Policy Recommendations for the Improved Implementation of Rain Gardens as a Storm Water Management Practice in Northfield, Minnesota

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I. Executive Summary

The city of Northfield, Minnesota is required by law and motivated by economic, social, and environmental benefits, to engage in sustainable stormwater management practices. Instead of relying on the traditional stormwater drainage system, many cities are now investing in green infrastructure, which aims to manage stormwater by retaining and treating stormwater at its source[1]. Green infrastructure includes many water retention methods, such as rain gardens. Rain gardens are made with a depression and filled with plants, allowing stormwater to collect and pollutants to be filtered out[2]. Northfield established a rain garden program in 2013 for the purposes of catching storm water runoff and preventing pollution of the Cannon River. However, this program is currently underutilized because the cost and effort required by a homeowner to install a rain garden is too great. To increase city-wide participation in this program, this report proposes a policy to require every street reconstruction project to involve a survey of affected homeowners and businesses about their interest in having a permanent rain garden installed in their boulevard. In order for this to be effective, the city also needs to undertake a greater public education action plan that will increase the participation rate in such installation projects. Advertising for Northfield's existing program must also continue to increase. These policies will lead to better water and air quality, aesthetically pleasing streets and community areas, and a decrease in maintenance costs for existing storm water systems.

[1] "Green Infrastructure." United States Environmental Protection Agency. https://www.epa.gov/green-infrastructure/what-green-infrastructure.

[2] Schmidt, Rusty, et al. *The Blue Thumb Guide to Raingardens: Design and Installation for Homeowners in the Upper Midwest*. Waterdrop Innovations, 2007.

II. Introduction

Storm water management has become a topic of concern in the broader discussion of climate change and its impacts on city operations. Stormwater is defined as "the proportion of precipitation or snowmelt that is not retained in the soil," and it is regulated on federal, state, and local levels[3]. As intense precipitation events increase and storm water continues to run through pipe systems out into rivers, not only are river ecosystems damaged due to pollutants in the storm water, but the storm sewer system is put under more pressure in order to prevent flooding[4]. This eventually wears down the pipes, costing the city money for repairs and potential flood damages[5]. An alternative to this is green infrastructure, which includes landscaping features and practices such as rain barrels, green roofs, permeable pavements, and rain gardens, among others. "While single-purpose gray stormwater infrastructure—conventional piped drainage and water treatment systems—is designed to move urban stormwater away from the built environment, green infrastructure reduces and treats stormwater at its source"[6]. Rain gardens are a particularly beneficial method for preventing runoff because they not only retain stormwater, filter out pollutants, and reduce the load on the storm drain system, but they also provide habitat space for pollinators and beautiful community spaces, improve air quality, and can add value to a home.

While storm water is being increasingly regulated, and innovative methods for management have been implemented, there is still need for further action, with most populations not understanding the significance of this issue, and local governments frequently underutilizing whatever management practices are in place. Northfield, Minnesota is one such municipality in

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[3] Tryhorn, Lee. "Improving Policy for Stormwater Management: Implications for Climate Change Adaptation." *Weather, Climate, and Society*, vol. 2, no. 2, 2010, pp. 113–126., doi:10.1175/2009wcas1015.1.
[4] Tryhorn, 2010
[5] United States. *Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure*, Environmental Protection Agency, 2010, pp. 1–70.
[6] "Green Infrastructure." United States Environmental Protection Agency https://www.epa.gov/green-infrastructure/what-green-infrastructure.

which problems continue to exist and the urgency of the issue continues to go unnoticed by the public.

This report makes policy recommendations for the city of Northfield's rain garden program, which has seen some success, but has the potential to accomplish much more. Options for Northfield that will help increase the number of rain gardens installed in the city include the collaboration of construction companies in implementing rain gardens during road side renovations, and increased advertising and public education for the existing rain garden program. In order to enact this, surveying homeowners about boulevard rain garden installation needs to become a default in street reconstruction planning. This practice needs to be applied to all municipal construction projects. Other suggested actions include increasing public outreach and participation by making rain gardens, and information pertinent to them, more easily accessible and visible to the average resident.

To understand the scope of this problem and why policy reform is needed, this report aims to first expand on the problems storm water runoff imposes on cities, and define the environmental, social, and economic benefits that can arise from incorporating green infrastructure, particularly rain gardens, into city planning. A discussion will follow on the management practices Northfield has already put in place, through their own rain garden program and their partnership with other outreach organizations. Northfield's policies will then be examined in the context of other cities' policies, and actions likely to yield the most significant impact will be identified. Concrete policy recommendations will be laid out. The goal of this report is thus to make a convincing case for a more active implementation of rain gardens in Northfield city policy.

III. Importance of Rain Gardens

Rain gardens are depressions in the ground filled with plants that can withstand being flooded, and are designed to catch rain water and let it soak back into the ground[7]. They can be designed in many unique ways and contain various features such as retaining walls and edging[8]. Rain gardens are an important part of managing stormwater runoff in cities and preventing the pollution of rivers with pesticides and excess nutrients. According to the EPA, storm water runoff is the number one threat to water quality in rivers and lakes.[9] It is becoming more commonplace for municipalities to encourage measures of storm water management, or for pollution control agencies to require such action by permit[10].

A. Problems with storm water runoff

1. Environmental Concerns

Due to the increase of impervious surfaces in cities, rainwater is frequently unable to soak into the ground and instead enters the storm drainage system and is emptied into rivers and streams. These drainage systems exist to move water out of streets and prevent flooding. They are therefore required by municipalities as a human safety measure. They also transport pollutants and nutrients with the stormwater into the rivers. This happens because rainwater comes into contact with pesticides, oil, gas, pet waste, and other pollutants, from touching roofs, lawns, driveways, and streets on its way to the storm drain and eventually the river[11]. A 1,500 square-foot home can produce over 5,000 gallons of runoff per one inch of rain[12]. Storm water lowers water quality by adding pollutants such as oil, metals, and ammonia, to the river, and it

[7] Schmidt, Rusty, et al., 2007.
[8] Schmidt, Rusty, et al., 2007.
[9] Schmidt, Rusty, et al., 2007.
[10] EPA, 2010.
[11] Schmidt, Rusty, et al., 2007
[12] Schmidt, Rusty, et al., 2007

also carries excess nutrients which can lead to soaring populations of microorganisms[13]. Phosphorus, for example, is a common nutrient in storm water that leads to mass production of algae. When excess phosphorus ends up in the river, "the potential for algal blooms also increases which results in oxygen depletion and accelerated sediment filling of lakes when the algae die".[14] Rivers already face degradation from erosion and sediment input, also carried in by storm water from industrial activity. Storm water runoff can even disrupt regular water flow cycles and endanger existing microorganisms that depend on a stable water flow.[15] Rain gardens, as a method for managing storm water runoff and reducing these impacts, should be a widely utilized tool.

2. Social Repercussions

Polluted waters and rivers filled in with sediment or covered in algae are not attractive to the public. The water quality of the Cannon River is thus important for attracting people to the downtown or even getting them to live in Northfield. The Cannon River Watershed is currently listed by the Minnesota Pollution Control Agency as containing many impaired lakes, streams, and stretches of river[16]. With the Cannon River right at the center of downtown, it is in the best interest of the City of Northfield to maintain it. Not effectively managing storm water runoff also poses a threat to human health and city infrastructure, as traditional storm drainage systems cannot withstand the increased volume of water from intense precipitation events, therefore increasing the likelihood of flooding events[17].

3. Economic Challenges

[13] West, Mary, et al. *Industrial Stormwater Best Management Practices Guidebook*. Minnesota Pollution Control Agency, 2015.
[14] West, et al., 2015.
[15] West, et al., 2015
[16] "Minnesota's Impaired Waters List." Minnesota Pollution Control Agency https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list.
[17] Denzin, Brent. *Local Water Policy Innovation: A Road Map for Community Based Stormwater Solutions*. American Rivers, Midwest Environmental Advocates, 2008.

Stormwater runoff has economic consequences as well. Increased water load wears down traditional stormwater infrastructure, causing money to be spent on more frequent repairs. Pipes often need to be replaced and overflow is becoming a more frequent problem. Most of the money collected from Northfield residents through Northfield's Stormwater Utility Fee is spent on maintenance of the storm drainage system[18]. By failing to address issues of storm water management, the city of Northfield has lost and can continue to lose money from its Stormwater Utility Fund. By depending on traditional storm sewer systems to handle rainwater, Northfield is also at risk for experiencing more frequent flooding, which can cause major damage to buildings and roads. Flooding decreases business and increases repair costs. Northfield experienced severe flooding in September of 2016, during which Minnesota Governor Mark Dayton requested "Individual Assistance for four counties, Public Assistance for nine counties and Hazard Mitigation statewide," with requested statewide assistance totaling over $18,000,000[19]. Rice County received public assistance through this process, and the state of Minnesota was declared as major disaster area by President Obama[20]. A few rain gardens cannot necessarily prevent such large-scale flooding, but they can mitigate effects of flooding, such as basement flooding and yard ponding, that often cause property damage to residents.

Northfield is classified as a small Municipal Separate Storm Sewer System (MS4) city and must comply with the Minnesota Pollution Control Agency (MPCA) permit regulating storm water runoff[21]. Under threat of heavy fines, every MS4 city must work towards six minimum

[18] Johnson, Cole. May 22, 2018.

[19] "Minnesota — Severe Storms and Flooding." 2016. https://www.fema.gov/media-library-data/1484059995312-609b845de2e0e6c1b9020bd51ce6dbf0/PDAReportFEMA-4290-DR-MN.pdfhttps://www.fema.gov/media-library-data/1484059995312-609b845de2e0e6c1b9020bd51ce6dbf0/PDAReportFEMA-4290-DR-MN.pdf.

[20] "Minnesota — Severe Storms and Flooding." 2016.

[21] "General Permit Authorization to Discharge Stormwater Associated with Small Municipal Separate Storm Sewer Systems under the National Pollutant Discharge Elminitation System/State Disposal System Permit Program." edited by Minnesota Pollution Control Agency, vol. MNR040000, 2013.

control measures for best management. These include "public outreach and education, public participation and involvement, illicit discharge detection and elimination, construction site storm water runoff control, post construction storm water management, and pollution prevention and good housekeeping in municipal operations".[22] The city of Northfield was fined $16,920 in 2016 for failing to comply with storm water management policies under their permit from the MPCA[23]. While this particular fine was largely the result of lack of storm water management for the duration of large scale construction projects--which cannot be addressed with rain gardens--it does highlight the financial importance of successfully managing stormwater runoff[24]. The MS4 permit also requires public outreach and education, as well as pollution prevention in municipal operations. The latter was, in fact, a regulated area the city was found to have violated in 2016, and both are areas that rain gardens *can* address[25].

B. Opportunities for Growth Provided by Rain Gardens

Besides serving as a preventative measure for problems such as water pollution and pipe replacements, rain gardens can provide opportunities for positive growth in the future. Rain gardens provide opportunity for restoring ground water by retaining runoff and recycling the water into the ground. A study done by the city of Burnsville in 2006 demonstrated that rain

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https://www.ci.northfield.mn.us/DocumentCenter/View/1262/MPCA-General-Permithttps://www.ci.northfield.mn.us/DocumentCenter/View/1262/MPCA-General-Permit.

[22] "General Permit Authorization to Discharge Stormwater Associated with Small Municipal Separate Storm Sewer Systems under the National Pollutant Discharge Elminitation System/State Disposal System Permit Program.", 2013

[23] "MPCA Completes 22 Enforcement Cases in First Quarter of 2016." Minnesota Pollution Control Agency, May 2, 2016. https://www.pca.state.mn.us/news/mpca-completes-22-enforcement-cases-first-quarter-2016https://www.pca.state.mn.us/news/mpca-completes-22-enforcement-cases-first-quarter-2016.

[24] Landgraf, Cole. "MPCA Stormwater Audit." February 6, 2015. general editor, Minnesota Pollution Control Agency, file:///Users/labuser/Downloads/1%20-%202014%20MPCA%20StormwaterAudit.PDFfile:///Users/labuser/Downloads/1%20-%202014%20MPCA%20StormwaterAudit.PDF.

[25] "MPCA Stormwater Audit.", 2015.

gardens can have a 90% reduction of runoff going into the storm drain[26]. Instead, microbes in the soil and roots are able to filter out pollutants in the water, improving water quality. Rain gardens also create a space for pollinators by featuring native plants[27]. They reduce grass space in yards and public areas, therefore decreasing the need for mowing on residential and city property. This can remove an additional maintenance cost for the city, and has the additional benefit of improving air quality[28]. Rain gardens have a positive social impact on cities by creating beautiful garden spaces in public settings. A sense of community can be built around rain gardens as an alternative type of landscaping. Rain gardens are an attractive feature for a property and they can increase the value of a property and make people feel closer to nature[29].

A more widespread adoption of rain gardens as a form of stormwater management can provide economic opportunity for the sale of rain-garden-specific plants and for landscaping companies that offer rain garden installation. They also reduce water bills for homeowners since money does not have to be spent on watering grass lawns and traditional flower beds. Green infrastructure, including rain gardens, is designed to be more cost effective than replacing pipes needed to maintain the storm sewer system, since there are little to no repair costs associated with green infrastructure[30]. Rain gardens can also help to meet the Best Management Practices required by the MPCA to prevent further fines.

IV. Northfield's Rain Garden Program and Other Storm Water Management Initiatives

A. Cost Share Program

[26] "Burnsville Stormwater Retrofit Study." 2006. general editor, Barr Engineering Company, http://www.ci.burnsville.mn.us/

[27] Schmidt, Rusty, et al., 2007

[28] Kallestad, Beth. Interview by Berit Hudson-Rasmussen, April 25, 2018.

[29] "Burnsville Stormwater Retrofit Study." 2006; Church, Sarah P. "Exploring Green Streets and Rain Gardens as Instances of Small Scale Nature and Environmental Learning Tools." *Landscape and Urban Planning*, vol. 134, 2015, pp. 229–240.

[30] "Green Infrastructure." United States Environmental Protection Agency

The city of Northfield implemented a rain garden cost share program five years ago, and as a result the awareness of rain gardens is growing. However, rain gardens in Northfield are quite sparse, with only seven residents having utilized the cost share program since it was established in 2013[31]. Two rain gardens have been installed in Way Park, but Northfield has otherwise not prioritized rain garden landscaping in public spaces. Northfield collects a storm water utility fee of about $5-6 per month per household, which goes to fund the rain garden cost share program along with other management practices such as "paying for new stormwater infrastructure on road projects, maintaining old stormwater infrastructure that is failing, completing studies to assess what stormwater needs [Northfield] has, [and] paying for equipment that is utilized in stormwater related activities.[32]"

Currently, the rain garden cost share program offers to reimburse 50% for the cost of garden materials, up to $250[33]. The program information is visible on the Northfield website and includes an application for designing and installing a rain garden. The application is quite extensive, requiring a sketch of the yard and proposed rain garden, testing procedures to determine soil infiltration, a list of intended plants to buy, and an estimated cost[34]. The website also provides a map for assessing locations in Northfield where rain gardens may or may not be feasible, indicating areas where bedrock is exposed near the soil or where soil infiltration is too low[35].

Despite this incentive program, the cost of installing a rain garden can still be more than homeowners are willing to pay. Rain gardens can cost $2-5 per square foot, at the most

[31] Johnson, Cole. May 22, 2018.
[32] Kallestad, Beth. Interview by Berit Hudson-Rasmussen, April 25, 2018; Johnson, Cole. May 22, 2018.
[33] "Rain Garden/Rain Barrels/Native Plant Rebate." City of Northfield Minnesota. https://www.ci.northfield.mn.us/338/Rain-Garden-Rain-BarrelsNative-Plant-Reb

[34] "City of Northfield Rain Garden Cost Share Application." City of Northfield Minnesota. https://www.ci.northfield.mn.us/DocumentCenter/View/275/RainGarden_ApplicationAgreement_Web.
[35] "Rain Garden/Rain Barrels/Native Plant Rebate." City of Northfield Minnesota.

conservative estimate, which can be too much for residents even after the city's reimbursement[36]. Besides cost, there is also the challenge of excavating one's yard, laying rock and soil foundations for the rain garden, planting, and maintaining the garden. Northfield does not provide any assistance with the landscaping, which can be a daunting project for the average homeowner. The process it takes for a homeowner to install a rain garden takes time, effort, and money, and the city currently does not provide sufficient funds or labor to make this process appealing for homeowners.

B. West 2nd Street Reconstruction

In 2015, Northfield went forward with a project for the reconstruction of West 2nd Street that included planning for curb cuts and rain garden construction. The city surveyed homeowners early in the planning process regarding their interest in getting a rain garden installed in their boulevard—the strip of grass between the sidewalk and the street. The city wanted rain garden installation to occur on a volunteer basis to make sure homeowners were actually interested and would put in the effort needed to maintain the rain garden[37]. Eight homeowners in the construction area expressed interest, however only four gardens were actually installed due to unfavorable site conditions for the other four[38]. This program received positive reviews from participants, however it has not been applied to any construction projects since[39]. A 2017 street "reclamation" project, which redid sections of Maple Street, Ninth Street, and Nevada Street, included some flower bed landscaping designs, but did not include any storm water management practices besides replacing the existing storm system[40]. Designs for a 2018 reconstruction project

[36] Schmidt, Rusty, et al., 2007
[37] "Feasibility Report." *Second Street Reconstruction Project*, November 6, 2014. general editor, SEH.
[38] Johnson, Cole. May 22, 2018.
[39] Johnson, Cole. May 22, 2018.
[40] "2017 Street Reclamation Project." City of Northfield Minnesota. https://www.ci.northfield.mn.us/1083/2017-Street-Reclamation-Project.

for Division St., 7th St., and Washington St. also lack details on installing green infrastructure that would handle storm water runoff[41].

C. Public Outreach

Northfield has a partnership with the Cannon River Watershed Partnership (CRWP) to do public outreach on storm water management. The CRWP helped organize the installation of the two rain gardens in Way Park, with assistance from the Friends of Way Park organization[42]. The Northfield Master Gardeners program has also featured rain gardens as part of their project work and the Northfield Gardening Club has included rain gardens on their annual garden tour[43]. Plants suitable for rain gardens are now sold at the Rice County Soil and Water Conservation District (SWCD) plant sale, and the CRWP does a booth including rain garden information at the annual Northfield Home and Garden Show[44]. Northfield has also hosted some workshops on rain gardens, led by Blue Thumb, a runoff prevention organization based in the Twin Cities, and the CRWP. Workshops and information sessions offered by Northfield in 2013, to meet their required public education goals under the MS4 permit, were attended by about 10-30 people[45]. The most recent Blue Thumb workshop, hosted by the CRWP, was offered on March 5, 2018.

D. Plans for the Future

Northfield currently does not have any rain garden projects listed on their website. No street reconstruction projects have resulted in the installation of rain gardens since 2015, even though many construction projects have occurred. According to the Northfield Water Quality Technician, "Rain Gardens have not been added on any of the recent street projects due to being federal

[41] "2018 Street Improvements (Division St., 7th St., Washington St.)
[42] Kallestad, Beth. Interview by Berit Hudson-Rasmussen, April 25, 2018.
[43] "Master Gardener." University of Minnesota Extension. http://www.extension.umn.edu/garden/master-gardener/; Kallestad, Beth. Interview by Berit Hudson-Rasmussen, April 25, 2018.
[44] Kallestad, Beth. Interview by Berit Hudson-Rasmussen, April 25, 2018.
[45] "MS4 SWPPP Application for Reauthorization." Permit Application, Minnesota Pollution Control Agency, August 1, 2013.

projects (Woodley [St.]) or the project not being a full reconstruct. We do plan to incorporate more curb cut rain gardens into Capital Improvement Projects if we are able to and residents are interested in having one.[46]" Northfield's Capital Improvement Plan for 2018 includes a long list of construction projects occurring in 2018 through 2022, several of which are street reconstruction projects. From this, it appears there is much potential for Northfield to install boulevard rain gardens, following a similar process as the 2nd Street project[47]. The Capital Improvement Plan budget does not currently mention rain gardens or other green infrastructure practices, however, and there is no information about future city rain garden installation that is easily accessible on the Northfield website.

V. Proposed Actions Yielding a Significant Impact

Further development of Northfield's rain garden program into a city-wide movement is recommended because increased action in stormwater management will improve water and air quality, reduce drainage system repair costs, and prevent flooding damages. When implemented properly, rain gardens can add value to a property and neighborhood and serve as a community-building practice. Northfield has the ability to take action on this issue and should strongly consider it for the practical reason that green infrastructure, such as rain gardens, is cheaper, more effective, and more beautiful than traditional stormwater infrastructure. Below, I have detailed strategies employed by other municipalities for encouraging widespread implementation of rain gardens or other green infrastructure practices. I have also recommended goals for Northfield to improve their existing program.

A. Policies in Other Municipalities/Counties

[46] Johnson, Cole. May 22, 2018.
[47] "2018-2022 Capital Improvement Plan." City of Northfield Minnesota. https://www.ci.northfield.mn.us/DocumentCenter/View/6006/FINAL-2018-2022-CIP-Detailhttps://www.ci.northfield.mn.us/DocumentCenter/View/6006/FINAL-2018-2022-CIP-Detail.

1. Dakota and Rice Counties

Rain garden reimbursement programs are commonplace methods for providing incentives for storm water management. Dakota and Rice counties both have reimbursement programs offering more money and assistance than Northfield. Rice County offers a 75% reimbursement of up to $1000, although they also require more maintenance and detailed engineering plans[48]. Dakota County SWCD offers ten "Landscaping for Clean Waters" workshops per year, in various cities across the county. There is a $25 fee for registering, but participants receive a book about how to build their rain garden, and they design the garden specifics during the course with help from community experts. A Dakota SWCD member will then come to the participant's house to approve construction plans. Upon completion of the garden installation, participants receive a $250 grant to reimburse some of the cost[49]. Rice County also offers workshops in partnership with Blue Thumb. Both Dakota and Rice counties use incentive programs as well as provide resources for technical assistance, and they prioritize public education as a way to increase the utilization of their rain garden program.

2. Maplewood and Burnsville

Maplewood is a suburb of St. Paul that has taken significant action in making rain gardens part of their default city infrastructure. Maplewood began their rain garden program in the 1990s and since 1996 they have installed 700 rain gardens in residential boulevards through street reconstruction projects. Maplewood also installed 60 rain gardens in public spaces and

[48] "Rice SWCD Rain Garden Cost-Share Program." Minnesota Board of Water and Soil Resources.; Kallestad, Beth. Interview by Berit Hudson-Rasmussen, April 25, 2018.

[49] "Rain Gardens." Dakota County. https://www.co.dakota.mn.us/Environment/WaterResources/Stormwater/Pages/raingardens.aspx

encourages businesses to install them on their properties as well[50]. Maplewood is a city of around 40,000 people--about twice the size of Northfield—meaning a Northfield-sized town with Maplewood's program would have 350 boulevard rain gardens. Maplewood is regarded as having the best rain garden program in Minnesota, and their success has come from using already existing road construction plans to implement rain gardens, taking the process of constructing a garden off the hands of the homeowner. Since the homeowner is still responsible for planting and maintaining the rain garden, Maplewood asks homeowners if they are interested in a rain garden in the early stages of construction planning. Maplewood regards proper upkeep and homeowner motivation to be crucial to the success of the program. They published a case study documenting homeowner reactions to boulevard rain gardens installed in 2002, describing challenges and successes the city underwent in communicating information to residents throughout the construction process[51]. In order to make this a wide-spread movement, Maplewood has managed to engage in public outreach and education so that their population is interested in and aware of the need for stormwater management practices.

Another model city for rain gardens is Burnsville, Minnesota. Burnsville conducted a study in 2006 on the effectiveness of rain gardens in retaining stormwater, which has been frequently cited and used to advocate for rain gardens. Burnsville did a retrofit project of a 1980s neighborhood where they asked homeowners if they would be interested in having rain gardens installed on their property. Burnsville achieved an 80% participation rate in this project[52]. In Northfield's 2nd Street reconstruction project, less than 20% of homeowners surveyed responded

[50] "Rain Gardens." Maplewood Minnesota. https://maplewoodmn.gov/1032/Rain-Gardens

[51] "Understanding Homeowner Reactions to Rain Gardens: Focus Group Reviews of the Maplewood Rainwater Garden Projects." 2002. general editor, City of Maplewood, https://maplewoodmn.gov/DocumentCenter/View/227/Focus-Group-Studyhttps://maplewoodmn.gov/DocumentCenter/View/227/Focus-Group-Study.

[52] "Burnsville Stormwater Retrofit Study." 2006

positively, and less than 10% of houses in the construction zone actually had rain gardens installed[53]. Getting a higher homeowner participation rate is essential in growing Northfield's rain garden program, and both Burnsville and Maplewood are examples of cities that have managed to adequately advertise the importance of rain gardens and prove their effectiveness to the public. Both cities involved homeowners extensively in the planning process, with rain gardens designed specifically for each yard[54]. The Burnsville study even reported that homeowners saw the rain garden as a house amenity, something that would actually increase the value of their home, should they sell it[55]. Maplewood and Burnsville also developed an expertise in installing rain gardens, with trained professionals within city planning and construction companies, dedicating specialists to this field. By doing this, Burnsville, and Maplewood in particular, were able to make rain gardens more of a default part of infrastructure, at least in the context of road construction.

3. Measuring Effectiveness in Other Municipalities

It is important to consider the effectiveness of these types of programs in their goal of preventing storm water runoff into rivers, creating aesthetically pleasing public spaces, and offsetting the cost of standard storm water drainage systems. The effectiveness of rain gardens themselves is usually measured in the amount of water collected that is not going into the storm sewer. Sometimes the pollution load reduction can also be estimated. To ensure rain gardens are doing their job, assessments are performed to make sure they are able to infiltrate runoff at a fast enough rate, so that the soil can drain within 48 hours. A case study by the University of

[53] "Feasibility Report." *Second Street Reconstruction Project*, November 6, 2014.
[54] "Understanding Homeowner Reactions to Rain Gardens: Focus Group Reviews of the Maplewood Rainwater Garden Projects." 2002.
[55] "Burnsville Stormwater Retrofit Study." 2006

Minnesota did this through "visual inspection, permeability tests, and a synthetic runoff test"[56]. Other measures for demonstrating effectiveness of a policy or program can be shown in the number of rain gardens or green infrastructure projects installed, the cost of implementing rain gardens versus the cost of maintaining standard storm pipe systems, or public response to green infrastructure in public spaces. It can be difficult to measure the long-term cost of rain gardens, but cities are generally seeing economic benefits to reducing the amount of runoff going down the storm drain. Portland, for example, reported their investment in green infrastructure to be $9 million by 2010, which they estimated would save them $224 million from the cost to maintain combined storm sewer overflow tunnels[57]. The city of Philadelphia estimates it has saved $170 million by installing green infrastructure. These cities implemented a wide variety of green infrastructure practices, which included, but was not limited to, rain gardens[58].

B. Recommendations for Northfield

While a variety of policies have been put in place by municipalities across the nation, successful implementation of storm water management, as seen in many case studies, seems to hinge on interdepartmental communication and early planning. Any policy put in place would need to require collaboration at all levels between city planning, the Northfield environmental quality commission, and construction companies. Actions that are predicted to have the most significant impact on storm water runoff in Northfield include policies that promote green infrastructure by consistently incorporating the installation of rain gardens into street

[56] Gulliver, J.S., A.J. Erickson, and P.T. Weiss (editors). 2010. *"Stormwater Treatment: Assessment and Maintenance."* University of Minnesota, St. Anthony Falls Laboratory. Minneapolis, MN. http://stormwaterbook.safl.umn.edu/

[57] United States. *Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure*, Environmental Protection Agency, 2010, pp. 1–70.

[58] United States. *Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure*, Environmental Protection Agency, 2010, pp. 1–70.

construction and renovation projects. Northfield should also continue to encourage all homeowners to install a rain garden by increasing incentives available to homeowners and advertising the funding available through the existing rain garden reimbursement program.

1. Incorporation of Rain Gardens into Street Reconstruction

One important policy proposal would specify requirements for all street reconstruction projects in residential and commercial areas to survey homeowners and businesses about their interest in having a rain garden installed in their boulevard. The contracted construction company would complete the installation and the homeowner would be responsible for planting and maintenance. This proposal must dictate early planning deadlines so that all parties are on board with the project from the start and public education measures can be taken early on to ensure public understanding of the project and justify its need. If plans can be made early enough, it could be possible for the company in charge of installing the rain garden to allow homeowners to choose the plants they would like in their yard, giving the homeowner a greater feeling of ownership of their rain garden.

In order to motivate homeowners in residential street construction areas to say yes when surveyed about rain garden installation, Northfield needs to incorporate a stronger incentive for the homeowner. Northfield should aim to increase their Stormwater Utility Fee by $2 per month and then offer to waive this fee for residents who opt to install a rain garden. Additional money can be used to fund further rain garden assistance and public outreach for the program. Increasing the Stormwater Utility Fee sends the message that stormwater runoff is a serious concern. It also has the potential to raise the property value when trying to sell a house with a rain garden, since potential buyers are more likely to view a rain garden as an amenity if it will save them money. Northfield should aim for a 30% participation rate of people in street

reconstruction areas opting for rain gardens. Commercial zones should also be required to evaluate the potential for boulevard rain gardens, especially as runoff is higher in these areas because of parking lots.

A policy requiring boulevard rain gardens would have numerous potential benefits for the Northfield community. The primary goal of this policy would be to reduce runoff from impervious surfaces and protect the quality of the Cannon River. Regularly inquiring about boulevard rain gardens in street reconstruction has the potential to drastically increase the number of rain gardens in the city of Northfield. Adopting these construction policies would substantially reduce the amount of planning and shoveling effort on the part of the homeowner, since yard excavation would now be done for them by the construction company as part of the street renovation. This would make cost and time less of a burden on the homeowner, encouraging a more positive perception of rain gardens in the city. City-wide implementation of rain gardens would create more of a community around this practice as well.

Key Implementation Issues

The Environmental Quality Commission raised concerns in 2015 about maintenance of the boulevard rain gardens, and eventually determined this process should be completed by the homeowner. Rain gardens do require consistent weeding, debris removal, and inspection in the first year, and gardens that are not properly maintained have the potential to not retain stormwater, drain effectively, or look aesthetically pleasing. Since maintenance is a key issue for Northfield rain garden construction, the city should always ensure interest in caring for a rain garden by conducting surveys, and this way prevent residents from obtaining a garden they are unwilling to maintain. For those who may want a rain garden, but are unable to maintain it, such as more elderly people, Northfield should offer to provide assistance through enlisting the help

of volunteer organizations. In these instances, and also in commercial areas, rain gardens will require the assistance of non-governmental organizations to maintain.

To make maintenance less of a daunting task for all homeowners, the city should reach out to volunteer organizations to perform routine check-ups on rain garden care. Many NGOs are active in community garden work in Northfield. The Master Gardener program, through the University of Minnesota Extension, names garden specialists by county who are required to do at least 40 hours of community service every year to maintain their qualifications[59]. The Northfield Gardening Club is also quite active, holding monthly meetings, helping with community landscaping projects, and leading a Northfield garden tour every year—featuring a rain garden in 2018[60]. The Friends of Way Park group has also been instrumental to the installation of two rain gardens in Way Park, with the assistance of the CRWP[61]. The city of Northfield can take advantage of this community expertise by listing rain garden maintenance as a priority for volunteer hours. There is a record of the number of rain gardens in Northfield, held by the Utilities office, which could be given to the Northfield Gardening Club or the Master Gardeners to perform an annual check on rain garden maintenance in both residential and commercial areas.

In designing a policy update to regularly survey residents about boulevard rain gardens with street reconstruction, it is important for city council to consider ways in which the construction process itself can cause loose sediment which can become part of the storm water runoff. Construction sites are strictly regulated in the MPCA MS4 permit, and the fine Northfield received in 2016 included violations of the strict construction guidelines in the permit. The city would want to ensure communication between city engineers, the construction company, and the

[59] "Master Gardener." University of Minnesota Extension. http://www.extension.umn.edu/garden/master-gardener/

[60] "Northfield Garden Club." http://www.thenorthfieldgardenclub.org/

[61] Kallestad, Beth. Interview by Berit Hudson-Rasmussen, April 25, 2018.

environmental quality council members, so that planning of street construction projects can happen well in advance and not slow down the process.

2. Increased Advertising for Existing Programs

Northfield is required by their MS4 permit to engage in public education. While they have enlisted the CRWP to do this for them, there is still a need for more awareness of the problems stormwater runoff causes and ways people can prevent further damage. For starters, the city website should be updated to feature rain gardens more prominently and include important information about where homeowners can receive technical assistance and how they should maintain their garden. Northfield should also reach out to landscaping companies in order to increase the accessibility and visibility of rain gardens in the public sphere and establish them as a more default landscaping feature. I contacted Knecht's Nursery about their willingness to increase the visibility of rain garden information to customers. My suggestions included a sign in their store advertising which plants would allow customers to get a rebate, making rain garden information more available on their website, and discounting the installation of a rain garden versus a traditional garden through their landscaping services. They agreed to bring my questions to their management meeting, and I will update the EQC on their thoughts when I hear back from them. Northfield can also increase advertising through signage on storm drains—a program they successfully implemented in 2013[62]. Increased visibility of rain gardens in the community will help foster a positive public perception of rain gardens as an amenity that adds value to their house—an investment they can get a return on—further increasing public appeal.

Another measure Northfield should consider taking to increase public awareness for rain gardens, is to partner with Dakota County SWCD and advertise the extensive courses available

[62]"MS4 SWPPP Application for Reauthorization." Permit Application, Minnesota Pollution Control Agency, August 1, 2013.

there. Northfield can request a "Landscaping for Clean Waters" class to be held in Northfield so that residents do not have to travel to the Twin City suburbs to take their rain garden workshop. The city should also continue to host workshops by outside groups, such as Blue Thumb. Residents of Northfield who live in Dakota County are also eligible to receive extra discounts on top of the $250 provided by the city of Northfield, which is not clear from the Northfield website. The city should advertise the programs in Dakota and Rice counties and include on their website information for Dakota County residents about the extra refunds they are eligible for if they install a rain garden.

It is important for Northfield to increase advertising and public education so they can increase the number of people building and advocating for rain gardens. By engaging in outreach, Northfield has the potential to create a stronger connection between the public, and city spaces and infrastructure. Studies done on public perception of green infrastructure in Portland, Oregon show 69% percent of people living amongst green infrastructure said it gave them more environmental awareness, and 44% said it made them more interested in the stormwater system[63]. The inclusion of rain gardens in public spaces and in boulevards will enhance the beauty of Northfield streets and create a more positive view of city infrastructure, which is perhaps needed in a town where busy roads and urban sprawl are a bit of a controversy. Education on storm water management will also make residents feel more aware of how their actions affect tangible things like the Cannon River, and feel more knowledgeable about the money they spend on the storm water fee and utility bills.

VI. Conclusion

[63] Church, 2015.

Storm water management is a problem that the city of Northfield needs to address in order to prevent ecosystem degradation, poor water quality, flooding, and high storm drainage repair costs. Green infrastructure projects such as rain gardens reduce the negative impact of runoff on river ecosystems, provide attractive spaces for people and pollinators, and lower costs for mowing and repairing aged storm system pipes. The best course of action for developing Northfield's rain garden program is to require all city construction projects to consider storm water management practices in their planning process, and to require all street reconstruction or renovation projects to ask residents and businesses about installing boulevard rain gardens. In order to achieve a higher participation rate in such construction projects, and to encourage other residents to install rain gardens, advertising for Northfield's rain garden program must be increased. Northfield should update their website and reach out to Dakota SWCD to see if one of their workshops can be hosted in Northfield. The city should take advantage of volunteer support from the gardening club and Master Gardener program to ease concerns about garden maintenance and build more of a community bond around the establishment of rain gardens.

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