.

The inclusion of stormwater monitoring in the project put constraints on the specific areas that would qualify for participation in the study. This resulted in turning away interested residents and having to recruit more in the test area. Conversely, the selection of monitoring sites favored certain locations despite site specific features of the collection site that were not optimum (such as proximity of downstream storm sewer connections). Some compromises were made to capture similar watershed characteristics for the test and control basins, as well as neighborhoods indicating there were willing participants.

Monitoring equipment was installed in the storm sewers at two locations to record stormwater flow for the test and control watersheds beginning in Spring 2009 through November 2011. The MPRB installed equipment & collected data for the three year period as shown in Figure 9 for one of the sites. Approximately 10 water quality samples were taken each year and analyzed for total phosphorus and total suspended solids. Equipment was removed in the winter months.

Figure 9 – Monitoring Equipment & Sites

Section 6.3 and Appendix A, Technical Memorandum- Powderhorn Lake Neighborhood of Raingardens Paired Watershed Analysis, provide a detailed accounting of the methods and results

from the stormwater monitoring. Section 2.0 presents the major monitoring activities to document the steps, issues, and successes along with the Neighborhood of Raingardens project phases.

1.5.3.2 Surveys, Site Assessments and Maintenance Activities

Several activities were used to measure progress and performance during the project phases. In the citizen engagement phase, the number of citizens responding to various methods were recorded. A survey was adapted for this project and used in the early citizen engagement phase to provide a stormwatershed audit of the test and control areas. Site assessments were performed by Metro Blooms staff throughout the project to determine if original stormwater management plans were being followed. In addition, maintenance activities were organized in 2011 and 2012, and the number of new plants provided, plus other information recorded provides a measure of the number of properties with continued performance as originally designed.

1.6 Report Organization

This project has a variety of information that provides value for planning future citizen-based stormwater management programs and specific needs for the Powderhorn Lake watershed and similar urban areas. Figure 10 summarizes the organization of the report.

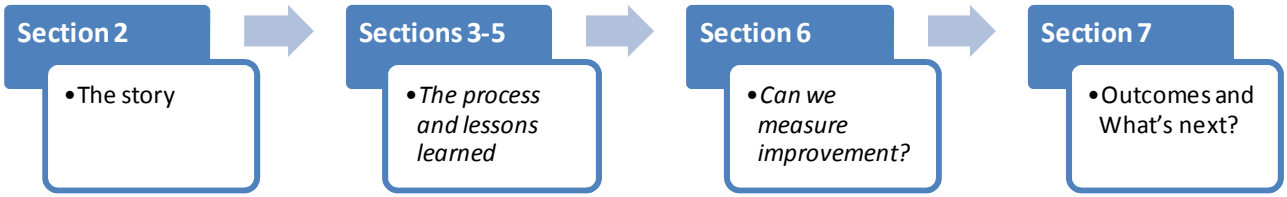
- *First – The story.* It is helpful to view the chronology of the project to understand the different methods used in each project phase and the results and challenges of each phase and the measurement of BMP performance. Section 2.0 tells the Powderhorn Lake Neighborhood of Raingardens story through a project timeline.

- *Second – The process and lessons learned.* Sections 3.0 – 5.0 define the processes that evolved to deliver the citizen engagement, design, and installation phases.

- *Third – Can we measure water quality improvement?* Section 6.0 presents the results of stormwater monitoring, land use and runoff capture changes, site surveys, and maintenance activities.

- *Last – Outcomes and What's next?* Section 7.0 summarizes the project's major outcomes and the opportunities identified to continue to build on the successes of the Powderhorn Lake Neighborhood of Raingardens.

Figure 10 – Report Organization



2.0 Project Timeline

2.1 Overview

This project spanned over three years. Project planning and stormwater monitoring were initiated in the spring of 2009 by the City of Minneapolis to provide as much time as possible for pre-installation monitoring and the ability to quickly mobilize efforts to enlist participants. Mid-2009 to mid-2010 involved outreach education programs, onsite consultations, stormwater management plan preparation, and raingarden design. Over 120 raingardens were installed in 2010, with 106 installed within a five-week period in the test area. Outreach

education programs continued over the course of the three years. The 2011efforts focused on maintenance of systems installed in 2010 and new installations with larger capture areas. Figure 11 summarizes the activity for the three-year period and Figure 12 provides a map of the properties participating in the study.

Figure 11 – Project Timeline

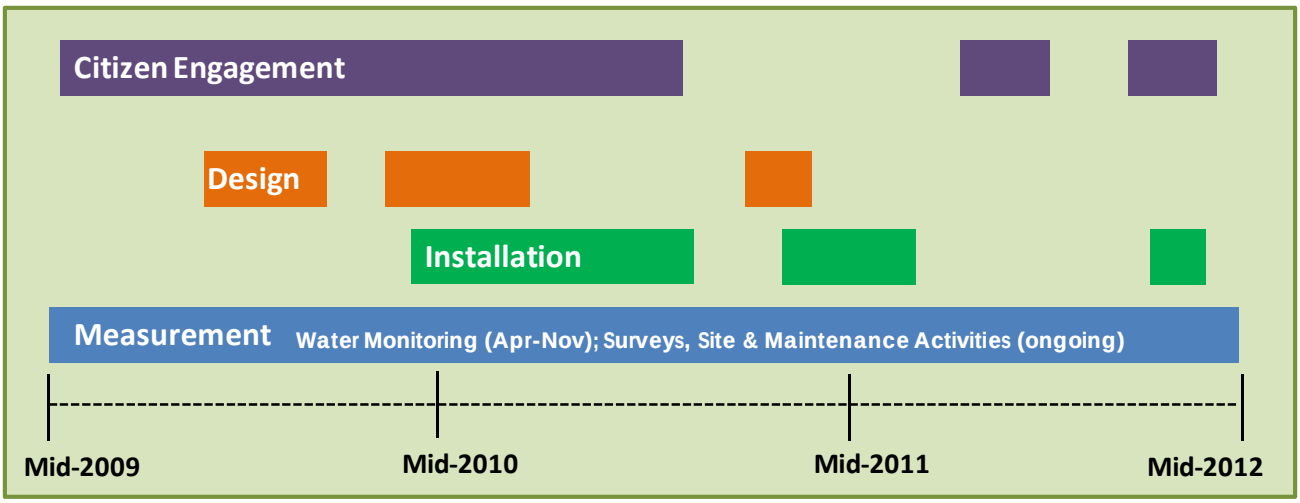
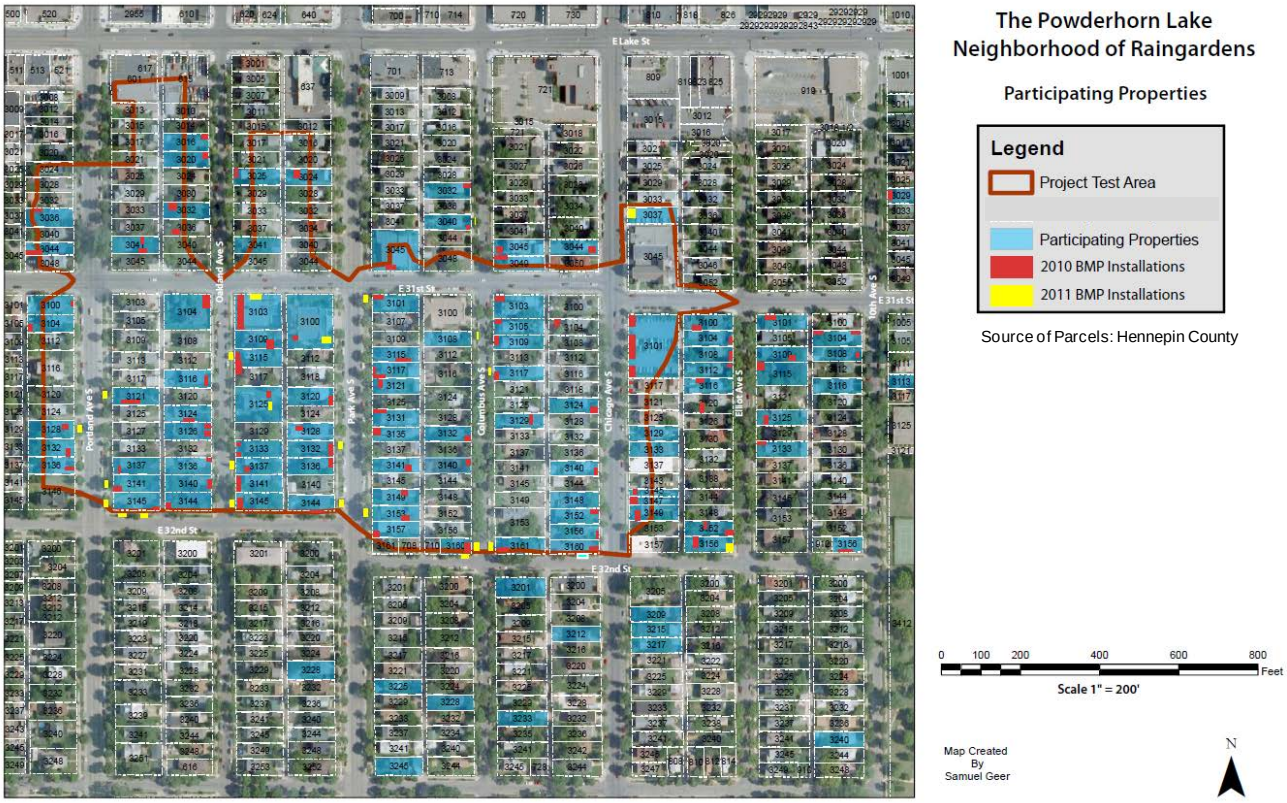


Figure 12 – Raingarden Installations



2.2 Year One: 2009

While the project funding from LCCMR is based on a project initiation date of July 2009, the partner team provided in-kind services so that the project could have a quick start and provide

the largest window of time for stormwater monitoring. The City supported the monitoring activities provided by MPRB staff. Partner members investigated sites, selected sites, installed, and begin monitoring of the control and test sites in May 2009. In addition, Metro Blooms staff organized materials and developed a plan for an intense effort for outreach activities.

The preliminary water monitoring data indicated that the test monitoring site was in a reach of the storm sewer pipe that was not ideal for data collection. The early summer was spent cleaning storm sewers and evaluating new locations for the monitoring equipment. The outreach education efforts continued, but with a revised plan for installations to occur in 2010, as opposed to Fall of 2009. The new sites selected (as shown previously on Figure 6) resulted in smaller watersheds for the test and control areas. There were 16 residents that signed up for the project prior to relocation of the test area boundaries. These residents served as a small pilot group in Spring 2010 to optimize the design/installation process prior to the August 2010 installation of 106 raingardens.

2.2.1 Citizen Engagement

The outreach activities in 2009 consisted of the following, as depicted in Figure 13:

- Raingarden Workshops in Powderhorn Neighborhood. Flyers announcing raingarden workshops were distributed to almost every household in the test area. This was done in coordination with the Green Team youth participation and a stormwater audit described in Section 2.2.3 below. This effort resulted in a total of 5 people at two workshops. Of those five, three agreed to host parties in their yards. After this experience, the efforts were refocused on canvassing and raingarden parties.
- Raingarden Parties. Over the summer, four hosted raingarden parties were held, where a property owner/participant agreed to invite their neighbors to their yard for a one hour introduction to the project and raingardens, and to sign up participants for an onsite consultation.
- Canvassing. Metro Blooms led groups of staff and volunteers in canvassing the neighborhood for four nights in August - knocking on doors, and talking with residents in their yard and on the streets about the project, asking them to sign up for an onsite consultation.

More than half of the conversations were in Spanish. Educational materials were translated to the adopted tag line for this project - Construye un Jardin de Liuvias. Restaura el Medio Ambiente. Colabora con una “Minga”. This means: Build a raingarden, Save the environment and Join a Minga. A Minga is a group that gathers to do charitable works for the community.

These activities were augmented with direct mail and other methods. Using Hennepin County property records a database of every property owner in the test area was created, including name and address. A packet of information was mailed to every property owner to describe the project and give them dates for upcoming raingarden parties, and contact information to sign up for an onsite consultation. Using online directories, telephone information was gathered and e-mail addresses were collected through the course of the project. To reach all property owners required a combination of direct mail, telephone calls, e-mail and door-knocking.

Figure 13 – Initial Citizen Engagement Strategies

Raingarden Workshops	Raingarden Parties	Canvassing
▪ 2 Workshops ▪ 5 People Attended ▪ 3 Agreed to Host Raingarden Party ▪ Not an Effective Tool	▪ 4 Raingarden Parties ▪ Friends and Neighbors Invited ▪ ~25 Homeowners Signed Up ▪ Effective Tool ▪ Attracted Residents from Outside of Test Area	▪ 4 Nights of Door-to-Door Canvassing ▪ Staff, LDAs, and Volunteers ▪ ~35 Homeowners Signed Up ▪ Best Method of Contacting Residents within Test Area

2.2.2 Design

Metro Blooms staff completed 56 onsite consultations, stormwater management plans, and raingarden designs for the test area by the end of December 2009. A total of 63 property owners were identified in the test area, with another 20 outside the test area.

Each participant received a copy of their stormwater management plan (SWMP) and raingarden design. The SWMP provides a variety of options, in addition to a raingarden installation, that the participant may adopt to manage their stormwater onsite.

2.2.3 Installation

The installation phase of the project included partnering with volunteers, youth/teen groups, the excavation team partner, Minnesota Conservation Corp, and other contractors in the propagation of plants for installation in 2010.

Metro Blooms initially worked with the MPRB Teen Teamworks and the Mississippi River Green Team (refer to Appendix C for details) to propagate native plants for the raingardens. Native perennials were purchased and a large donation of cultivars and natives was received. Metro Blooms landscape design assistants directed the youth crews to propagate through cuttings and thinnings of the donated plants. All plants were planted in organic potting soil in one gallon pots to allow them to grow and develop their root structure for planting in 2010.

Metro Blooms led the crew to build a shade structure for the nursery at the MPRB's JD Rivers Children's Garden on Glenwood at Vincent Avenue North, just east of Theodore Wirth Park (Figure 14). The supports and shade cloth protect the shade loving natives from the harsh sun in the open field. Much of the Powderhorn neighborhood is shady, with many trees. The new transplants were bedded in 2 inches of mulch and then tucked in all around with mulch to the rim of the pot in an effort to protect them through the winter.

Figure 14 – Propagation Garden Developed by Team Members and Volunteers

In the late fall of 2009, two additional large donations of perennials – approximately 250 flats (4,400 – 1 inch and 4 inch pots) of cultivars were provided by Dragonfly Gardens and approximately 40 gallon pots of natives were provided by Minnesota Native Landscapes. These over-wintered based on instructions from Dragonfly on how to overwinter plants in their nursery pots – covered in two feet of mulch.

By December 2009, approximately 4,600 raingarden perennial natives and cultivars for the project (approximately 30 per garden) were prepared for over-wintering.

2.2.4 Measurement

2.2.4.1 Stormwater Monitoring

With the delayed start in data collection for the 2009 pre-installation rain events, only 5 paired (test and control watersheds) events were collected and of these only 1 had water quality samples. After reviewing the monitoring data, the team agreed to delay excavation until August 2010, which would allow time to install over 100 raingardens in 2010 and obtain more pre-test monitoring results.

The initial results indicated that the control and test areas have similar storm runoff characteristics, which improves the ability to measure differences and possibly require less data for statistical significance. For additional detail see Appendix A.

2.2.4.2 Other Measurement Activities

Stormwatershed Audit. The Mississippi River Green Team completed a Stormwatershed Audit of the test area. Michael Keenan, Metro Blooms, presented a raingarden workshop to teach the students about raingardens. Rusty Schmidt trained the team on an audit tool modified for an urban environment based on a stormwatershed audit tool created by the Washington Conservation District (Appendix C). Metro Blooms designers and University of Minnesota Landscape Design

and Architecture Students (LDAs) led the Green Team as they completed the assessment of every property in the test and control area.

The plan was to use the data collected as another pre-test measure to determine the impact of stormwater education and participant initiated stormwater management practices beyond the project installed raingardens. Given the size and experience level of the group doing the assessment, and an initial review of some audit forms, it was determined it would not provide accurate information for the project. However, it is expected to have made an impact on some teen participants in better understanding how their actions affect the water environment.

Participants. By year end 2009, the net result of promotions, raingarden parties and canvassing was a total of 63 property owners signed up to participate in the project, including two faith-based organizations: Mount Olive Lutheran Church and All God's Children, both on 31st Avenue in the test area.

2.3 Year Two: 2010

This period had active involvement in all project phases. Most notable was the installation of 106 raingardens within a five-week period. Also included in this period were over 40 designs and onsite consultation, managing additional requests for design changes, and four significant outreach education events for the project.

2.3.1 Citizen Engagement

Citizen engagement had a boost in March 2010 with the first episode preview of *A Neighborhood of Raingardens*, a film produced by University of Minnesota's Mark Pedelty (Figure 15). The film gives an introduction to raingardens and stormwater runoff and highlights the Powderhorn Park project. It aired on the Twin Cities Public Television MN Channel on April 22nd (with repeat showings) and provided a useful tool to introduce participants to raingardens and the project.

Figure 15 – Neighborhood of Raingardens Documentary Provides Additional Outreach

Raingarden parties continued at participant's homes. Four parties from January through June with 46 in attendance generated 6 new participants for the project. More than a recruitment tool, these parties were raingarden educational events, and a chance to discuss installation details with property owners who were already signed up to participate. They also helped to build community among participants.

On April 24, 2010 Metro Blooms hosted an event at the Powderhorn Park Recreation Center. Project participants were invited to review their plans with Metro Blooms designers. The Neighborhood of Raingardens film was shown to about 25 residents.

Working with Blue Thumb, Metro Blooms hosted the National Geographic's Expedition Blue Planet in Powderhorn Park on July 4 to highlight water quality improvement efforts and the Powderhorn Lake project. The event was promoted to test area residents with an offer of a free t-shirt and native plants for all those who showed up at the Metro Blooms booth. At the end of the day, the remaining native plants were donated to Metro Blooms for the project. (For details refer to http://www.bluethumb.org/natgeo/).

On July 19, Metro Blooms hosted a community meeting for Powderhorn Lake participants at All God's Children church (a participating congregation). About 40 participants showed up to discuss the logistics of the installations, view the film, review their plans with the landscape designers, and sign waiver forms.

By July 15, 2010 over 100 participants signed up to participate.

Figure 16 summarizes the second year citizen engagement strategies.

Figure 16 – Second Year Citizen Engagement Strategies

2.3.2 Design

Stormwater management plans and raingarden designs were completed of the106 test area participants signed up for installation in August. Some of the issues and observations associated with the design process include:

- A lot of no-shows for onsite consultations, which needed to then be rescheduled. The initial onsite consultation sign-up sheets stated that property owners who did not show up

for their scheduled consultations would be ineligible to participate in the project. After struggling to identify participants over the past year, this statement was eliminated, but resulted in excessive rescheduling, sometimes multiple times for one property owner.

- Requests for plant changes. As the installation date approached, several participants wanted to make plant changes to their designs. While trying to accommodate as many requests as possible, this added labor effort to meet with many homeowners to discuss changes. Additionally, some changes were not possible if the plant was not it in stock.
- Additional design adjustments were also required when marking the garden. This was mainly due to an incorrect design. With the intense design/installation schedule for this project, LDAs with varied experience were involved in the project and extra effort was required to review and change design and plant selection.
- A lot of property owners do not have downspouts, and the landscape designers encourage homeowners to get them installed and directed to the raingarden. In 7 of the 16 gardens installed last June, homeowners re-directed their downspouts to the garden. Three of these installed new or replaced old gutters and downspouts.
- A portion of the people are interested in incorporating their new raingarden with other landscaping they are planning in their yard – which meant more coordination for Metro Blooms, but was also seen as a good sign in terms of long term maintenance of the gardens.
- Unfortunately, there have been few opportunities for raingardens in the back half of the properties, largely due to the fact that it is really built up with garages and driveways and most people are not willing to give up their driveway. It was observed that the backyards often contributed more sediment and other pollutants (i.e. pet waste) than the front yards.
- The church properties require more planning and resources. More time is required to include multiple members in the design plan and more time must be planned for organization approval. In addition, the larger property size takes more time for design and more materials for installation.

2.3.3 Installation

Working with Ecoscapes for excavation and the Mississippi River Green Team for planting, from June 14 - 17, 2010, 16 raingardens were installed within the original test area, but just outside the final test area. These properties were signed up to participate in the project before the monitoring sites were changed in 2009. Project partners determined that there were sufficient resources to install these gardens even though they were not in the test area. The installations served as a model for recruiting more residents in the test area and continuing education of those already recruited. The June installations also served as a test run for the larger August installation.

At the July 4 Expedition Blue Planet event (Figure 17) Metro Blooms received approximately 1,500 additional native plugs that were left over from this event. These were used where possible in the Powderhorn gardens.

The 2011 installation phase highlight was the excavation and planting of 105 raingardens in a five-week period. Section 5.0 provides the details on this accomplishment.

Figure 17 – Expedition Blue Planet Partner for Outreach

2.3.4 Measurement

2.3.4.1 Stormwater Monitoring

The 2010 monitoring season started in April and continued through late November. The equipment performed well, notably with modifications adopted by the MPRB, to provide measurement even with sand and debris build-up on the bottom of the storm sewer where the monitoring probe was located. Unfortunately, the high intensity storms during this year caused the storm sewers to surcharge and accurate data could not be collected for some events. In addition, there were dry periods during this year that limited the storm events for evaluation. The number of paired storm events to characterize the calibration period for 2009-2010 was 33, of which 8 included water quality samples. For additional detail see Appendix A.

2.3.4.2 Other Measurement Activities

Of 100 participating test properties, 11 are rental units, six are owned by non-profit organizations and three properties are churches, which leaves about 80% of the participants as homeowners. Some properties have two raingardens, bringing the total in the test area to 106. It is estimated that the project had a 50% participation rate among owner-occupied properties.

It was estimated that 8 current participants are in primarily Spanish-speaking households. This is out of an estimated 36 Spanish-speaking households, or just under one quarter of the Spanish-speaking households in the test area. If the overall rate of Spanish-speaking households in the neighborhood is around 16%, the participation rate for this group is half that at 8%.

As anticipated, encouraging participation has been more challenging among rental property owners, non-profit property owners, businesses, and non-English speaking households.

2.4 Year Three: 2011 - June 2012

This year was marked with ongoing education of participants with maintenance activities and focusing on management practices with higher capture volumes.

2.4.1 Citizen Engagement

In May and June 2011, Metro Blooms organized events for volunteers and Powderhorn participants to get to know the project, receive training and assistance to install boulevard gardens to capture stormwater, and to check in to see how the gardens were doing. Volunteers and participants were asked to join a group on Saturday, June 11th for a day-long event in the neighborhood to maintain gardens planted in 2010 and to install new boulevard gardens.

On May 28th a tour of the Powderhorn project was given. Powderhorn participants and volunteers were paired with Metro Blooms landscape designers and given a list of raingardens to visit, talk about their garden's performance, and make appointments for the June 11th installation and maintenance day.

On June 4th volunteers were trained on how to install boulevard gardens, do downspout redirection, and other water capturing features. Volunteers also assisted Metro Blooms staff in marking project locations and conducting preliminary site visits and follow up meetings.

2.4.2 Design

Metro Blooms staff prepared designs for general boulevard plantings and new raingardens and other stormwater management systems as described in the next subsection.

2.4.3 Installation

On June 10th volunteers assisted in preparation for the Powderhorn raingarden maintenance event. A group met at All God's Children Church and assembled boulevard garden packages for boulevard tolerant plantings that will have interest and beauty and are divisible by 100 square foot areas.

The Powderhorn maintenance event was held on June 11th. Volunteers assembled to assist participants with re-planting efforts, downspout redirection, and boulevard garden creation. The Metro Blooms Board and Fundraising Committee hosted a luncheon at Mount Olive Church: preparing bratwurst, hot dogs, chips, and sodas for all volunteers, neighborhood participants, and staff.

Throughout the week of June 13th – 17th: Staff and volunteers provided assistance with re-planting, downspout redirection, and re-mulching assistance as they were available.

A total of 23 new boulevards and 5 new raingardens were installed by residents and volunteers with staff oversight.

Ecoscapes installed:

- At the home of Florence Hill, a rubber razor across the 300 square feet (sf) of gravel driveway and 683 sf garage that redirected runoff to a raingarden.
- At Mount Olive Church, a 480 sf permeable strip at the driveway entrance to the parking lot to disconnect 3,444 sf of parking lot.
- All God's Children: a 185 sf permeable strip to disconnect 3,348 sf of parking lot.

2.4.4 Measurement

2.4.4.1 Stormwater Monitoring

Intermittent software equipment problems in 2011 reduced the number of stormwater events available for the paired watershed analysis. Once the software issues were corrected, there was little precipitation to record. It was a very dry mid-summer through fall in 2011. Out of 15 rain events with acceptable flow monitoring data, six included water quality sampling. Unfortunately, the end result was insufficient data to provide conclusive results to measure water quality improvement. Interestingly, the last four water quality samples showed the test site with consistently lower phosphorus and solids concentrations than at the control site. The City is funding monitoring in 2012 to continue the evaluation of stormwater quality. For additional detail see Section 6.0 and Appendix A.

2.4.4.2 Other Measurement Activities

Participation. Several larger groups participated in activities during the last year and a half of the project. It is estimated that 230 community members contributed time to the project.

BMP Assessment. Metro Blooms staff reviewed gardens in 2011 and 2012 as part of the maintenance activities. Of the original 106 raingardens installed in August 2010 only a couple were not operating as designed. In 2011 cosmetic and general maintenance was performed. Another measure of BMP performance is the number of plants replaced in the spring. In 2011 and 2012, approximately 3,600 plants were replaced by Metro Blooms during the scheduled maintenance activities. It is also possible that property owners replaced some plants or provided further improvements on their own.

Clean up and Maintenance Days. Events were held in Spring 2011 and 2012 related to street cleaning and garden maintenance. MCC crews were on-hand to provide edging to remove turf creeping and improve inlets to gardens. Metro Blooms staff and volunteers helped replace plants that died over the winter and coordinated overall neighborhood watershed cleanup.

Post-Project Survey. A survey was sent out to asses participant stormwater management practices and related information.

3.0 Citizen Engagement

3.1 Initial Activities

Prior to project initiation, Metro Blooms gathered address and other data and built relationships with the Powderhorn Park and Central Neighborhood Associations and used their help to establish an e-mail list, gather address information and create a mailing list for the project.

The initial outreach packets were mailed out in February 2009 with the intended project launch and initial on-site consultations scheduled to begin in April. This method got the outreach and planning process started and resulted in 50-60 initial participants. It also revealed the challenges involved in engaging a demographically diverse community.

3.2 Outreach Methods

Outreach methods used to enlist participants in the project included the following:

- door-to-door visits (in teams),
- neighborhood e-mail lists and web forums,
- garden parties,

- mass mailings (no name),
- direct mailings (using resident's names),
- project flyers and door knob hangers,
- face to face community events,
- dedicated Hispanic outreach,
- onsite consultations,
- neighbor referrals, and
- phone calls.

3.3 Method Description and Results

3.3.1 Direct Door-to-Door Visits

Door to door recruitment took place in the early evening on weeknights and during the morning on weekends. The efforts took place in the two weeks prior to project meetings to attract new participants. There were four door to door recruiting efforts in Powderhorn that took place involving Metro Blooms staff and volunteers. University of Minnesota (UMN) journalism students also canvassed the neighbor to generate participation (student volunteers from UMN were helpful, but due to lack of detailed knowledge of the project, often led to the spread of misinformation). Each effort lasted about 3 hours and was able to reach about 20-30 homes per hour.

Out of 20-30 residences visited about 10-15 were home during those times and about 1 in 3 signed up. The survey indicated that others who did not immediately sign up at the door were more likely to participate. There were 2-3 follow up attempts to recruit those missed in previous canvassing efforts before the final target number was met. Many homeowners were aware of the project before being visited. This made the canvassing more effective as it already had more legitimacy than other door-to-door efforts.

This method got the most people enrolled (according to the post-installation survey). We attribute this level of success to the preliminary mailings and e-mail efforts to spread the word about the project. Many of the residents were already aware of the project when the door to door teams arrived, meaning that this method resulted in prompting the decision to participate for many of the residents. Door knocking was the most effective approach but was also very time intensive. The greatest success resulted from pairings that included a neighborhood resident or volunteer and a Metro Blooms staff. This allowed for the neighbor to attest to the validity of the project and the staff member to answer questions about the process. Metro Blooms created hangers that rested on the doors of the homes visited during the canvassing.

Metro Blooms maintained a project database that kept track of whether or not contact had been made with specific homeowners and their reaction (excited, bothered, hostile). This meant that the homes were not canvassed multiple times.

3.3.2 Neighborhood E-mail lists and Web Forums

This method was the least time intensive, but also did not prove to be particularly effective in generating support for the project. E-mail messages resulted in relatively low rates of return and were not a reliable way to communicate information to project participants presumably due to language, age, and access barriers.

3.3.3 Mass Mailings

Mailings in the early spring of 2010 were the most costly process. This involved assembling a mailing list, printing materials hand stuffing envelopes, and paying for postage. This approach in

and of itself was not particularly effective in generating participation, but as it preceded the door to door canvassing many participants were aware of the project when approached in person, resulting in greater openness to participation. We found that people disregarded form letters but were more likely to respond to letters that addressed them by name with a hand written envelope. This personal touch tended to take more time, but yielded better results.

3.3.4 Fliers and Door Hangers

These methods proved to be effective ways to catch the eye of neighborhood residents (Figure 18) either as an advertisement on the door of a visited home or when the participant went to church or a commonly frequented establishment. This was a cheap method that required little labor, but also did not seem to yield striking results in terms of direct response from the door hangers.

Figure 18 – Sample Door Hanger

3.3.5 Face-to-Face Community Meetings

This method of engaging the community was most successful in communicating technical information about the project. Often, written communications or graphic mailings went unread or failed to inform the population about project timing and goals. Face to face meetings with church congregations, neighborhood groups, and garden parties proved to be an effective way to clear up misconceptions, answer questions, and clearly communicate technical information.

A large map showing the different lots participating in the project was the one that drew the most interest from community members. People reacted to the quantitative display of information on the map and were very interested in technical information that showed the connection between their property and the lake.

3.3.6 Garden Parties

The use of raingarden parties, where a resident invites their neighbors over for a party to discuss the project, had mixed results in terms of engaging people. The first party was hosted by Florence Hill, a well known and long term neighborhood activist. The party was very effective and well attended (28), with all property owners in attendance signing up to participate in the project. Subsequent events had very poor attendance overall (1-2 at each event). The characteristics of the host seemed to be critical in terms of whether the garden parties were a success or not. Low attendance may have been due to the hosts' lack of relationships in the neighborhood or lack of experience or effort to turn out folks for an event.

3.3.7 Neighbor Volunteers and Referrals:

The willingness of some neighborhood residents to become strong supporters and advocates of the project resulted in greater trust and legitimization of the outreach process as friends and neighbors proved more willing to trust and commit to the project when they knew someone that was invested in the project and its goals.

3.3.8 Phone Calls

Phone calling as a tool for initial recruitment resulted in suspicions that this project was some sort of scam. Whereas, the use of follow up phone conversations was very effective in encouraging people to participate once they had heard about the project. It gave them a way to actively voice their concerns and have their questions answered.

3.4 Summary of Citizen Engagement Methods

Overall the best process seemed to be an initial broad outreach followed by more targeted outreach activities. Broad outreach can be with electronic media, widely distributed fliers, and to a lesser extent - mass mailings. This mass outreach "primes the pump" by generating a baseline level of familiarity with the project and reaches early supporters. With this level of outreach, interested community members were then were able to provide referrals and access to audiences such as church congregations, community organizations, and gardening clubs. These groups are ideal venues for spreading the word of mouth information about the project and establishing true community engagement. After engaging these key groups the next step is to conduct more targeted outreach based on analysis and mapping techniques. This can include direct mailings, and most preferably door to door canvassing.

Language was definitely a barrier to reaching members of recent immigrant communities. Metro Blooms produced materials for Spanish speaking individuals, but found that these materials did not generate good returns. It appeared there was greater suspicion of the mailings and community outreach materials, either as a scam or as a way to catch immigrants. Face to face outreach to Spanish speaking persons was much more successful.

3.5 Recommended Approach

A recommended approach to recruit property owners based on lessons learned:

- Start broad and then narrow the focus.
- Hold community events and workshops early in the process to attract and identify the active and interested residents.
- Deliver clear and simple communications from a trusted source.
- Use graphics and limit text.
- Ensure that efforts are coordinated and are kept on track.
- Offer customized end products.
- Provide adequate resources for face-to-face contact (i.e. door-to-door, neighborhood meetings, faith-based organization meetings), particularly for non-English speaking residents.

3.6 Factors Affecting Recruitment

Among the primary factors that influenced recruitment, a FREE raingarden was the largest factor, followed by concern for Powderhorn Lake.

The principle reasons property owners chose not to participate had to do with lack of interest in gardening, general disbelief in the premise of the project, concerns about long-term maintenance, and unwillingness to give up space.

There were very few property owners (3) that initially agreed to participate and received an onsite consultation and then choose not to receive a garden. The primary reasons that gardeners backed out of the project was due to extenuating circumstances (a house burned down), difficult personalities (excessive demands, repeated design changes), or changes in home ownership during the project.

4.0 Design

4.1 The Design Process

The design process begins when the landscape designers first meet the homeowner with an onsite consultation, and spend an hour discussing their property from a stormwater perspective as well as from a landscaping perspective. The designer also asks the homeowner individual questions about their property, such as things they have seen during rainstorms, areas where water has ponded, drainage problems, and water in the basement issues. From the information gathered from site observation and discussion with the property owner, designers decide on a garden location before leaving. Incorporated in the location decision are basic design guidelines such as the minimum distance from raingarden to a building foundation is 10 ft.

After the onsite consultation, designers complete both a stormwater plan and a raingarden design for each property. Each product is sent to the property owner for approval. Almost all designs were approved. Certain homeowners required a little more diplomacy, in which case the Metro Blooms Lead Designer would usually provide another onsite consultation to ease their worries. The garden location was marked on each property prior to installation. This also gave the property owner another opportunity to approve or disapprove the design. Installation usually followed the marking within a week. In most cases, the designer had a follow up conversation with each property owner to discuss notable details of the installation, maintenance requirements, and next steps in the project.

4.2 Design Products

Each participant received a stormwater management plan and raingarden design similar to the examples provided in Figures 19 and 20.

Figure 19 – Sample Stormwater Management Plan

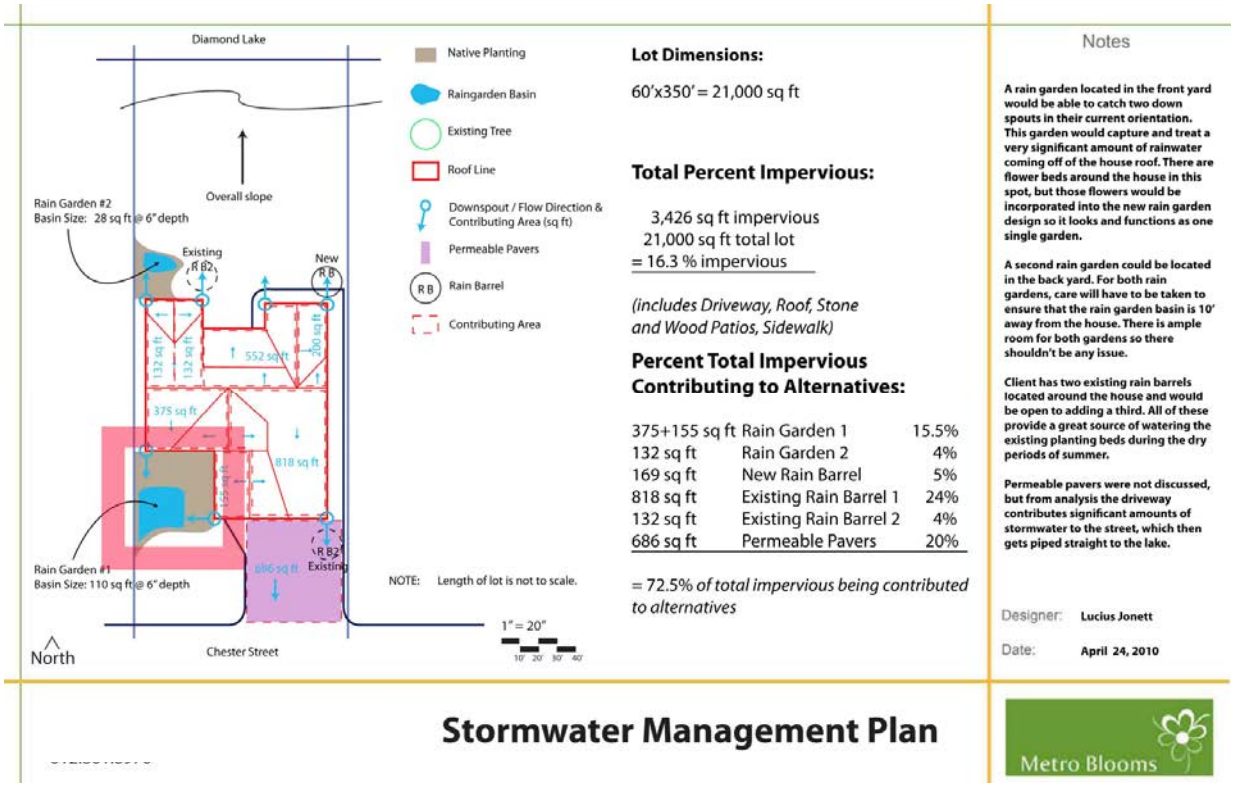
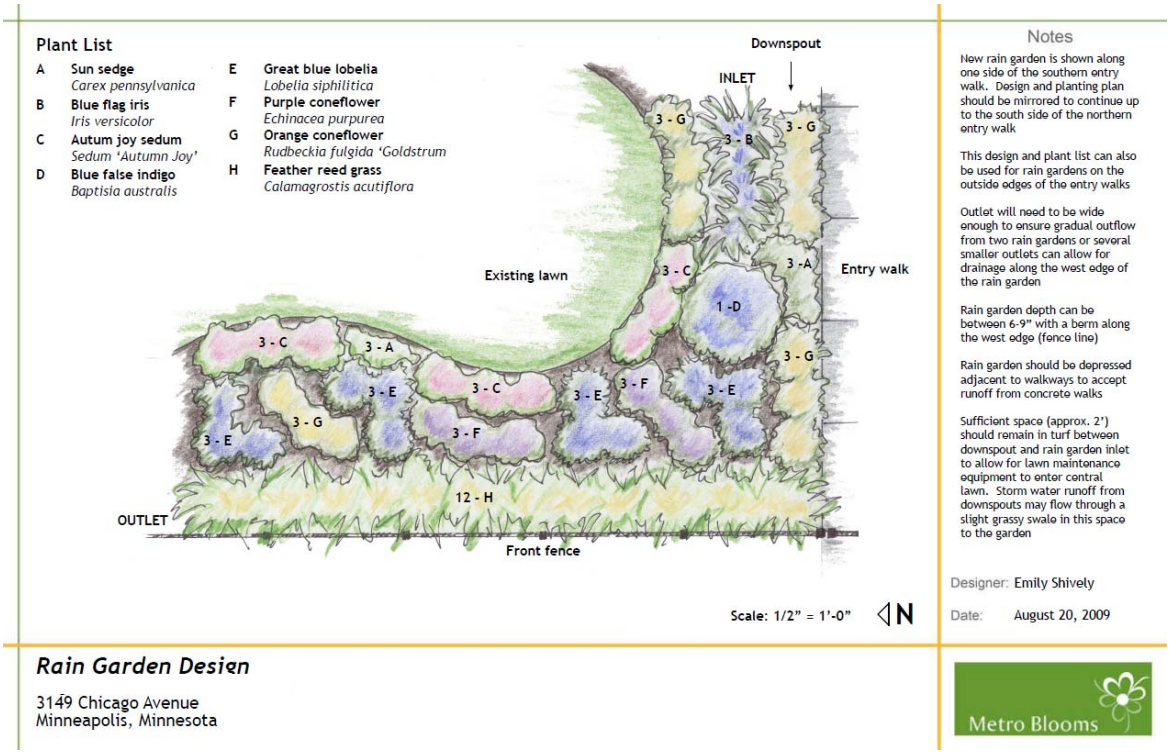


Figure 20 – Sample Raingarden Design

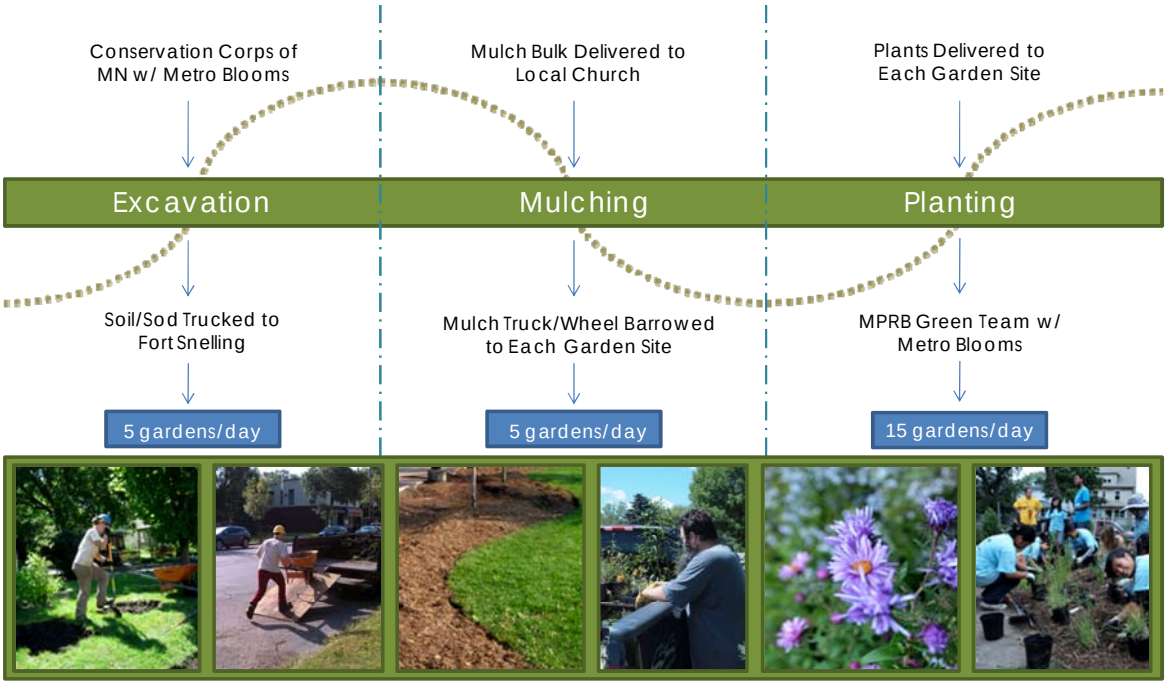


5.0 Installation

5.1 Installation Process

This project required a very organized system to install 106 raingardens in five weeks. Figure 21 presents the process devised to accomplish this task.

Figure 21 – Installation Process



The test watershed was comprised of an area 1.5 blocks long by 6 blocks wide. In an attempt to be as systematic as possible, the plan was to move North to South on each block and from West to East (toward the park). Communication with the homeowners about their planned installation date was critical. A prototype process developed in June was used to finetune needs and establish a plan to accommodate scheduling complications associated with weather, truck problems, or crew scheduling issues. Originally, homeowners were to be included in the installation process, but this proved to be too time intensive and too cumbersome to fit into the excavation schedule.

Two separate crews were utilized (a crew for soil excavation and mulching and a crew for planting). The excavation crew included 5-7 members of the Minnesota Conservation Corps supervised by Metro Blooms. The planting crew included 20 members of the Mississippi River Green Team, a youth crew led by two supervisors and two landscape designers from Metro Blooms.

5.2 Excavation and Mulching

First, the sod was removed with a sod kicker. All sod was wheel-barrowed to the trailer. In some cases, the property owner requested to keep the sod to use elsewhere in the yard. Second, the soil excavation began. Shovels were used to remove the soil to a 6" depth on average. Some installations required creation of an earthen berm to hold water in the garden or a drainage channel to divert runoff to the garden. Each property possessed its own intricate requirements for drainage and water conveyance. The level and landform of each garden was checked with a laser transit. After the grades were close to finished, the bottom of the basin garden was de-compacted and amended with compost when necessary. Shovels were used to turn the soil over to a depth of at least 18" to insure adequate infiltration. Excavated soil was also wheel barrowed to the trailer. All soil and sod was trucked to the MPRB tree and soil site at Fort Snelling, 5.5miles away. The garden was immediately mulched after excavation to avoid any problems with erosion.

After mulching, the garden waited to be planted. In some cases the garden would be planted as much as a week after excavation. Soil excavation took about 3 times as long as planting which required careful planning. As a result, excavation began about one week prior to the start of planting to create a pool of gardens ready to plant. Additionally, the planting crew was scheduled in two separate periods which allowed the excavation crew to create another pool of gardens to plant after the planting crew had caught up halfway through the project. The excavation crew was able to excavate an average of 5 gardens per day while the planting crew was able to plant nearly 15 gardens a day.

5.3 Planting Process

The August 2010 installation was conducted by a 20 member Green Team crew that was split into two groups, each with a supervisor and a Metro Blooms designer. Plants were delivered to each site either the morning of planting or the night prior. At each site, the designer would lay out the plants within each garden. After layout, the youth crew would begin planting the garden. This activity provided several insights for the youth crew. First, they learned about the basics of planting. Also, they played educational games with their designer and supervisor related to native plants and identification. The designer would check the planting for quality and the crew would move on to the next garden. Each member was also given the opportunity to layout a garden with the designer. By the end of the project, each youth crew member was able to layout a garden and to identify nearly every plant in it.

Other plantings were performed by volunteer teams as indicated in Figure 22.

Figure 22 – Planting Process

5.4 System to Track Plants

Metro Blooms kept a running inventory of stock and what was to be ordered at all times. After all designs were completed, we had a comprehensive plant list for the project. However, several property owners decided to change their garden's palette at the last minute. In most cases, accommodations were made, but there was difficulty locating certain plants. Turtlehead *Chelone glabra*, and Blue Flag *Iris Iris versicolor*, became nearly impossible to find from a Minnesota native nursery at the time of installation. One staff member was the point person in charge of the plant inventory and delivery system. This person kept a detailed inventory close at hand during the entire project.

As excavations were completed, slight changes in form and shape were constantly necessary for the gardens which often meant plant changes as well. A separate delivery ticket was prepared for each property. This was used to locate the plants at the Metro Blooms nursery, load the truck, and deliver the plants to each respective property. The ticket was left with the plants and was double checked by the designer before planting. Sometimes, there was a surplus of plants and in other cases, plants were missing. This required a change ticket for the next day. A paper trail for each garden ensured the team that all required tasks had been completed before moving on to another garden.

5.5 Excavation by Hand vs. Heavy Equipment

In the Powderhorn Park neighborhood, many of the spaces where gardens were installed are very tight and excavation equipment simply wouldn't fit. When you bring large equipment onto a lawn, sod often has to be replaced, which would have slowed progress. Also, heavy equipment has a soil compaction factor which would inhibit infiltration elsewhere and be a detriment to the project's goal to capture runoff. For the majority of the project, a crew of 5-7 people armed with spade shovels and sod kickers was the optimal tool.

Heavy equipment was used in a few instances. Five raingardens were built at churches to capture surface runoff from their parking lots (Figure 23). Three of these five were built with the help of an excavator. Much of the soil around a parking lot is heavily compacted and is

very difficult to dig by hand. Also, the scale of these gardens was much larger to accommodate the scale of the much larger drainage area.

Figure 23 – All God's Children, Metropolitan Community Church Raingarden - August 2011

5.6 Installation Totals

Overall, 200 yards of soil was removed, 175 cubic yards of shredded hardwood mulch was applied to 122 gardens and over 15,000 plants were installed.

5.7 Limiting Factors

Limiting factors for the installation process:

- All soil and turf were removed by hand, which requires more labor to coordinate and is slower than with machinery
- All materials had to be delivered and transported by two 1 ton trucks and two hydraulic dump trailers
- Some of the installations were in very small spaces, limiting the crew's progress
- Many times the truck and trailer could not park very close to the excavation site, requiring long distances to be traveled with soil
- Soil excavation takes much longer than planting, which requires a head start for the excavation crew
- Time was wasted waiting for the soil truck and trailer to dump refuse soil
- Some excavations yielded unforeseen buried objects and lines (buried concrete, electric lines, compacted gravel)

6.0 Measurement

This section summarizes the project results measured by key project elements.

6.1 Impervious Surface Area Redirected

The Powderhorn Neighborhood of Raingardens project resulted in reducing the storm runoff from over 70,000 sf of impervious area. This includes all the BMPs installed in and outside the test watershed area. In the test area, approximately 53,800 sf of impervious runoff area was redirected from Powderhorn Lake in 2010. Another 16,400 sf was directed to BMPs in 2011.

Assuming that the BMPs were designed to remove up to a 1-inch rain event, it is estimated that for a 1-inch rain event this would result in a decrease of 5,553 cf of water from entering the storm sewer system. This is approximately 0.8% of the estimated runoff from a 1-inch rain event discharging to Powderhorn Lake, based on the total watershed area of 286 acres.

Table 2 summarizes the impervious area statistics for the watershed. The total test watershed area of 1.24 million sf is estimated to have a 58% impervious surface area (City of Minneapolis GIS data for subwatershed 82-040). Of this total area, about 564,000 sf or 45% of privately owned property participated in the study. It is estimated that about 50% of the participating property area is impervious, which equates to an area of 281,000 sf. Overall, about 6% of the total watershed area, or 10% of the total impervious area was directed to a BMP. When considering only the participating properties, approximately 25% of the impervious area of those properties was directed to a BMP.

Table 2 - Neighborhood of Raingardens Test Watershed Impervious Area

Area Description	Area sf	% of Total Watershed Area	% of Participating Property Impervious Area
Total watershed area	1,241,500		
Total impervious area[1]	720,070	58%	
Total participating property area[2]	563,960	45%	
Participating property impervious area[2]	280,962	23%	
Participating property impervious area redirected in 2010	53,783	4.3%	19%
Participating property impervious area redirected in 2011	16,359	1.3%	6%
Participating property impervious area redirected in 2010 and 2011	70,142	5.6%	25%

[1] *Source: City of Minneapolis GIS database*

[2] *Source: Stormwater management plans developed for study*

6.2 Stormwater Monitoring

6.2.1 Background

Stormwater monitoring was the key driver for the project schedule. The three-year period was selected to provide as much time as possible to collect an adequate number of samples to establish the runoff characteristics of the watershed in a test and control area before and after the raingardens were installed. The test approach, methods, and detailed results are provided in Appendix A, Powderhorn Lake Neighborhood of Raingardens Paired Watershed Analysis Technical Memorandum.

6.2.2 Results

Monitoring in urban storm sewers has its challenges, and these sites and climatic conditions provided various issues resulting in insufficient data to statistically show that the Powderhorn Lake Neighborhood of Raingardens improved the water quality of the runoff going to Powderhorn Lake. However, the few water quality samples collected in 2011 provide promise that the test neighborhood efforts could have reduced total phosphorus and total suspended solids loadings when compared to the control area. Figures 25 and 26 present the average total phosphorus and total suspended solids concentration results. As shown by the error bars, there is a wide variation in samples.

Figure 24 – Average Total Phosphorus Concentration

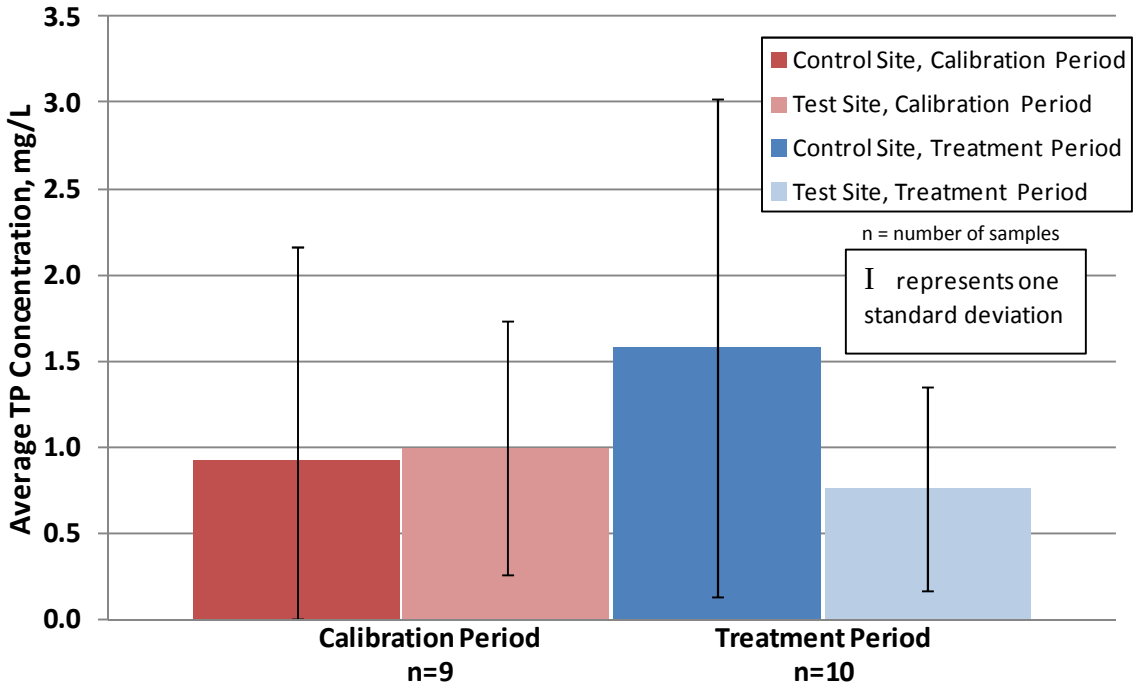
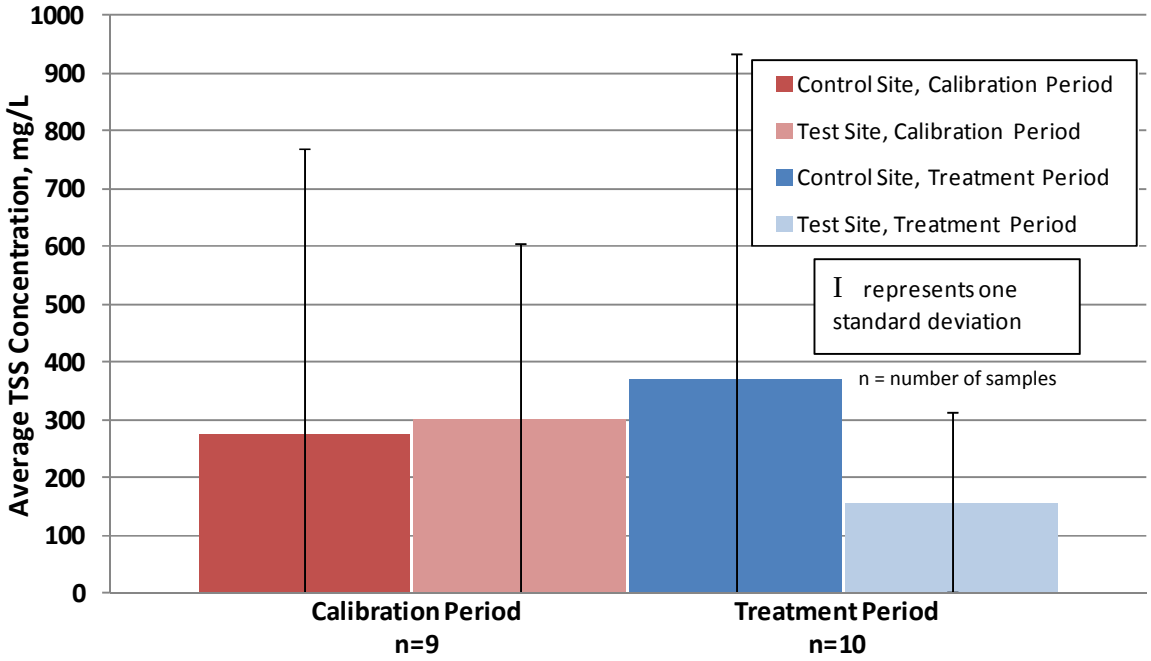


Figure 25 – Average Total Suspended Solids Concentration



In the paired watershed analysis, same storm even data are compared in the calibration and the treatment period. The regression analysis results show that the BMP did not influence the volume of runoff. This result is not surprising, given that only 10% of the impervious area was directed to a BMP. The impervious areas in the public right-of-way dominates the land use and the ability to redirect enough volume from private properties. There were not enough data to provide a statistically significant regression result for total phosphorus and total suspended solids. Appendix A provides the tabular and graphic results.

6.2.3 Future Considerations

The City of Minneapolis will continue to support monitoring at the same test and control sites as in the past three years. The MPRB will be using new instrumentation to improve efficiencies in downloading data and checking for equipment problems.

In addition to more stormwater monitoring, it is recommended that modeling be performed to determine if some storm events that were excluded from the analysis because of surcharging can be estimated and provide additional data points to the data set. The data collected for this project provides a representative set of storm events for model calibration. The water quality sampling in 2012 can include water quality characterization over the course of a storm event for the model calibration. The model results could be used to simulate similar urban watersheds and the potential impacts of citizen-based or other stormwater management practices.

6.3 Participation Records

This project engaged over 230 different people in various project roles. Table 3 summarizes the number of people involved and the number of properties associated with planting, excavating and maintaining gardens.

Table 3 - Events & Participants

Date	Residents	Volunteers	Gardens		
			Planted	Excavated	Maintained
June 2010	15	0	16	16	-
August 2010	101	78	106	106	-
June 2011	4	21	13	13	98
June 2012	8	9	0	0	12
Unduplicated Total	**116**	**101**	**130**	**130**	**98**

6.4 Maintenance Observations

The original designs reflected a large, diverse plant palette. The 2011 and 2012 replacement plant palette was carefully selected to handle the very dry and nutrient poor conditions. Good choices were sedums and wild geraniums. Plants that had dramatic die-off in the gardens were ferns, prairie coreopsis, blue lobelia, and liatris.

Consistent care, especially watering, was very important to the newly planted gardens. Close to 35% of the gardens were consistently cared for and watered. In these gardens plant loss was less than 10%. Another 45% of the gardens were obviously cared for, but the care appeared to be more sporadic and watering less consistent. In these gardens, the plant loss ranged from 20-30%. The remaining 20% of the gardens were poorly maintained by the spring of 2011. For these gardens, where there was more than 80% die-off of plants. The decision was made not to reinvest in replanting of these gardens.

The decision was made early in the June 2010 installations to omit compost from a large portion of the garden installations because it wasn't needed to enhance infiltration and there seemed to be enough nutrients in the soil to support healthy plant growth. In retrospect, the decision to omit compost from the garden installations led to very slow plant growth in the gardens and perhaps was the cause for alot of the die-off witnessed in many of the gardens by the spring of 2011 and 2012.

In some instances, gardens may have been over-mulched, resulting in slowed plant growth in some of the gardens. The reason for heavy mulching was to preserve moisture and inhibit weed growth. However, because the soil drained rapidly, heavy mulching did not provide much benefit for moisture loss in the Powderhorn Lake area. While the mulch did inhibit weed growth, it may also have inhibited plant growth in some gardens.

Table 4 provides a list of the plants purchased and donated for the project. Nearly 12,000 plants were installed in new gardens and over 3,500 plants were used to replace plants that died off and for overall garden improvements in Years 2011 and 2012.

Table 4 - Plants Purchased for the Project

Vendor	Date Received	No. of Plants
Dragonfly Gardens (donation)	2009	5,000
Glacial Ridge	1-Jul-09	654
Gertens	10-Aug-09	6
Dragonfly Gardens	24-Sep-09	152
	22-Oct-09	77
	4-May-10	1,776
	14-Jun-10	462
	7-Jun-10	66
	27-Aug-10	1,913
	16-Jun-10	258
	12-Aug-10	90
Landscape Alternatives	7-Aug-10	52
	27-Aug-10	108
Dragonfly Gardens	Jun-11	1,210
First Planting		**11,824**
Friends School Plant Sale (donation)	May-11	1,500
Dragonfly Gardens	4-May-12	1,016
	15-Jun-12	1,100
Re-planting		**3,616**
Total		**15,440**

6.5 Post-Project Survey Results

A survey conducted in June 2012 provides proof that education and action influenced community members to improve Powderhorn Lake water quality. Approximately 25% of participating property owners responded. While it is likely that those participants responding to the survey are community members with more interest in water quality issues and Powderhorn Lake and results are biased, the items below were selected to demonstrate the number of members making changes in management of stormwater on their property.

Check all that apply:		
Answer Options	**Response Percent**	**Response Count**
I enhanced my raingarden with edging, statues, more plants, etc.	76.0%	19
I added another raingarden on my own or through Metro Blooms	12.0%	3
I would like to add another raingarden	32.0%	8
I look forward to upkeep in my raingarden	72.0%	18
The raingarden is suitable just how it was planted	40.0%	10
The raingarden is too much for me to maintain	4.0%	1
I'm not interested in my raingarden	0.0%	0
	answered question	25
	skipped question	2

How many times have you explained your raingarden to neighbors, friends or family?		
Answer Options	**Response Percent**	**Response Count**
1-5	24.0%	6
5-10	44.0%	11
10-15	8.0%	2
15-20	4.0%	1
20 or more	20.0%	5
answered question		25
skipped question		2

What was the most important reason that you decided to build a raingarden?		
Answer Options	**Response Percent**	**Response Count**
Concern for Powderhorn Lake	46.2%	12
Neighbors were building raingardens	3.8%	1
Improving the landscaping of my yard	15.4%	4
Free plants and free raingarden installation	34.6%	9
answered question		26
skipped question		1

Beyond the raingarden, what other stormwater strategies have you implemented either from a stormwater plan or on your own?		
Answer Options	**Response Percent**	**Response Count**
Redirected downspouts of house	52.2%	12
Redirected downspouts of garage	13.0%	3
Installed a "French drain"	8.7%	2
Installed a rainbarrel	56.5%	13
Installed permeable pavers	8.7%	2
Planted new gardens to reduce turf	56.5%	13
Other (please specify)		5
answered question		23
skipped question		4

7.0 Outcomes and Future Plans

The Powderhorn Lake Neighborhood of Raingardens project heralds successes, lessons learned, and ideas to improve on implementation of citizen-based approaches to improve impaired waters.

7.1 Citizen Engagement for Fast-Paced, Focused Implementation

Successes

- Nearly 50% of the property owners residing (excludes rental units) in the test watershed participated in the study. This participation rate speaks to the effectiveness of the multi-faceted outreach education program developed through this study. Metro Blooms also used a flexible and diplomatic approach in the design/installation process to keep property owners participating after they signed up.

- 116 property owners plus an estimated 115 other community members were educated on water quality protection and volunteered in various events for the project.

Lessons Learned

- Factors influencing recruitment
  - At time of installation, 2010: A FREE raingarden was the largest factor that influenced recruitment, followed by concern for Powderhorn Lake.
  - Post Survey, 2012: With 25% property owners responding, 46% identified "concern for Powderhorn Lake" as the most important reason they installed a raingarden, and 35% said it was because of the "free" services provided with the project. It is assumed that those property owners taking time for a survey nearly two years after the installation, are likely those that have the greatest concern for Powderhorn Lake and so the results are biased towards this reason for raingarden installation.
- What Worked
  - Neighborhood Events
  - Door to Door Outreach
  - Garden Parties & Community Events
  - Neighborhood Newsletter and List-serve
  - Help from Local Representative
  - Block Leaders/Community Leaders
- What Didn't Work
  - Email and Phone outreach…initially
  - Workshops
  - Unannounced Canvassing
- Recommended approach to recruit property owners
  - Start broad and then narrow the focus.
  - Community events and workshops attract the active and interested residents.
  - Clear and simple communications from a trusted source.
  - Use graphics and limit text.
  - Ensure that efforts are coordinated and are kept on track.
  - Offer customized end products.

7.2 Design

Successes

- Onsite consultations included additional engagement and commitment to water quality protection.
- Use of graphics with onsite discussion aided in understanding & selection of plant types & overall efficiency of the design process.

Lessons Learned

- Plan for no-shows for onsite consultations.
- Institutional property owners require more planning and resources.

- Plan time to accommodate for owner design changes or make it clear that designs may be difficult to change.
- Put greater emphasis on backyard stormwater capture opportunities. Front yard raingardens were a good option because they were visible and provided additional opportunity for education and engagement with community members.

7.3 Installation

Successes

- 106 raingardens installed in a five-week period (total of 125 in summer 2010).
- Nearly 12,000 plants installed in new gardens developed by project-related staff.
- Over 3,500 plants were installed the second and third years as part of maintenance activities.

Lessons Learned

- Excavation by hand was preferable for this urban environment, except for larger areas and parking lot locations where soil is more heavily compacted.
- Allow time or plan for larger equipment to bring in soil or remove refuse soil in considering efficiencies with work crews.

7.4 Measurement

Sucessess

- Over 70,000 sf of impervious area was directed to a raingarden, permeable pavers, or boulevard garden.
- The involvement of 230 people in numerous activities demonstrates the Powderhorn Lake community's commitment to water quality protection. It also demonstrates the potential for large-scale community stormwater management practices.
- Representative stormwater monitoring of a densely populated urban watershed with applications for projecting the impacts of future BMPs.

Lessons Learned

- Including monitoring in a project adds complexity to the process and requires extra effort for the Neighborhood of Raingardens team objectives.
- Smaller-scale BMP test areas will provide a better measurement for volume reduction and water quality improvements. The results can then be extrapolated to larger areas.
- Replicability of this approach depends on many factors, including consideration of the funding source. The outcomes measured in this project need to be compared to other urban stormwater management projects to assess whether the cost/benefit of this approach is an appropriate use of the funding source as compared to other types of projects.

7.5 Outcomes Summary

7.5.1 Education and action influenced community members to improve Powderhorn Lake water quality.

- The Powderhorn Park community implemented best management practices to reduce stormwater runoff to Powderhorn Lake by directing 70,000 square feet of impervious area to bio-infiltration areas (raingardens).

- 230 community members were involved in activities related to implementation of water quality protection practices.
- 125 raingardens were installed through a fast-track design and construction process.
- Multiple community cleanup events were held which resulted in over 130 bags of leaves and debris from entering the lake.

7.5.2 Citizen engagement methods key to successful outcomes.

- Enlist local champions of stormwater management to reach out to their community members.
- Use a combination of outreach methods: workshops, mass mailings, door knockers, neighborhood home meetings, and canvassing.
- Include multi-lingual staff and community members to engage non-english speaking community members.
- Use a non-profit organization for outreach and implementation to offset skepticism associated with a pivate firm or city-led effort.
- Provide an economic incentive and a well-crafted, educated message.

7.6 Future Plans

- Continue stormwater monitoring (City of Minneapolis is funding 2012 monitoring by MPRB).

- Further develop Metro Blooms' volunteer-based, raingarden evaluation program to provide added incentive for continued maintenance of raingardens.

- Focus new urban projects on maximizing backyard runoff capture with multiple types of BMPs.

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Appendix A

Powderhorn Lake Neighborhood of Raingardens Paired-Watershed Analysis

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SEH MEMORANDUM

TO: Becky Rice/Metro Blooms

FROM: Rebecca Nestingen/SEH
Patti Craddock/SEH

DATE: June 22, 2012

RE: Powderhorn Lake Paired-Watershed Study
LCCMR Project No. 09-05e
SEH No. METRB 116238

Introduction

The purpose of this technical memorandum is to report the results of the paired-watershed study used to measure the effects of raingardens installed in the Powderhorn Lake neighborhood. For further project background refer to *A Citizen-Based Approach to Stormwater Management* (Metro Blooms, LCCMR Project 09-05e, June 2012).

Study Methodology

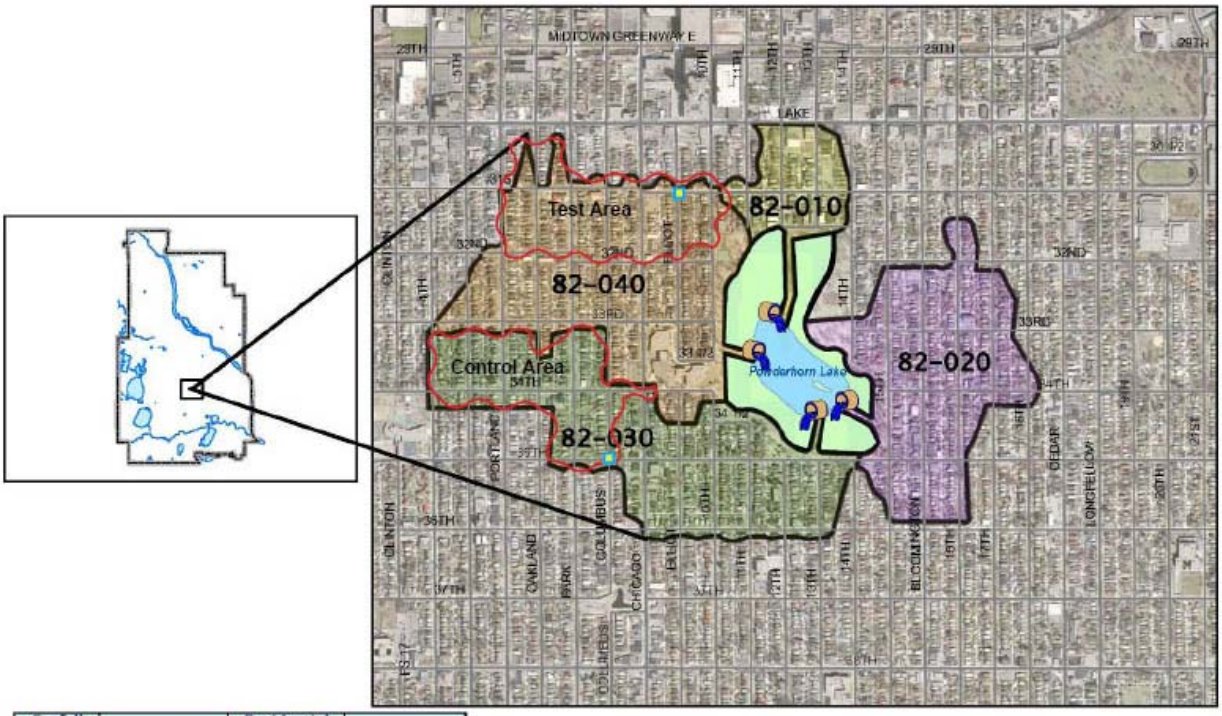
Paired-Watershed Approach

A paired-watershed study design is used to study the effects of implementing best management practices (BMPs) in one watershed, known as the *test* watershed compared to that of another similar watershed known as the *control* watershed. Monitoring is conducted in both watersheds prior to and after implementing BMPs. The monitoring conducted prior to BMP implementation is used to develop a baseline relationship between the paired event-based data observations and this is referred to as the *calibration* period. The monitoring period after BMPs are implemented in the test watershed is referred to as the *treatment* period. Advantages of using the paired-watershed study design are that the control watershed accounts for year-to-year or seasonal variability and the baseline relationship developed in the calibration period accounts for differences between the two watersheds. The schedule of BMP implementation is displayed below in Table 1.

Table 1. Schedule of BMP implementation (Adapted from Clausen and Spooner, 1993)

	Control Watershed	Test Watershed
Calibration Period	No BMPs	No BMPs
Treatment Period	No BMPs	BMPs

The Powderhorn Lake Neighborhood paired watersheds are displayed in Figure 1. The test and control watersheds are 28.3 acres and 32.5 acres, respectively. In summer of 2010, over a five-week period 106 residential raingardens were installed in the test watershed as displayed in Figure 2. Installation ended on August, 31st, 2010. The monitoring period prior to August 31st, 2010 is the calibration period and the monitoring period after August 31st is the treatment period.



Outfall Number	Total Acres	Residential Percentage	Population
82-010	23.5	72%	457
82-020	73.5	94%	1,285
82-030	90.0	91%	1,998
82-040	98.5	85%	1,881
Total	285.51	88%	5,621

Figure 1. Paired-Watershed Study Area Map

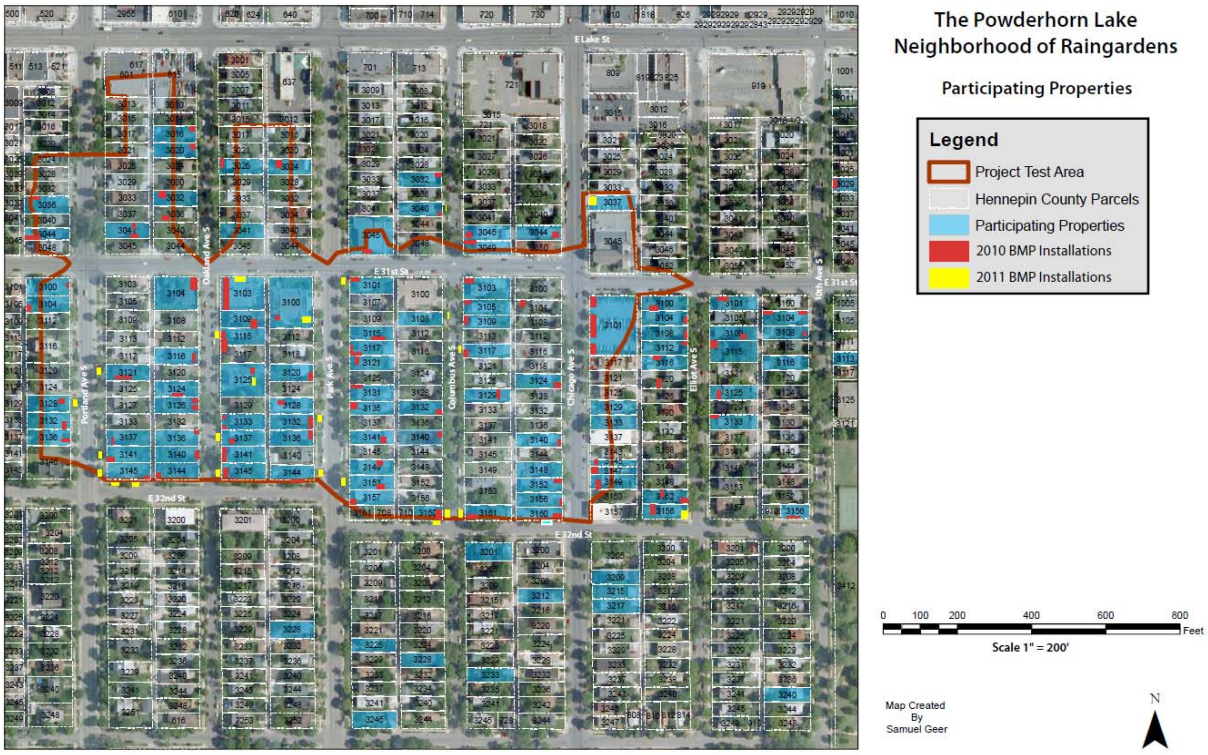


Figure 2. Test Watershed Raingarden Map

Monitoring

Precipitation monitoring was conducted throughout the project duration to define rain events which coincide with flow monitoring. For this project, a rain event was considered a measured rainfall depth greater than 0.10 inches. Rain events were also distinguished from one another by a separation of greater than 8 hours. In 2009, the rainfall was measured by using a Davis Weather Wizard III station located at 38th Street West and Bryant Avenue South. In 2010 and 2011, the precipitation monitoring was conducted using a Nova Lynx tipping bucket (1/100th of an inch) and an Onset Hobo datalogger located at the Powderhorn Park Recreation Center, 3400 15th Avenue South.

Stormwater flow and water quality were monitored using ISCO stormwater equipment. Each monitoring location was outfitted with the following equipment:

- two 2150 dataloggers
- a 2105 interface control module
- two digital low profile AV probes (one invert, one offset)
- a 24 bottle multiplexed auto-sampler (model 3700) complete with 3/8” ID vinyl tubing and standard intake strainers
- multiplex sampling (4 samples per bottle)

At the project initiation in May 2009, two 36” reinforced concrete pipes (RCP) were chosen at 33rd Street East and 10th Avenue South (test watershed), and at 35th Street East and 12th Avenue South (control watershed). The test site was found to have significant problems with standing water, decaying organic debris and sand deposition in the pipe, which prevented accurate measurement. In late summer, two new monitoring locations were chosen at 31st Street East and Elliot Avenue South, and at 35th Street East and

Columbus Avenue South. The monitoring equipment was installed in 24" RCP at these new locations. An example of the flow and water quality monitoring equipment is shown below in Figure 3.

Figure 3. Flow and Water Quality Monitoring Equipment

When uninstalling the monitoring equipment for the 2009 season, it was noted that both of the new sites had significant sediment accumulation around the invert AV probes. Offset AV probes were installed in 2010 and 2011 to avoid sedimentation and interference with accurate flow measurement.

The Minneapolis Park and Recreation Board (MPRB) was responsible for conducting all monitoring throughout the project and reporting the resulting data to SEH for analysis. Precipitation and flow data were reported in Flowlink file format for analysis using Flowlink 5.1 software and the water quality data were reported as a flow-weighted composite concentration.

Data Quality Control and Analysis

The MPRB follows a rigorous quality control and assurance program for sampling protocol and laboratory analysis as detailed in the annual MPRB Water Resources Reports (produced by the Environmental Operations Section).

The data analysis tasks began with a review of the raw precipitation data to define the observed rain events. A flow hydrograph was created and the total flow volume was calculated using Flowlink 5.1 for each rain event. Each hydrograph was scrutinized for erroneous flow data caused by a multitude of factors such as pipe surcharging or equipment malfunction. Rain events which were suspected to have erroneous flow data were omitted from the analysis. The watershed area was used to normalize the volume of flow into a depth of runoff in unit inches. The water quality samples were collected as flow-weighted concentrations and are reported as the representative sample for a complete storm event.

An example hydrograph for one of the calibration period events is shown below in Figure 4. As displayed in the hydrograph, the monitored flows at both sites closely mimic one another indicating that the runoff characteristics for the test and control watersheds are a good match.

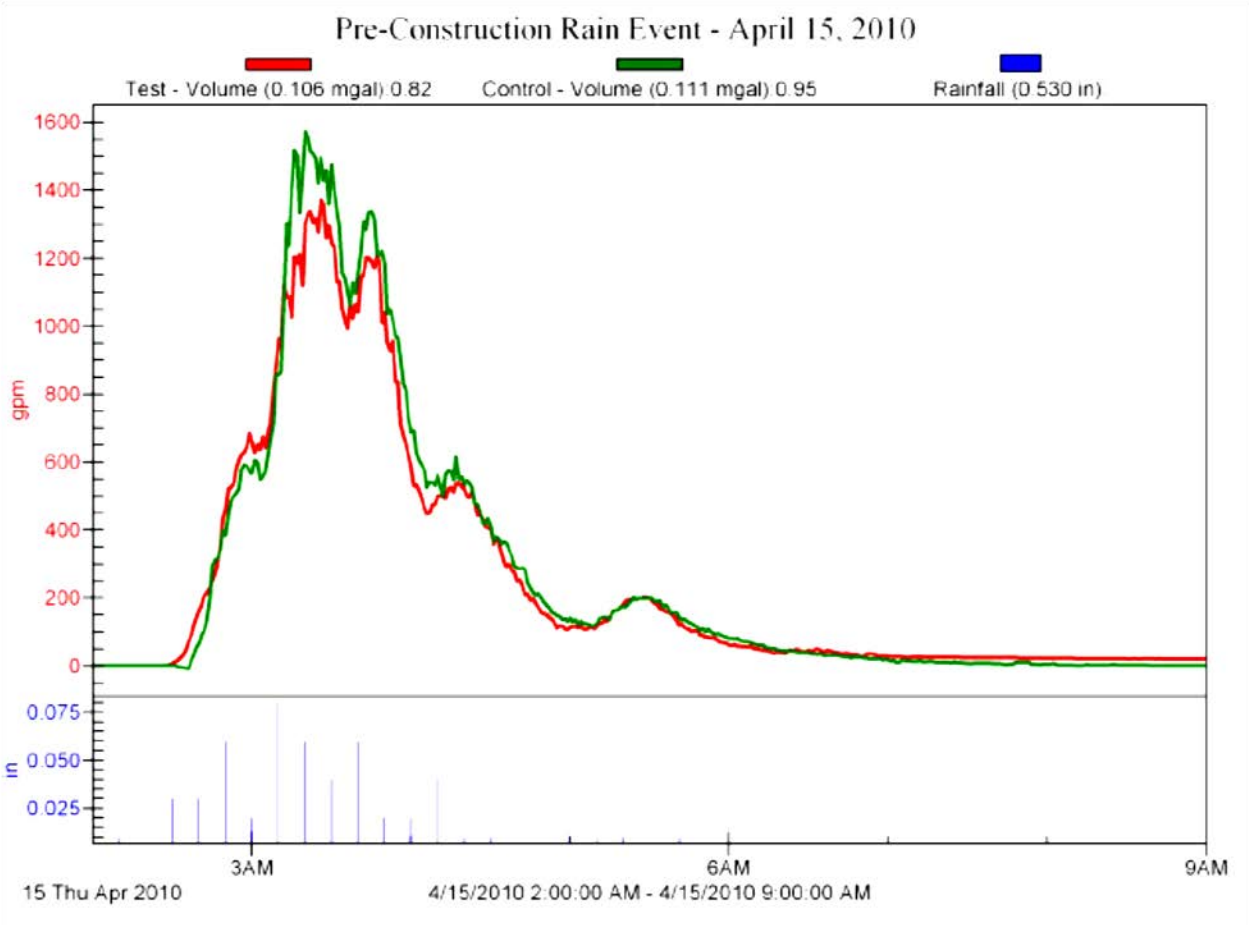


Figure 4. Example Event Hydrograph

Upon compilation of the final flow volume and water quality paired-data observations, linear regressions were derived. The regression significance and the significance of the effect of the raingardens were determined using the statistical test procedures described by Clausen and Spooner in *Paired Watershed Study Design* (1993). Tables 2 and 3 summarize the data calibration period and treatment period data used for the final analysis and individual event hydrographs are attached as Exhibits.

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Table 2. Calibration Period Paired Event Data

			Precipitation		Test Site - 31st & Elliot			Control Site - 35th & Columbus		
Event	Start Date/Time	End Date/Time	Total Depth (in)	Total Duration (hr)	Volume* (inches)	TP Conc. (mg/L)	TSS Conc. (mg/L)	Volume* (inches)	TP Conc. (mg/L)	TSS Conc. (mg/L)
2009-20	9/27/2009 20:45	9/28/2009 2:30	0.11	5.75	0.01			0.02		
2009-21	10/1/2009 6:00	10/3/2009 10:15	1.52	52.25	0.31			0.28		
2009-24	10/12/2009 11:15	10/12/2009 18:00	0.23	6.75	0.01	0.442	16	0.01	0.169	13
2009-25	10/14/2009 22:45	10/15/2009 16:30	0.42	17.75	0.07			0.05		
2009-26	10/21/2009 8:54	10/21/2009 18:45	0.51	9.85	0.09			0.09		
2010-02	4/13/2010 2:38	4/13/2010 9:26	0.59	6.80	0.14			0.13		
2010-04	4/15/2010 2:04	4/15/2010 5:41	0.53	3.61	0.14	0.873	259	0.13	0.594	202
2010-05	4/23/2010 22:30	4/24/2010 12:14	0.50	13.73	0.07			0.06		
2010-06	5/6/2010 20:04	5/8/2010 3:19	0.75	31.25	0.11	0.353	59	0.11	0.280	43
2010-07	5/10/2010 18:45	5/11/2010 18:26	0.81	23.67	0.13			0.12		
2010-08	5/12/2010 16:39	5/13/2010 17:09	0.74	24.49	0.19			0.17		
2010-09	5/22/2010 11:01	5/22/2010 12:21	0.16	1.34	0.02			0.02		
2010-10	5/25/2010 9:21	5/25/2010 21:55	0.37	12.57	0.06			0.06		
2010-11	6/1/2010 10:48	6/2/2010 6:40	0.19	19.86	0.02	0.831	185	0.02	0.983	234
2010-12	6/3/2010 15:30	6/4/2010 4:00	0.41	12.50	0.08			0.08		
2010-13	6/5/2010 12:08	6/5/2010 17:10	0.32	5.03	0.05			0.05		
2010-14	6/8/2010 4:46	6/8/2010 15:58	1.01	11.20	0.18			0.19		
2010-15	6/11/2010 3:28	6/11/2010 14:17	0.92	10.82	0.22			0.22		
2010-16	6/12/2010 12:01	6/12/2010 18:20	0.14	6.31	0.01			0.01		
2010-17	6/14/2010 9:14	6/14/2010 13:18	0.27	4.06	0.04			0.05		
2010-18	6/22/2010 19:40	6/23/2010 15:57	0.50	20.30	0.06			0.08		
2010-19	6/25/2010 16:07	6/25/2010 21:39	3.35	5.53	0.53	1.970	708	0.78	4.160	1578
2010-20	6/26/2010 9:23	6/27/2010 0:13	0.75	14.83	0.13			0.14		
2010-21	7/4/2010 7:30	7/4/2010 16:51	0.15	9.36	0.01			0.01		
2010-22	7/5/2010 14:46	7/5/2010 23:49	0.51	9.05	0.15	2.480	910	0.15	0.561	97
2010-24	7/10/2010 11:31	7/11/2010 3:25	0.23	15.91	0.02			0.01		
2010-25	7/11/2010 15:50	7/11/2010 22:44	0.52	6.90	0.01			0.02		
2010-26	7/14/2010 9:21	7/14/2010 19:54	0.12	10.55	0.02			0.02		

Table 2. Calibration Period Paired Event Data

			Precipitation		Test Site - 31st & Elliot			Control Site - 35th & Columbus		
Event	Start Date/Time	End Date/Time	Total Depth (in)	Total Duration (hr)	Volume* (inches)	TP Conc. (mg/L)	TSS Conc. (mg/L)	Volume* (inches)	TP Conc. (mg/L)	TSS Conc. (mg/L)
2010-27	7/17/2010 15:27	7/17/2010 21:43	1.18	6.27	0.29			0.26		
2010-28	7/21/2010 21:33	7/22/2010 7:39	0.24	10.11	0.01			0.01		
2010-29	7/23/2010 20:02	7/24/2010 3:46	0.62	7.72	0.11			0.12		
2010-32	8/10/2010 0:43	8/10/2010 23:40	2.31	22.95	0.57			0.64		
2010-33	8/12/2010 20:46	8/13/2010 5:13	1.24	8.44	0.26	0.498	201	0.24	0.169	41
2010-36	8/31/2010 3:36	8/31/2010 6:19	0.39	2.70	0.10	0.581	127	0.11	0.484	80

*Storm runoff volume divided by the watershed area monitored.

Table 3. Treatment Period Paired Event Data

			Precipitation		Test Site - 31st & Elliot			Control Site - 35th & Columbus		
Event	Start Date/Time	End Date/Time	Total Depth (in)	Total Duration (hr)	Volume* (inches)	TP Conc. (mg/L)	TSS Conc. (mg/L)	Volume* (inches)	TP Conc. (mg/L)	TSS Conc. (mg/L)
2010-37	9/1/2010 21:33	9/2/2010 7:34	1.08	10.02	0.26			0.27		
2010-38	9/6/2010 12:03	9/7/2010 17:37	0.36	29.56	0.03			0.04		
2010-39	9/10/2010 17:58	9/11/2010 4:30	0.26	10.53	0.04			0.04		
2010-40	9/15/2010 5:17	9/16/2010 0:25	0.98	19.14	0.23			0.23		
2010-42	10/24/2010 1:54	10/24/2010 12:05	0.66	10.19	-	2.040	542	-	1.570	67
2010-43	10/25/2010 14:35	10/27/2010 18:16	1.64	51.69	-	0.506	52	-	0.470	38
2011-05	5/20/2011 10:44	5/21/2011 12:52	1.61	26.14	0.35			0.35		
2011-06	5/22/2011 0:38	5/22/2011 15:33	1.08	14.91	0.28			0.28		
2011-07	5/27/2011 16:57	5/28/2011 1:48	0.27	8.84	0.04			0.04		
2011-08	5/30/2011 8:33	5/31/2011 1:44	0.20	17.18	0.02			0.01		
2011-09	6/10/2011 1:44	6/10/2011 6:37	0.25	4.88	0.02	1.490	169	0.03	4.890	1705
2011-10	6/10/2011 15:59	6/11/2011 1:58	0.18	9.97	0.01			0.02		
2011-11	6/14/2011 16:02	6/15/2011 8:46	1.56	16.73	0.29	0.283	218	0.36	0.429	61
2011-15	6/21/2011 14:08	6/22/2011 7:39	0.84	17.53	0.19			0.21		
2011-16	6/22/2011 19:11	6/23/2011 4:31	0.25	9.34	0.04			0.06		
2011-17	7/1/2011 19:13	7/1/2011 21:25	0.31	2.21	0.04	0.972	248	0.06	3.260	1077
2011-18	7/9/2011 23:23	7/10/2011 7:32	1.16	8.15	0.12	0.279	24	0.21	0.993	285
2011-22	7/15/2011 23:09	7/16/2011 2:49	2.21	3.66	0.53			0.59		
2011-23	7/19/2011 3:16	7/19/2011 3:38	0.36	0.38	0.14			0.14		
2011-31	9/20/2011 22:16	9/21/2011 6:50	0.17	8.57	-	0.451	61	-	1.370	140
2011-33	10/10/2011 16:59	10/10/2011 20:36	0.15	3.62	-	0.335	43	-	1.680	90

*Storm runoff volume divided by the watershed area monitored.

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Results and Discussion

Stormwater Volume Results

The stormwater runoff volume regression results are shown in Figure 5. Each data point on the plot is a paired-event observation with the control watershed volume on the x-axis and the test watershed volume on the y-axis. The colors on the plot differentiate the data points and trendlines between the calibration period and the treatment period. During the calibration period (in which there were no BMPs installed), the runoff from the test watershed is approximately 78% of that of the control watershed as indicated by the slope of the linear regression trendline.

Under ideal experimental conditions the test watershed would decrease during the treatment period from the installation of raingardens, however, the linear regression trendline indicates an increase in runoff volume of the test watershed relative to that of the control as indicated by the trendline slope of 0.91 (i.e. the test watershed runoff volume is 91% of that of the control watershed) - an increase from the slope of 0.78 during the calibration period. This increase, however, is not statistically significant as indicated by the overlap of the confidence intervals as shown in Figure 5. There was too much variability in the data to detect any difference in stormwater runoff volume between the test and control area.

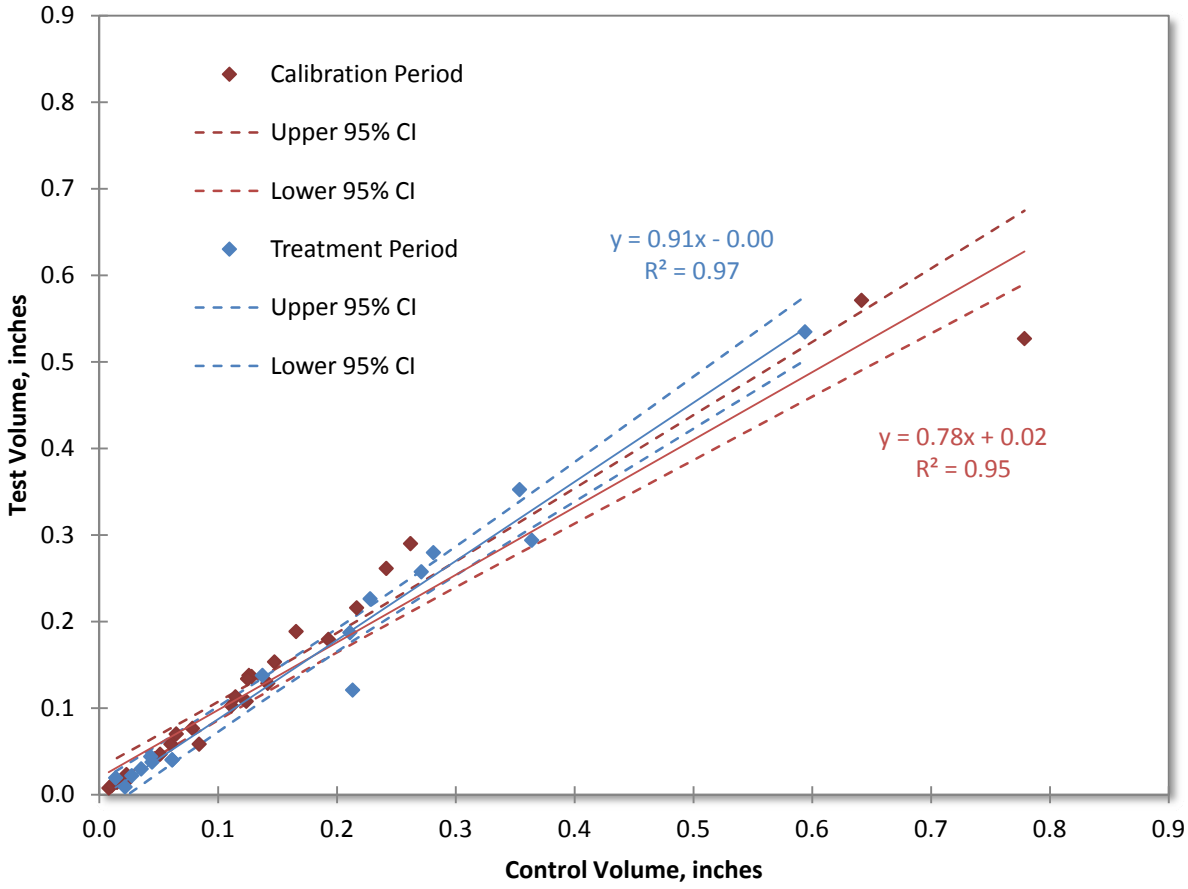

Figure 5. Stormwater Volume Regression Results

Table 4 displays the average stormwater runoff volume by period and watershed. The predicted test value comes from the regression relationship during the calibration period. Comparing the observed and

predicted average values of the test watershed there is a 0% change in the runoff volume. Given the amount and variability of the data and that approximately 6% of impervious area in the total watershed area was redirected into raingardens, it was anticipated that there would not be a measurable amount of change in the amount of runoff.

Table 4. Average Runoff Volume (in)

Calibration Period	
Control	0.133
Test	0.123
Treatment Period	
Control	0.174
Test	0.155
Test Predicted	0.155
Change	0%

Stormwater Quality Results

Paired observations for total suspended solids (TSS) and total phosphorus (TP) flow-weighted concentrations were analyzed in the same manner as runoff volume and the regression results are displayed in Figures 6 and 7. Similarly to runoff volume, there is too much variability and too little data to report results with statistical significance as indicated by the confidence intervals. Monitoring equipment software problems during the wettest month of the treatment period coupled with a very dry late summer and fall, limited the number of samples collected.

Although not statistically significant there is a general decrease in TSS and TP concentrations for the test watershed after raingarden installation. Figure 8 and Figure 9 display the average stormwater TSS and TP concentrations by period and watershed. A summary of the average TSS and TP concentrations is shown in Table 5. Overall there was 52% and 37% decrease in average TSS and TP concentrations, respectively.

Table 5. Average TSS and TP Concentrations (mg/L)

Calibration Period	**TSS**	**TP**
Control	275	0.920
Test	301	0.995
Treatment Period	**TSS**	**TP**
Control	369	1.580
Test	158	0.759
Test Predicted	331	1.208
Change	-52%	-37%

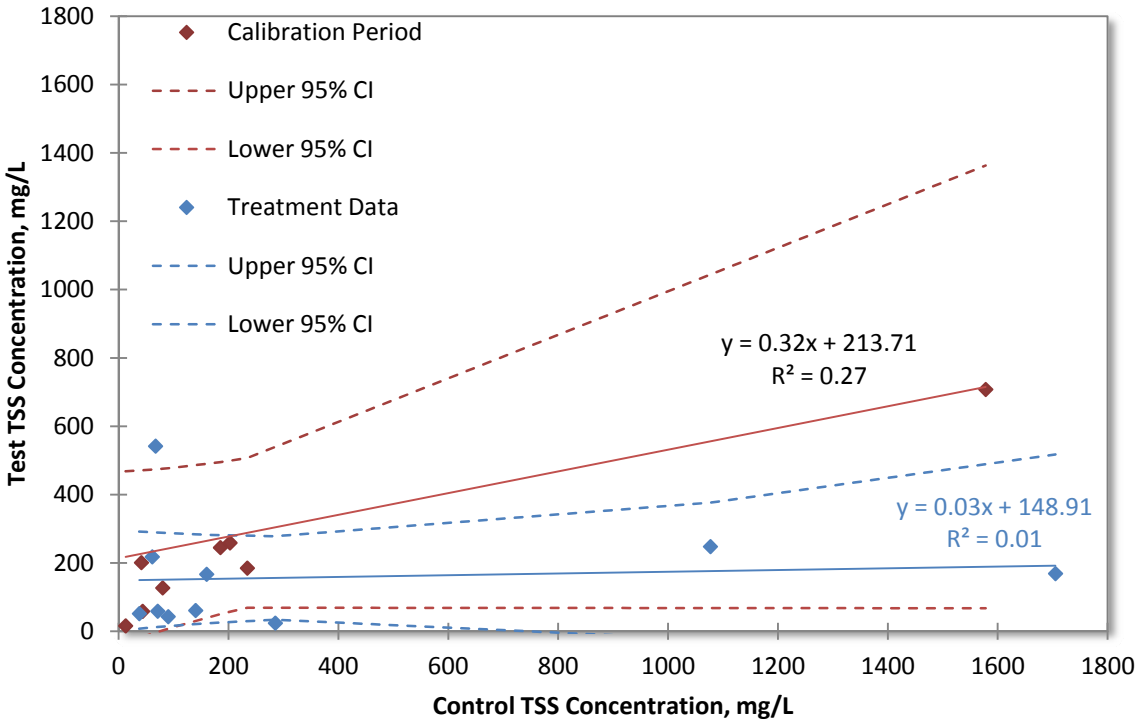

Figure 6. Total Suspended Solids (TSS) Regression Results

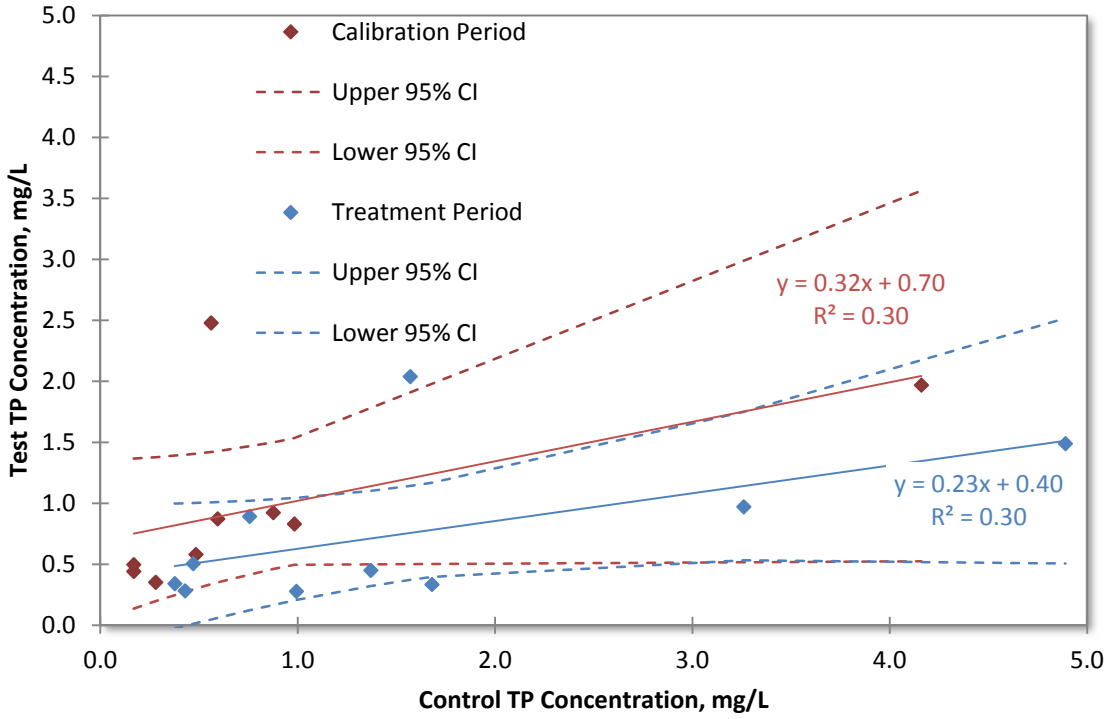

Figure 7. Total Phosphorus (TP) Regression Results

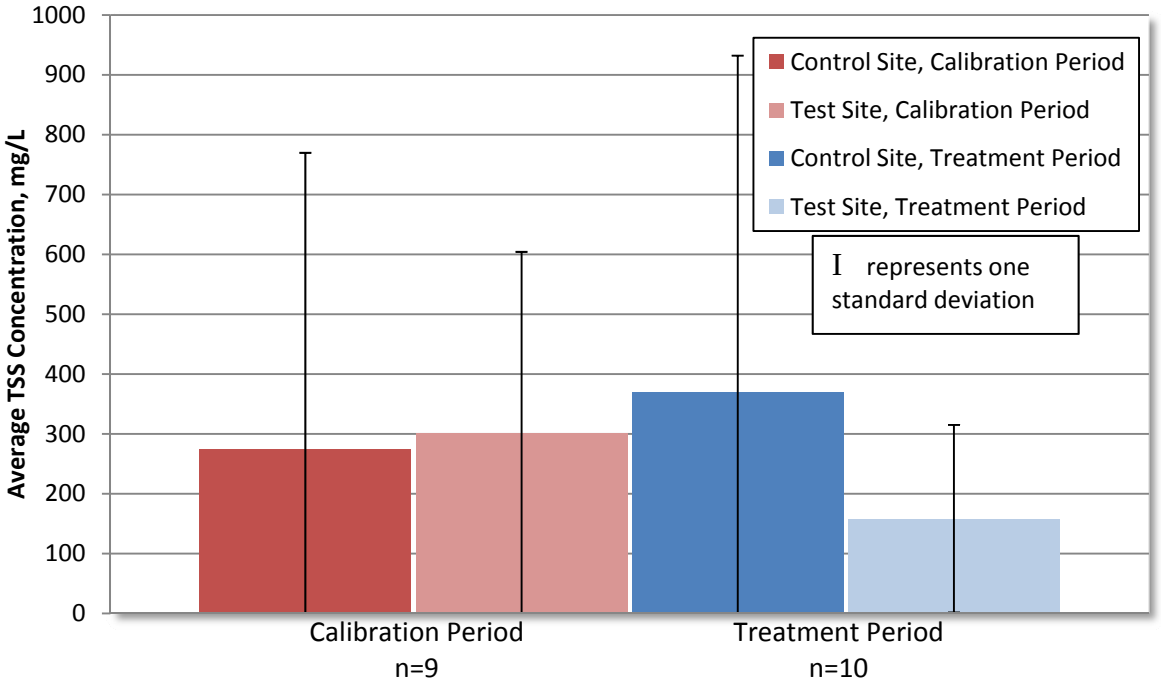

Figure 8. Average TSS Concentrations (n=number of paired samples)

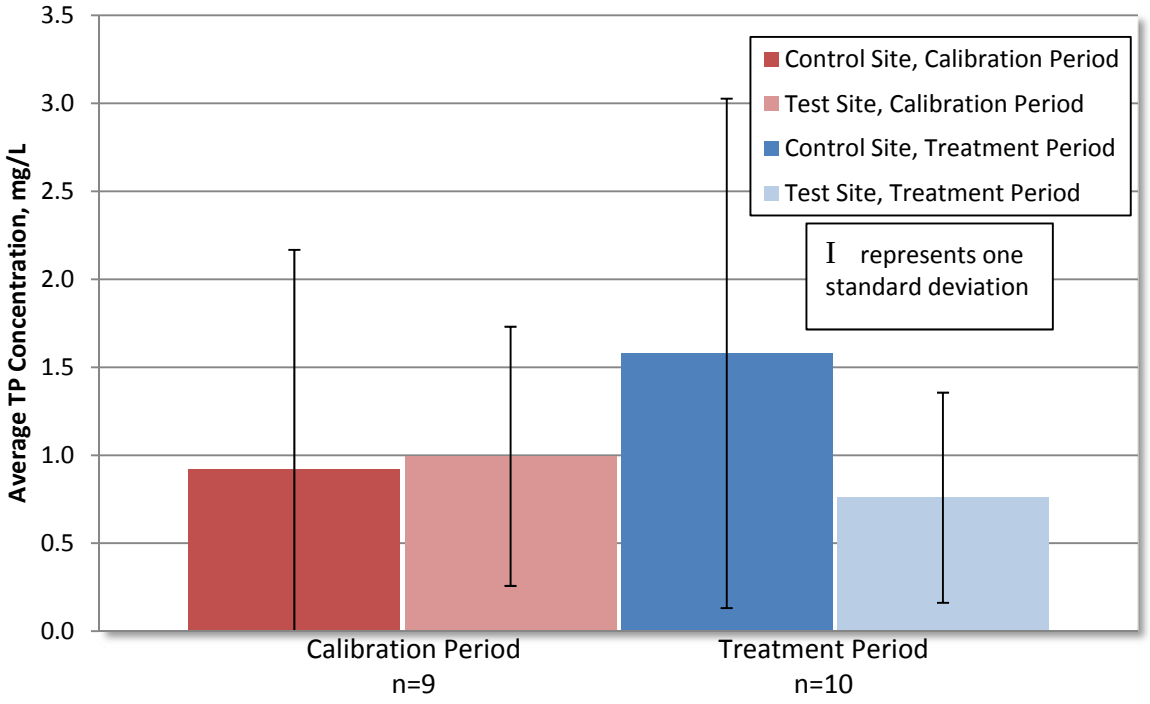

Figure 9. Average TP Concentrations (n=number of paired samples)

Conclusions and Recommendations

Although the study did not conclude with statistically significant results, the data resulting from this study provides a significant data set to which a hydrologic model of the watersheds can be calibrated. With a calibrated hydrologic model, multiple scenarios in which various amounts of impervious area are treated could be explored to determine if efforts such as redirecting alley runoff will provide a reduction in runoff volume.

Continued water quality monitoring could be of value to develop a data set to which a water quality model could be calibrated. In addition to flow-weighted composite concentrations, the TSS and TP concentrations throughout the hydrograph of various representative storm events should be analyzed to support potential water quality modeling efforts. Creating a calibrated hydrologic/water quality model such as P8, would allow for further study of impacts of various treatment scenarios and would be a valuable tool in decreasing the stormwater pollutant loads and improving the water quality of Powderhorn Lake.

References

Clausen, J.C., and Spooner. 1993. Paired Watershed Study Design. Prepared for the U.S. Environmental Protection Agency. Office of Water. Washington, D.C. Report 841-F-93-009.

Metro Blooms. 2012. A Citizen-Based Approach to Stormwater Management. Prepared for the Legislative-Citizen Commission on Minnesota Resources. St. Paul, MN. Project 09-05e.

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Attachment – Exhibits

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Exhibits

Paired Event Hydrographs

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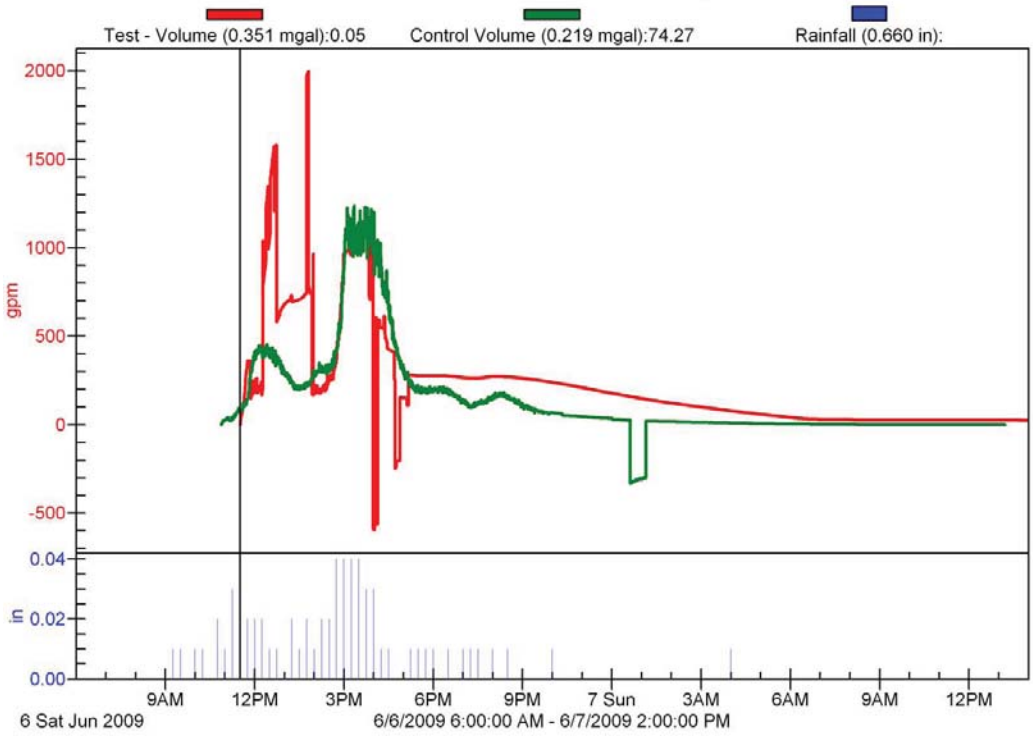
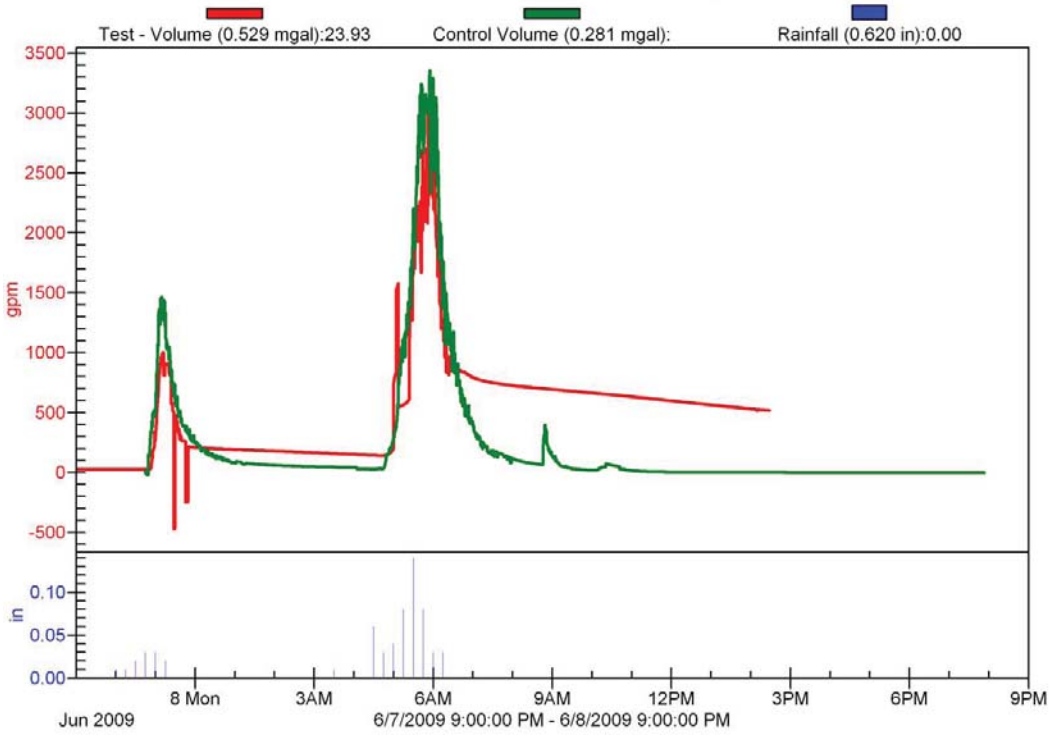
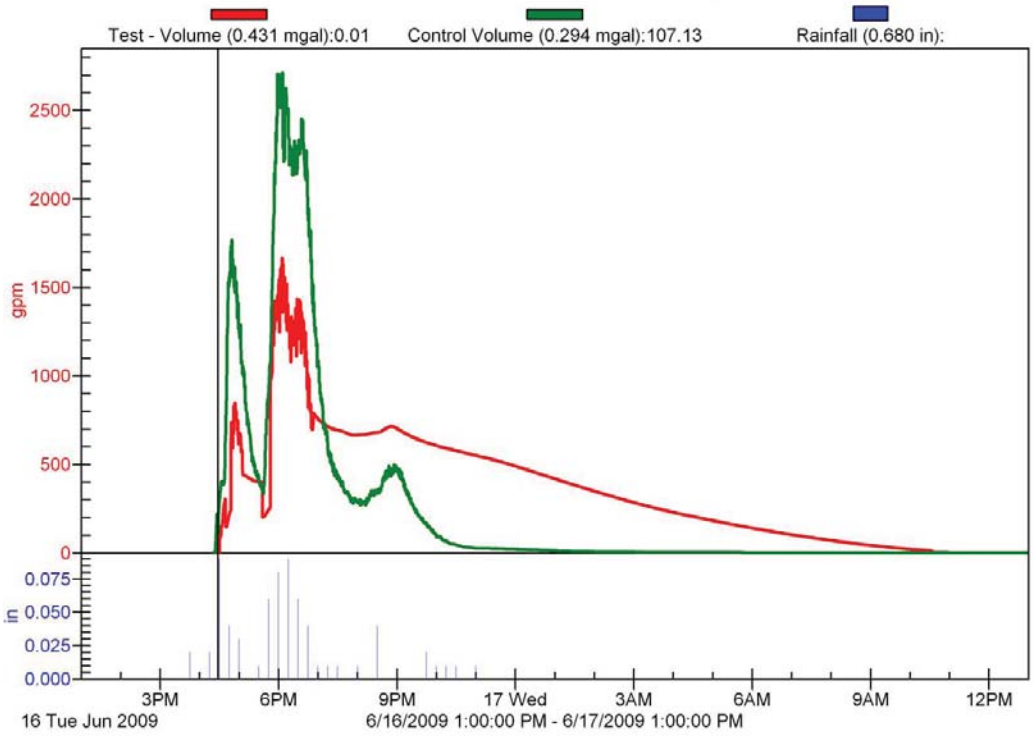
Pre-Construction Rain Event - June 6, 2009



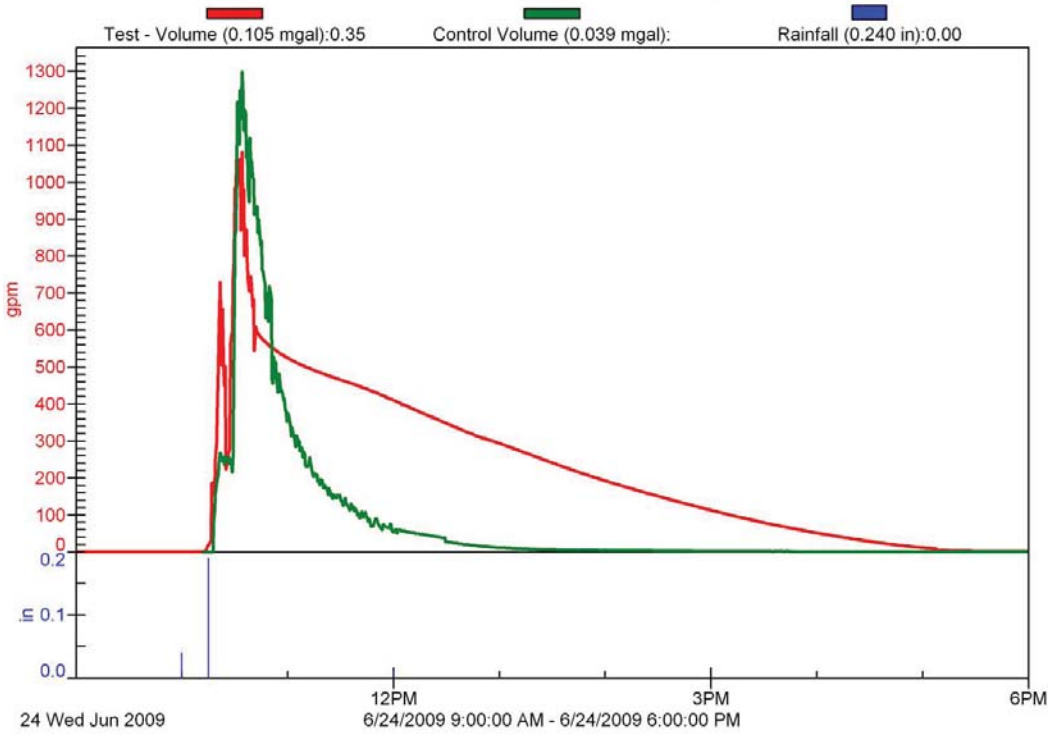
Pre-Construction Rain Event - June 7-8, 2009



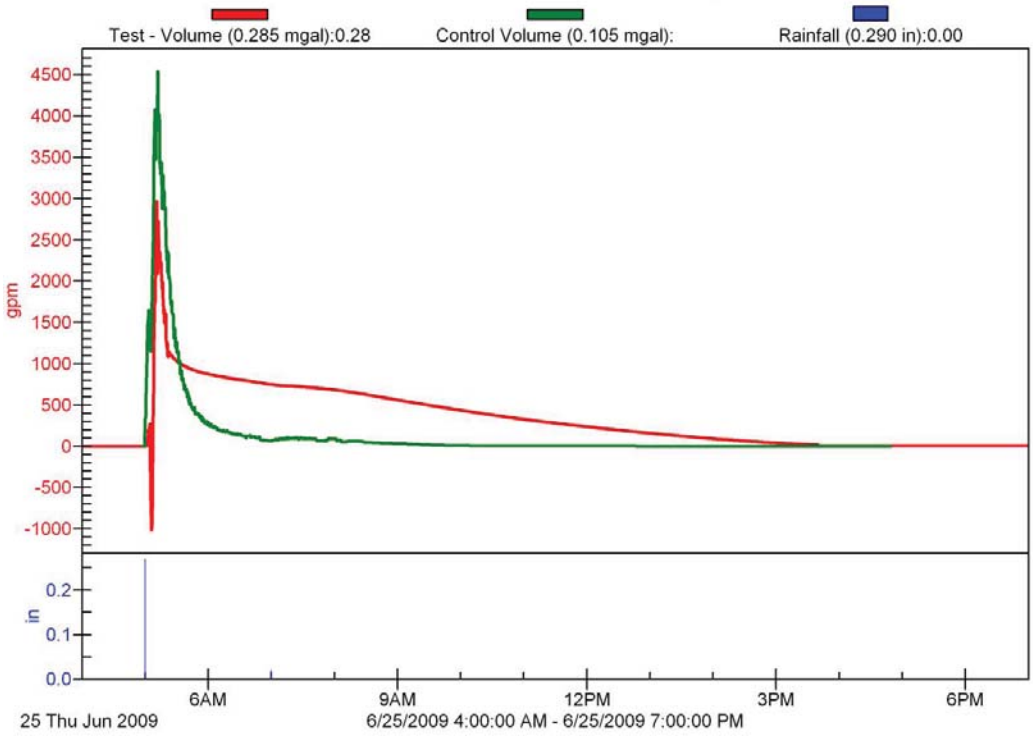
Pre-Construction Rain Event - June 16, 2009



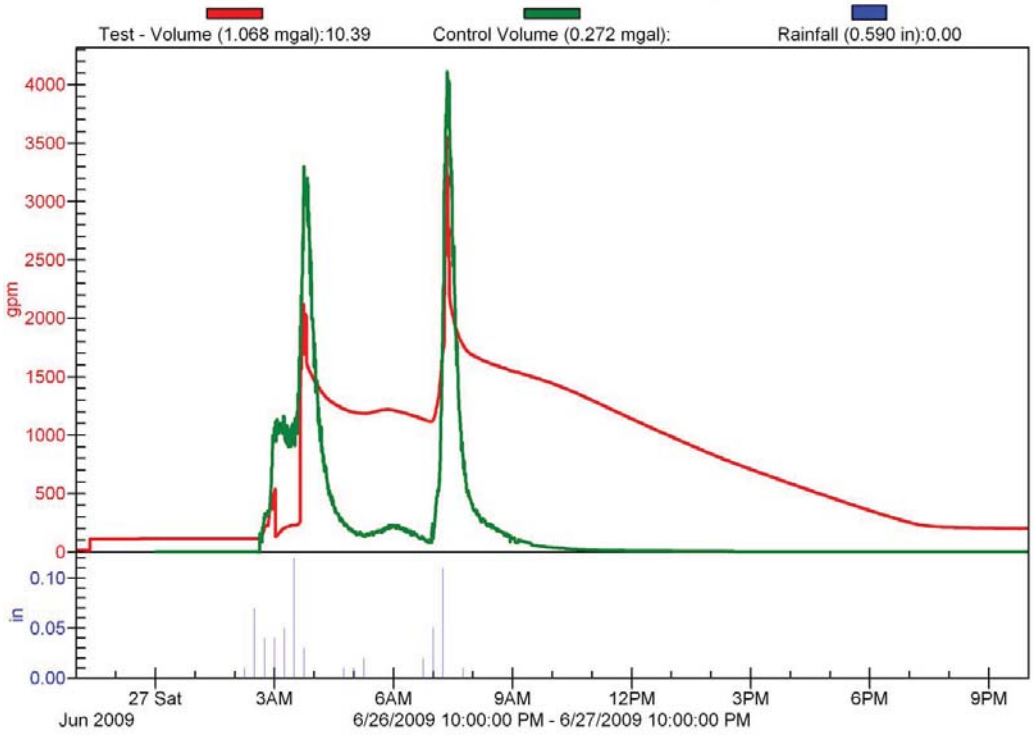
Pre-Construction Rain Event - June 24, 2009



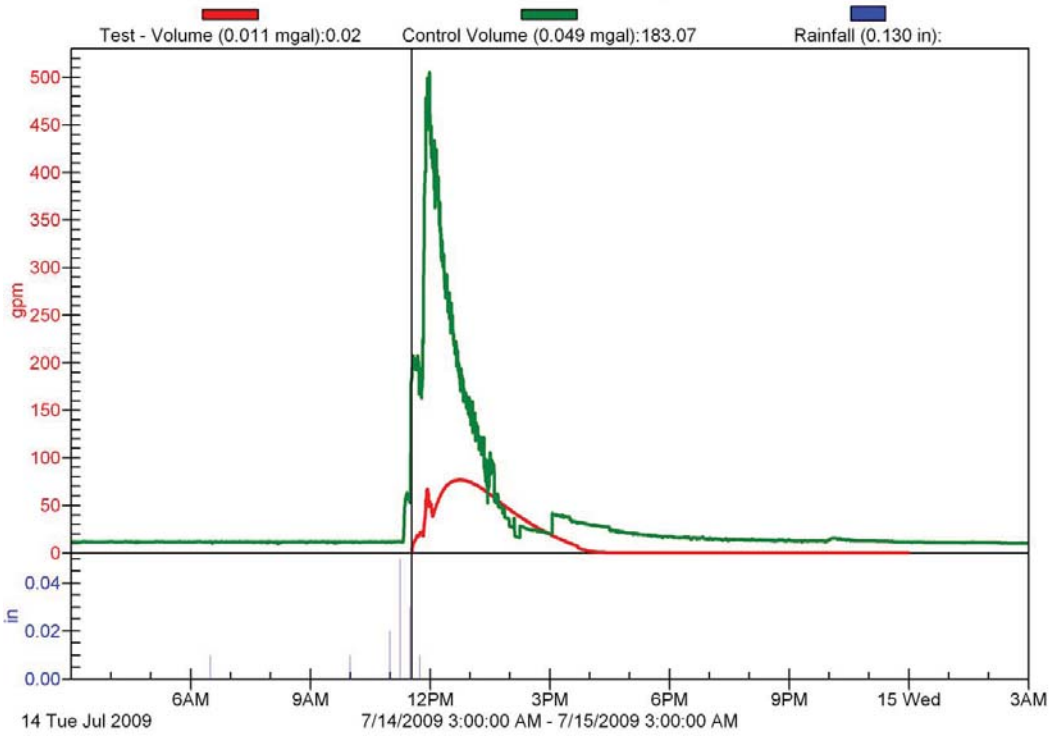
Pre-Construction Rain Event - June 25, 2009



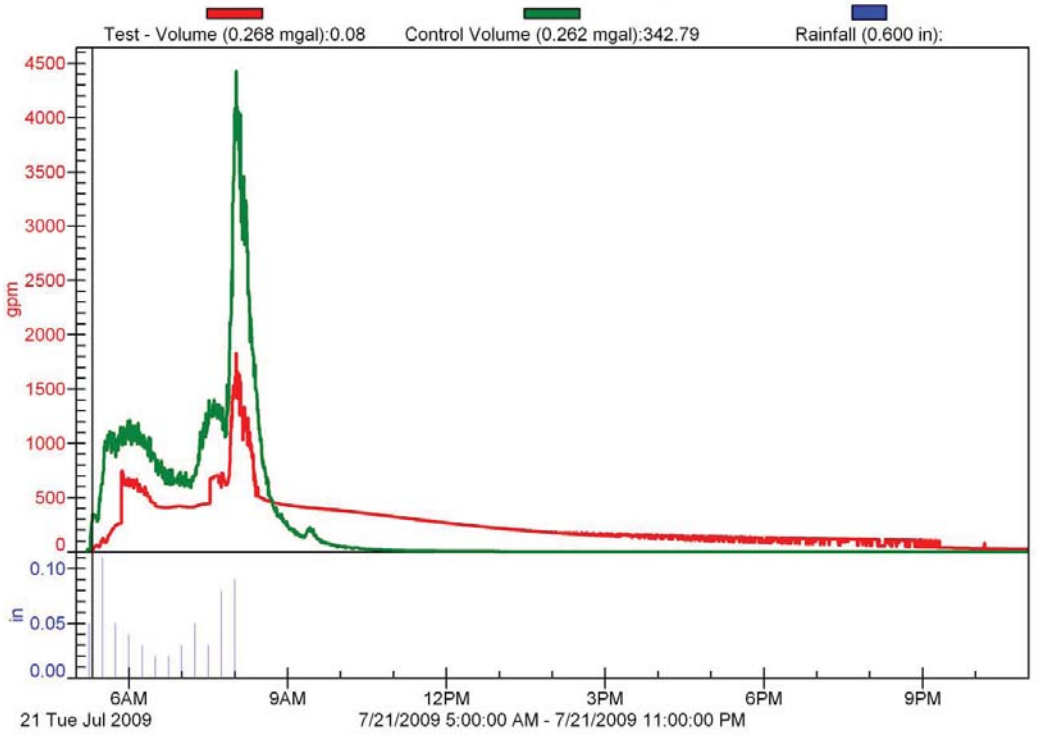
Pre-Construction Rain Event - June 27, 2009



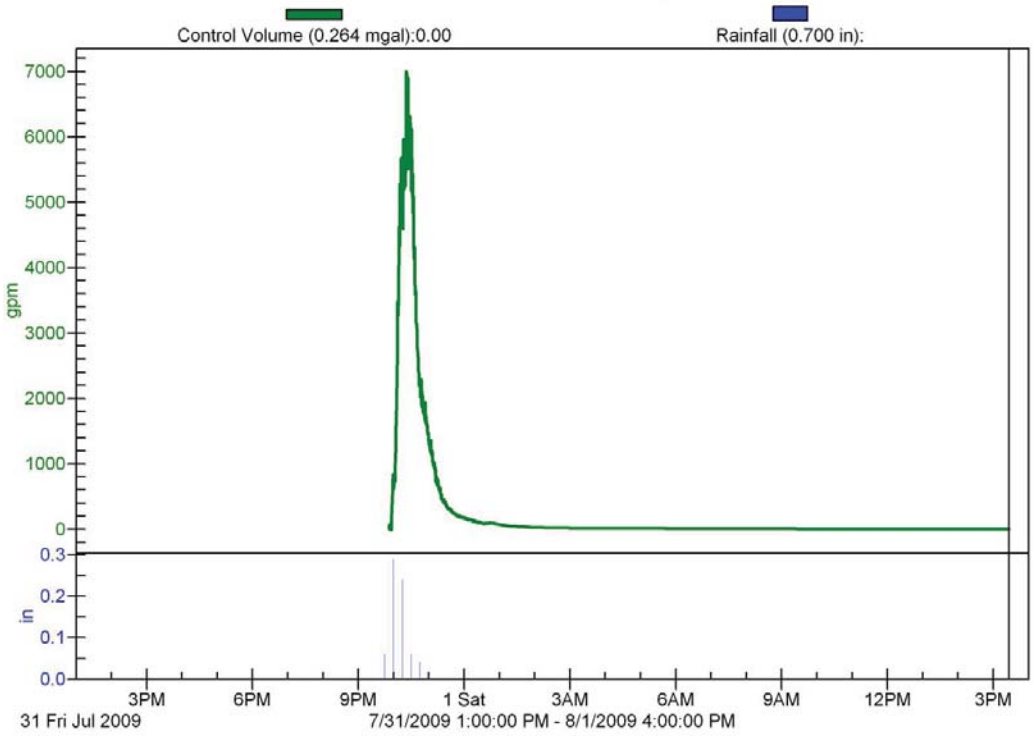
Pre-Construction Rain Event - July 14, 2009



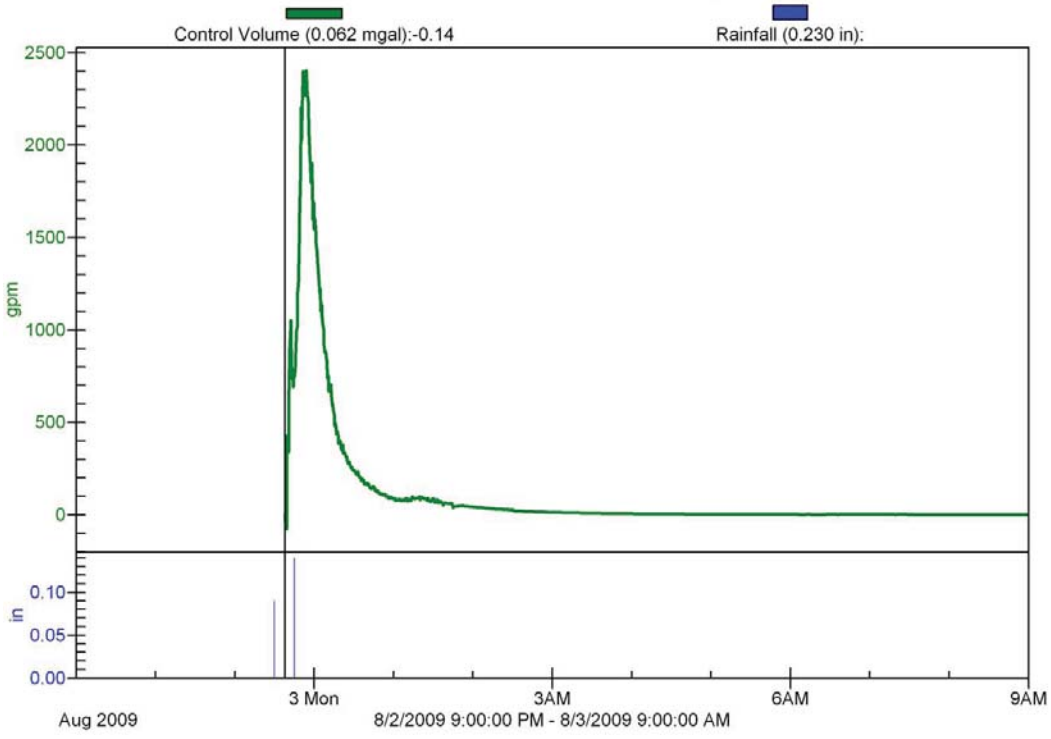
Pre-Construction Rain Event - July 21, 2009



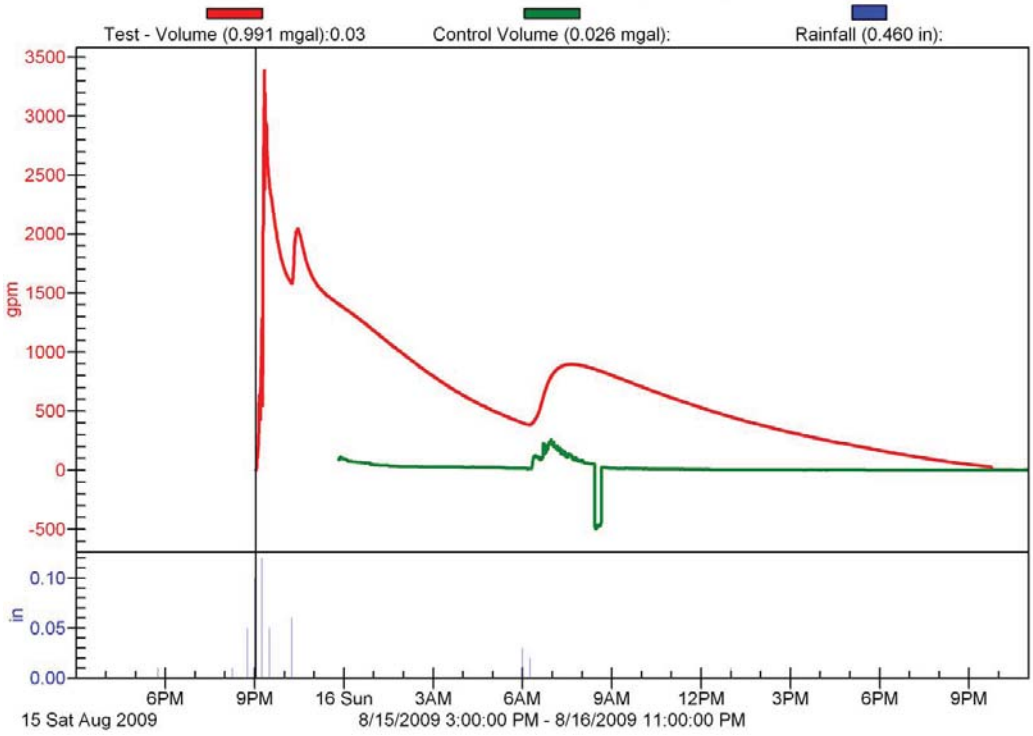
Pre-Construction Rain Event - July 31, 2009



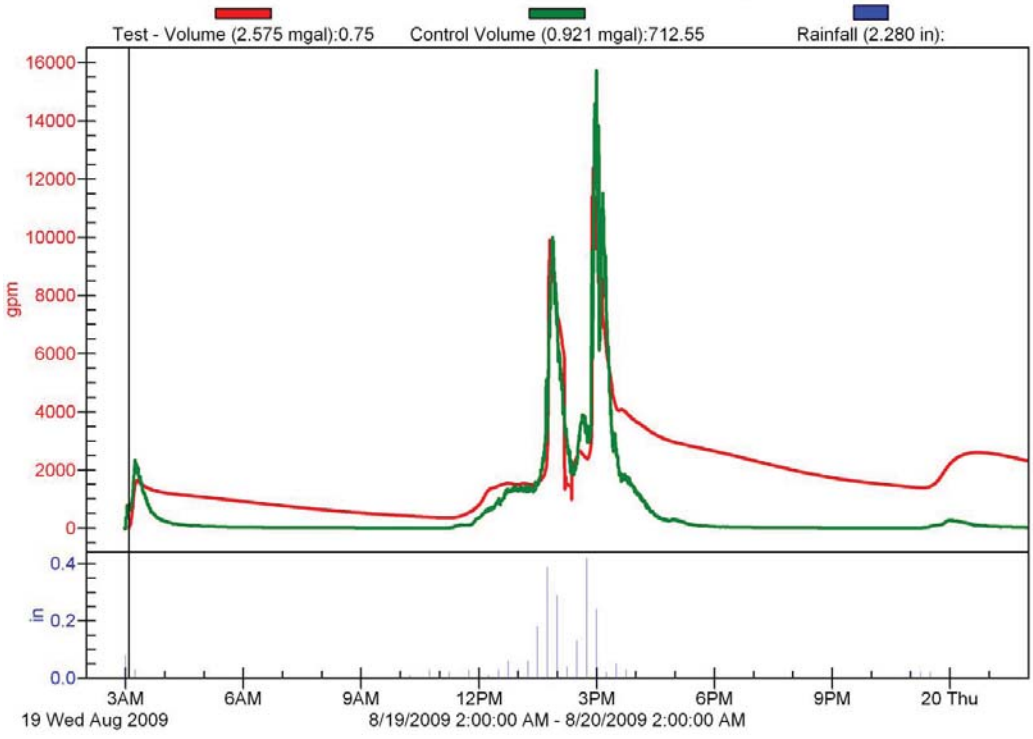
Pre-Construction Rain Event - August 2, 2009



Pre-Construction Rain Event - August 15, 2009



Pre-Construction Rain Event - August 19-20, 2009



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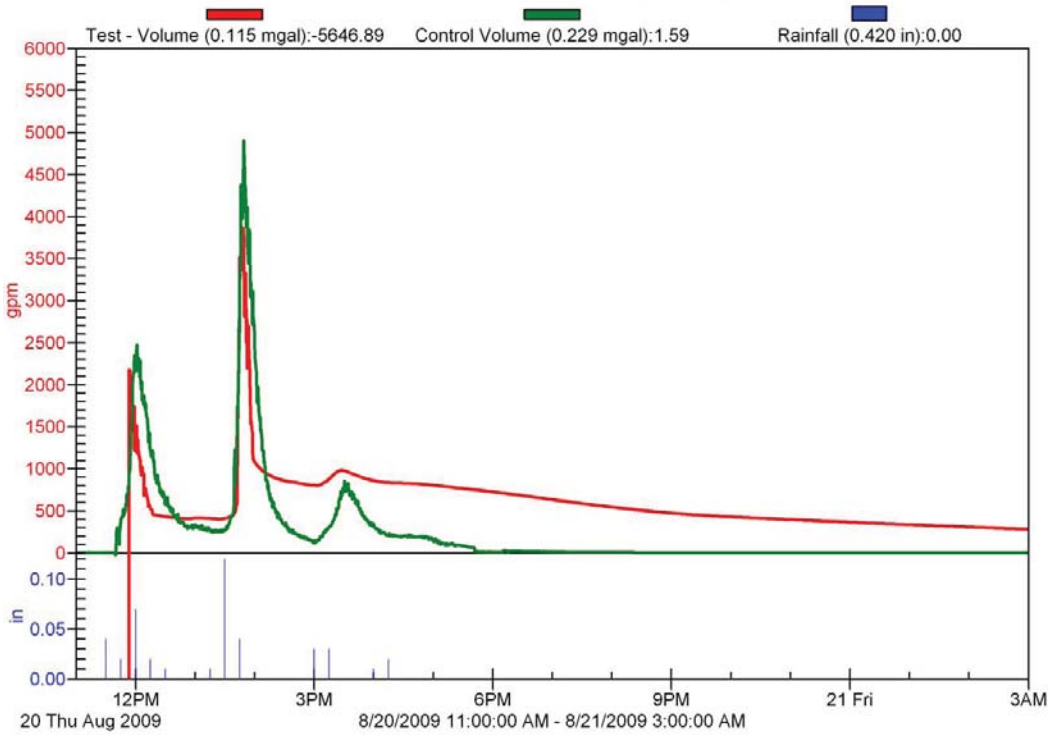

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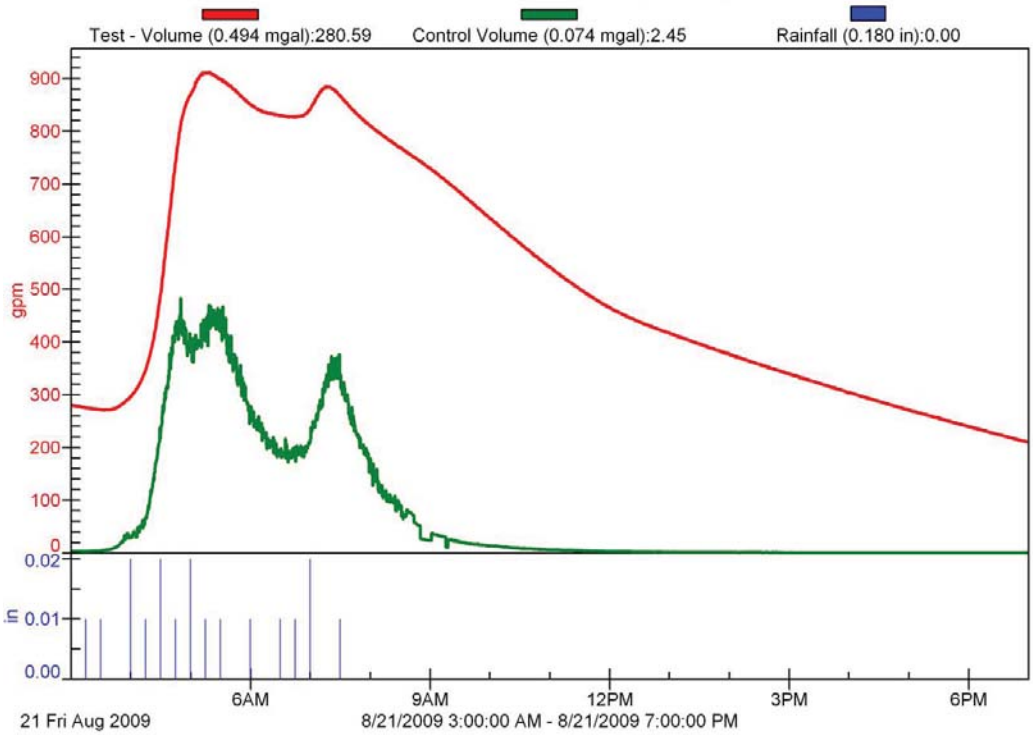
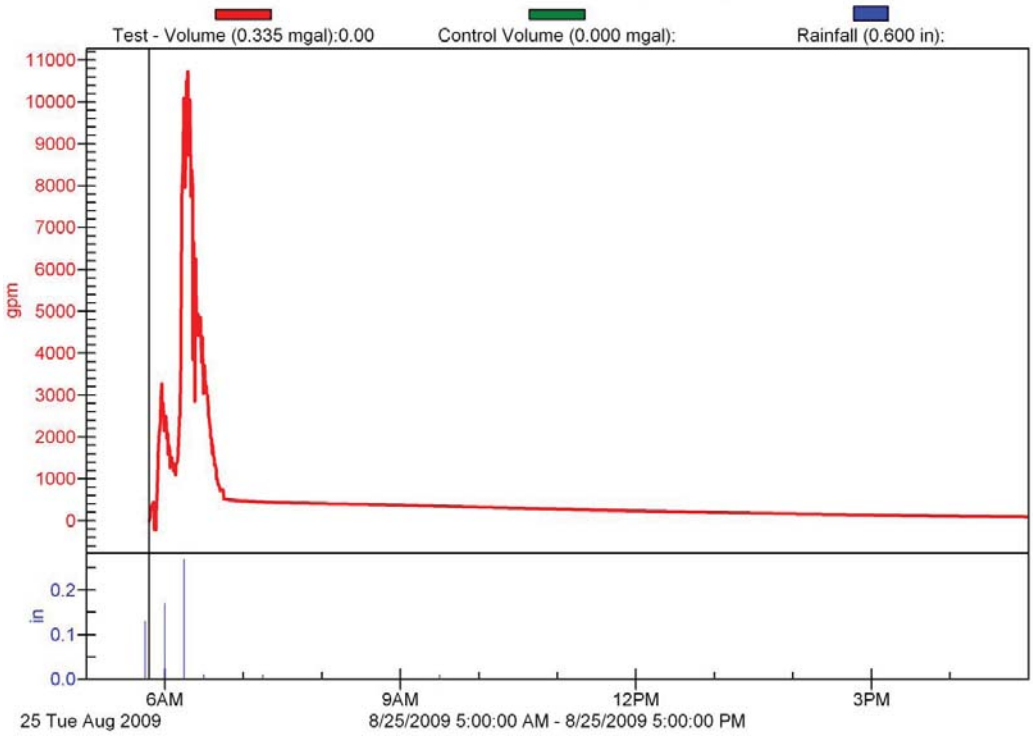


Pre-Construction Rain Event - August 25, 2009



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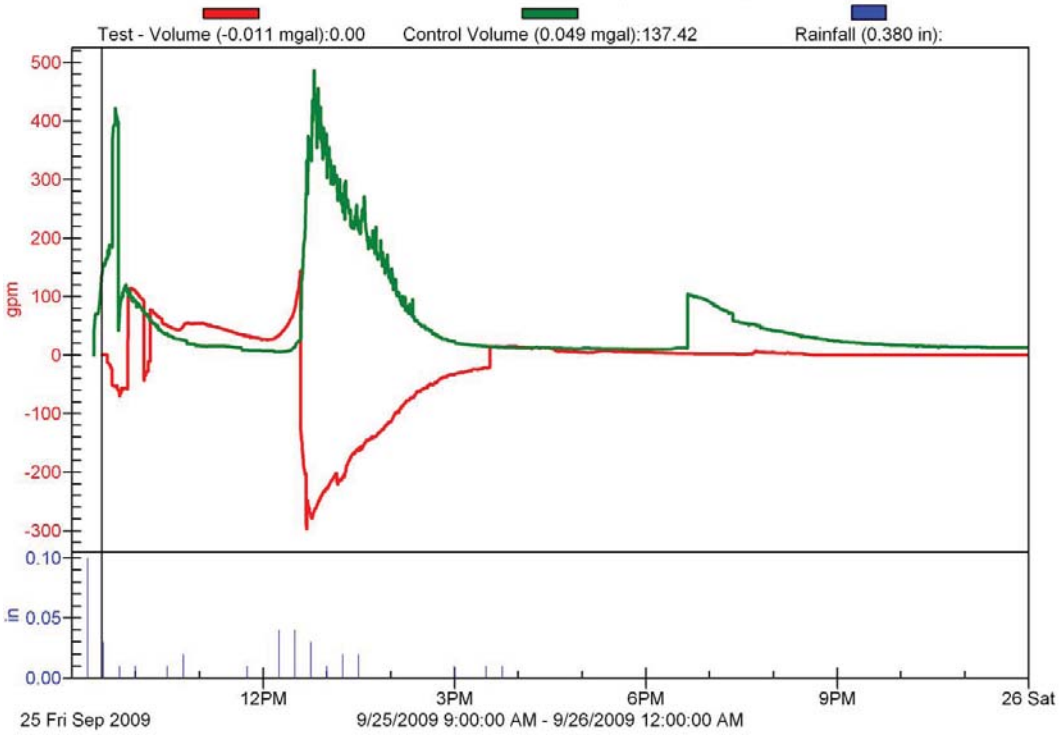
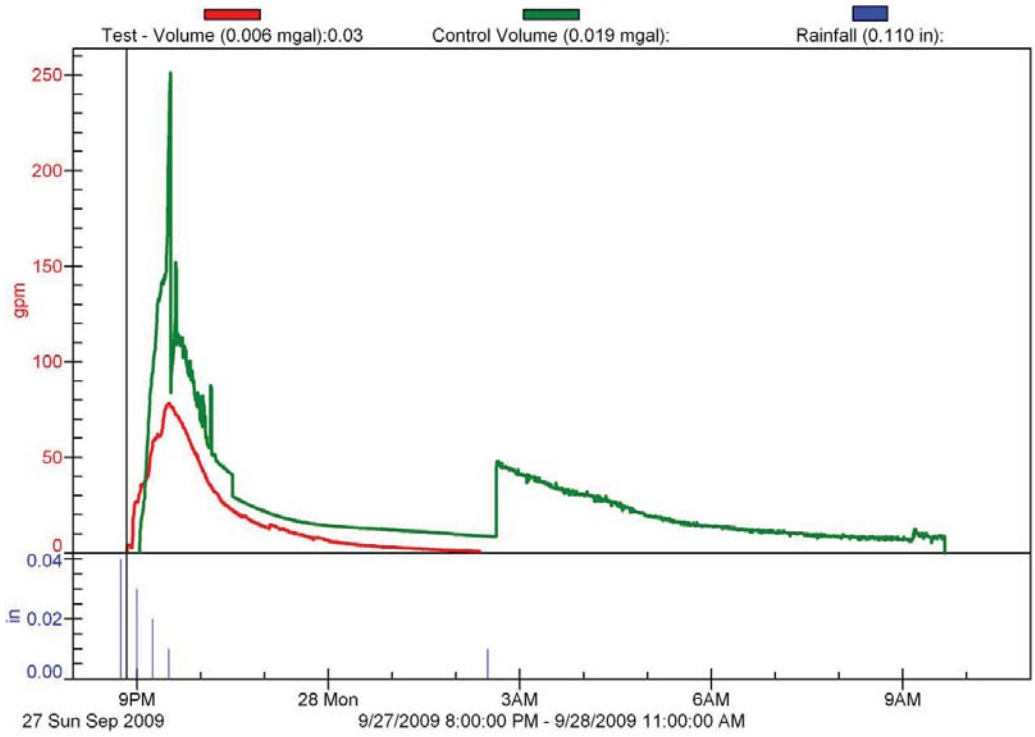
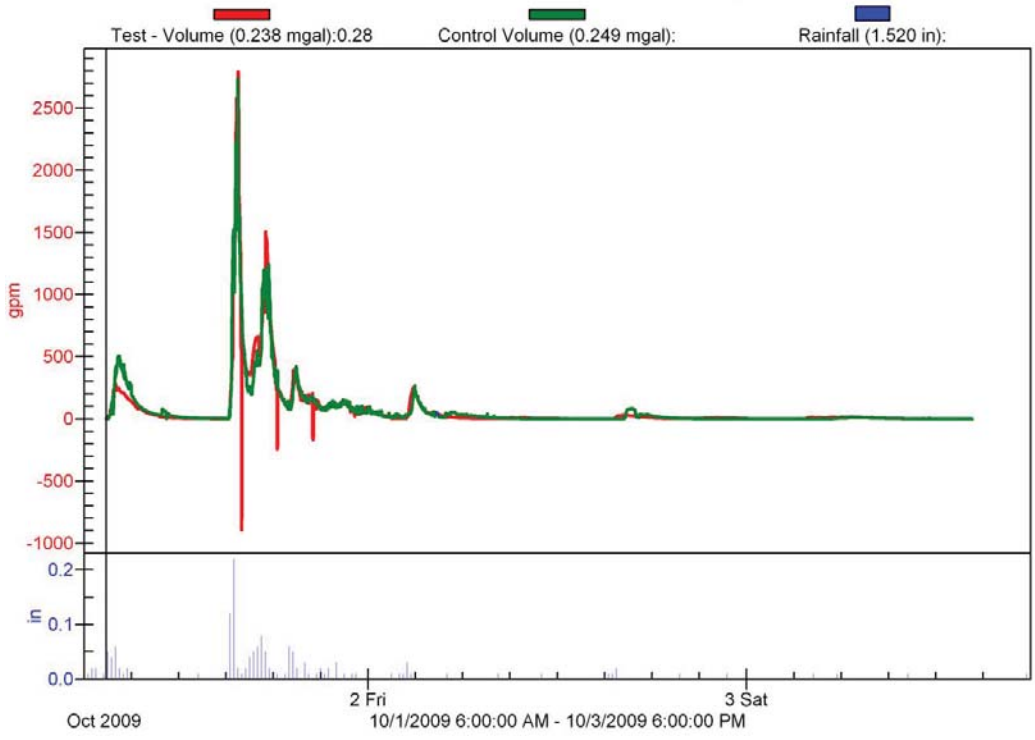


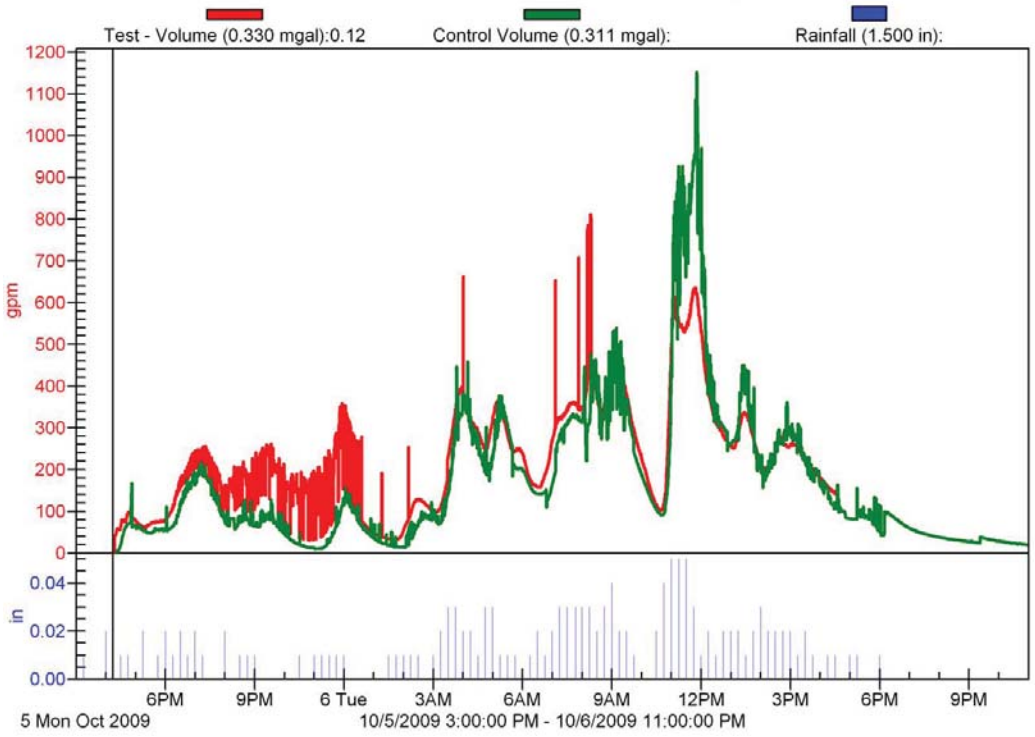
Pre-Construction Rain Event - September 27-28, 2009



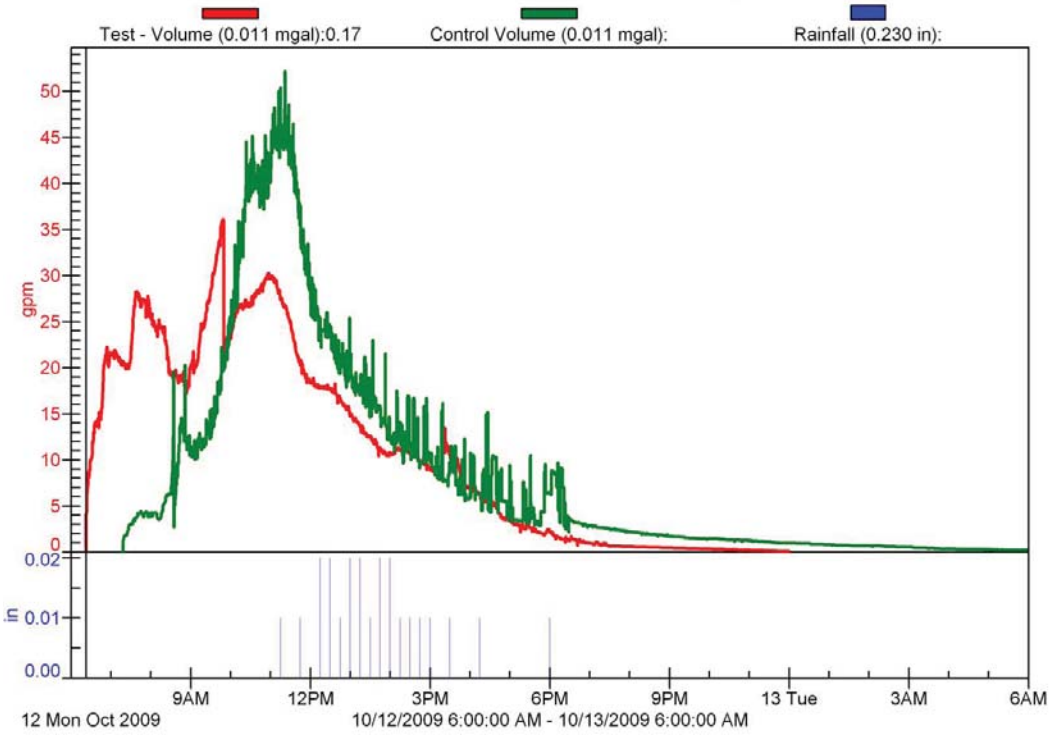
Pre-Construction Rain Event - October 1-3, 2009



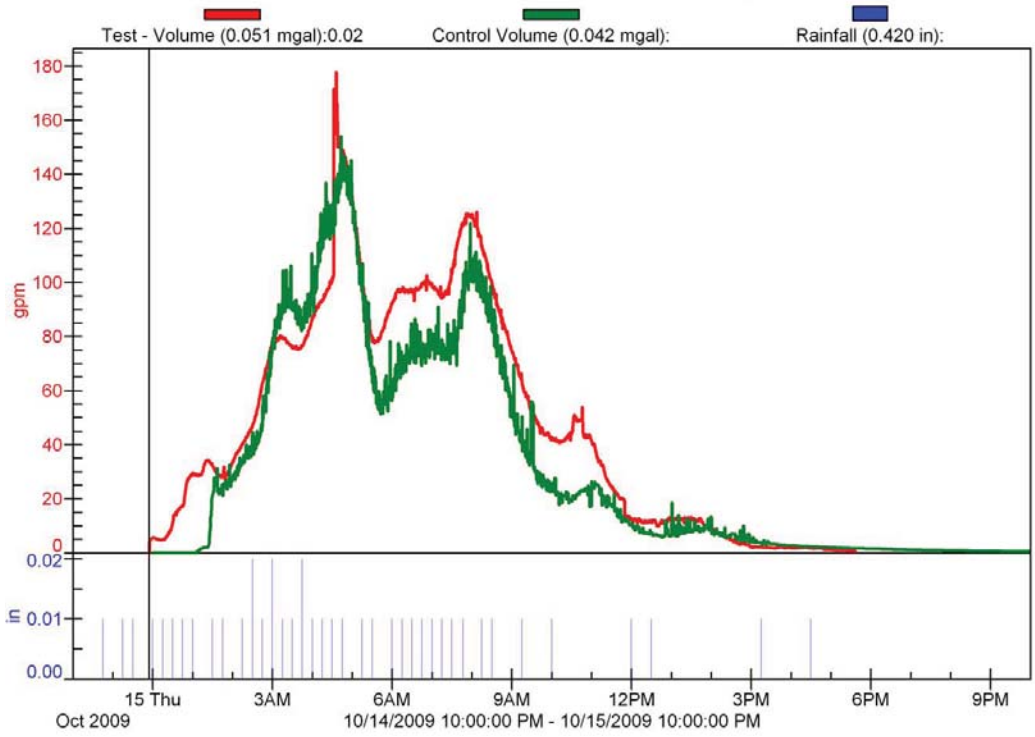
Pre-Construction Rain Event - October 5-6, 2009



Pre-Construction Rain Event - October 5-6, 2009



Pre-Construction Rain Event - October 14-15, 2009



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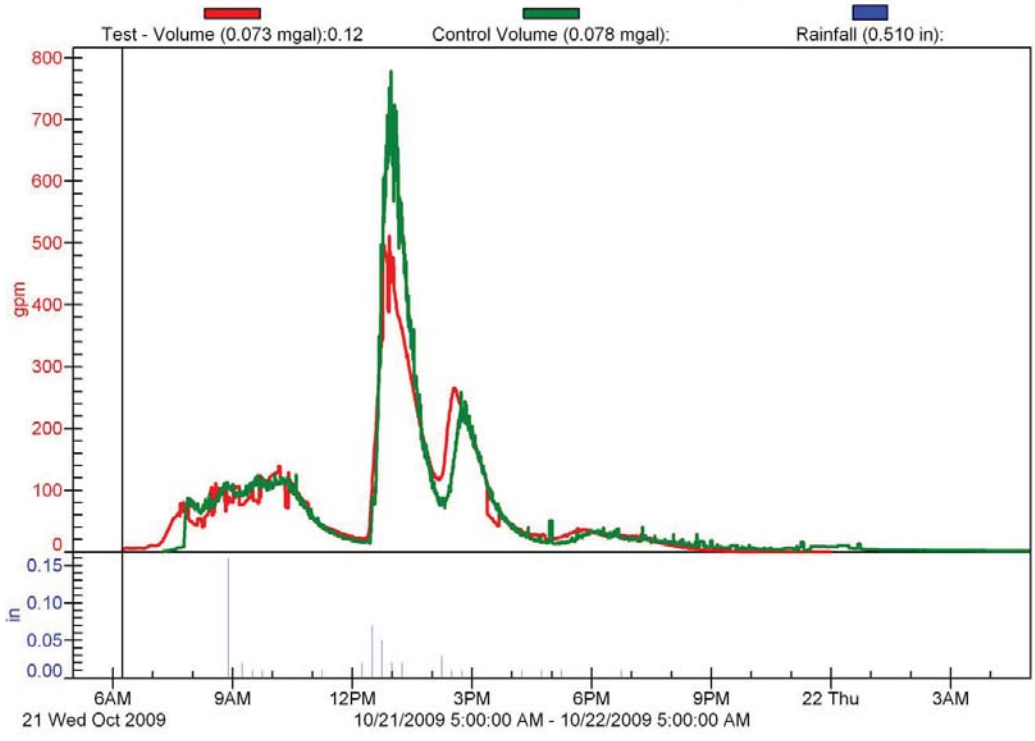

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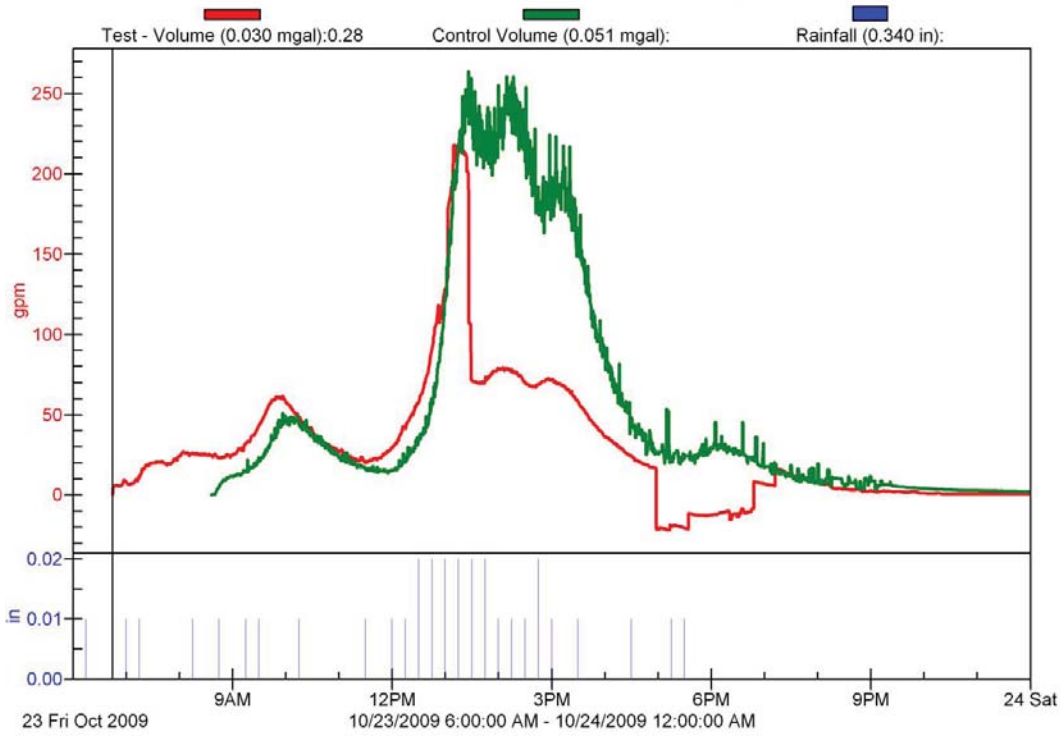
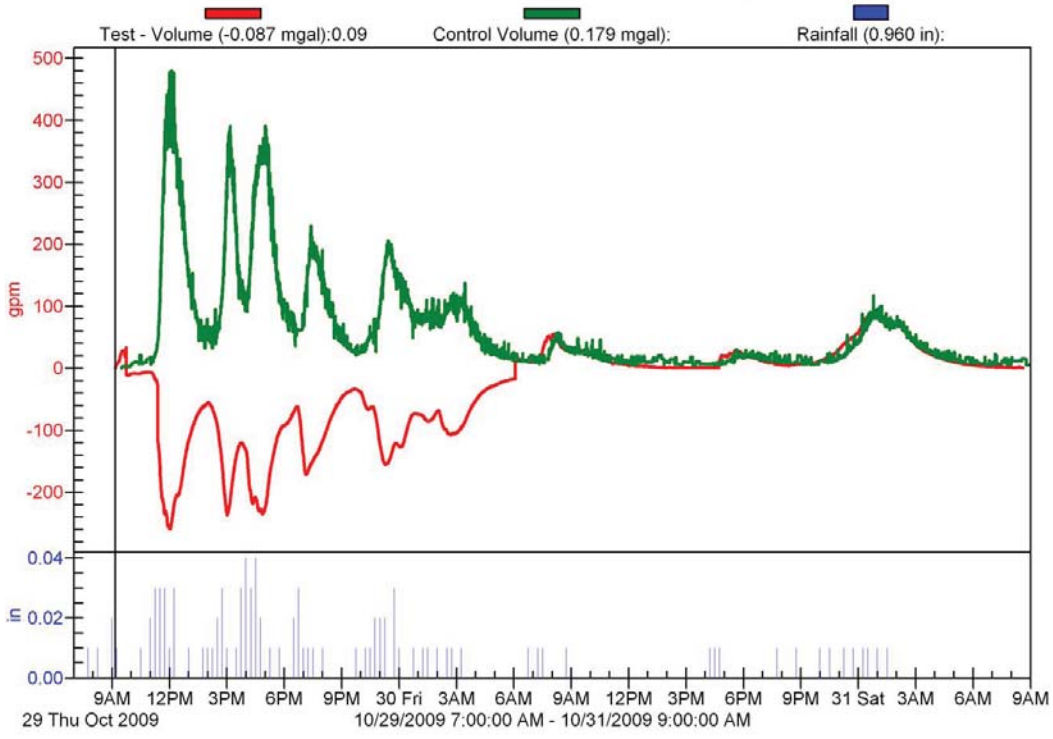
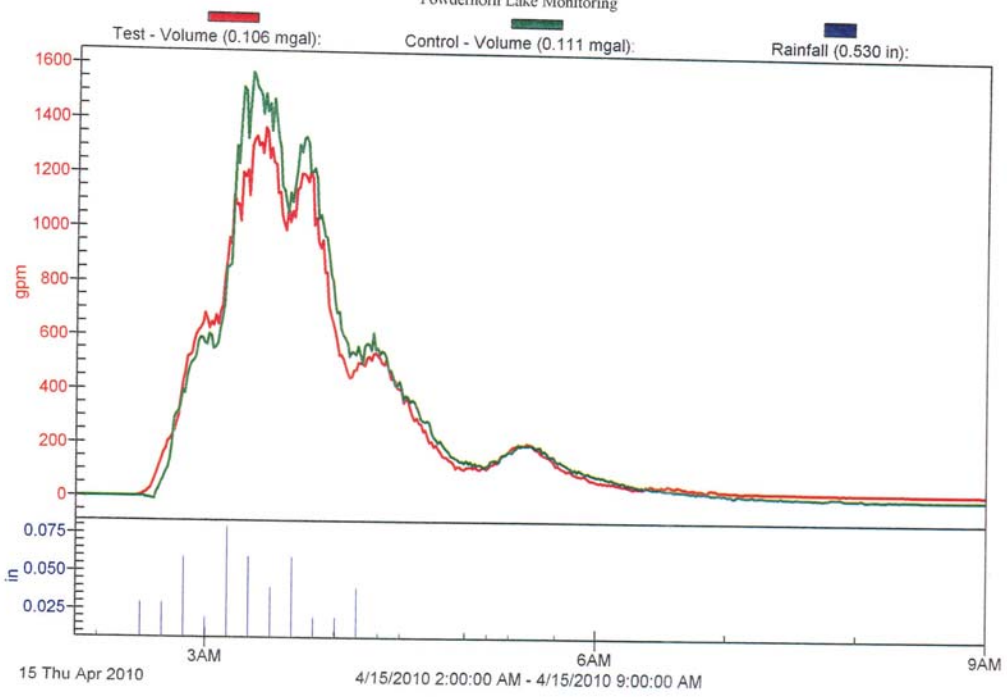


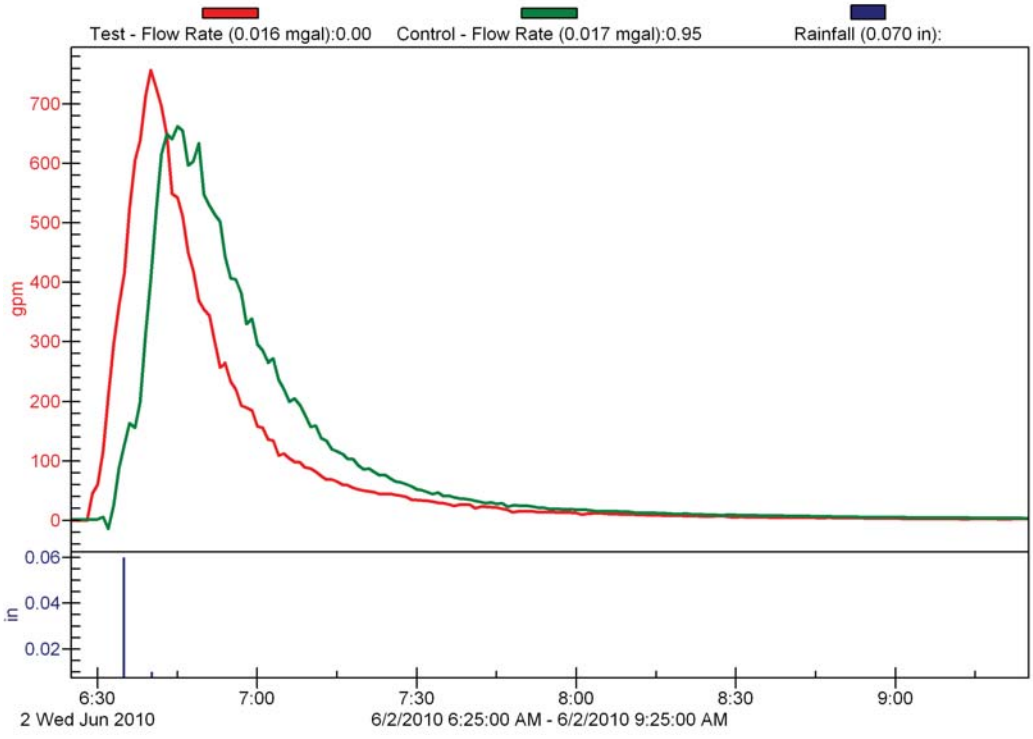
Pre-Construction Rain Event - October 29-31, 2009



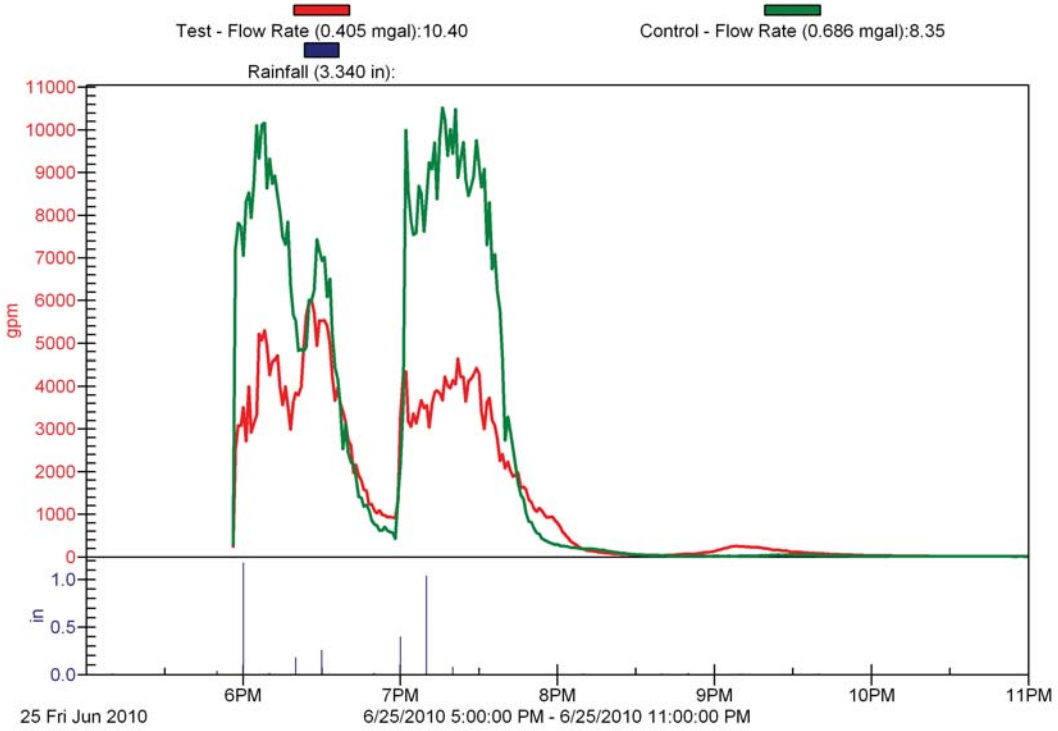
Pre-Construction Rain Event - April 15, 2010



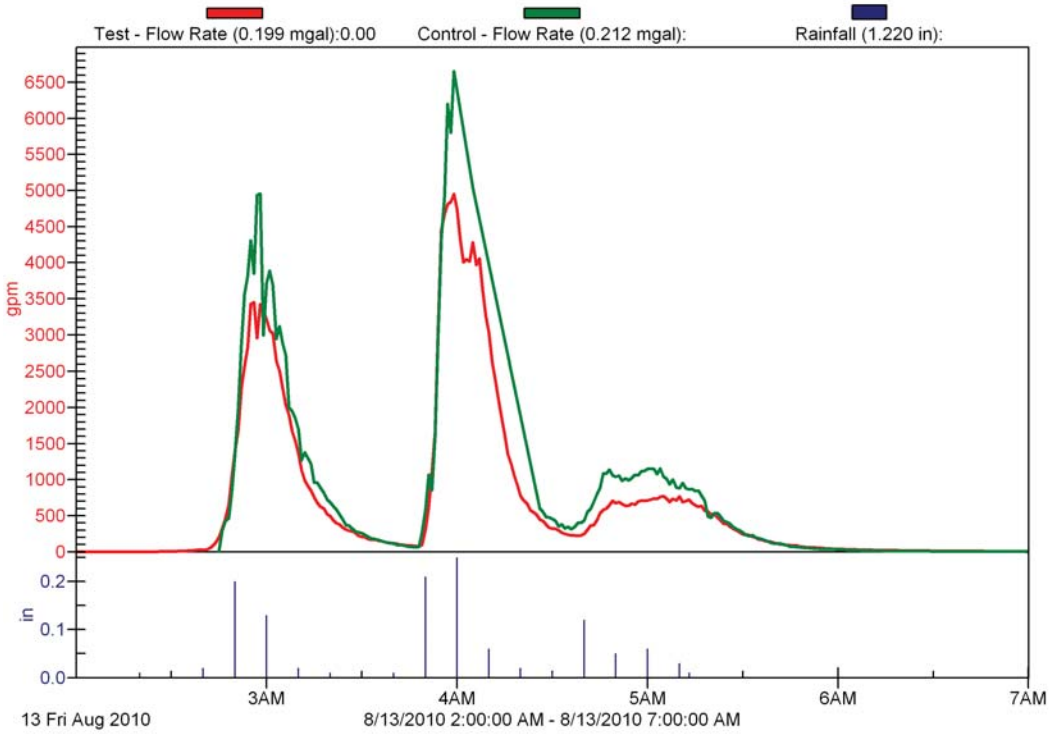
Pre-Construction Rain Event - June 2, 2010



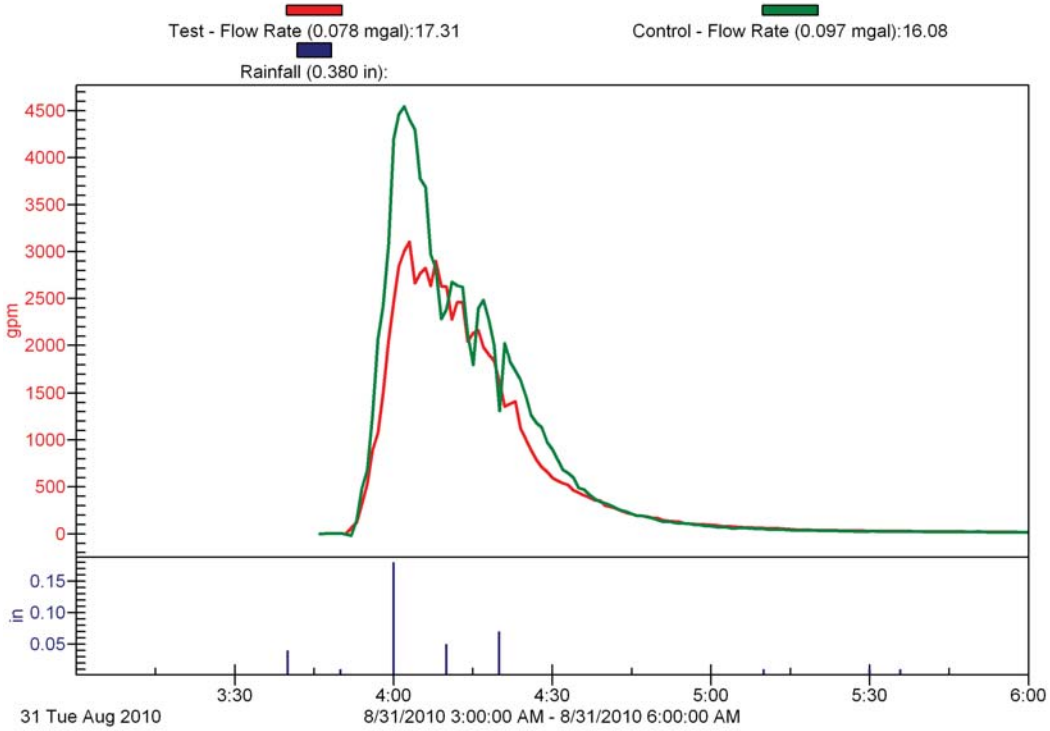
Pre-Construction Rain Event - June 25, 2010



Pre-Construction Rain Event - August 13, 2010



Post-Construction Rain Event - August 31, 2010



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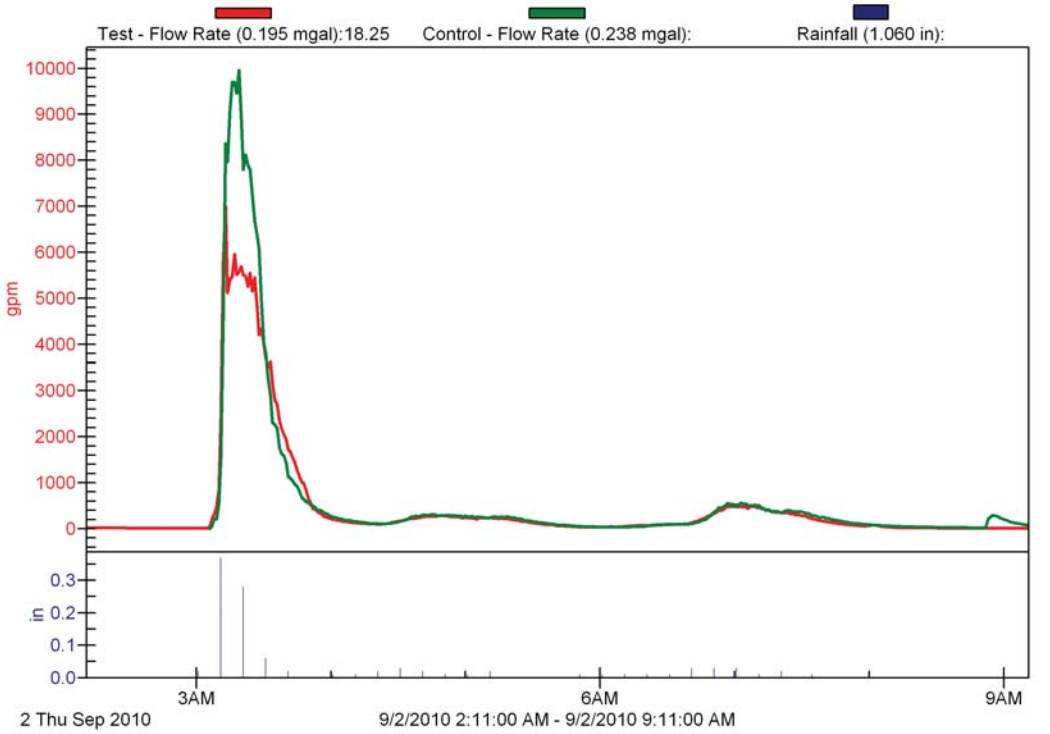

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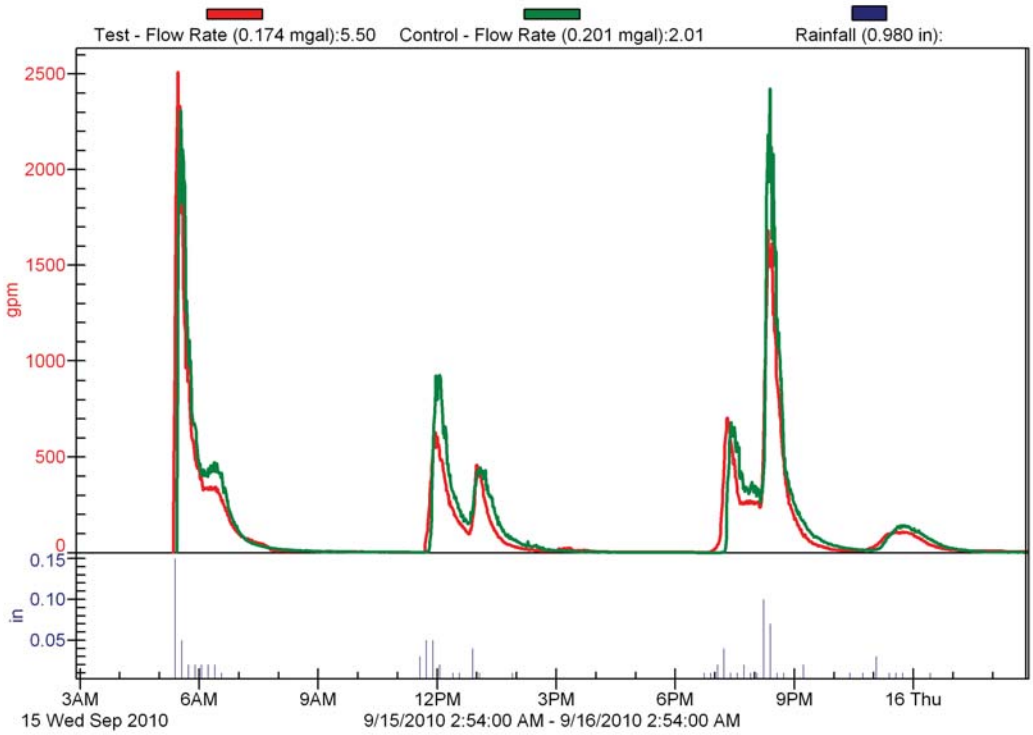
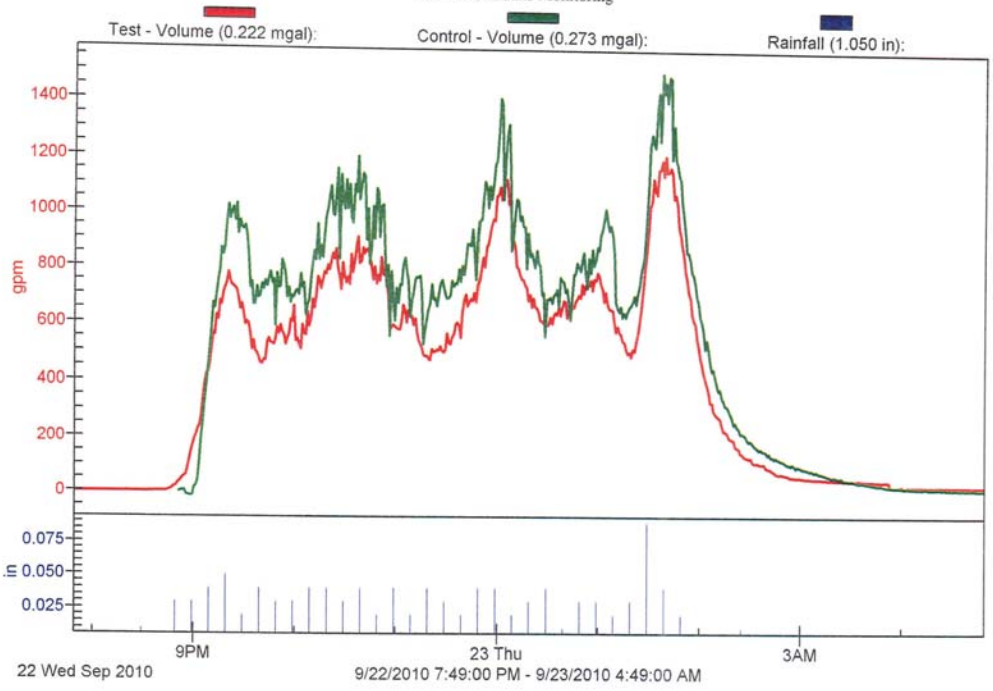


Post-Construction Rain Event - September 22 to September 23, 2010

Powderhorn Lake Monitoring



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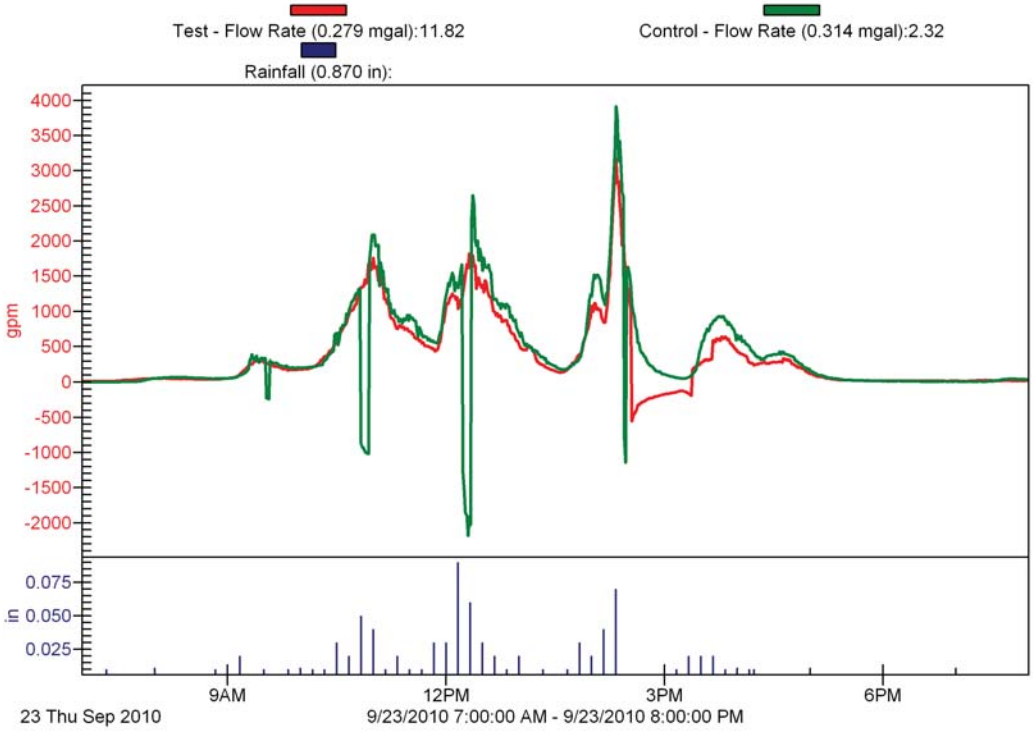
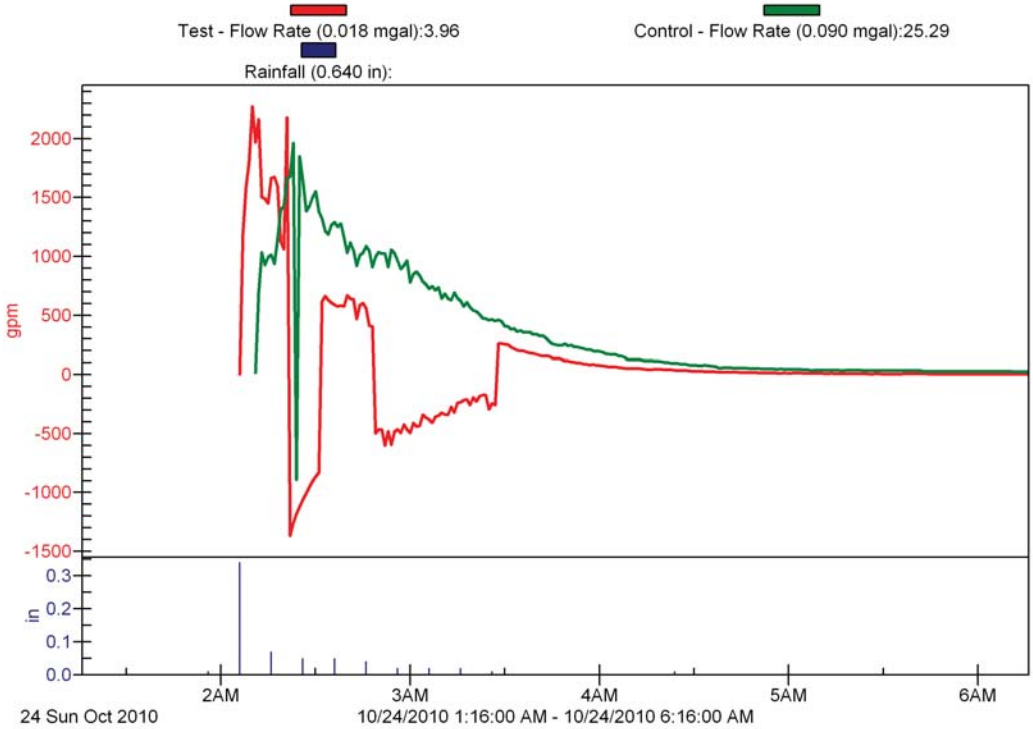
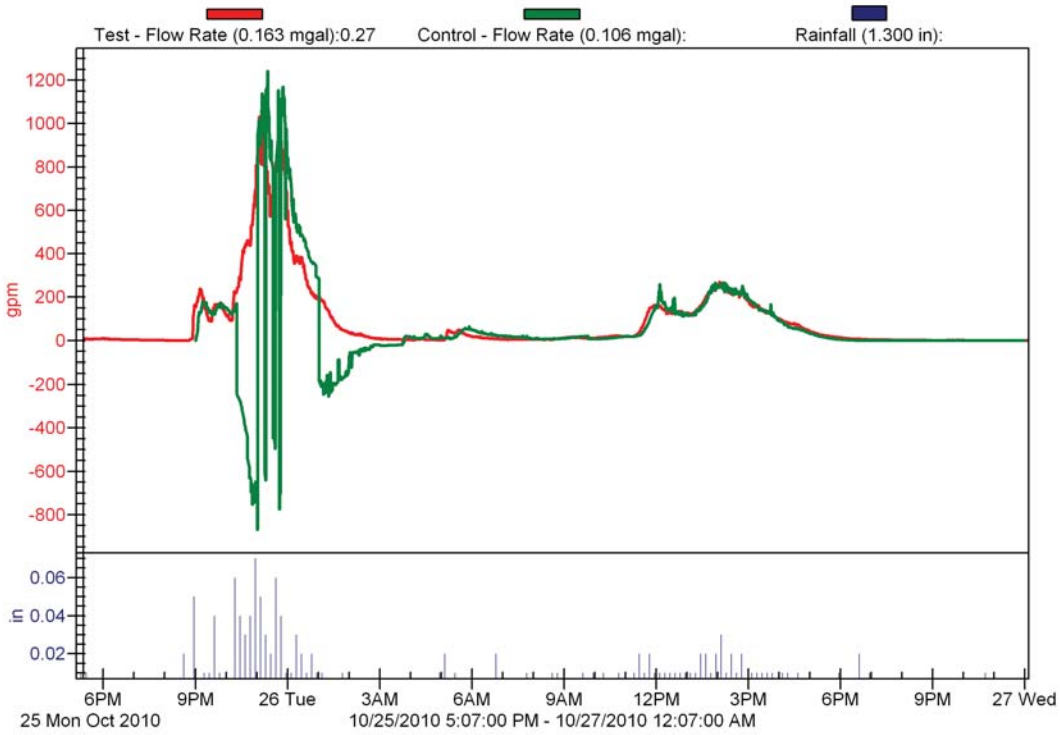


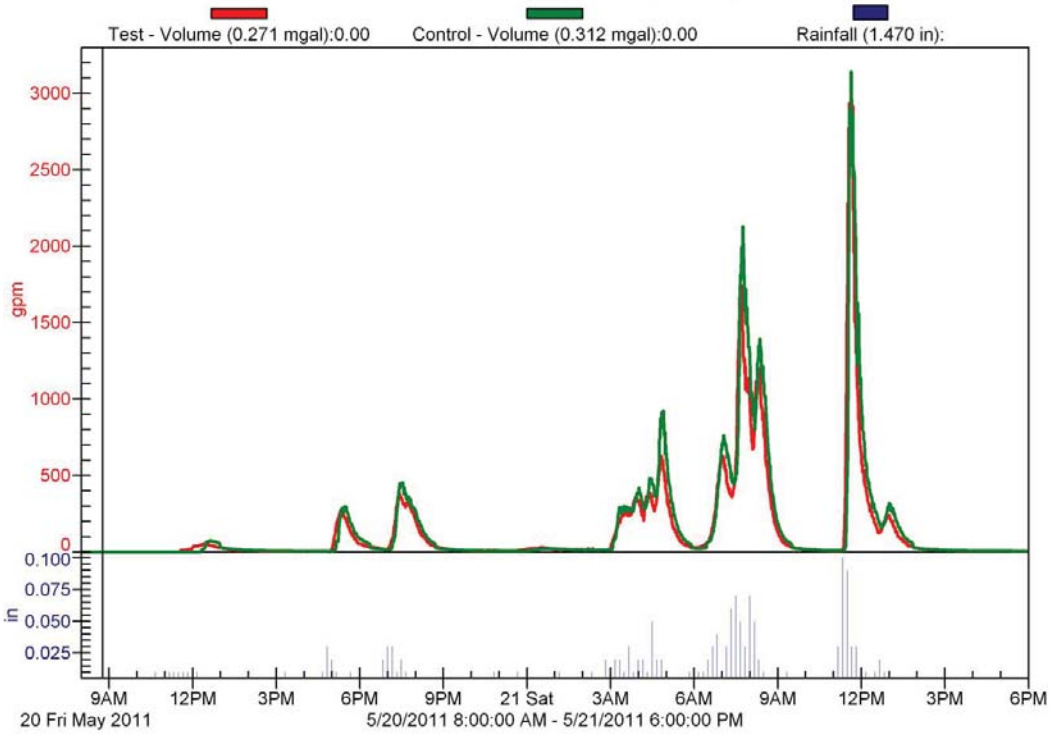
Post-Construction Rain Event - October 24, 2010



Post-Construction Rain Event - October 25, 2010



Post-Construction Rain Event - May 20-21, 2011



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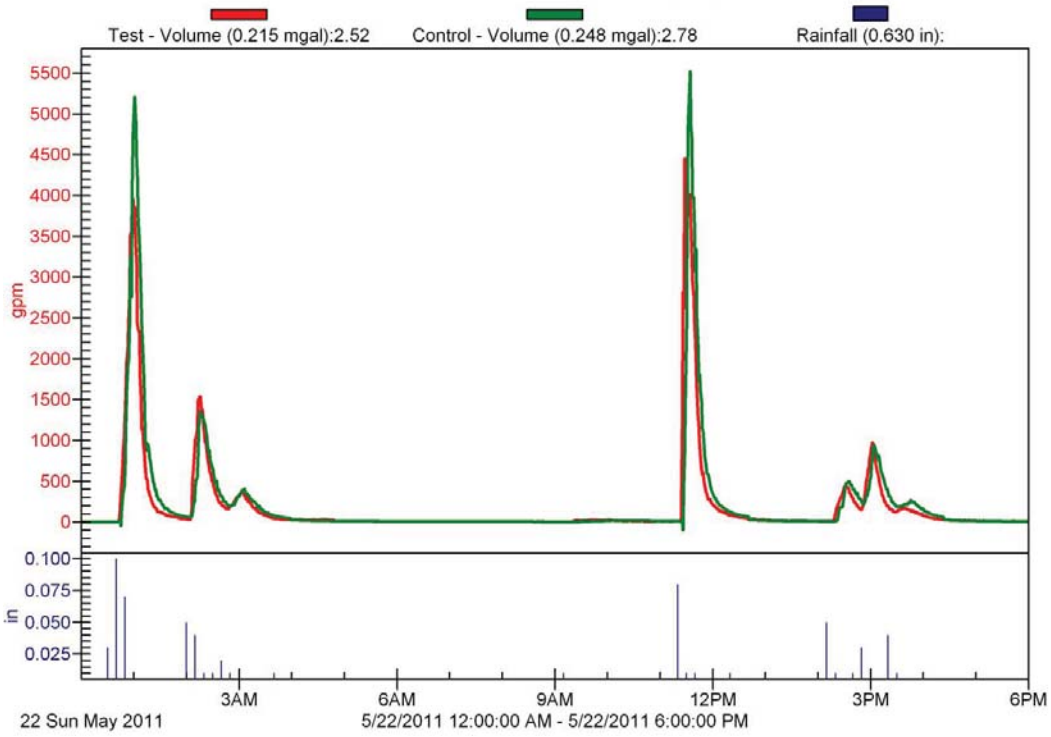

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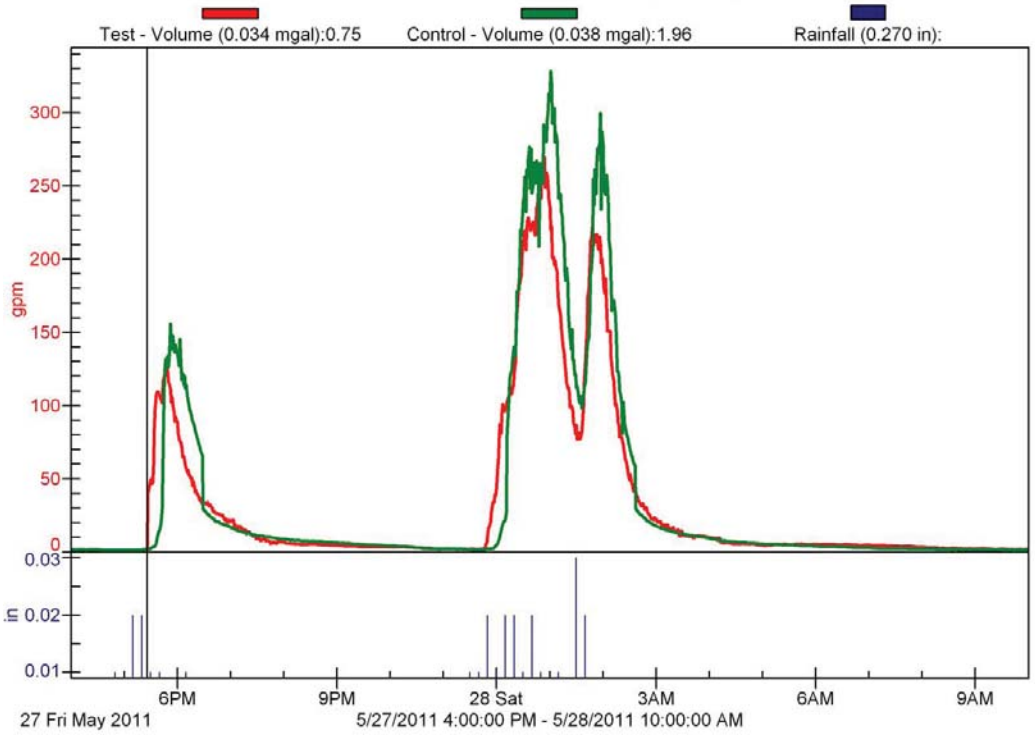
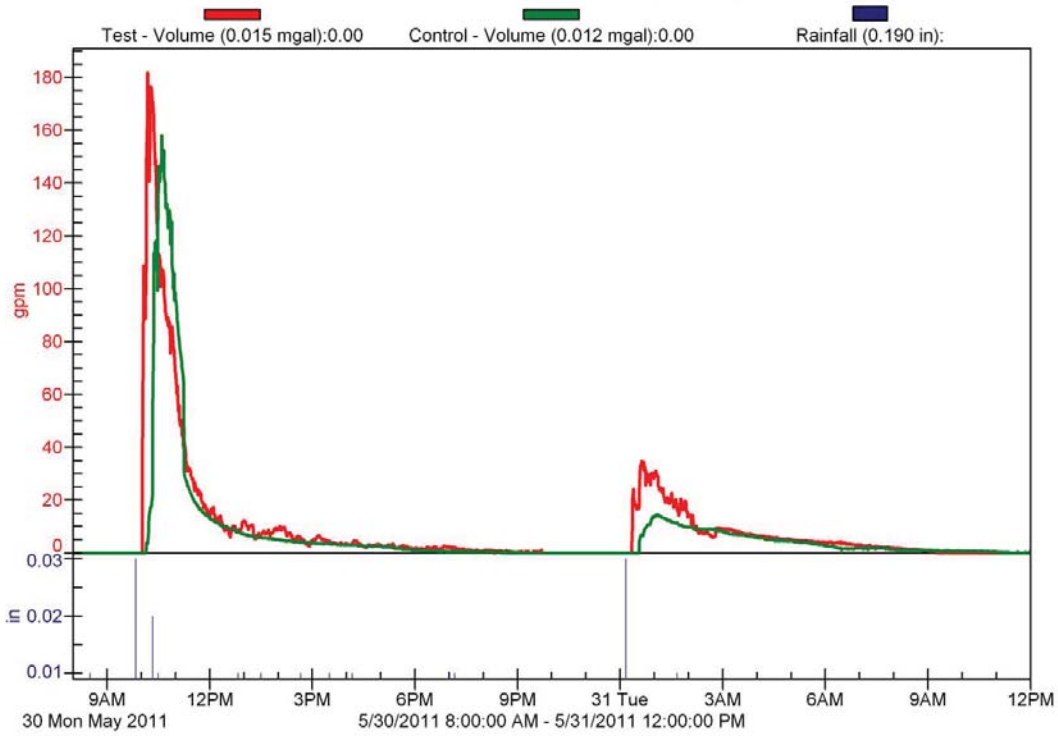
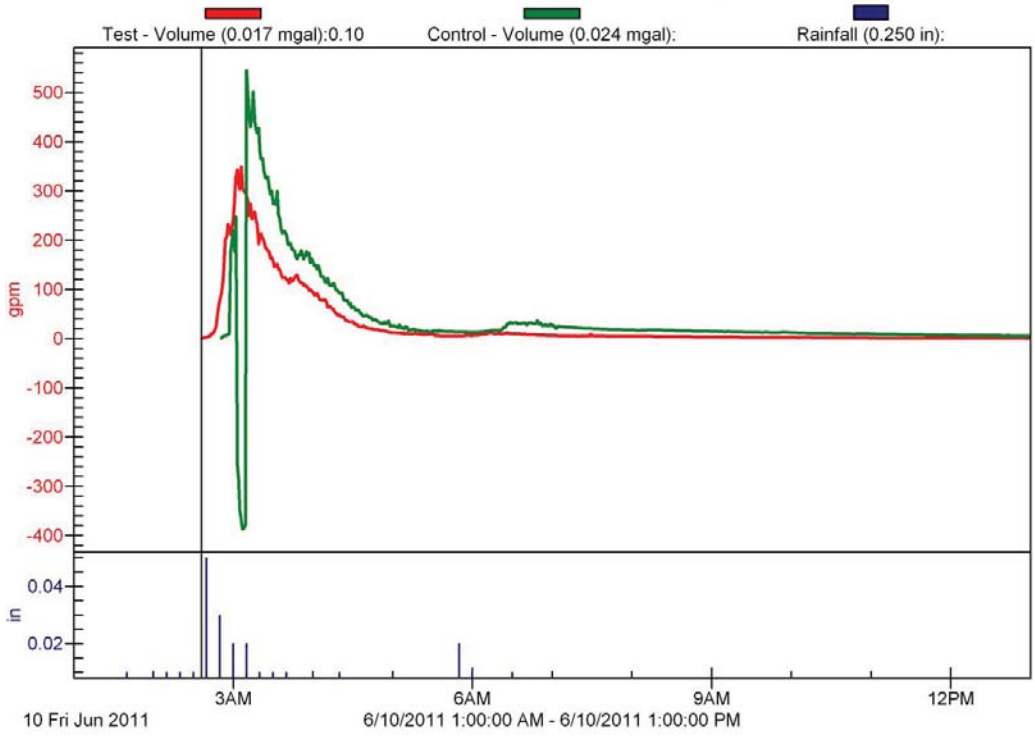


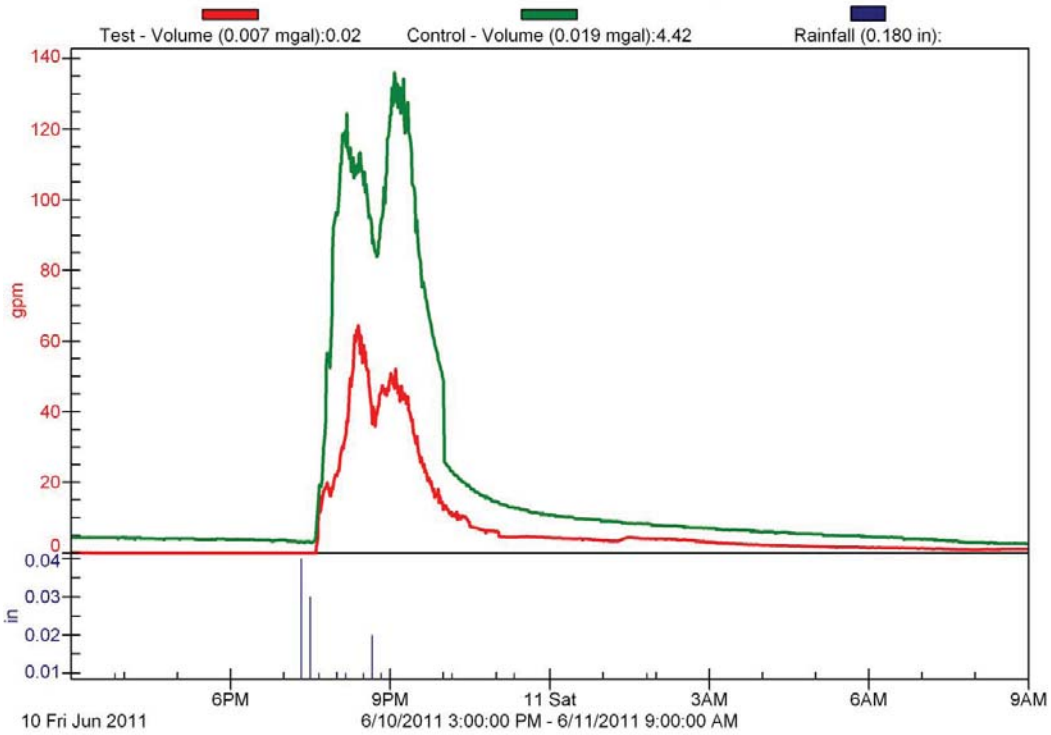
Post-Construction Rain Event - May 30-31, 2011



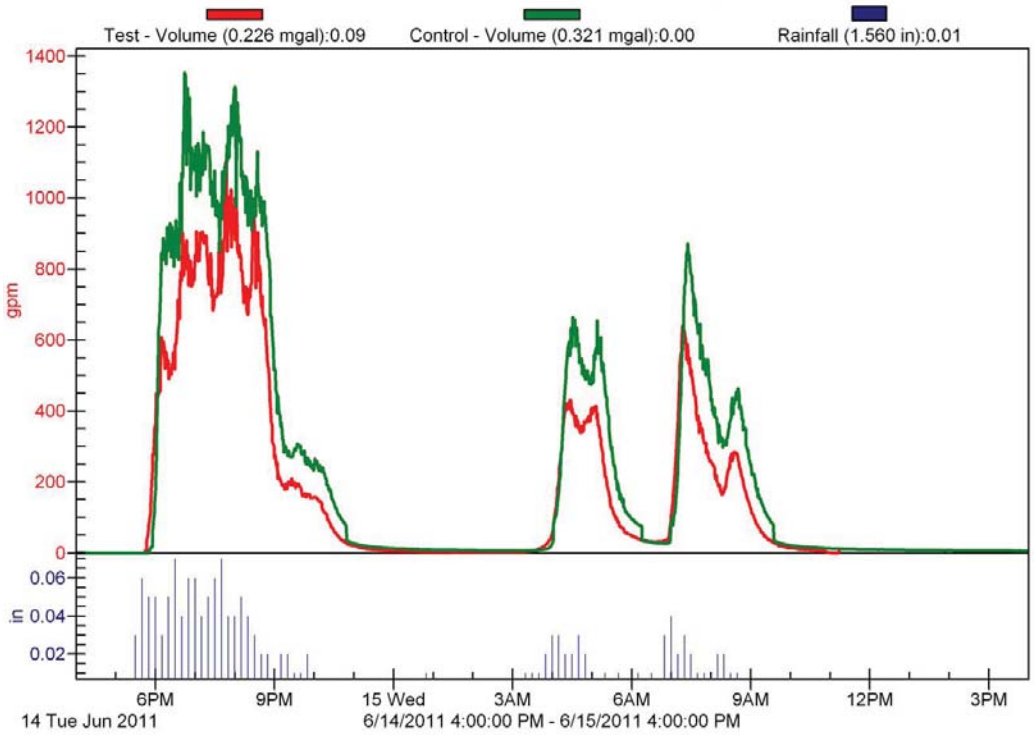
Post-Construction Rain Event - June 10, 2011



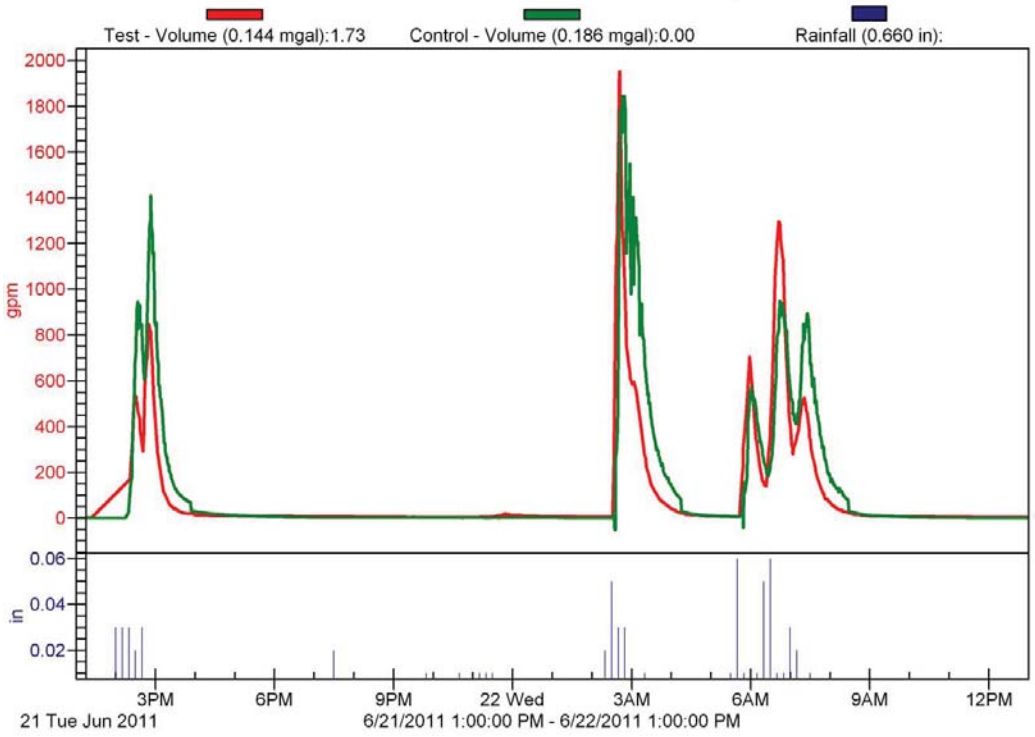
Post-Construction Rain Event - June 10, 2011



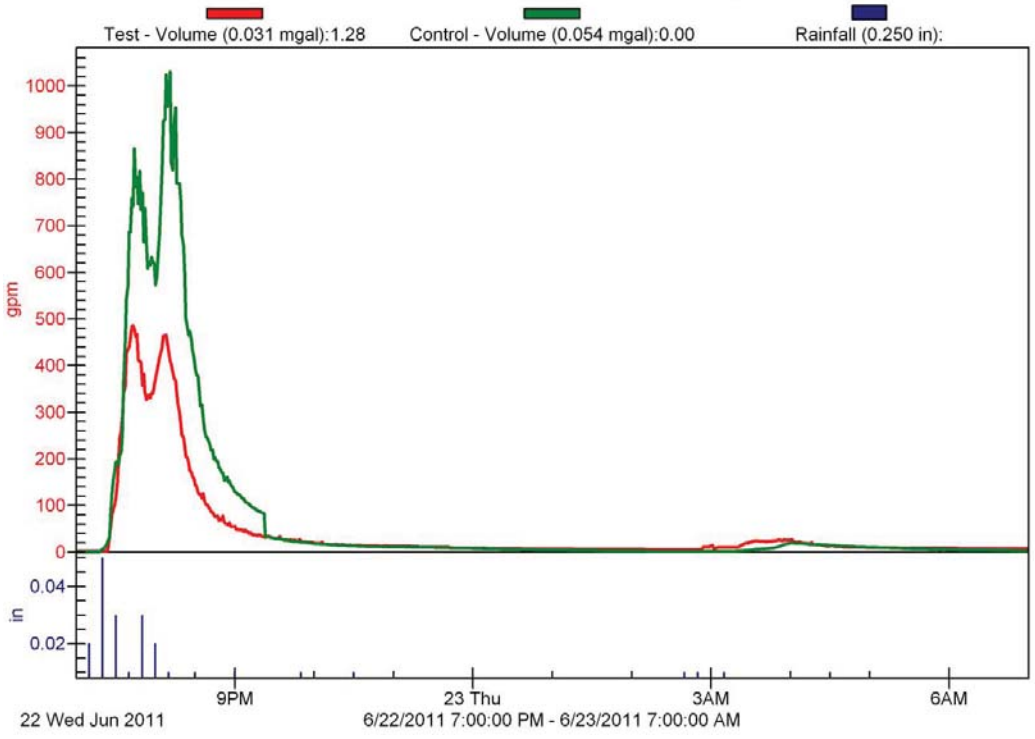
Post-Construction Rain Event - June 14, 2011



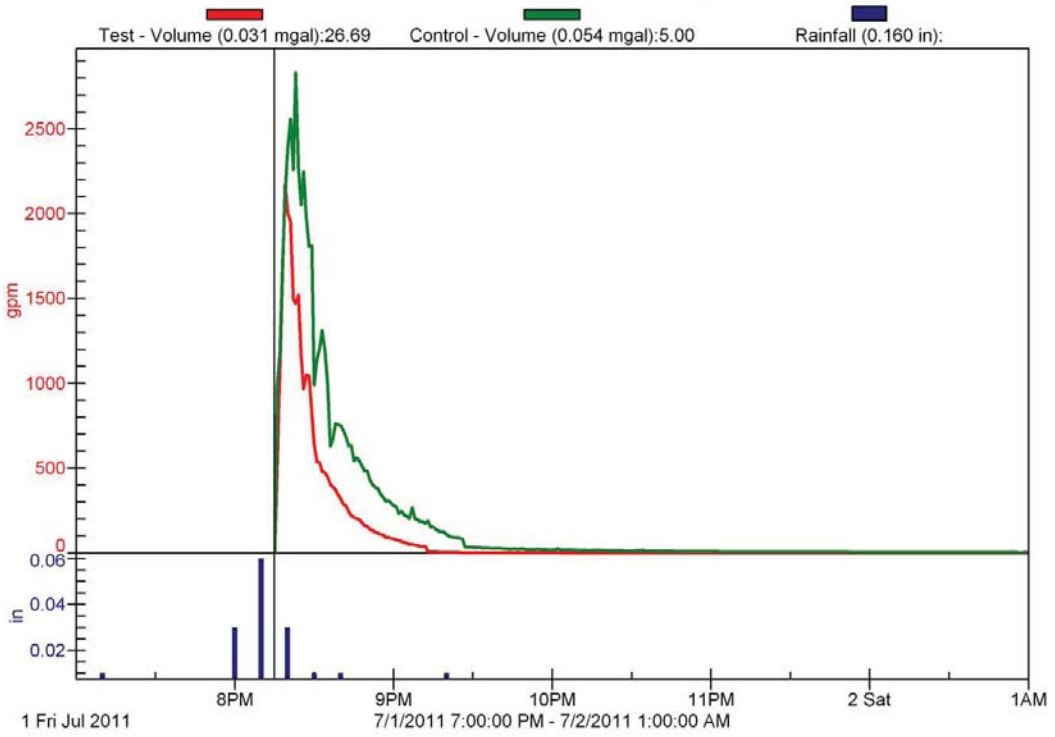
Post-Construction Rain Event - June 21-22, 2011



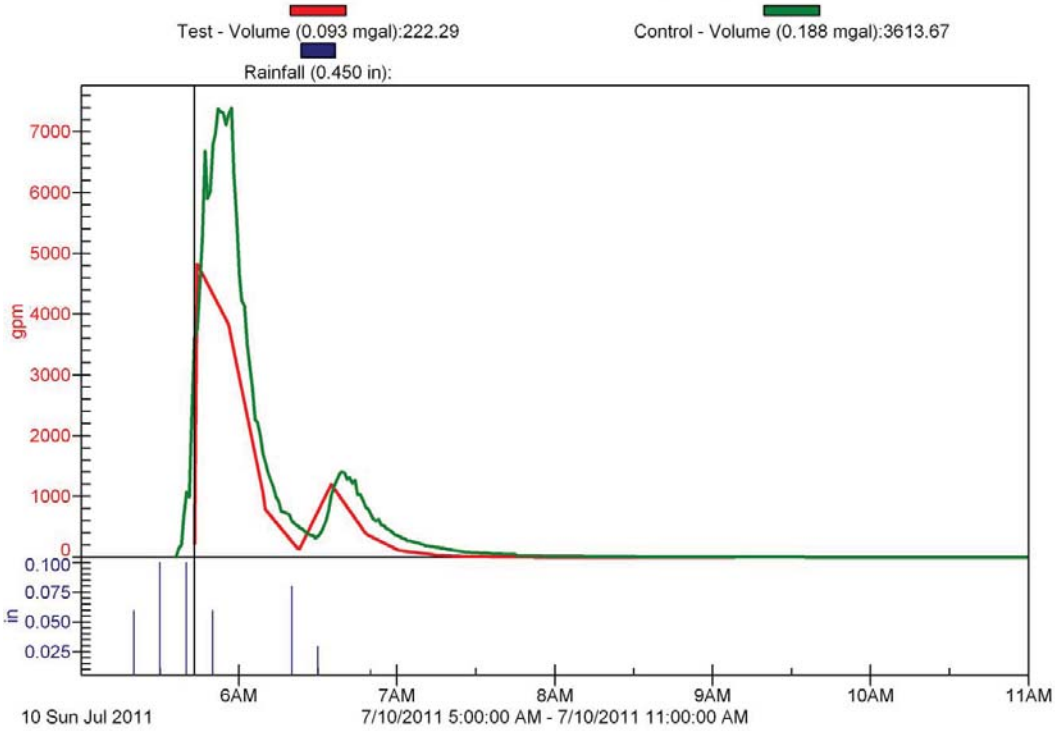
Post-Construction Rain Event - June 22-23, 2011



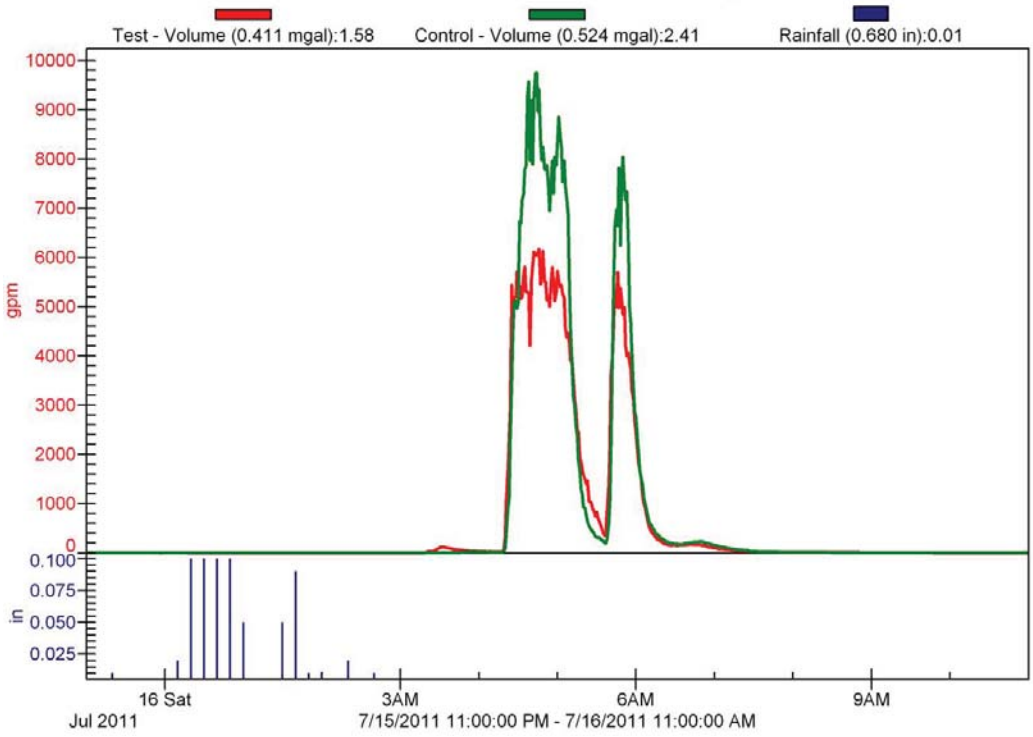
Post-Construction Rain Event - July 1, 2011



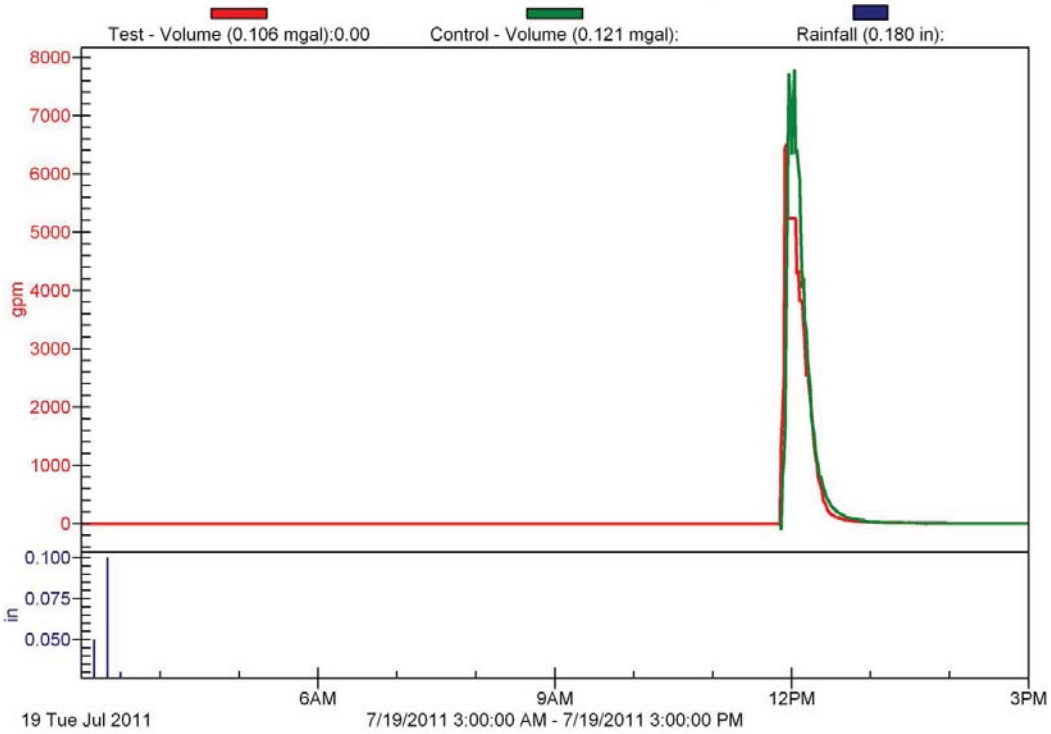
Post-Construction Rain Event - July 9-10, 2011



Post-Construction Rain Event - July 15-16, 2011



Post-Construction Rain Event - July 19, 2011



Appendix B

Sample Outreach Materials

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Powderhorn Neighborhood of Raingardens

The Story

During the summer of 2010 and spring of 2011, residents of the Powderhorn Park and Central Neighborhoods worked with Metro Blooms to install 130 raingardens as part of the Powderhorn Lake Neighborhood of Raingardens project.

The effort to improve water quality in urban lakes and waterways requires greater public awareness and adoption of environmentally responsible landscape design and management practices. This project engaged 122 property owners to install and maintain raingardens on their property, demonstrating that communities can directly impact local water quality by creating sound stormwater practices as shown here in Powderhorn.

The findings of this project can be applied to similar urban areas and provides a basis to target citizen-based involvement to improve our water bodies.

Where are the gardens?

The test area gardens, highlighted in green below, are located between Lake Street on the north, 32nd Street on the south, Portland Avenue to the west and 10th Avenue to the east. Please view the raingardens that are visible from the public sidewalk only.

What is a Raingarden?

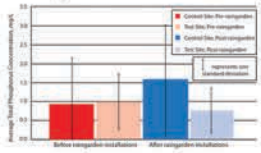
A raingarden is designed and planted to capture rainwater so it can infiltrate deep into the soil to help protect and restore water quality. This helps to reduce the amount of stormwater runoff that would otherwise take pollutants from the air, our yards, and the streets and carry them into our lakes, rivers, and wetlands.

Test and Control Site Watersheds

The project area is a set of properties that drain from a single storm sewer pipe into Powderhorn Lake. A paired watershed study was set up, requiring both a test and control area. The Minneapolis Park and Recreation Board installed monitoring equipment to measure the quality and quantity of stormwater from the test area pipe, comparing data from the pipe in the control area nearby. The project area with the newly installed raingardens and other Best Management Practices (BMPs) is the test area and the one without BMPs is the control area.

What are the measured results?

Monitoring in urban storm sewers has its challenges, and these sites and climatic conditions resulted in less samples than planned. While the paired watershed analysis results are inconclusive and do not show a statistically significant outcome, the few water quality samples collected in 2011 provide promise that the test neighborhood efforts could have reduced total phosphorus and total suspended solids loadings when compared to the control area.








The project was funded by the Minnesota Environment and Natural Resources Trust Fund, and project partners include Metro Blooms, Short Elliott Hendrickson Inc., the City of Minneapolis, Minneapolis Park and Recreation Board, Minnehaha Creek Watershed District, and the Conservation Corps of Minnesota & Iowa.

Build a neighborhood of Raingardens

Metro Blooms

Free Raingardens

Available to selected homeowners

Metro Blooms will install up to 150 rain gardens at addresses on the enclosed map. With funding provided by the Environment and Natural Resources Trust Fund, this project is a partnership of Metro Blooms, the City of Minneapolis, Minneapolis Park and Recreation Board and Minnehaha Creek Watershed District to determine whether raingardens can improve water quality in Powderhorn Lake.

What is a Raingarden?

A raingarden is a garden designed to catch water running off a rooftop, driveway, or other hard surface and to keep this water from running into the street where it will enter storm drains, polluting our lakes and streams.

What do I get?

- **An on-site consultation with a landscape design assistant**
- **A garden design customized for my yard**
- **Complete garden installation, including plants**

What do I have to do?

- **Attend a raingarden workshop**
- **Be at the property when the raingarden is installed**
- **Participate in the planting, as you are able**
- **Agree to maintain the raingarden for three years**

How do I get started?

Contact Corrie Zoll at corrie@metroblooms.org or call Corrie at 612-871-0740
More information at metroblooms.org

Join us for a Raingarden Party

Your property may be eligible for a complete raingarden installation - AT NO COST TO YOU.

Join Metro Blooms, the City of Minneapolis, Minneapolis Park and Recreation Board, and Minnehaha Creek Watershed District to reduce the pollution in Powderhorn Lake by installing 150 raingardens throughout our neighborhood.

Join us to learn more about the POWDERHORN NEIGHBORHOOD OF RAINGARDENS and how you can participate.

Funding provided by the Environment and Natural Resources Trust Fund

Host |

Date |

Time |

Place |

Construye un Jardin de Lluvias.

Restaura el Medio Ambiente.
Colabora con una "Minga".
Carlos Zhingre
612-819-5146

Metro Blooms metroblooms.org

Build a neighborhood of Raingardens

Metro Blooms

Construye un Jardin de Lluvias. Restaura el Medio Ambiente. Colabora con una "Minga."

Community Clean Up for Powderhorn Lake!

Just one pound of leaves in the street contains enough phosphorus to bloom ten pounds of algae in Powderhorn Lake.

Your neighbors together with Metro Blooms installed more than 100 raingardens this year. These raingardens are the first step to keep gunk out of Powderhorn Lake.

Help us take the next step. On Saturday, neighbors will clear leaves from curbs and boulevards.

Saturday, October 23
10:00 am to Noon
Meet at All God's Children
31st St. and Columbus

Bring leaf rakes. Welna Hardware donated leaf bags. Metro Blooms will have gloves.
For more information call 651-699-2426.

Metro Blooms
metroblooms.org

Funding provided by the Minnesota Environment and Natural Resources Trust Fund, City of Minneapolis, Minneapolis Park and Recreation Board, and Minnehaha Creek Watershed District

Join Us!
Powderhorn Lake
Metro Blooms
Community Clean Up

Restaura el Medio Ambiente. Colabora con una "Minga."

A NEIGHBORHOOD OF RAINGARDENS

The Film Society of Minneapolis/Saint Paul presents a film about a group of Minnesotans who are cleaning up our troubled waters, one yard a time.

September 9, 2011 7:00 P.M.
Saint Anthony Main Theater

Build a Neighborhood of Raingardens

Construye un Jardin de Lluvias.
Restaura el Medio Ambiente.
Colabora con una Minga.

Metro Blooms

Join Metro Blooms,
City of Minneapolis, Minneapolis Park and Recreation Board, and Minnehaha Creek Watershed District as we embark on a mission to reduce the pollution in Powderhorn Lake by installing raingardens throughout your neighborhood.

If you are interested in joining us to build a raingarden on your property the first step is to attend an informational workshop to learn more about the benefits and beauty of raingardens, and how you can participate.

These workshops are free for Powderhorn and Central Neighborhood residents only.

To register please call 651-699-2426, or email info@metroblooms.org.
Be sure to include your name and contact information and bring your neighbor!

Mon | July 13 | 6:30 - 8pm
Powderhorn Neighborhood Association
821 E 35th St Minneapolis

Tues | July 14 | 6:30 - 8pm
Artstop
Corner of 32nd St. and Chicago Ave Minneapolis

Major funding for this project provided by the Environment and Natural Resources Trust Fund

Construye un Jardin de Lluvias. Restaura el Medio Ambiente. Colabora con una Minga.

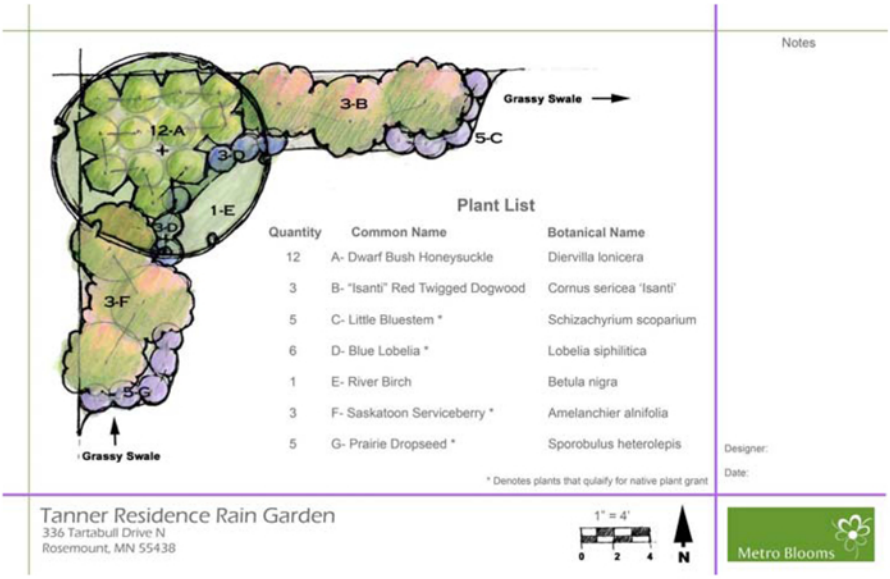
Carlos Zhingre, zhin0001@umn.edu, 612-819-5146

ONSITE CONSULTATION AND DESIGN
NEIGHBORHOOD OF RAINGARDENS FOR POWDERHORN LAKE

Join Metro Blooms, the City of Minneapolis, Minneapolis Park and Recreation Board, and Minnehaha Creek Watershed District as we embark on a mission to reduce the pollution in Powderhorn Lake

If you are interested in joining us to build a raingarden on your property **the first step is to attend an informational workshop to learn more about the benefits and beauty of raingardens, and how you can participate.**

These workshops (or raingarden parties) are free for Powderhorn and Central Neighborhood residents only. The onsite consultation and raingarden design assistance are available for priority properties as part of a paired-watershed study to determine the impact residential raingardens will have on the water quality of Powderhorn Lake.



The next step is to sign up for an Onsite Consultation: A Metro Blooms Landscape Design Assistant will come to your home for one hour to help take measurements, size and site your raingarden, give advice on native plants and downspout redirection, and address any other stormwater problems you might have before installing a raingarden. These consultations are meant strictly for advice on your landscaping plans and not for manual labor (i.e. digging holes, installation or construction).

Your Landscape Design Assistant will take the information you discuss at your onsite consultation and will create an sketch of your stormwater management plan and raingarden design (see raingarden design example above) with specifications and plant list.

Following your onsite raingarden consultation, your design will be emailed (or mailed) to you.

You will be notified by October 31st if your property has been selected as one of 150 raingardens scheduled for installation beginning the spring of 2010.

Even if you're not selected for installation assistance, we encourage you to consider implementing the recommendations you receive at the onsite consultation and in your stormwater management plan. We will be in your neighborhood for the next couple of years and available to answer questions and provide other assistance, whenever possible.

Construye un Jardin de Lluvias. Restaura el Medio Ambiente. Colabora con una Minga. Carlos Zhingre, | 612-819-5146 | zhin0001@umn.edu

Major funding for this project is provided by the Environment and Natural Resources Trust Fund

Onsite Consultation and Raingarden Design Assistance Waiver Form

My **Onsite Consultation** has been scheduled for _____(date),_____(time)
with:

_____ (LDA assigned).

I understand that I am receiving advice from Landscape Design Assistants from the Metro Blooms Program regarding the possible installation of a raingarden on my property and other stormwater management plans. I understand that these are recommendations only and that Metro Blooms does not warrant that the advice given to me will not result in damage to my -property. I agree that it is solely my decision as to whether or not to implement the recommendations provided and that I am waiving any claim for damages which may result from following the recommendations. Further, I understand that Metro Blooms is not responsible and does not warrant outcomes or plans that result from any possible future services provided independently by a Landscape Design Assistant to me on my property. Lastly, I understand that if I am not present at the scheduled time of my onsite consultation, my participation in the program will be forfeited.

Print Name (Property Owner)_____Date_____

Signature (Property Owner)_____Date _____

Phone _____Email Address _____

Street Address where raingarden will be installed _____

City, State, Zip _____

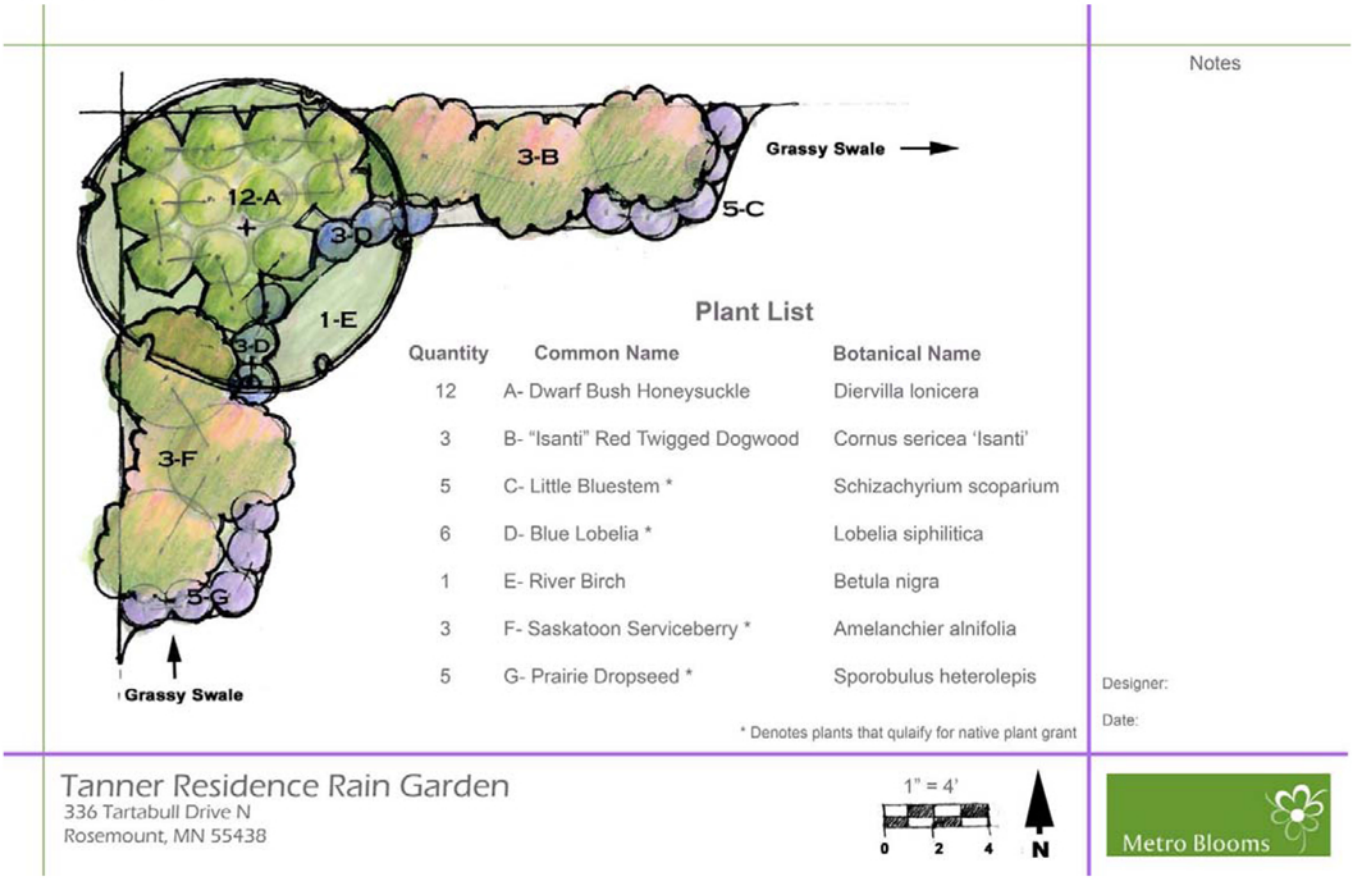
Mail completed form to:

Metro Blooms,
attn: Neighborhood of Raingardens
P.O. Box 17099,
Minneapolis, MN 55417

BARRIO DE JARDIN DE LLUVIAS Y DISEÑO EN SU PROPIEDAD PARA EL LAGO POWDERHORN

Únete a Metro Blooms, la ciudad de Minneapolis, la Junta de Parques y Recreación de Minneapolis y el Distrito de la Cuenca del Minnehaha Creek en un esfuerzo comunitario, cuya misión es reducir la contaminación en el lago Powderhorn. Si usted está interesado en unirse a esta causa y así juntos construir un jardín de lluvia en su propiedad; **el primer paso será asistir a unos talleres informales. En ellos aprenderá más sobre los beneficios y la belleza de estos jardines, y sobre todo cómo usted puede participar.**

Estos talleres (o fiestas de jardín de lluvias) son gratuitos para los residentes que viven en el Barrio Central y en el área de Powderhorn. Habrá asistencia disponible gratuita en su propiedad para consulta y diseño; siendo estas una prioridad como parte de un estudio de las cuencas hidrográficas-vinculados a determinar el impacto residencial de los jardines de lluvia que tendrá sobre la calidad del agua del Lago Powderhorn.



El siguiente paso es inscribirse para una consulta gratuita en su sitio: Un Asistente de Diseño o Paisajista de Metro Blooms vendrá a su casa durante una hora para ayudar a tomar medidas, determinar el tamaño y el sitio de su jardín, dar asesoramiento sobre las plantas nativas a usar, reubicar los canalones , y sobre todo verificar si existe algunos problemas pluviales que pueda tener antes de instalar su jardín de lluvias.

Estas consultas son exclusivamente para su asesoramiento en jardinería y no para la mano de obra (es decir, cavar agujeros o para la instalación o construcción).
Su Asistente de Diseño o Paisajista tomara la información junto con usted de su sitio y creara un esbozo de

su plan de gestión de aguas pluviales y un diseño de su jardín de lluvias(véase el ejemplo anterior del diseño de un jardín de lluvias) con las especificaciones y lista de plantas.

Tras la consulta in su sitio, su diseño será enviado por correo electrónico (o correo normal) para usted. **Usted será notificado el 31 de octubre, si su propiedad ha sido seleccionada para ser parte de la instalación de 150 jardines de lluvia prevista para el comienzo de la primavera del 2010.**
Incluso si no es seleccionado para asistirle en la instalación, le animamos a que considere e implemente las recomendaciones que usted recibió en la consulta hecha en su propiedad y en su plan de gestión de aguas pluviales. Vamos a estar en su vecindario los próximos par de años y estaremos disponibles para contestarle preguntas y proporcionar otro tipo de asistencia, siempre que sea posible.

Construye un Jardín de Lluvias. Restaura el Medio Ambiente. Colabora con una Minga.
Si tiene preguntas contacte a Carlos Zhingre,| 612-819-5146 | zhin0001@umn.edu
Este proyecto es posible gracias al Fondo del Ambiente de Recursos Naturales

Formulario de Consentimiento para Consulta en su sitio para el Diseño del Jardín de Lluvias
La Consulta para Asistencia se ha previsto para_____ (fecha), _____(tiempo) con:
_____ (Paisajista asignado).

Yo entiendo que estoy recibiendo el asesoramiento de Asistentes de Diseño Paisajistas del Programa de Metro Blooms con respecto a la posible instalación de un jardín de lluvias en mi propiedad y otros planes de gestión de aguas pluviales. Entiendo que estos son sólo recomendaciones y por tanto Metro Blooms no se garantiza que las recomendaciones dadas a mí no causen daños a mi propiedad. Estoy de acuerdo en que es únicamente mi decisión de aplicar o no las recomendaciones dadas, y que estoy renunciando a cualquier reclamación por daños y perjuicios que puedan provenir de las siguientes recomendaciones. Además, entiendo que Metro Blooms no se responsabiliza y no garantiza los resultados de quizás futuros planes que se obtengan de cualquier futuro servicio prestado por Paisajistas de Diseño Independientes en mi propiedad. Por último, entiendo que si no estoy presente a la hora prevista para consulta en mi sitio, mi participación en el programa no será considerado.

Nombre (Propietario)_____ Fecha_____
Firma (Propietario)_____Fecha_____
Teléfono_____ Correo electrónico_____
Domicilio donde se instalará el jardín de lluvias_____
Ciudad, Estado, Código Postal_____

Envie su formulario completo a:

Metro Blooms,
Atención: Barrio de Raingardens
Casilla Postal 17099
Minneapolis, MN 55417

Powderhorn Neighborhood of Raingardens

Construye un Jardin de Lluvias. Restaura el Medio Ambiente. Colabora con una "Minga."

FREE! RAINGARDENS TO ELIGIBLE PROPERTIES

Sign Up Now!

Metro Blooms is working in partnership with the City of Minneapolis, Minneapolis Park and Recreation Board, Minnehaha Creek Watershed District, and with funding from the Environment and Natural Resources Trust Fund.

Metro Blooms

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Weeding

Plants compete with each other for nutrients, light, water, and space. Weeds, when given a chance, almost always win. The easiest thing to do to keep weeds out is to maintain a thick layer of mulch and perform light weeding periodically.

Weeding becomes less demanding as the garden matures. A newly planted garden will need to be weeded often throughout the season, but once established the plants will naturally suppress weed growth. If unruly weeds continually sprout up in the garden, take time to discover their source.

Perennial Plants

Most raingarden plants are perennials that come back year after year. Though hardy, they need a little attention to keep looking their best.

Remove declining flowers from perennials to encourage more flowers and a longer bloom time. This may also help the plants appear tidier. However, towards the end of the season, you may wish to leave seedheads on the plants for winter interest.

To make plants bushier and more compact, pinch young stems back a couple of inches to just above a bud or leaf. You can pinch back a third of the plant at a time to extend the blooming time as well.

Some plants will benefit from more aggressive pruning if they are starting to outgrow their spot. Prune plants after they bloom to reshape the plant and give time for new flower buds to form for next year's blooms.

Robust perennials may outgrow their original planting areas and become crowded. You may need to remove or divide plants. This is best done in the spring before the plant is four inches tall, or after the plant has flowered. To divide them, dig up the entire plant and cut them into sections so that each has roots attached and replant them. If you have extras, share them with a friend or neighbor!

Metro Blooms

www.metroblooms.org
P.O. Box 17099 • Minneapolis, MN • 55417
651-699-2426

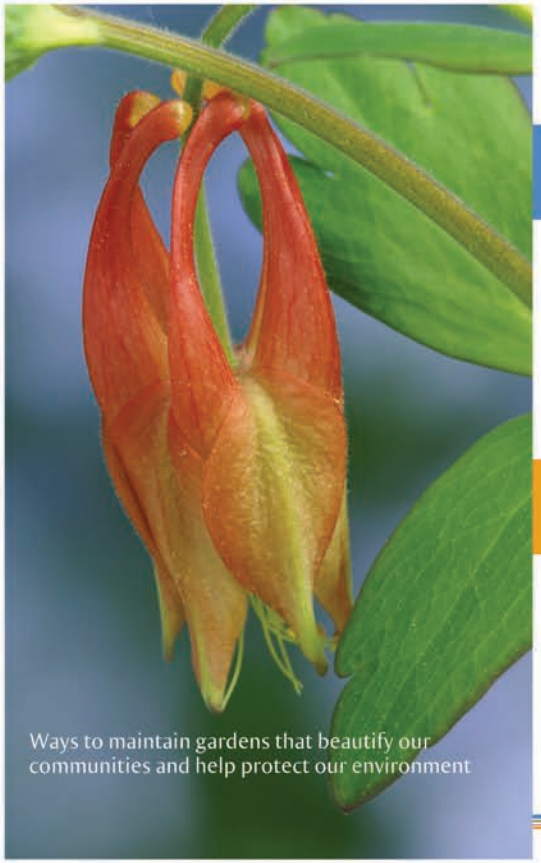
The design and printing of this brochure was made possible with the support of the Environment and Natural Resources Trust Fund and the City of Minneapolis.

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

Minneapolis City of Lakes

Metro Blooms

A Raingarden Maintenance Guide



Ways to maintain gardens that beautify our communities and help protect our environment

Maintaining a Raingarden

Congratulations on installing your new raingarden! The following maintenance guidelines and gardening tips will help you to keep your raingarden looking great year after year.

Raingardens are essentially perennial gardens that also work to protect water quality in our lakes and rivers. With the proper amount of water and regular maintenance, no additional fertilizers or herbicides should be needed; further reducing chemical pollutants in the environment.

As with perennial gardens, there are a few basic tasks that will keep your raingarden looking great. Regular ongoing maintenance will be easier to tackle than waiting until weeds are out of control and perennials have overgrown their space.

Watering

In their first year, young plants need one inch of water per week. Water about twice a week for the first month to help their roots get established. Additional watering may be needed during dry, hot days. As plants mature over the years, they should need less water, though they will benefit from supplemental watering during dry periods. Keep watering into the fall to ensure that plants stay healthy over the winter.

Mulch

Maintaining a 3" layer of double shredded hardwood mulch in your garden is the best defense against weeds. Mulch greatly reduces the germination rate of new weeds and helps the soil stay moist during dry spells. Mulch biodegrades over time, gradually thinning out. To maintain these benefits, apply additional mulch every spring. Keep mulch away from the base of trees and shrubs to protect them from disease and rot.

Spring

Mulch

Start the year off great and apply new mulch in areas that are thin to maintain a 2" layer across the garden. This will help to deter weed growth and hold in moisture.

Cut Last Year's Growth

Remove last year's growth in the spring before new growth emerges to ensure vigorous and uninhibited growth. All removed material may be composted.

Inspection

Prior to the growing season, check all drainage ways (downspouts, underground pipes, and grates) and make sure they are unobstructed and allow water to easily enter the garden basin. Inspect your berm or overflow device to ensure that frost heaving or winter damage has not occurred. Remove any trash, sediment, or excess leaves that may have accumulated in the garden.

Pull Weeds

Cool-season weeds (dandelions, thistle) sprout and set seed by Memorial Day (on a year with normal Spring temperatures). It is imperative that they are pulled prior to setting seed. The longer they persist, the more established the weed population will become. Avoid using herbicides to remove weeds as this often results in harm to desirable garden plants and is detrimental to beneficial insects.

Summer

Pull Weeds

Pull all warm-season weeds (crab grass, creeping charlie, foxtail) and volunteer trees (ash, elm, hackberry, boxelder, buckthorn) prior to the Fourth of July. Monitor weed emergence throughout the growing season and pull as necessary.

Inspection

After large rain events, make sure the garden is draining in less than 24 hours. Always inspect for signs of erosion throughout the season. If erosion occurs, re-grade the eroded area and replant with a clump-forming grass or sedge, such as Side-Oats Grama, 'Karl Foerster' Feather Reed Grass, or Bebb's Oval Sedge. If the erosion continues, place large cobblestones or boulders in the eroded area. This will minimize the incoming water's energy. Pay close attention to the side-slopes of the garden as these areas are susceptible to erosion and may be too steep.

Water

In times of drought, give your garden a drink. This is especially important during the first two years of the garden's life, when plants are establishing their root systems.

Take pictures

Please remember to document your garden and its progress. Send us your pictures and maybe you will become famous!

Fall

Inspection

Check to see if all original plant species are still present in the garden. Fall is a good time to plant replacements or any additional species. Remove leaves from drainage ways to ensure free flow of water into the garden. If a specific plant continually shows poor performance, fall is a good time to re-evaluate its placement and potentially move it. Consider shade/sun tolerance and soil moisture (too wet or too dry) as the main factors of poor performance.

Clean up

Remove excess leaves. A small layer (less than 2") of leaves may be beneficial to the garden as a source of nutrients and will often break down by next year's growing season. Trim shrubs and trees during cool periods of late fall.

Mulch

Add mulch to maintain a 3" depth if necessary.

Perennial Division

Divide any large or overgrown perennials to plant elsewhere in the yard. These plants can be excellent gifts for neighbors and friends.

Deadheading

Leave all non-diseased plant material in the garden over the winter. This provides food and habitat for many species of birds and small mammals. Also, leaving your plants up for the winter can provide winter interest and create scenic value.

Winter

Snow Removal

Do not plow or shovel snow into your rain garden. Excess snowpack on your garden can compact the soil and minimize its infiltration capacity. Mark the boundaries of your garden to ensure that snow plows and shovels don't cause damage. Keep de-icing salt from sidewalks and roads out of the rain garden area. Excessive accumulation of salt in the rain garden can be toxic to your plants.

Next year's plans

Plan your next rain garden installation. Use your available time in the winter to dream up new garden possibilities. Review photos of your raingarden to see if there are any bare spots or plants that have overgrown their space and plan for new plants or dividing existing ones.

Equipment Maintenance

Clean and repair garden tools so that they are in great shape to be put to use in the springtime.

Appendix C

Project Forms and Documentation

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Green Team / Teen Teamworks

http://www.minneapolisparks.org/default.asp?PageID=1168&SearchID=383735

June 2012

The Minneapolis Park and Recreation Board is making great strides in developing management practices that promote “green” thinking. These practices have become an important factor in its summer youth employment program Teen Teamworks.

Teen Teamworks mission is to partner with the community to provide fundamental education and skill building opportunities for youth, preparing them to become contributing members of our society. We provide a safe, structured and secure work experience where participants actively engage in learning and caring for the natural environment as part of the team. The specific goals for youth are to help them gain work skills focused on restoration and conservation of natural areas, education related to the environment with a focus on the Mississippi’s watershed and water quality, and exposure to green careers. Other goals are that Teen Teamwork youth will be the next generation of stewards for parks and natural resources and that they will pursue green careers; or if they are not directly in a green career, they will understand how in any job situation, they can still make decisions that positively impact the natural world.

Youth are part of place-based conservation crews working on local restoration and environmental stewardship projects connected to all park properties and improving the water quality of all its lakes and the Mississippi River. These projects include removal of invasive plant species, erosion control, restoration of native landscapes and shorelines, enhancing habitat for native pollinators, and care of storm water treatment sites. Youth learn about watersheds, storm water runoff, bio-engineering, native and invasive plants and insects, best practices related to urban forestry and more.

With an average of 320-350 youth working in Teen Teamworks each summer, they contribute greatly to the safety, maintenance and overall beauty of the Minneapolis Park and Recreation Board.

Best Management Assessment – Onsite Questionaire

Address: _____

General Property Questions

1. Land use	a. Residential b. Apartment c. Business	d. Park e. Open Space f. Other
2. Size of City Lot	a. Small (1 normal city lot) b. Medium (1-2 normal city lots) c. Large (More than 2 city lots)	_____size, if large (in blocks or lot #s)
3. Number/type of buildings _____#	a. House b. Detached garage c. Shed/out building d. Other	
4. Driveway type	a. Blacktop/asphalt b. Concrete c. Pavers d. Gravel e. Other	
5. Percentage of property that is impervious	_____% (estimate)	

General Property Maintenance Questions

6. Groundcover on property	a. Turf ____% b. Gardens _____% c. Native Plants _____% d. Other _____%	
7. Number of trees onsite	a. 0 b. 1-2	c. 3-4 d. 5+

General Stormwater Management Questions

8. Describe drainage patterns on site (use aerial photos to make notes, drawings –run-off destination).		
9. Is stormwater runoff being retained onsite?	Yes, if yes how: No, if no how could it be:	
10. Does the home have gutters and downspouts?	Yes	No
11. Are steep slopes present? (>12%)	Yes	No
12. Are there unvegetated/bare areas on site?	Yes	No
13. Are there issues related to soil erosion?	Yes	No

BMP Priorities On Site

14. Is the site suitable for the following:	a. Raingarden b. Rain barrel c. Native Vegetation planting d. French Drain/Dry Creek e. Pavement Reduction f. Permeable Pavers
15. Raingardens	a. New Easy Raingarden (Priority 1) b. Raingarden placed in existing bed (Priority 2) c. Raingarden in easy location, but overhead trees (Priority 3) d. Not easy, but will work Raingarden (Priority 4)
16. Rain barrels	a. Only a rain barrel can disconnect downspout (Priority 3) b. An extra rain barrel (Priority 4)
17. Native Vegetation Planting	a. Disconnect downspout, but raingarden will not work - Priority 2 b. Only native planting will work – Priority 3 c. Reduction to lawn is only benefit – Priority 4
18. Pavement Reduction	a. Convert pavement to a Raingarden – Priority 1 b. Convert pavement to another pervious system – Priority 2
19. Permeable Pavers	a. Place Grass Pavers – Priority 2 b. Patio – Priority 3 c. Driveway – Priority 4

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