# NPDES MS4 Phase I Permit No. MN0061018
# Annual Report for 2017 Activities

City of Minneapolis and the Minneapolis Park & Recreation Board
Co-Permittees

June 29, 2018

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Minneapolis
City of Lakes

# NPDES MS4 Phase I Permit
# Annual Report for 2017 Activities

June 30, 2018

I hereby certify that this plan, specification, or report, was prepared by me or under my direct Supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.

Katrina Kessler

Katrina Kessler, PE

Date 6/27/2018 Registration No. 45463

NPDES PERMIT NO. MN0061018

Issued December 1, 2000

Re-issued January 21, 2011

CITY OF MINNEAPOLIS
CERTIFICATION

State of Minnesota
County of Hennepin } ss.
City of Minneapolis

I, Casey Joe Carl, City Clerk of the City of Minneapolis, in the County of Hennepin, and State of Minnesota, certify that I have examined the attached copy of Resolution No. 2018R-194 (File No. 2018-00432) adopting the Minneapolis Stormwater Management Program and National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase I Permit Report for 2017 Activities, adopted by the Minneapolis City Council at a meeting held on June 15, 2018, and have carefully compared the same with the original on file in the Office of City Clerk, and that the attached copy is a true, correct, and complete copy of the original.

SEAL OF THE CITY OF MINNEAPOLIS, MINN. APPROVED JUNE 5TH 1878 — EN AVANT

IN WITNESS WHEREOF, I have signed and affixed the City seal on June 20, 2018.

Casey Joe Carl, City Clerk

**Resolution No. 2018R-194** | **City of Minneapolis** | **File No. 2018-00432**

Author: Reich | Committee: TPW | Public Hearing: Jun 05, 2018

Passage: Jun 15, 2018 | Publication: JUN 23 2018

| RECORD OF COUNCIL VOTE | | | | |
|---|---|---|---|---|
| COUNCIL MEMBER | AYE | NAY | ABSTAIN | ABSENT |
| Bender | ✖ | | | |
| Jenkins | ✖ | | | |
| Johnson | ✖ | | | |
| Gordon | ✖ | | | |
| Reich | ✖ | | | |
| Fletcher | ✖ | | | |
| Cunningham | ✖ | | | |
| Ellison | ✖ | | | |
| Warsame | | | | ✖ |
| Goodman | ✖ | | | |
| Cano | ✖ | | | |
| Schroeder | ✖ | | | |
| Palmisano | ✖ | | | |

**MAYOR ACTION**

☑ APPROVED ☐ VETOED

MAYOR

JUN 19 2018

DATE

*Certified an official action of the City Council*

ATTEST

CITY CLERK

Presented to Mayor: JUN 15 2018

Received from Mayor: JUN 20 2018

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**Adopting the Minneapolis Stormwater Management Program and National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase I Permit Report for 2017 Activities.**

Whereas, the City of Minneapolis is committed to improving water quality in the lakes, wetlands, streams, and Mississippi River; and

Whereas, on January 21, 2011, the City of Minneapolis was issued National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit No. MN0061018 (Permit); and

Whereas, the Stormwater Management Program was prepared in accordance with the Permit, was approved by the Minnesota Pollution Control Agency (MPCA) in 2013, and was updated in 2014 and in 2015 and provided to the MPCA; and

Whereas, as required under the Permit, a public hearing was held on June 5, 2018; and

Whereas, the Annual Report for 2017 Activities will now be submitted to the Minnesota Pollution Control Agency;

Now, Therefore, Be It Resolved by The City Council of The City of Minneapolis:

That the Minneapolis City Council hereby adopts the Stormwater Management Program and the Annual Report on 2017 Activities.

## ACRONYMS

| | |
|---|---|
| **BCWMC** | Bassett Creek Watershed Management Commission |
| **BMP** | Best Management Practice |
| **$BOD_5$** | Biochemical Oxygen Demand of wastewater during decomposition occurring over a 5-day period |
| **CB** | Catch Basin |
| **CIP** | Capital Improvement Program |
| **COD** | Chemical Oxygen Demand |
| **CPED** | Community Planning and Economic Development |
| **CSO** | Combined Sewer Overflow |
| **CWA** | Clean Water Act |
| **DNR** | Department of Natural Resources |
| **EPA** | Environmental Protection Agency |
| **ESC** | Erosion and Sediment Control |
| **FWMC** | Flow Weighted Mean Concentration |
| **GIS** | Geographic Information Services |
| **I & I** | Inflow and Infiltration |
| **IPM** | Integrated Pest Management |
| **LAURI** | Lake Aesthetic and User Recreation Index |
| **LGU** | Local Government Unit |
| **LID** | Low Impact Design |
| **LSWMP** | Local Surface Water Management Plan |
| **MCES** | Metropolitan Council Environmental Services |
| **MCWD** | Minnehaha Creek Watershed District |
| **MDH** | Minnesota Department of Health |
| **MECA** | Minnesota Erosion Control Association |
| **MEP** | Maximum Extent Practicable |
| **MH** | Manhole |
| **MDA** | Minnesota Department of Agriculture |
| **MDR** | Minneapolis Development Review |
| **MIDS** | Minimal Impact Design Standards |
| **MNDOT** | Minnesota Department of Transportation |
| **MOU** | Memorandum of Understanding |
| **MPCA** | Minnesota Pollution Control Agency |
| **MPRB** | Minneapolis Park and Recreation Board |
| **MS4** | Municipal Separate Storm Sewer System |
| **MWMO** | Mississippi Watershed Management Organization |
| **NFIP** | National Flood Insurance Program |
| **NPDES** | National Pollutant Discharge Elimination System |
| **NRCS** | National Resources Conservation Service |
| **NURP** | Nationwide Urban Runoff Program |
| **PW-SWS** | Public Works – Surface Water and Sewers |
| **PW-TED** | Public Works – Transportation, Engineering and Design |
| **PW-TMR** | Public Works – Transportation Maintenance and Repair |
| **RDP** | Rainleader Disconnect Program |

**SCWMC** Shingle Creek Watershed Management Commission
**SMP** Stormwater Management Practice
**SOP** Standard Operating Procedure
**SSO** Sanitary Sewer Overflow
**SW** Stormwater
**SWMP** Stormwater Management Program
**SWPPP** Stormwater Pollution Prevention Plan
**TMDL** Total Maximum Daily Load
**TP** Total Phosphorus
**TSI** Trophic State Index
**TSS** Total Suspended Solids
**USACE** United States Army Corps of Engineers
**VRS** Vehicle Related Spills
**WMO** Watershed Management Organization

## ACKNOWLEDGEMENTS

**Minneapolis Public Works - Surface Water & Sewers Division**

Nico Cantarero
Paul Chellsen
Lane Christianson
Dennis Daly
Kevin Danen
Lois Eberhart
Paul Hudalla
Kelly Moriarity
Kelly MacIntyre
Matt Stonich
Elizabeth Stout
Jeremy Strehlo
Karl Westermeyer

**Minneapolis Public Works - Transportation Maintenance & Repair**

Steve Collin

**Minneapolis Health Department - Environmental Services**

Tom Frame
Patrick Hanlon
Jim Doten

**Minneapolis Park & Recreation Board**

Rachael Crabb
Michael Perniel
MaryLynn Pulscher

**Minneapolis Regulatory Services**

Steve Kennedy

## EXECUTIVE SUMMARY

This report provides documentation and analysis of the Minneapolis Stormwater Management Program (SWMP) activities conducted during the previous year, 2017. The City and Minneapolis Park & Recreation Board (MPRB) are responsible for the SWMP activities and are jointly responsible for the completion of the required Permit submittals.

This annual report is prepared in compliance with the requirements of National Pollutant Discharge Elimination System (NPDES) Permit No. MN0061018, a Municipal Separate Storm Sewer System (MS4) Phase I permit issued to City of Minneapolis (City) and the Minneapolis Park & Recreation Board (MPRB) as co-permittees. Permit No. MN0061018 was issued in December 2000 and reissued in January 2011. A updated NPDES permit was reissued in February 2018. Activities completed under the new permit will be reported in the 2018 Annual Report and submitted to the MPCA next year.

The NPDES program was created in 1990 by the United States Environmental Protection Agency (EPA) to safeguard public waters through the regulation of the discharge of pollutants to surface waters including lakes, streams, wetlands, and rivers. The Minnesota Pollution Control Agency (MPCA) is the local authority responsible for administering this program. Under this program, specific permits are issued to regulate different types of municipal, industrial and construction activities and this report is related to the municipal program.

The SWMP is based on an adaptive management system, as outlined in Part V.A. of the Permit, by which the Permittees continuously monitor, analyze, and adjust the SWMP to achieve pollutant reductions. Using the adaptive management approach, revisions to the SWMP are made and submitted to the MPCA as necessary. A 2013 EPA/MPCA audit helped to identify opportunities for improvement regarding comprehensive training, written procedures and documentation, and availability of staff resources that have influenced subsequent revisions to the SWMP. The Permit requires the implementation of approved stormwater management activities, referred to as Stormwater Management Practices (SMPs), also known as Best Management Practices (BMPs).

Minneapolis Public Works provides program management and completes each Annual Report. An opportunity for public input into the SWMP and priorities is required. The permit also requires the adoption of a formal resolution each year, adopting the Annual Report and the Stormwater Management with the Annual Report. Resolution 2018R-194 was passed on June 15, 2018.

In February 2018 the City's NPDES permit was reissued by the MPCA. The City is currently working on updates to the SWMP to reflect the new permit requirements. The updated SWMP will be approved by the City Council and submitted to the MPCA once it has been completed.

## MINIMAL CONTROL MEASURE ONE: PUBLIC EDUCATION

### PROGRAM OBJECTIVES

The objective of this stormwater management program is to educate the public regarding point and non-point source stormwater pollution.

Targeted pollutants include:

All pollutants

### PROGRAM OVERVIEW

The City of Minneapolis and the Minneapolis Park & Recreation Board (MPRB) implement their Public Education Program to promote, publicize, and facilitate the proper management of stormwater discharges to the storm sewer system. The program's focus is to educate Minneapolis residents, business owners, employees, and visitors about how everyone's actions affect the quality of our lakes, wetlands, creeks, and the Mississippi River, and how to control pollutants at the sources to reduce the discharge of pollutants to our receiving waters. The desired result is to change behavior in ways that will improve water quality. Many of the components of the program can be found at the City of Minneapolis Stormwater website or on the MPRB Water Resources website.

Some of the program activities are carried out directly by the co-permittees - the City and the MPRB. Other activities are coordinated with and carried out by watershed organizations, Hennepin County, and other entities.

### PREVIOUS YEAR ACTIVITIES

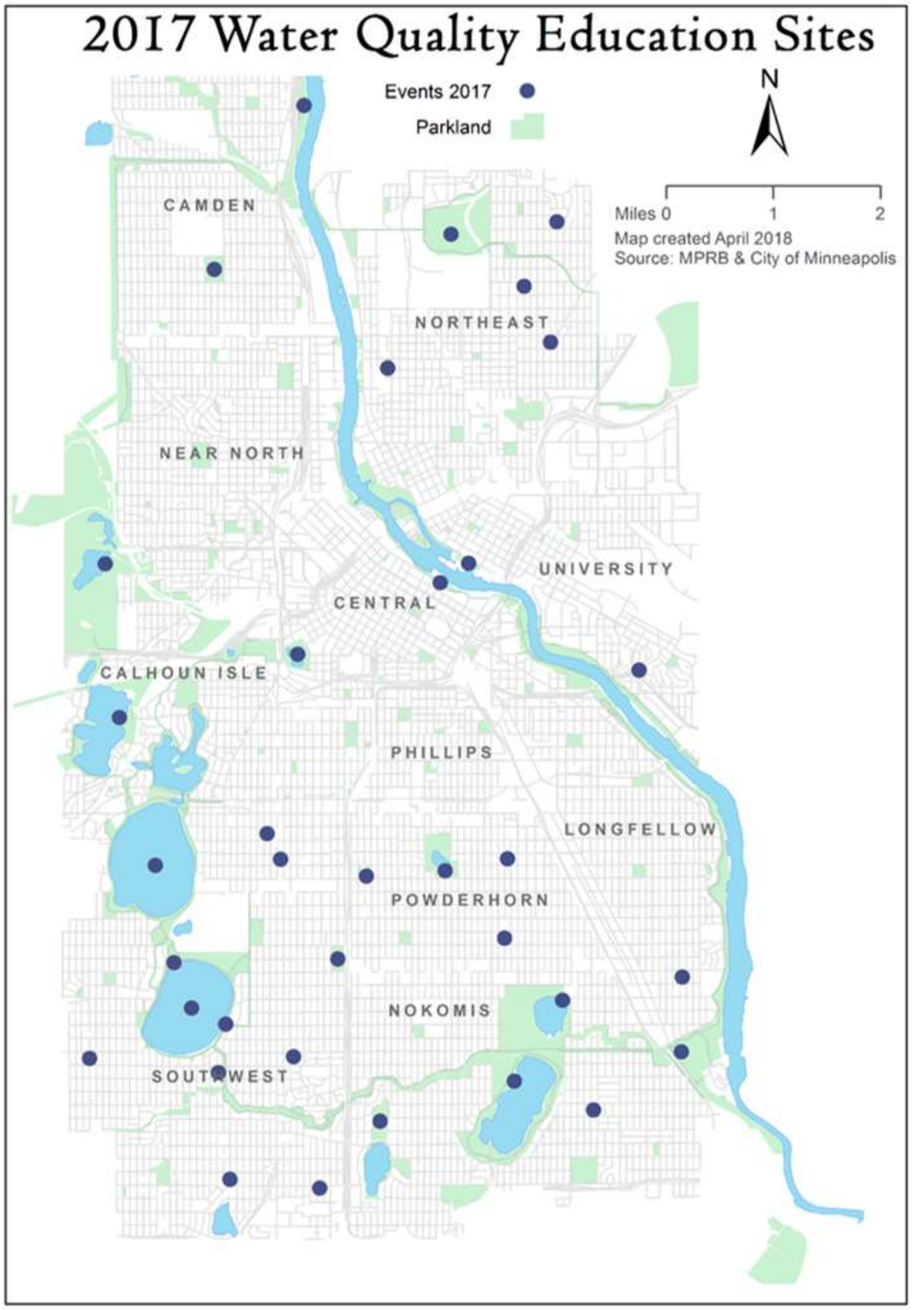
In 2017, MPRB staff provided water quality education programs throughout the City. Environmental Management naturalist staff participated in 30 Minneapolis community festivals, neighborhood events, as well as concerts and movies (see map and site below). Hands-on water quality educational displays focused on neighborhood watersheds and how human activities impact local water bodies. Education staff utilized portable mini-golf, bean bag toss, an aerial photo floor graphic of the City and its watersheds, and other hands learning activities. In addition, 495 people experienced water quality education during guided canoeing on the lakes of Minneapolis. Other children's programming focused on water quality education themes in summer programs including a partnership with the Minneapolis Institute of Art that used art and water related activities to serve 335 kids between 6 and 12 years old. Still more programs incorporated water education themes into the summer camps called Urban Adventure Camp, Outdoor Survival, and Nature Explorers serving 245 kids between 6 and 12.

### *At the lakes*


The MPRB continued its extensive Aquatic Invasive Species (AIS) Inspection Program at the public boat launches located at Bde Maka Ska (formerly Lake Calhoun), Lake Harriet, and Lake Nokomis. The boat launches are staffed seven days a week from May 1 to December 1 and all boats entering and leaving the lakes are inspected for AIS. In addition to providing boat inspections, staff are an information source for the park visitors. Staff directly interacted with 18,000 park visitors in 2017. Adjacent to the AIS booths are sandwich boards with action steps people can take to be a good water steward. The sandwich board messages can be changed out daily based on weather, time of year, etc. Annually more than five million people visit the Chain of Lakes and more than one million visit Lake Nokomis.

### *Do Not Feed the Ducks*

Based on a successful pilot program in 2016 that focused on persuading park patrons to not feed the ducks, the MPRB moved forward with fabrication of permanent education pieces in 2017. An oversized buoy in the shape of a rubber duck will float along the Lake Harriet shoreline that abuts Bread & Pickle (see photos). And more than 200 table-toppers featuring regular size ducks and 'do not feed the ducks' messaging will be installed on picnic tables at Bread & Pickle, Sand Castle (Lake Nokomis), and Lola's (Bde Maka Ska) in 2018.


**Neighborhood water quality education event sites. Some sites had multiple events.**

- Audobon
- Bottineau
- Bryant Square
- Bde Maka Ska
- East Cedar Lake Beach
- Central Park Gym
- Columbia
- Corcoron
- Creekview
- East Harriet neighborhood
- Father Hennepin Bluffs
- Folwell
- Fuller
- Hiawatha School
- Keewaydin
- Kenny
- Lake Harriet
- Lake Harriet Bandshell
- Lake Hiawatha
- Loring
- Luxton
- Lynnurst
- Minnehaha Park
- Martin Luther King
- Nokomis
- North Mississippi
- Painter
- Pearl
- Pershing
- Powderhorn
- Sibley
- Waite
- West River Parkway
- Windom South
- Wirth

### *Minnehaha Park*

A moveable water quality education exhibit was deployed at Minnehaha Park near the pavilion that houses the popular restaurant, Sea Salt. The spinning cubes provide information about watersheds, stormwater runoff, and actions people can take to positively impact water quality. This location was chosen because of the consistent captive audience of people standing in line waiting to order food. Intermittent staff observations throughout the season confirmed that many of the people waiting in line were reading the cubes.

### *Canines for Clean Water*

More than 100,000 dogs reside in the City of Minneapolis. They generate an estimated 41,000 pounds of solid waste each day. A water quality education program targeting dog owners was initiated in 2009 called Canines for Clean Water, and we continue to build on this work.

In 2017 the Canines for Clean Water campaign continued to focus on Public Service Announcements (PSAs) shown at the Riverview Theatre, located near the Mississippi River and Lakes Nokomis and Hiawatha. The PSAs focus on two main actions: getting pet owners to pick up after the dogs and encouraging all property owners to stop or reduce their use of salt or chlorides. The PSAs had a simple message with images of the Mississippi River, Lake Nokomis, and Minnehaha Creek. The summer and fall message was to *Protect the River, Protect the Lake, Protect the Creek: Grab a Bag and Scoop the Poop*. For winter, the images featured winter scenes of the Mississippi River, Lake Nokomis, and dogs frolicking in the snow. The message here was to *Protect the River, Protect the Lakes, Protect the Paws: Shovel, Don't Salt*. The word *chloride* was not used in the PSA because more people understood ice melt as salt. Detailed information about chlorides, their impacts, best practices for distribution was found on the Minneapolis Park & Recreation Board website [www.minneapolisparks.org/dogs](www.minneapolisparks.org/dogs)

### *Greening Teen Teamworks*

Teen Teamworks is a summer youth employment program managed by the MPRB for 30+ years. In 2017 Teen Teamworks hired and trained 150 youth to assist in park maintenance work for eight weeks. The Greening Teen Teamworks program, led by two MPRB Environmental Educators, meets weekly with all sites supervisor and youth to provide education on stormwater runoff, water quality, and actions that should be taken to help keep our lakes, creeks, and river healthy. These site-based youth crews are charged with keeping the parks stormwater drains clear and curblines picked up, and at parks with waterbodies, the crews remove debris from outlets and tidy up shorelines.

All program participants complete a pre and post knowledge test. Teens participate in park-based education opportunities, demonstrating what they've learned about water quality to children and adults. By sharing their newfound knowledge, it reinforces water quality concepts. Post knowledge test results show that the teens - and their adult supervisors - increase their knowledge and understanding of water quality, watersheds, runoff, and the actions that should be taken to benefit our lakes, creeks, and river. In 2017 work sites included the following parks: Bottineau, Farview, Folwell, Martin Luther King Jr, North Commons, Pearl, Powderhorn, and Webber. The Greening Teen Teamworks program is funded by the Mississippi Watershed Management Organization.

### *Earth Day Watershed Clean-up*

The Earth Day Watershed Clean-up was initiated in 1995 to draw attention to the water quality improvement needs of Minneapolis' lakes, and the effects that individual actions have on urban water quality. The goals of the Earth Day Clean-Up event are to prevent trash and debris from entering Minneapolis water bodies, and to provide a volunteer experience and environmental education to Minneapolis residents and park users. This annual event occurs in Minneapolis parks and neighborhood areas that are part of the watersheds of Minneapolis water bodies, including the Chain of Lakes, Lake Nokomis, Lake Hiawatha, Powderhorn Lake, Diamond Lake, Shingle Creek, Minnehaha Creek, Bassett Creek, and the Mississippi River (see complete list below).

The 2017 Minneapolis Earth Day Clean-Up Event was held at 38 sites throughout the City of Minneapolis. It is a collaborative effort between the MPRB and City of Minneapolis Public Works - Solid Waste and Recycling Division. More than 1,800 volunteers collected an impressive 7,700 pounds of trash, recycling and metal. Hands-on learning activities were also provided throughout the day and focused on water quality, recycling, composting, and organic gardening and lawn care.

**2017 Earth Day Clean Up Sites**

| SITE | ADDRESS |
|---|---|
| 29th Ave and Midtown Greenway | 29th Ave and Midtown Greenway |
| Bassett's Creek | SE corner of Penn Ave. N. and 1 1/2 Ave. N |
| Bde Maka Ska East | Corner of W Lake St. & E Calhoun Pkwy |
| Bde Maka Ska West | W 32nd Street and Calhoun Parkway |
| Beltrami Park | 1111 Summer Street NE |
| Boom Island | 724 Sibley St. NE |
| Bryant Square Park | 3101 Bryant Ave S |
| Cedar Lake | Cedar Lake Pkwy & 25th St. W |
| Columbia | Columbia Pkwy & 35 Ave NE (playground parking lot) |
| Creekview | 5001 Humboldt Ave. N |
| East River Pkwy | E River Pkwy & Franklin Ave. |

| | |
|---|---|
| Father Henn Bluff | 100 6th Ave. SE |
| Folwell Park | 1615 N Dowling Ave |
| Heritage Park/Sumner Field | 10th Ave. N and Van White Memorial Parkway |
| Kenny/Grass Lake | 1328 58th St. W |
| Kenwood | 2101 Franklin Ave. W |
| Lake Harriet | 4135 Lake Harriet Parkway, Band Shell parking lot |
| Lake Hiawatha | 2701 E 44th St. |
| Lake of the Isles East | W 27th St and E Lake of the Isles Pkwy |
| Longfellow Park | 3435 36th Ave S |
| Loring | 1382 Willow Street |
| Lynnhurst | 1345 W Minnehaha Pkwy |
| Mill Ruins | 102 Portland Ave S, Minneapolis, MN 55401 |
| Minnehaha Falls | 4801 South Minnehaha Drive |
| ML King | 4055 Nicollet Ave. S |
| Nokomis | 2401 Minnehaha Pkwy. E |
| Pearl | 414 Diamond Lake Rd. E |
| Powderhorn | 3400 15th Ave. S |
| Seward Towers West | Cleaning up frontage road and 9$^{th}$ St. |
| Sibley | 1900 E 40th Street |
| Theodore Wirth | 3200 Glenwood Ave (Wirth Beach Parking lot) |

| | |
|---|---|
| Triangle Park | 10th Street between 4th and 5th Ave. between the in-bound and out-bound access ramps to 35W |
| W River Pky 24th | W River Parkway and $24^{th}$ Street |
| W River Pky 36th | W River Pkwy & 36th |
| W River Pky 44th | W River Pkwy & 44th |
| Waite Park | 1810 34th Ave. NE (near playground off Garfield) |
| Webber Park | 4300 Webber Parkway |
| Whittier | 425 W 26th St. |

### *Mississippi River Green Team*

The Mississippi River Green Team (Green Team) is a conservation-based teen crew engaged in daily hands-on environmental work throughout the summer. There are two crews of ten youth each, which work mostly in the natural areas of the Minneapolis park system, and within the watershed of the Mississippi River. Typical work days include invasive species removal, weed wrenching, planting, watering, mulching, and citizen science work. As part of weekly career exposure days, the crews learned about being an arborist with the Minneapolis Park & Recreation Board, a water quality specialist with the Mississippi Watershed Management Organization, a garden designer with MetroBlooms, a Forest Plant Ecologist and a Wildlife Biologist with the US Forest Service, and lots more. The Green Team also participated in the new Pollinator Ambassadors Program led by the University of Minnesota's Bee Lab.

In 2017 the Green Team continued their work as citizen scientists for the Minnesota Dragonfly Society. Each week the teens caught and identified dragonflies at North Mississippi Regional Park. Dragonflies are an indicator species for assessing habitat and water quality in wetlands, riparian forests, and lakeshore habitats. You can read more about dragonfly survey work here: http://www.mndragonfly.org

The Mississippi River Green Team is made possible through a partnership between the Minneapolis Park & Recreation Board and the Mississippi Watershed Management Organization, with additional funding through the City of Minneapolis STEP-UP Youth Employment Program.

The Green Team is also supported by City of Minneapolis Public Works through their contract with Landbridge Ecological, formerly known as Wetland Habitats Restoration (WHR), which manages vegetation at stormwater BMPs throughout the City. Landbridge and the Green Team's work in 2017 focused on weed and invasive species management at Heritage Park. The crew also toured the newly renovated Nicollet Mall to see the work WHR completed at this site.

One of the projects that the Green Team worked on in 2017 near the 25th Ave SE pond, the site was grown over with invasive and non-native species. The green team worked hard on this site and their work was transformative as shown below

Before The Green Team

After the Green Team

The Green team also worked with Landbridge at Camden Central Pond, Logan Pond, Heritage Park, and the Park Avenue ponds. The teens removed invasive species and weed trees, picked up trash, and mulched trees and shrub beds.

### *Storm Drain Stenciling*

Stenciling of catch basins (also called storm drains), educates the people painting stormwater messages on the storm drains, and shares an environmentally friendly message with area residents and other people passing by. It is a great team-building exercise that allows volunteer organizations to educate people about simple steps they can take to help improve the quality of the lakes, creeks, and the Mississippi River in Minneapolis.

There was great participation in this program in 2017. Different organizations such as local breweries, elementary schools, Minnesota Continuing Legal Education, and neighborhood block clubs all participated. Kate Clayton from the Friends of the Mississippi River was instrumental in helping to coordinate multiple stenciling events in the Mississippi

River Gorge area in Minneapolis.

In 2017, 565 volunteers participated in the program and stenciled 640 storm drains citywide. These volunteers distributed 2,003 doorhangers and collected 110 bags of trash and debris amounting to approximately 3,300 lbs. of trash, leaves, and debris being removed from the City's stormwater system.

### *Adopt a Drain*

In 2016 the City introduced a new Adopt a Drain program Citywide. The program is designed to empower City residents to take responsibility for cleaning the storm drains and gutters in their neighborhoods.


In 2017 the City began partnering with the Center for Global Environmental Education at Hamline University to develop a comprehensive AAD program designed to reach a more diverse group of City residents. This program involves designing, producing, and distributing doorhangers to **all** homes in Minneapolis, designing yard signs for all relevant water bodies in Minneapolis, and designing an evaluation tool, such as Survey Monkey, for AAD participants. In addition, through this partnership the City and Hamline will work to create and pilot an AAD program for neighborhood businesses and conduct an in-depth evaluation of the program to help expand the reach to neighborhoods and individuals that are not yet participating. Full implementation of this program with Hamline will take place over 2017 to 2020.

There were 344 new catch basin adopters in 2017 for a total of 478 people adopting storm drains citywide. These 344 adopters adopted 1,044 storm drains with the average person participating in the program adopting three drains in their neighborhood. In the fall of 2017, adopters reported back to the City that they had collected 1,182 bags of leaves, debris, and trash, removing over 35,460 lbs. of trash from the storm sewer system. This is significantly up from the 7,680 lbs. of trash reported removed in 2016.

### *Metro Blooms*

In 2017 the City of Minneapolis supported the non-profit Metro Blooms in implementing a Resilient Yards Workshop. 2017 was the pilot season and nine of the 10 locations were sold out.

- 88% of respondents indicated they were likely or very likely to install native plants in their yard this year.
- 2/3 of respondents indicated they were likely or very likely to install a "bee lawn" in their yard this year.
- 58% of respondents indicated they were likely or very likely to install a raingarden in their yard in the next two years (many of the respondents who were unlikely noted they already had at least one).
- "Bee lawns" and turf alternatives in general were the clear favorite topics—our next workshop series will definitely include more information about these.

- 95%+ of respondents rated the workshop experience, the presenters, and the information presented "above average" or "excellent".

**OTHER EDUCATION PARTNERS**

The City of Minneapolis has an official arrangement with the Bassett Creek Watershed Management Commission (BCWMC) to provide financial contributions to the watershed through an annual assessment. This assessment provides funding for the commissions administrative operations and its public education program.

Education-related activities of the BCWMC are guided by its 2015 Watershed Management Plan, specifically its education and outreach policies (Section 4.2.9), and its overall Education and Outreach Plan found in Appendix B. The specific activities of the BCWMC public outreach and education program are set annually by the Commission after recommendations are forwarded by the BCWMC Education and Outreach Committee. The 2017 BCWMC education and outreach activities can be found in Appendix A1.

The Shingle Creek Watershed Management Commission (SCWMC) conducts education and public outreach activities on behalf of its member cities as well. A detailed report on the 2017 SCWMC education and outreach activities can be found in Appendix A2.

## MINIMAL CONTROL MEASURE TWO: PUBLIC PARTICIPATION

### PROGRAM OBJECTIVE

The objective of this stormwater management program is to maximize the effectiveness of the City's NPDES program by seeking input from the public.

Targeted pollutants include:

All pollutants

### PROGRAM OVERVIEW

The City of Minneapolis and the MPRB are the joint holders of the NPDES MS4 Permit, and the Annual Report is a coordinated effort by various City departments and the MPRB. The Permit requires an opportunity for public input in the development of the priorities and programs necessary for compliance.

The Permit requires the implementation of approved stormwater management activities, referred to as Best Management Practices (BMPs). As outlined in Part V.A. of the Permit, the Stormwater Management Program (SWMP) is based on an adaptive management system by which the Permittees continuously monitor, analyze and adjust the Program to achieve pollutant reductions. Using the adaptive management approach, revisions to the SWMP are submitted along with the Annual Report.

Each year, the City holds a public hearing at a meeting of the Transportation & Public Works Committee of the City Council, prior to submission of the Annual Report. The hearing provides an opportunity for public testimony regarding the Program and Annual Report prior to report submittal to the Minnesota Pollution Control Agency. The hearing is officially noticed in the Finance and Commerce publication, and also publicized through public service announcements on the City cable television channel. This year's public hearing date was June 5, 2018 at 10:00 AM in Council Chambers, Room 317 City Hall, 350 S 5th Street, Minneapolis, MN. A copy of the presentation, a list of public notice recipients, public comment received, and the staff letter can be found in the City's Legislation Management System (LIMS).

A notice of the opportunity for public comment along with availability of the Stormwater Management Program, was sent to the 81 Minneapolis neighborhood organizations, to the governmental entities that have jurisdiction over activities relating to stormwater management, and to other interested parties announcing the web site link, and informing that written comments were being accepted until Noon on June 15, 2018.

The notice explained that emails were the preferred methods for submitting written comments, rather than conventional mail due to the additional time involved. The contact information for written comments was listed as:

City of Minneapolis
Department of Public Works
Surface Water & Sewers Division c/o Liz Stout
300 City of Lakes Building, 309 2nd Avenue S, Room 300
Minneapolis MN 55401-2268

Phone: 612-673-5284 Fax: 612-673-2048
E-mail: Elizabeth.stout@minneapolismn.gov

All testimony presented at the public hearing, and all written comments received, are recorded and given due consideration. The comments are included with the Annual Report as Appendix C. A copy of the City Council resolution adopting the Stormwater Management Program and Annual Report Activities is included each year with the submission to the Minnesota Pollution Control Agency. The Stormwater Management Program and the Annual Reports are available for viewing or downloading.

## PREVIOUS YEAR ACTIVITIES

98 interested parties, including 81 neighborhood organizations were directly notified of public hearing, Stormwater Management Program (SWMP) availability, and proposed SWMP changes. The comments that the city received are incorporated in Appendix A3.

## MINIMAL CONTROL MEASURE THREE: ILLICIT DISCHARGE DETECTION AND ELIMINATION

### PROGRAM OBJECTIVE

The objective of this program is to minimize the discharge of pollutants to lakes, creeks, wetlands, and the Mississippi River by appropriately responding to spills and to detect, investigate and resolve illegal dumping, and disposal of unpermitted, non-stormwater flows in the City's stormwater drainage system including pipes, gutters, swales, and other conveyance infrastructure.

Targeted pollutants include:

All pollutants

### PROGRAM OVERVIEW

**DRY WEATHER FLOW SCREENING**

The City has implemented a storm drain outfall inspection program that includes inspections for flows during dry weather as an approach to identification of Illicit Discharge Detection and Elimination (IDDE) sources. If dry weather flows are detected during an inspection, then a grab sample is collected for analysis to determine if pollutants are present. City Public Works Field Services and Department of Health Environmental Services work together to discover the source and ultimately to eliminate the illicit flows.

**TYPICAL HAZARDOUS SPILL RESPONSE**

The immediate goals of hazardous spill response are safety, containment of the spill, recovery of hazardous materials, and collection of data for use in assessment of site impacts. Motor vehicle collisions and electrical transformer overloads are examples of accidental releases, and results can include untreated waste and hazardous materials including heavy metals, toxics and solvents.

The life cycle of an event requires personnel from various departments within the City and outside agencies to work as a team, utilizing available resources to protect people, the environment, and property. Training and response procedures are coordinated among the Regulatory Services, Public Works, and Fire Departments. The Regulatory Services Hazardous Materials Manager is responsible for coordinating recovery efforts. Events are followed by post-action debriefings to determine the causes of the events, to identify measures to improve the City's response, and to determine the means to limit future occurrences. As the assessment of the event progresses, other departments and/or outside agencies or contractors may become involved. Full procedures are documented in the City of Minneapolis Emergency Action Plan.

For small spills of petroleum products or other vehicle fluids, personnel are dispatched with appropriate equipment to apply sand or floor-dry. Once the sand or floor-dry has absorbed the spill, it is removed and then deposited in a leak-proof container. For large or extremely hazardous spills, a Hazardous Materials Response Team is also mobilized and augmented with staff from additional departments, outside agencies and/or contractors if warranted as the event progresses. For spills that reach the Mississippi River or Minneapolis lakes, boats are available for spill response and personnel are trained in boom deployment.

Spills are reported to the MPCA Public Safety Duty Officer, 911 Emergency Communications and, for qualified spills, to the State Duty Officer as required by law.

The protocol used by the Street Maintenance section for handling spills is documented in Appendix A4: Standard Operating Procedure for Vehicle Related Spills (VRS).

**EMERGENCY RESPONSE PROGRAM**

The Department of Regulatory Services operates a boat for use on the Mississippi River and other Minneapolis water bodies, to be able to respond to spills that could impact our valuable water resources. The presence of a properly equipped boat facilitates addressing these events on the Mississippi River as well as on City lakes. Regulatory Services and Public Works staff are trained in the river deployment of booms, have field experience in placement of both containment and absorbent types of booms, and have years of experience on the water. These skills, coupled with an extensive level of knowledge of the Mississippi River, City lakes, landings, and outfalls, provide a high

*Boom Deployment Drill*

level of protection for our precious natural resources.

Additionally, Regulatory Services uses the boat for the placement of monitoring and sampling equipment used for tracking water quality, identifying points of illegal discharges, assessment of outfalls, and investigation of complaints that are inaccessible from shore. The City assists the Mississippi Watershed Management Organization (MWMO) in conducting a sampling program of the storm drainage system that drains to the Mississippi River. The intent of this sampling is to detect illegal discharges, and to establish a baseline of chemical, physical, and biological parameters.

**UNAUTHORIZED DISCHARGES**

City Environmental Services personnel carry out pollution prevention and control activities. Results are achieved through educational efforts, inspections, and coordinated community outreach events. These activities include enforcement pursuant to applicable City codes, and coordination with other regulatory agencies at the county, state and federal levels. Enforcement yields identification of the responsible party, documentation of clean-up activities, and also endeavors to reduce the flow of pollutants from illegal dumping and disposal. Response is made to reports of unauthorized discharges and illicit connections.

Complaints are received from the public, City and private contractors, City staff and other government agencies, by the following means:

- Environmental Management Complaint Form.
- Confidential calls to Minneapolis Information & Services. Within Minneapolis, the phone number is 311. Outside of Minneapolis, the phone number is 612-673-3000.
- Reports from sewer maintenance crews, plumbing inspectors, and other City personnel**.** These reports may be received directly by Environmental Services or submitted to Minneapolis 311.
- Reports received from the State Duty Officer.

Additionally, on occasion the Public Works-Surface Water & Sewers Division provides site investigation and mapping assistance to the MPCA related to the Minnesota Pollution Control Agency's permit enforcement and compliance programs for various types of discharges.

**DETECTION AND REMOVAL SCREENING PROGRAM**

The field screening program to detect and investigate contaminated flows in the storm drain system is an integral part of daily operations for personnel of Public Works Surface Water & Sewer Operations, Environmental Services, and Regulatory Services. Maintenance crews routinely inspect and clean storm drain structures throughout the City. In addition, inspections of flows that generate unusual odors, stains, and deposits are included in the annual tunnel inspection, outfall inspection, and grit chamber inspection and cleaning programs. Any suspect flows are then reported to Environmental Services inspectors for further investigation. Environmental Services personnel also receive reports of alleged illicit discharges to the storm drain system from the public, other City departments, and various agencies. These combined efforts result in an annual screening of more than 20% of City drainage areas.

**FACILITY INSPECTION PROGRAM**

Inspectors perform site visits of facilities that store large quantities of regulated and hazardous materials. Inspections include review of handling, storage and transfer procedures as they relate to the site, spill response plans and equipment on site, employee training on spill response procedures, and identification of the required spill response contractor. The Minneapolis Fire Inspection Services participates in the majority of inspections, reviewing spill response strategies. In addition, site plan inspections also look at drainage patterns from the site to the nearest storm sewer inlet or water body and the watershed destination and outlet location.

*Boom Deployment*

## PREVIOUS YEAR ACTIVITIES

**DRY WEATHER FLOW SCREENING**

In 2017 the City visited 261 outfalls. Of those 66 were fully inspected, 138 were submerged and will be re-inspected as conditions allow, 22 were inspected by have follow-up needed (damaged, need cleaning, etc.), and 35 were identified in the field that are not part of the city's GIS system of record.

**SPILL RESPONSE**

City of Minneapolis Fire Inspection Services responded to 27 Emergency Response requests. In addition, the Minneapolis Fire Department also responds to a number of these requests. The response time varies between 5 to 20 minutes depending on Fire Department response and type of Emergency Response request. The City responded to four spill incidents on the Mississippi River where containment boom was deployed. Minneapolis Fire Inspection Services, Minneapolis Public Works (Surface Water & Sewers Division) and MPCA participated in these efforts.

Fire Inspections Services participated as an instructor at WAKOTA CAER Boom School. Spill response planning, boat safety, boom deployment techniques and oil spill recovery are covered.

**OUTFALL MONITORING**

36 days of outfall sampling were conducted, including visual inspections of outfalls and developing spill response strategies by boat. Participating agencies included Minneapolis Fire, Minneapolis Public Works, Minnesota Pollution Control Agency (MPCA) and Mississippi Watershed Management Organization (MWMO).

**SPILL RESPONSE/CONTAINMENT BOOM DEPLOYMENT TRAINING**

*Mississippi River Spill Drill/Training Exercise*


Minneapolis Public Works, Minneapolis Fire, Minneapolis Regulatory Services and the Minnesota Pollution Control Agency (MPCA) conducted a Spill Response Training/Exercise on the Mississippi River on June 21, 2017. Spill response strategies and Standard Operating Procedures (SOPs) were discussed and storm sewer outfall map reading was reviewed.

The training scenario was a 1,000 gallon gasoline spill from a tanker truck, on the street and into the storm sewer system, to the outfall on the Mississippi River. See the map above for the training location.

The goals for the training were:

- Responder/ public safety
- Discussion of evacuation/shelter in place
- Air monitoring, sewer monitoring

Flushing of the storm sewer system
River safety procedures
Spill boom deployment

*Waterworks Drill/Training*

Minneapolis Public Works, Minneapolis Fire, and Minneapolis Regulatory Services conducted 3 Spill Response/Boom deployment trainings at Minneapolis Waterworks. Each shift of Minneapolis Fire participated in the training.

Using the spill boom deployment system developed at Waterworks to protect the water intakes, staff deployed boom, Fire and Regulatory Services placed and secured the spill boom.

*University of Minnesota Spill Drill*

Spill drill training was conducted in partnership with the University of Minnesota, an MS4 that owns and operates storm sewer facilities within the City of Minneapolis. The University is responsible for several outfalls that discharge directly to the Mississippi River.

**FACILITY INSPECTION PROGRAM**

City staff conducted inspections on 46 TIER II Hazardous Materials Facilities. Inspections include review of the storage of hazardous materials, spill response plans and equipment on site, employee training on spill response procedures, identification of required spill response contractor. The Minneapolis Fire Department participates in the majority of inspections, reviewing spill response strategies.

376 Emergency Response plans for TIER II Hazardous Materials Facilities were reviewed. Reviews include hazardous materials storage and spill response plans.

## MINIMAL CONTROL MEASURE FOUR: CONSTRUCTION RELATED EROSION AND SEDIMENT CONTROL

### PROGRAM OBJECTIVE

The objective of this stormwater management program is to minimize the discharge of pollutants through the regulation of construction projects. Regulation addresses erosion and sediment control for private development and redevelopment projects and for public projects completed by the City and the MPRB. Minneapolis Code of Ordinances Title 3 Air Pollution and Environmental Protection, Chapter 52 Erosion and Sediment Control and Drainage contains erosion and sediment control requirements and other pollution control requirements related to construction site management.

Targeted pollutants include:

Phosphorus

Total Suspended Solids (TSS)

### PROGRAM OVERVIEW

**ORDINANCE**

In 1996 the Minneapolis City Council amended Title 3 of the Minneapolis Code of Ordinances relating to Air Pollution and Environmental Protection by adding Chapter 52, entitled *Erosion and Sediment Control for Land Disturbance Activities (*now *Erosion and Sediment Control and Drainage*. This ordinance was most recently updated in 2013 and is expected to be updated again in 2019.

**REQUIREMENTS**

The City's Erosion and Sediment Control ordinance addresses development sites, demolition projects, and other land disturbing activities. Sites disturbing more than five cubic yards, or 500 square feet, are required to have an erosion control permit. Erosion and Sedimentation Control (ESC) Permits must be acquired prior to commencement of work and must be obtained before a building permit will be issued for the site. If there will be a disturbance of greater than 5,000 square feet, an approved erosion control plan is also required for demolition and construction projects before the ESC Permit can be issued.

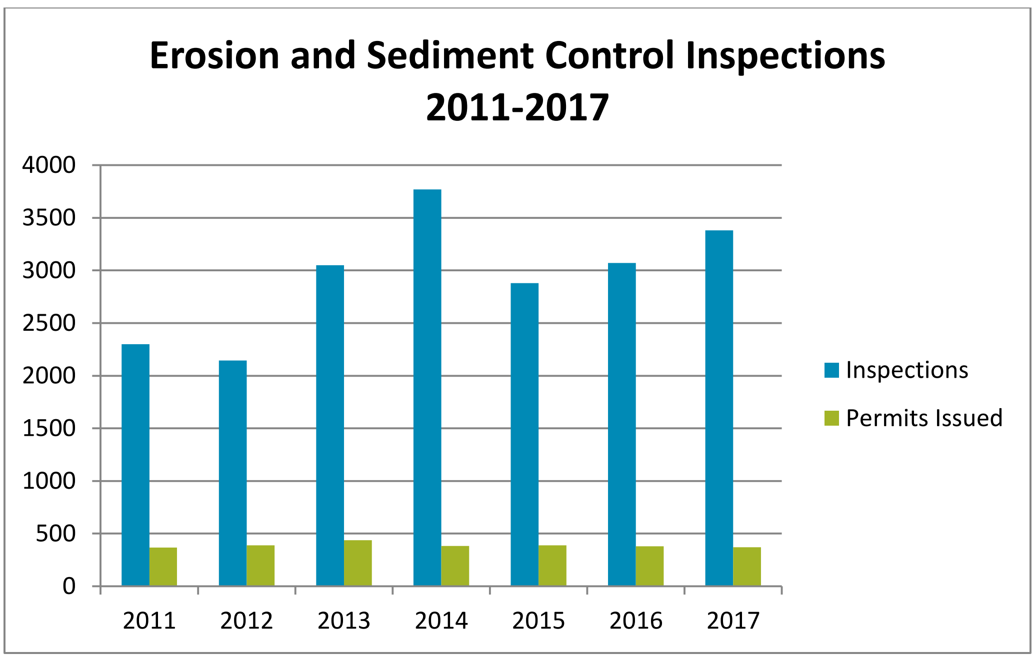
**Enforcement**

Ongoing site inspections are performed by City Environmental Services inspectors. Inspectors may issue citations and fines. Failure by the permittee to comply with the ordinance will constitute a violation pursuant to Section 52.300. If there is a demonstrated failure to comply, the City reserves the right to terminate an ESC permit at any time. The City then has the option of proceeding with the necessary restoration of the site. This restoration would be done at the expense of the owner/permittee.

## PREVIOUS YEAR ACTIVITIES

Generally, since 2011 the number of sediment and erosion control permits issue has remained relatively consistent, ranging from 438 in 2013 to 367 in 2011. Despite the fact that the number of permit issued by the City has been consistent there has been an increase in the number of inspections. The City has four environmental inspectors that address sediment and erosion control enforcement and for the last several years the City has hired four additional interns to help increase inspection frequency during the busy summer months.

| Year | Permits Issued | Cases | Inspections | Enforcement Actions | Citations |
|---|---|---|---|---|---|
| 2010 | | | 1943 | 194 | 33 |
| 2011 | 367 | | 2300 | 142 | 32 |
| 2012 | 388 | | 2144 | 147 | 34 |
| 2013 | 438 | | 3048 | 353 | 113 |
| 2014 | 384 | 433 | 3769 | 237 | 77 |
| 2015 | 388 | 1832 | 2880 | 250 | 77 |
| 2016 | 381 | 674 | 3071 | 259 | 51 |
| 2017 | 372 | 674 | 3379 | 349 | 109 |




In 2017 the City worked with the University of Minnesota Extension Service to develop and implement a construction site management training for City employees. The pilot training involved approximately 70 Public Works Water Treatment and Distribution field staff. This training will be implemented across Public Works in 2018/2019.

## MINIMAL CONTROL MEASURE FIVE: POST-CONSTRUCTION STORMWATER MANAGEMENT FOR PUBLIC AND PRIVATE PROJECTS

### PROGRAM OBJECTIVE

The objective of this stormwater management program is to reduce the discharge of pollutants and stormwater runoff from public and private development and redevelopment projects, as compared to conditions prior to project construction. Redevelopment of existing sites presents the opportunity to lessen the impacts of urbanization on the lakes, creeks, and the Mississippi River in Minneapolis since most present land uses were created prior to regulation under the Clean Water Act.

Regulation includes approval of stormwater management including ongoing operation and maintenance commitments. Minneapolis Code of Ordinances Title 3 Air Pollution and Environmental Protection, Chapter 54 (Stormwater Management) contains stormwater management requirements for developments and other land-disturbing construction activities.

Targeted pollutants include:

Phosphorus

Total Suspended Solids (TSS)

### PROGRAM OVERVIEW

**ORDINANCE**

In 1999 the Minneapolis City Council amended Title 3 of the Minneapolis Code of Ordinances (relating to Air Pollution and Environmental Protection) by adding Chapter 54, which is entitled *Stormwater Management*. The ordinance establishes requirements for permanent stormwater management for development/redevelopment projects on sites that are greater than one acre. This ordinance is anticipated to be updated in 2018/2019.

Inspecting Private Stormwater BMPs

The ordinance sets standards according to the specific receiving water body or type of water body. These standards include but are not limited to:

- Controlled rate of runoff to all receiving water bodies.
- Reductions of TSS for discharges to all receiving water bodies.
- Reductions in nutrients for stormwater that discharges to lakes and wetlands.
- Maximizing infiltration by minimizing the amount of impervious surface.

- Employing natural drainage and vegetation.

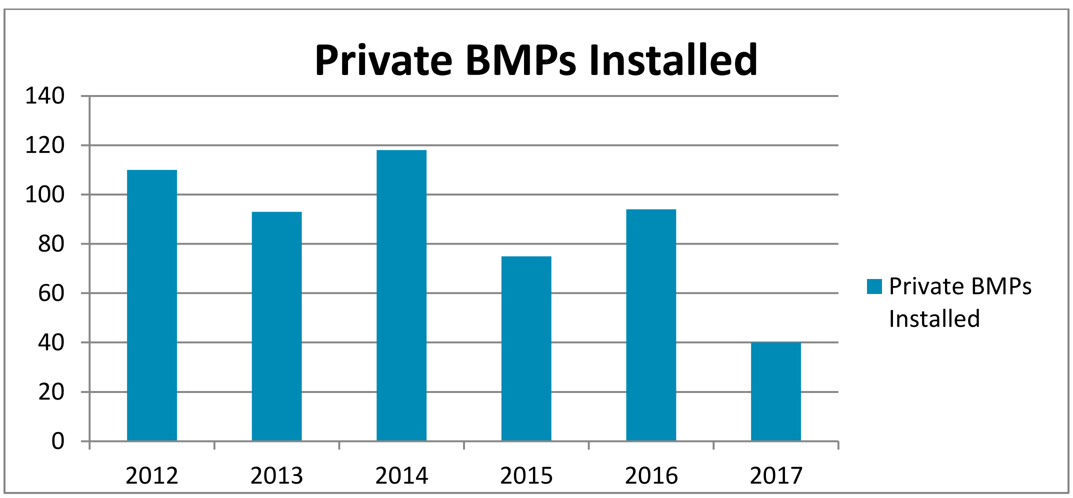
**REQUIREMENTS**

Redevelopment of existing sites provides an opportunity to lessen the negative impacts of existing urbanization on the Mississippi River and other Minneapolis water resources. Stormwater management plans are required for all construction projects disturbing sites greater than 1 acre in size. Sites less than 1 acre are also encouraged to incorporate stormwater Best Management Practices (BMPs) in their design as a means of satisfying other City codes such as green space requirements. Plans are reviewed through the Minneapolis Development Review (MDR) process and approved by the Minneapolis Public Works Surface Water & Sewers Division.

Operation and Maintenance Plans for BMPs are required as part of the approval process. Inspections and document checks are carried out at least annually or as needed, to ensure that the BMPs continue to function as approved. Once constructed and inspected for compliance with approved plans, the BMP stormwater device systems are registered with the City of Minneapolis Environmental Services, with an annual Pollution Control Annual Registration (PCAR) fee required for each stormwater device system registered.

**PREVIOUS YEAR ACTIVITIES**

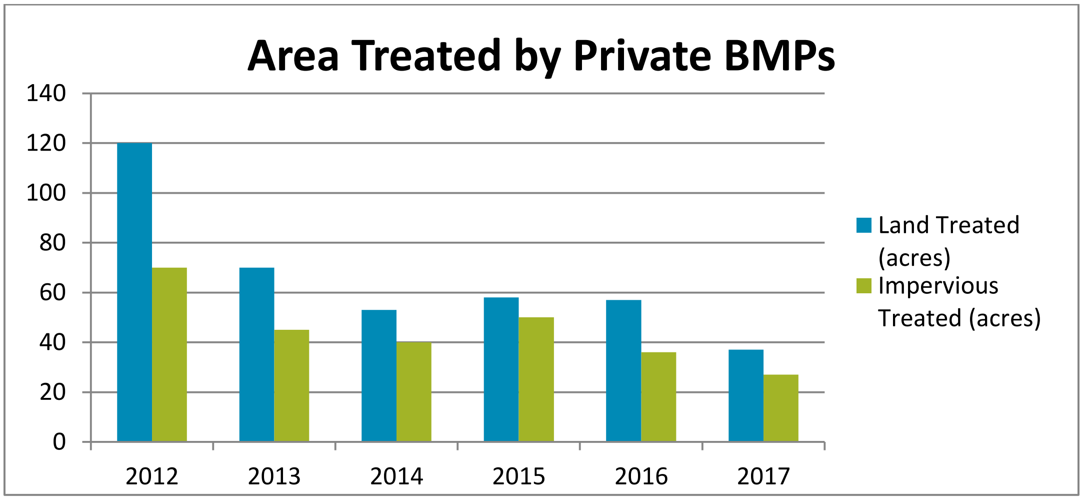
During 2017, Minneapolis Public Works took part in the preliminary review of 150 projects. Of those 150 site plans, 94 projects with a total of 40 BMPs received final approval, with the appropriate permits issued. These BMPs will provide rate control and water quality for approximately 37 acres of land, including 27 acres of impervious area.




Common BMP types included:

- Rain gardens
- Pervious pavement
- Infiltration basins
- Filtration basins
- Detention ponds
- Underground infiltration chambers/pipe galleries

- Underground storage/detention chambers
- Proprietary filter chambers
- Bio-swales



## MINIMAL CONTROL MEASURE SIX: POLLUTION PREVENTION AND GOOD HOUSEKEEPING FOR MUNICIPAL OPERATIONS

### STORM DRAIN SYSTEM OPERATIONAL MANAGEMENT AND MAINTENANCE

**PROGRAM OBJECTIVE**

The objective of this NPDES stormwater management program is to minimize the discharge of pollutants through the proper operational management and maintenance of the City's storm drain system, streets, alleys, and municipal property. The City of Minneapolis contributes stormwater runoff to various receiving waters within the community and outside of the City's boundaries, including Minnehaha Creek, Bassett Creek, Shingle Creek, a number of lakes, and the Mississippi River. Maps of the drainage areas that have been delineated according to topographic contours and the storm drain system are included in Appendix B. The 1990 population, size of drainage area, and land use percentages by body of receiving water are listed in Appendix A5.

Targeted pollutants include:

Total Suspended Solids (TSS)

Nutrients

Floatable Trash

**PROGRAM OVERVIEW**

The City's storm drain system is managed and maintained by the Operations section of the Public Works Department Surface Water & Sewers (PW-SWS) Division. Design engineering and regulatory issues are managed by the division's Capital and Regulatory sections, respectively.

The City has introduced Maximo™ as an asset management system to compile assets, track work orders, and assist in work scheduling and purchasing. The City launched the work order functions of the Maximo™ software in spring, 2017.

The City's goals in implementing Maximo™ include identifying the current state of assets and asset attributes (e.g., age, condition, etc.) and developing a standardized rating process for assets and asset attributes (e.g., National Association of Sewer Services Companies (NASSCO) Pipeline Assessment and Certification Program (PACP)).

Brick Egg-type Sewer

Operations is looking to Identify risk areas, criticality of system, and life-cycle costs. This will improve future decision-making as a result of data and analysis (e.g., succession planning, level of maintenance response, capital improvement project (CIP) prioritization), improve documentation and recordkeeping of assets (e.g., Maximo software), improve coordination and communication, lower long-term operation and maintenance costs, improve regulatory compliance, and be used as a communication tool for staff and regulators for effective information transfer and knowledge retention.

An appropriate higher staffing level is a key component for achieving the City's overall goals. The current staffing level of the Operations section is approximately 113 full-time employees, up from 75 in 2013. This increase is anticipated to bring about a more proactive approach, including pollution prevention that the City is striving for. For the Operations section, there are currently 63 permanent, full-time and 6 seasonal employees working directly within the operations and maintenance area, and the remainder work within the construction area. General operations and maintenance efforts include pump station and pipeline inspections, pipeline cleaning, system repairs, rehabilitation or reconstruction, inspection and operation of control structures, operation of pump stations, cleaning of water quality structures, and operational management of stormwater detention ponds.

The table below shows the base operational functions along with the corresponding staffing:

| Crews | Staff/crew | Type | Tasks |
|---|---|---|---|
| 4 | 2 | Route Truck | Daily pipe line system inspections, complaint response, and resolution to minor system operational problems |
| 5 | 2 | Jet Truck | "As-requested" cleaning of storm system components, routine cleaning of sanitary system pipes, and "as-requested" cleaning of pump/lift stations. Hydro jet-wash technique. |
| 3 | 2 | Jet-Vac Truck | Routine cleaning of sanitary system pipes. Hydro jet-wash technique. Sanitary sewer cleaning by vacuum removal of sludge and debris build-up |
| 3 | 2 | TV Truck | Televise and inspect storm drain and sanitary sewer system components. Log and assess condition of televised lines to determine and prioritize rehabilitation and/or repair needs to storm drain and sanitary sewer system components. |
| 2 | 2 | Repair Truck | Perform medium-sized repairs, requiring minimum excavation, to storm drain and sanitary sewer system pipeline components. May assist in the repair or reconstruction of larger repair/ reconstruction jobs. |

| | | | |
|---|---|---|---|
| 2 | 2 | Vacuum Truck | Vacuum-cleaning of water quality structures, manholes, and catch basins within the storm drain system. Assist in sanitary sewer cleaning by vacuum removal of sludge and debris build-up. Assist in repair/ construction activities using vacuum excavation process. Assist in erosion control compliance using vacuum cleanup of eroded soils and/or cleaning of erosion control structures. |
| 1 | 2 | Rod Truck | Remove roots and foreign objects from sanitary sewer system. Remove large debris from storm drain pipes and free ice from frozen catch basin leads. |
| 2 | 1 | Pond & Pump | Operate, maintain, and repair sanitary lift station and stormwater pump stations. Operate and maintain stormwater detention basins. |
| 1 | 1 | Shop | Perform general maintenance and repair to specialty use vehicles and emergency response equipment. Fabricate, as needed, custom metal and wood objects for sewer and storm drain operations. Provide field deliveries of materials, tools, and equipment. Maintain material inventory and fleet management data. |

In 2016 the City began developing Stormwater Pollution Prevention Plans (SWPPPs) for City and MPRB owned facilities to reduce the discharge of pollutants into the storm sewer system from municipal and Park Board operations. Site specific plans have been developed for each facility which include site maps, operations specific Best Management Practices, and inspection and reporting requirements. An inventory of municipal operations facilities has been created which includes over 90 facilities; examples include Vehicle and Equipment Maintenance Facilities, Fleet Services, Parking Lots and Ramps, Fire Stations, Police Stations, Water Services Facilities, Stockyards, MPRB Service Centers, and MPRB Dog Parks. Plan development is being prioritized by facilities with the highest pollutant potential.

These facility plans are being used to facilitate monthly site inspections that will document all potential sources of pollution or illicit discharge to the storm sewer system from City or MPRB owned properties. Once routine monthly inspections have been well established the inspection frequency will be evaluated and increased or decreased as needed based on site specific needs such as continuing or ongoing issues, seasonal site usage, or change in property use. Ultimately the plans will lead the City to install additional structural BMPs where needed for long-term pollution prevention at City and MPRB facilities.

The City also implemented a pilot program in 2017 to look at trash in Lake Hiawatha. A University of Minnesota Capstone group analyzed options for trash mitigation within the Lake Hiawatha watershed and provided several alternatives for addressing this issue. That study can be made available upon request. Building off of that research project the City installed three trash screens within the watershed to capture trash and other floatable debris upstream of the lake. City crews will be monitoring the trash screens and tracking the amount of trash removed from the watershed. See Appendix A6 for details.

**PREVIOUS YEAR ACTIVITIES**

Some of the noteworthy 2017 cleaning and repair statistics are summarized in the following list:

- Completed repairs on 318 catch basins.
- Cleaned 943.9 miles of storm drain utilizing hydro-jet washing and removed 1,681 cubic yards of sediment/material.
- Televised and condition assessed 100 miles of storm drain pipes.
- Continued repairs of 4,050 feet of storm tunnel.
- Work on the 10th Avenue SE and Central City tunnels continues, which is improving the condition of the structures and reducing erosion/transfer of the sandstone outside of the tunnel. This is decreasing transport of sand particles/solids to the Mississippi River.



## WATER RESOURCE FACILITIES OPERATIONAL MANAGEMENT AND MAINTENANCE

**PROGRAM OBJECTIVE**

The objective of this NPDES MS4 stormwater management program is to minimize the discharge of pollutants through the proper operational management and maintenance of water resource facilites within the City's storm drain system that affect system flow rates and water quality discharges.

Water resource facilities include:

- Retention Ponds (Wet)

- Detention Pond (Dry)
- Bio (in)filtration Basins (Rain Gardens)
- Tree Trenches, some with Silva Cells, and Pervious Pavers
- Underground Structural Sedimentation Devices (Sumps, Detention Pipes, Detention Chambers)
- Underground Structural Infiltration Devices
- Underground Structural Filtration Devices
- Hydrodynamic Separators (Proprietary Units; Stormceptor, CDS, Bay Saver, etc.)
- Outfall Structures
- Pump Stations and Level Control Weirs
- Catch Basins

Targeted pollutants include:

Total Suspended Solids (TSS)

Nutrients

Floatable Trash

**PROGRAM OVERVIEW**

Water resource facilities that are part of the City's overall storm drainage system are operationally managed and maintained by the Operations section of the Public Works Surface Water & Sewers Division. These components are routinely inspected and maintained to ensure proper operation and reliability. Frequency of inspections and assigned maintenance efforts are based on both operational experience and incurred environmental events.

By agreement with the City of Minneapolis and the MPRB, the Minnehaha Creek Watershed District monitors the design capacity of several stormwater ponds in Minneapolis and performs dredging and restoration as needed including testing for proper disposal. The MPRB also maintains small scale Park Board stormwater devices including ponds, rain gardens, and pervious pavement.

Water resource facilities for water quality improvement are separated into five separate categories:

*Pretreatment Practices*

Pretreatment is an integral part of BMP application. In many applications (infiltration and stormwater ponds) the practice would not function properly if pre-treatment is ignored. The purpose of pre-treatment techniques is the necessity to keep a BMP from being overloaded, primarily by sediment. Pretreatment can also be used to dampen the effects of high or rapid inflow, dissipate energy, and provide additional storage. All of these benefits help overall BMP performance.

Vegetated Swale at 25th Ave. SE

Types of pre-treatment practices include settling devices such as grit chambers, sump manholes and catch basins – sometimes enhanced with SAFL baffles, forebays, oil/water separators, and vegetated filter strips. Street sweeping is also an effective pretreatment practice.

### *Filtration Practices*

Filtration BMPs treat urban stormwater runoff as if flows through a filtering medium, such as sand or an organic material. They are generally used on small drainage areas and are primarily designed for pollutant removal. They are effective at removing total suspended solids (TSS), particulate phosphorus, metals, and most organics. They are less effective for soluble pollutants such as dissolved phosphorus, chloride, and nitrate. Most filtration BMPs will achieve some volume reduction, depending on the BMP design and the use of vegetation to promote evapotranspiration. Filtration practices used in the City include rain gardens with underdrains and iron enhanced sand filters.


Vegetated Swale at Redeemer Church

### *Infiltration Practices*


12x10 Infiltration Box Culvert Installation

Infiltration BMPS treat urban stormwater runoff as it flows through a filtering medium and into underlying soil, where the water eventually percolates into groundwater, while the pollutants are removed from the runoff, either by being trapped within the practice for eventual removal after a period of accumulation, or broken down by chemical processes within the first few feet of soil (natural attenuation). The filtering media is typically coarse-textured and may contain organic material, as in the case of bio-infiltration BMPs. These practices are primarily designed for removal of stormwater runoff volume and pollutants in that runoff. They are effective at removing total suspended solids, (TSS), particulate phosphorus, metals, bacteria, nitrogen, and most organics. Soluble pollutants such as chloride and nitrate typically percolate through these BMPs and into underlying groundwater. These BMPs, when designed with no underdrain, include rain gardens, tree trenches (including Silva Cell systems), underground infiltration, and infiltration trenches including dry wells.


Infiltration Box Culvert – inside view

### *Sedimentation Practices*

Sedimentation is the process by which solids are removed from the water column by settling. Sedimentation practices include dry ponds, wet ponds, wet vaults, and proprietary devices. Proprietary hydrodynamic devices are limited to treating small tributary areas while constructed ponds and constructed wetlands are able to be designed to treat the runoff from a much larger tributary area. These BMPs provide temporary storage of stormwater runoff and allow suspended solids to settle and be retained by the stormwater treatment practice. These BMPs are effective at removing total suspended solids (TSS) and any pollutant adsorbed to the solids but that are not effective in removing soluble pollutants or in providing any volume reduction.

In 2017 a new protocol was implemented for cleaning out sump structures, grit chambers, hydrodynamic separators, and other underground sedimentation facilities. Instead of pumping standing water in the practice to the nearby storm sewer system or discharging it to a grassed area this water will now be pumped to the sanitary sewer prior to removal of sediment. It was found that this water was exceptionally high in bacteria and the change was made to try to mitigate the amount of bacteria in receiving waters, especially Minnehaha Creek which has a bacteria impairment.

### *Chemical Practices*

Stormwater BMPs that employ chemical treatment are typically designed for treatment of a specific pollutant. Phosphorus is the most common pollutant of concern, but chemical treatment may also be employed for nitrogen, metals, and organic pollutants. The City has installed iron-enhanced sand filters and the MPRB has historically used alum as an in-lake treatment to enhance settling of suspended sediment and phosphorus by encouraging flocculation.

The City also employs structural controls to manage stormwater runoff that are not directly related to water quality. These include:

### *Storm Drain Outfalls*

These are the structural ends of system pipelines where conveyance of stormwater runoff is discharged into receiving water bodies. Outfalls are inspected on a 5-year schedule. Site inspections evaluate the general condition of structures, determine if any significant erosion has occurred and observe any contaminant discharges. When indications of illicit or otherwise contaminated discharges are observed, they are reported to Minneapolis Environmental Services for reporting to the Minnesota State Duty Officer for further investigation and resolution. Any identified structural repair or maintenance work is prioritized and scheduled considering available personnel, budget funding, and coordination with other essential operations. Appendix A7 contains outfall maintenance information.

*Pumps & Weirs*

These are structural devices that mechanically affect the flow of stormwater runoff through the storm drain system. Pump stations are inspected on a regular basis for routine operational checks and are inspected annually for detailed condition assessment. Maintenance and/or repairs are performed with routine items being completed as needed and larger items being coordinated into a budgeted pump station operation program. Weirs and outlet structures are inspected and repaired as needed to facilitate their proper operational working order.

Grit Chamber Construction at Dean Pkwy

*Catch Basins*

These are structural devices located along the City's street system that provide entrance of stormwater runoff into the storm drainage system. Public Works crews routinely look for plugged or damaged structures. Reported damages and/ or plugs are given a priority for repair and/or cleaning. Cleaning catch basins, also known as storm drain inlets, while ensuring proper runoff conveyance from City streets, also removes accumulated sediments, trash, and debris. Augmenting this effort is the street sweeping program that targets the pick-up of street sands, leaves, and debris prior to their reaching catch basins. Repair of damaged catch basins is also a priority, given their location in City streets and ultimate impact to the traveling public.

**PREVIOUS YEAR ACTIVITIES**

- Inspected and maintained 392 public Stormwater BMP's including the following:
    - 11 Bio-retention Facilities
    - 23 Infiltration Rain Gardens
    - 7 Filtration Rain Gardens
    - 16 Wet Detention Ponds
    - 14 Filtration Basins
    - 4 Infiltration Basins
    - 1 Pervious Paver Plaza
    - 9 Underground Structural Infiltration Devices
    - 58 Silva Cell Systems
    - 3 Constructed Stormwater Wetlands
    - 5 Dry Swales
    - 4 Aggregate Filters
    - 2 Underground Structural Sand Filters
    - 1 Natural Wetland
    - 36 Green Sump Catch Basins
    - 43 Wet Vaults
    - 8 Sedimentation Storage Pipes

- 53 Sump Manholes
- 71 Hydrodynamic Separators
  - 5 Stormceptor
  - 61 CDS
  - 2 Eco Storm
  - 2 Bay Saver
  - 1 Vortechnics

- Inspected 131 of 455 storm drain outfalls in 2017 condition assessment inspection program (additional outfalls were inspected as part of the dry weather flow screening discussed under Section 3).

- Monitored and maintained 25 pump stations.

- Continued storm pump stations rehabilitation project. Anticipated completion in 2019.

- Dredged four stormwater management ponds over the winter of 2016/2017. Approximately 8,600 cubic yards of dredged material was removed along with invasive shoreline vegetation and cattails surrounding the ponds.

## DISPOSAL OF REMOVED SUBSTANCES

**PROGRAM OBJECTIVE**

A key component of the MS4 stormwater management program is collection and disposal of materials removed from the storm drain system and structural controls in a manner that will prevent pollution and that will comply with applicable regulations.

Targeted pollutants include:

Sediment

Nutrients

Floatable Trash

Additional pollutants analyzed for stormwater pond sediment dredging are Copper, Arsenic, and Polycyclic Aromatic Hydrocarbons (PAH)

**PROGRAM OVERVIEW**

Accumulated materials are removed from grit removal structures, catch basins, system piping, and deep drainage tunnels during the process of inspection and cleaning. Removed substances are screened for visual or olfactory indications of contamination. If contamination of the material is suspected, the City's Engineering Laboratory will select representative samples for an environmental analysis. Contaminated substances are disposed of in a landfill or another site that is approved by the MPCA. Non-contaminated targeted pollutants are disposed of the same way as street sweepings. During cleaning and disposal operations, erosion control measures are applied when needed to prevent removed material from re-entering the storm drain system.

The process for accumulated materials dredged from stormwater ponds is similar. The materials to be dredged from stormwater ponds are tested in advance and disposed of properly according to MPCA guidance.

**PREVIOUS YEAR ACTIVITIES**

In 2017, Minneapolis Public Works crews removed approximately 312 cubic yards of sediment and debris from grit chambers, and approximately 1,681 cubic yards from storm drains during hydro-jet washing operations.  Four stormwater ponds were dredged over the winter of 2016/2017. Approximately 8,600 cubic yards of material was dredged and disposed of.

## ROADWAYS

**PROGRAM OBJECTIVE**

The objective of this stormwater management program is to minimize the discharge of pollutants through the proper operation and maintenance of public streets, alleys, and municipal equipment yards.

Targeted pollutants include:

TSS

BOD5

COD

Phosphorus

Chlorides

**PROGRAM OVERVIEW**

*Street Sweeping*

Minneapolis Public Works employs several street sweeping approaches. Some are Citywide, and some vary by area or land use. Curb-to-curb sweeping operations occur Citywide twice a year in the spring and fall. At those times, all City streets are swept systematically (alleys are also included in the spring), and temporary parking bans are enforced to aid with sweeping operations. Operational routines and special methods are employed to address seasonal conditions, and to optimize cleaning. Flusher trucks apply pressurized water to the streets in an effort to push sediment and debris to the gutters. Street sweepers follow behind the flusher trucks and clean the gutters. During the fall, leaves are first bunched into piles, and then the leaves are picked up before flushing and sweeping occurs. During the summer, between the spring and fall sweep events, sweepers are assigned to maintenance districts for periodic area sweeping. Downtown and other high traffic commercial areas are swept at night on a weekly basis. In addition, summer sweeping in the Chain of Lakes drainage areas has occurred since 1995 as part of the

Clean Water Partnership project. Two sweepers are dedicated to cleaning drainage areas around the Chain of Lakes, and one sweeper is devoted to the Minneapolis Parkway System.

The materials collected from street sweeping are received at two different locations, based on time of the year and nature of the material. The inorganic materials go to a construction demolition landfill site in Becker, Minnesota, to be used as daily cover. The Mulch Store, based in Chaska, MN, receives the City's organics in the fall of each year. The Mulch Store features 4 retail locations, but their main mulch operation originates in Chaska.

### *Special Service Districts*

Special service districts are defined areas within the City where increased levels of service are provided and paid for by charges to the commercial or industrial property owners in the district. One of these special service districts, the Downtown Improvement District (DID) is a business-led non-profit organization with "a mission to make downtown Minneapolis a vibrant and attractive place for recruiting and retaining businesses, employees, residents, shoppers, students, and visitors. This is accomplished by providing services that make the 120 block district cleaner, greener, and safer." The organization is an important partner to the City, carrying out maintenance activities in the downtown public realm that minimize the discharge of pollutants through the proper maintenance of public right-of-way areas. The DID removes trash from sidewalks and operates sweepers for gutters and sidewalks throughout the 120 block district.

### *Snow and Ice Control*

The Minneapolis Public Works Street Maintenance section applies salt and sand to City roadways every winter for snow and ice control. Efficient application of de-icing materials is sought to appropriately balance three primary concerns: public safety, cost control, and environmental protection

Reduced material amounts not only provide a cost savings but are also the best practice available for reducing harmful impacts on the environment. Sand harms lakes and streams by disturbing the ecosystems, and in depositing pollutants that bind to sand particles in lake bottoms and streambeds. An accumulation of sand calls for more frequent cleaning of catch basins and grit chambers. Salt is harmful to aquatic life, groundwater and to most plant and tree species. Salt causes corrosive damage to bridges, reinforcement rods in concrete streets, metal structures and pipes in the street, and vehicles.

Within Minneapolis, the following lakes and creeks do not meet standards for concentrations of chlorides set by the Minnesota Pollution Control Agency and are considered impaired:

- Bassett Creek
- Minnehaha Creek
- Shingle Creek
- Brownie Lake
- Diamond Lake
- Loring Lake
- Powderhorn Lake
- Spring Lake

Reducing usage of salts was the focus of the Shingle Creek TMDL, which was approved by the EPA in 2007. It placed limits on chlorides (salt) discharged to Shingle Creek. Consequently, the City developed improved snow and ice control practices, and they are being implemented not only in the Shingle Creek drainage area but also citywide. These practices are in line with the 2016 Twin Cities Metropolitan Area Chloride Management Plan completed by the MPCA.

City maintenance supervisors and equipment operators are trained in appropriate winter maintenance techniques. Specific topics covered include guidelines for sand and salt application rates that are based on weather conditions, application techniques, and spreader calibration. Material spreaders are calibrated annually before the winter season. Maintenance yard housekeeping practices are designed to minimize salt/sand runoff. The materials that are used are tallied on a daily basis. Salt stockpiles are stored under cover to minimize potential groundwater contamination and runoff to surface waters.

**PREVIOUS YEAR ACTIVITIES**

The 2017-2018 winter season began early, with the first event in late October and numerous snow events in December then a continued pattern of snow throughout the season right into April along with cold temperatures mostly below 32 degrees at night. There were 32 notable events with 78.3 inches for the season, as compared to an average of 48 inches. The most snowfall was observed in April. There were five declared snow emergencies, compared to the annual average of four, and there were 159 days of temperatures at or below freezing. There were two notable freezing rain events in 2017-2018. The quantities of salt and sand used in snow and ice control are tracked by recording amounts that are delivered by suppliers, and also by estimating the quantities that are on-hand on a daily basis. Street sweepings are scaled at the disposal site and reported to the City for record purposes only. Leaves picked up are weighed at the contractor's transfer facility in Minneapolis. The statistics for last year's program are as follows:

- 16,100 Tons of salt applied to roadways
- 10,561 Tons of sand applied to roadways
- 21,835 Tons of materials reclaimed during spring and summer street sweeping operations:
- 4,570 Tons of leaves collected for composting during the fall Citywide sweeping
- 32 staff members attended eight-hour refresher for 40-hour hazardous materials training class
- 6 staff members attended training on the use of salt as presented by watershed organizations

All division shift–staff attended the annual review of procedures and best practices. The review covers the recognition and response to hazardous materials or situations. The Division Director is a trainer for the American Public Works Association (APWA) Snow Fighters coursework.

The City has been tracking the amount of salt applied within the City since 2001. The Figure 6-1 shows the tons of salt applied annually. Figure 6-2 shows the amount of sand and salt applied in the City relative to the days below freezing and Figure 6-3 shows the amount of sand and salt applied in the City relative to the total amount of snowfall. In general all of these figures show that there has been an overall reduction in the amount of salt applied in the City. There has also been a reduction in the amount of salt applied relative to both the days below freezing and the inches of snowfall in the City.

***Figure 6-1***

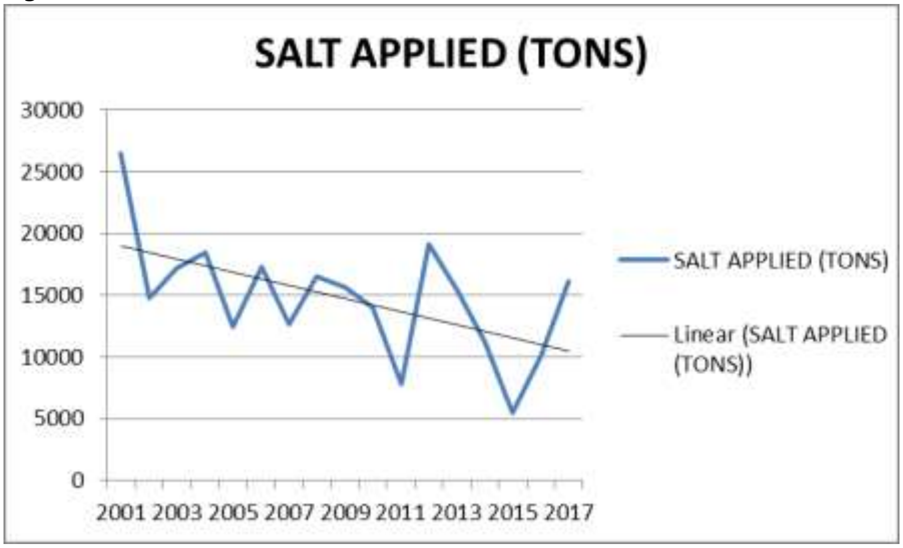



***Figure 6-2***

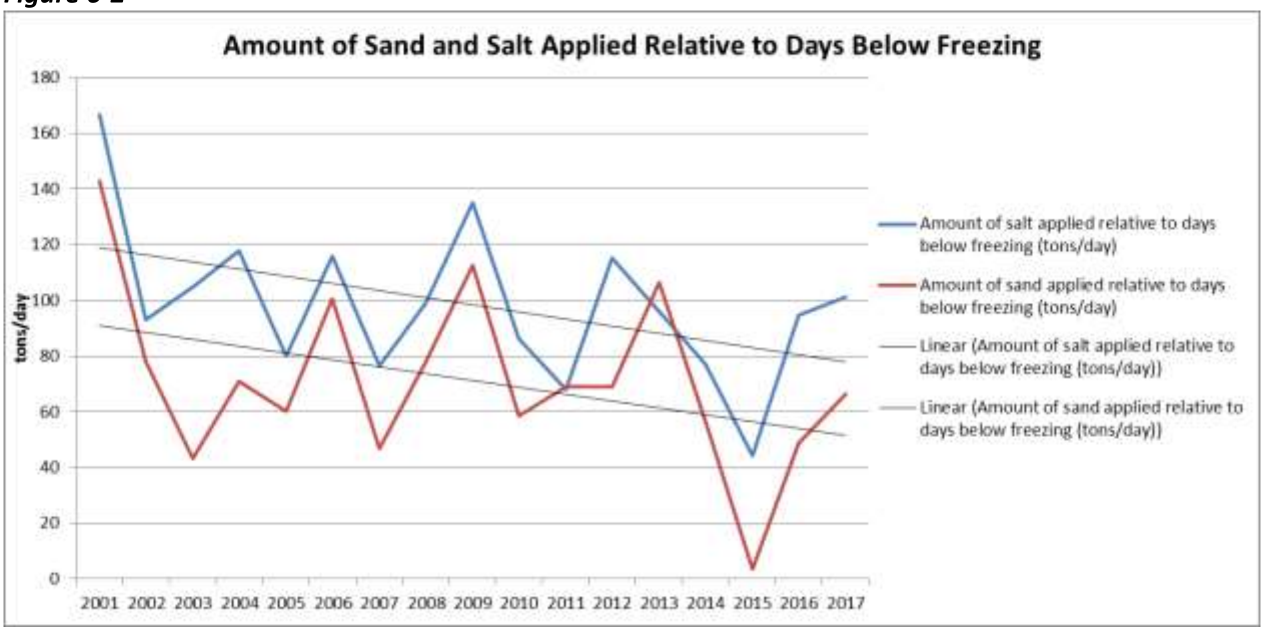
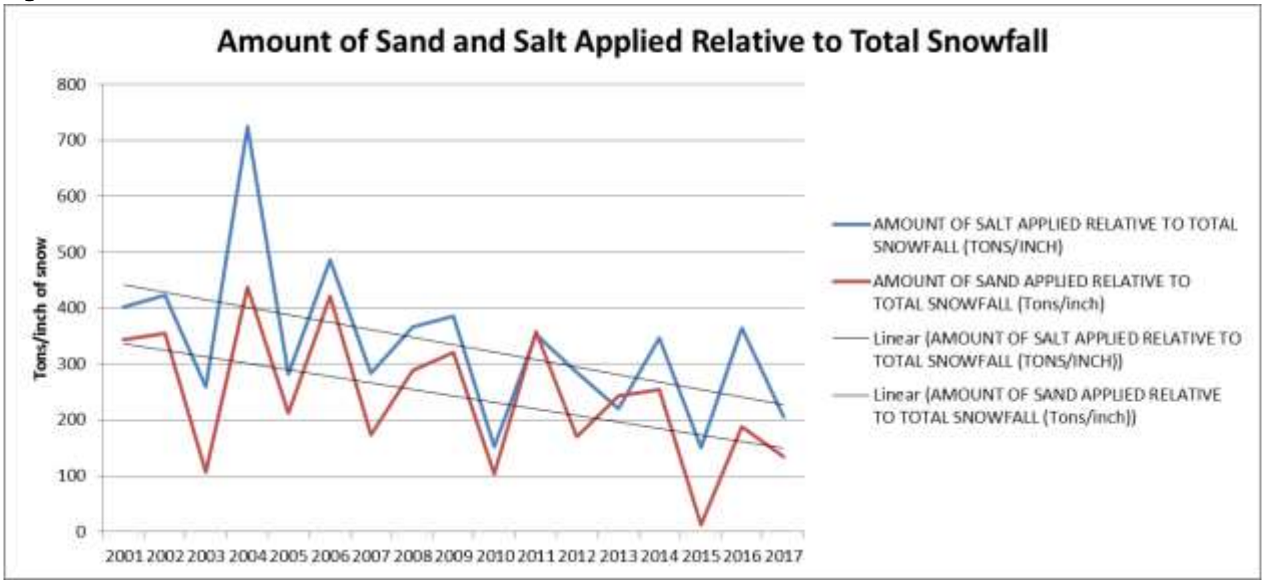


***Figure 6-3***




Performance Measures

- Amount of materials recovered as a percentage of materials applied: 99%
- Amount of salt and sand applied relative to total snowfall: 340 tons/inch

*MPRB Snow and Ice Management Training*

The MPRB has 27 staff that hold the MPCA's Road Salt Applicators Training Certificate. Individuals who hold this certificate have attended a voluntary training, completed and passed an associated test, and agreed to voluntarily apply best management practices to reduce chloride impacts. Attendees chose trainings that focused on the type of work they do at MPRB, either application to roads or to small sites (parking lots and sidewalks).

## VEGETATION MANAGEMENT: PESTICIDES AND FERTILIZER CONTROL

**PROGRAM OBJECTIVE**

The objective of this stormwater management program is to minimize the discharge of pollutants by utilizing appropriate vegetation management techniques and by controlling the application of pesticides and fertilizers.

Targeted pollutants include:

Pesticides (insecticides, herbicides, fungicides etc.)

Nutrients (phosphorus, nitrogen etc.)

**PROGRAM OVERVIEW – MINNEAPOLIS PARK & RECREATION BOARD PROPERTIES**

### *Integrated Pest Management (IPM) Policy and Procedures*

The Minneapolis Park and Recreation Board's (MPRB) Integrated Pest Management (IPM) policy for golf courses and general park areas is included in the MPRB's General Operating Procedures. Specific areas where IPM is intensely used is the Minneapolis Sculpture Garden and the major display gardens at Lyndale Park, Loring Park, and Minnehaha Falls Park. Gardener staff have adopted IPM techniques and use them as the appropriate course of corrective action.

The golf course foremen, along with other staff, attend the annual Minnesota Green Expo in January. There they receive updated information on the newest turf and other related research as it applies to fertilizers, pesticides, bio-controls, and other topics.

All new hires for full-time positions of park keeper, mobile equipment operator (MEO), gardener, golf course park keeper, and arborist are required to obtain their Minnesota Non-Commercial Pesticide Applicator license within one year of being hired. Every two years, as mandated by the Minnesota Department of Agriculture, staff attends re-certification training, that is offered and coordinated by the University of Minnesota. This effort is in conjunction with the Minnesota Department of Agriculture.

### *Pesticides Use on Park Lands*

The MPRB manages 6,400 acres of park land and water in the City of Minneapolis (approximately 18% of the City's 35,244 total land acres).

Use of pesticides to control turf weeds is not a regular practice of park maintenance for general grounds and athletic fields. Weed control pesticides may be used when a park is being renovated, or when athletic fields and surrounding areas are being sodded/seeded. It may also be used when weeds exceed 50% of the ground "turf" cover. These procedures for general grounds and athletic field maintenance are included in the MPRB's General Operating Procedures. In 2016, the MPRB banned the use of glyphosate in neighborhood parks. It may still be used in regional parks and golf courses.

### *Invasive Species Control*

MPRB Environmental Management (Natural Resources) staff use a variety of management techniques to control invasive plants in park natural areas. These techniques include mowing, weed whipping, hand pulling, and the use of biological controls. Biological controls are a sustainable management technique that does not involve herbicides or other labor-intensive mechanical strategies. Biological control agents are insects or pathogens that are native to the invasive plant's country of origin. They are introduced after extensive research has been done by the scientific community. Biological control agents have been used in the park system for control of purple loosestrife, spotted knapweed, and leafy spurge. The MPRB has partnered with Minnesota Department of Agriculture (MDA) and Minnesota Department of Natural Resources (MnDNR), in an effort to control invasive plants with biological control agents.

Purple Loosestrife is a major invasive species problem in Minnesota wetlands. Working with the MnDNR the MPRB began a biocontrol program in the early 1990s. Leaf feeding beetles were reared and released into several sites throughout the City. At this time, these populations are self-sustaining.

Partnering with MDA, spotted knapweed and leafy spurge biological controls were released into the prairie planting along the Cedar Lake bike trail in 2003. Insects that specifically feed on these plants are successfully controlling spotted knapweed and leafy spurge in this natural area.

In its General Operating Procedures, the MPRB has established that no chemical application will be used to control aquatic weeds.

Eurasian watermilfoil, an invasive aquatic weed, is harvested mechanically on Lakes Harriet, Wirth, Cedar, Isles, and Calhoun throughout the summer months and harvested by hand at the beaches at Lake Nokomis and Wirth Lake. Eurasian watermilfoil is managed through permits through the Minnesota Department of Natural Resources, Division of Ecological and Water Resources. Coordination of control programs for Eurasian watermilfoil are determined and supervised by the Environmental Stewardship Department.

### *Fertilizer Use*

In September 2001, the Minneapolis City Council amended Title 3 of the Minneapolis Code of Ordinances (relating to Air Pollution and Environmental Protection) by adding Chapter 55 regarding Lawn Fertilizer in January 1, 2002. The retail sale of fertilizer containing any amount of phosphorus or other compound containing phosphorus, such as phosphates, is prohibited in Minneapolis, as of January 1, 2002. The Minnesota Statute allows the use of phosphorus turf fertilizer if an approved and recent test indicates that the level of available phosphorus in the soil is insufficient or if the fertilizer is being applied to newly established turf, and only during the first growing season.

Under certain conditions specified in the Statute, fertilizer use is allowed on golf courses. Fertilization of turf on Minneapolis Park & Recreation Board Property is performed for golf courses, around athletic fields, and in areas of heavy traffic. Golf course managers and maintenance foremen do not use phosphorus fertilizers unless a current soil test has demonstrated the need for this nutrient. MPRB staff is required to complete a report for every turf fertilizer application. These records are maintained for a period of 5 years, per state law.

### *Recordkeeping*

MPRB staff who apply pesticides and fertilizers keep records of their applications, as required by the Minnesota Department of Agriculture. Since the 1980s, golf course foremen and park maintenance staff have documented the type, amount, and locations of the chemicals that are stored at park storage facilities. These chemical inventories provide detailed information to the Fire Department as to how to deal with a possible fire at these sites. The plans identify how the fires are best extinguished and how to protect surface water in the surrounding area. The plans were put into place in the early 1980s, following a chemical company fire in north Minneapolis that resulted in the contamination of Shingle Creek.

### *Audubon Cooperative Sanctuary Program (ACSP) for Golf Courses*

Audubon International provides comprehensive conservation and environmental education assistance to golf course superintendents and industry professionals through collaborative efforts with the United States Golf Association. The ACSP seeks to address environmental concerns while maximizing golf course opportunities thereby providing open space benefits. An important component of this program is the implementation of IPM procedures, to reduce chemical and fertilizer use to protect water quality and provide a healthier habitat for wildlife.

Participation in the program requires that golf course staff address environmental concerns related to the potential impacts of water consumption, and chemical use on local water sources, wildlife species, and native habitats. The program also provides assistance in comprehensive environmental management, enhancement and protection of existing wildlife habitats, and recognition for those who are engaged in environmentally responsible projects.

Audubon International provides information to help golf courses with:

- Environmental Planning
- Wildlife and Habitat Management
- Water Conservation
- Water Quality Management
- Outreach and Education

Rain Garden at Riverside and 8th St. S

By completing projects in each of the above, the golf course receives national recognition as a Certified Audubon Cooperative Sanctuary. MPRB Golf Course foremen are expected to maintain the ACSP certification for courses. MPRB water quality staff conducts yearly water quality and wetland vegetation monitoring at the courses. All of the MPRB golf courses with the exception of Hiawatha have obtained Audubon Certification and the MPRB is currently in the process of obtaining certification for Hiawatha as well.

**PREVIOUS YEAR ACTIVITIES**

Currently 162 MPRB employees hold pesticide applicator licenses, through the Minnesota Department of Agriculture (MDA). MPRB staff continues to reduce the use of pesticides through the use mechanical techniques and biological controls that are available for control of invasive species on park properties.

Zero phosphorus turf fertilizers were specified for purchasing bids beginning with the 2002 fertilizer bid. This was done in response to the 2002 City and State regulation changes regarding phosphorus turf fertilizers. A wide range of zero phosphorous fertilizers are available to park maintenance and golf course foremen if fertilizer is needed due to soil test results.

**PROGRAM OVERVIEW – CITY OF MINNEAPOLIS PROPERTIES**

The City of Minneapolis maintains vegetation on its properties, including on stormwater management sites for a variety of reasons. These include public safety, preventing erosion, protecting and improving water quality and ecological function, and creating wildlife habitat. Proper vegetation management will slow water movement, hold or convert pollutants, and enhance infiltration and evapotranspiration within stormwater management facilities like rain gardens and grass swales.

### *Integrated Pest Management*

The City uses integrated pest management when addressing pest management on the sites that the City maintains. Integrated Pest Management (IPM) is a pest management strategy that focuses on long-term prevention or suppression of pest problems with minimum impact on human health, the environment and non-target organisms. In most cases, IPM is directed at controlling pests that have an economic impact on commercial crops; however, in the instance of mosquito control, IPM is used to control nuisance and potentially dangerous mosquito populations. The guiding principles, management techniques and desired outcomes are similar in all cases.

The City complies with the City of Minneapolis ordinance (Minneapolis Code of Ordinances Title 11 [Health and Sanitation] Chapter 230 [Pesticide Control]) and Minnesota Department of Agriculture rules regarding pesticide application by posting plant protectant applications and maintaining the necessary records of all pest management activities completed by the City.

**Management Guidelines**

- Perpetuate the original intent of the species planted. On many sites the original intent was to establish a simplified native grassland community. Plant species were selected for their resilience, habitat value and beauty. These plants shall be managed for their proliferation.

- Manage land areas using pollinator-friendly practices. Control invasive plant species to enhance biodiversity essential to pollinators. Plant pollinator forage in appropriate locations. Do not use insecticides known to kill bees and other pollinators. Avoid spray drift at all times.

- Control all species listed on the MN Noxious Weed List and comply with the MN Noxious Weed Law.

- Control invasive species in order to prevent Public Works sites from becoming sources of invasive weed seed that can disperse and establish on neighboring properties. An example is Canada thistle, which produces copious amounts of wind-blown seed that can easily become a problem on nearby public and private lands. Early detection and control will reduce the amount of herbicide needed in the long term.

- Control aggressive species that if allowed to exist on a site will quickly spread and overwhelm the site. Aggressive native species include but are not limited to Canada goldenrod, sandbar willow and cottonwood. Non-native species include but are not limited to Canada thistle, crown vetch, bird's-foot trefoil, reed canary grass, *Phragmites australis*, spotted knapweed, smooth brome, sweet clover, purple loosestrife, Siberian elm, European buckthorn, and Tartarian honeysuckle.

- Control non-native cattails (hybrid and narrow-leaf). They are common weeds in stormwater treatment facilities that may clog inlet and outlet structures, and they reduce habitat function. They are to be controlled when a threat to structures occurs, primarily by cutting the plant below the water surface. Where this is not feasible, as a last resort wick application of an aquatic-safe herbicide may be warranted, however herbicide application over water shall be avoided where practicable.

- Control fast growing, woody species such as willow, Siberian elm and box elder located where they can quickly establish and form a thicket around stormwater treatment facilities or can cause a public safety issue.

- Control species that are allelopathic. These include but are not limited to spotted knapweed, garlic mustard, and leafy spurge.

**Invasive Plant Management Tools**
Invasive plants “spread like wildfire” at stormwater ponds. Where feasible, use mechanical means such as pulling and mowing, in order to minimize chemical usage.

- Herbaceous Plantings
  - Pulling (preferred)
  - Mowing (preferred)
    - Flail mowing
    - Spot mowing
  - Herbicide application
    - Spot spraying
    - Wick application
- Woody Plants
  - Pulling (preferred)
  - Cutting with stump application of herbicide

**Turf Areas**
PW-SWS follows the Minneapolis Park and Recreation Board’s General Parks and Parkways threshold of 50% for broadleaf and/or grassy weeds in turf areas. When it has been determined that this percentage has been reached or exceeded, the appropriate post emergent or pre-emergent herbicide may be applied, preferably on a spot spray basis. Selection of the appropriate herbicide of choice will be determined by trained staff after evaluating the site, the hazard rating of the product and the specific location.

**Weed Control in Upland Plantings, Shrub Beds and Around Trees**
Plants are selected and/or replaced in order to provide disease and insect resistant plantings. Weeds listed on the State of Minnesota’s Noxious Weed List are controlled as per state statute. Mechanical or manual means of weed control will be tried first when feasible. However, due to global climate change, increasing populations of tap-rooted and other perennial weeds are being transported by birds and other means. Pulling or digging of these weeds is usually not successful. Spot spraying of these tap-rooted weeds with a low toxicity herbicide will help prevent flowering, seeding and further dispersal of these pest

*37th Avenue Greenway*

weeds. Appropriate mulching of upland plantings, shrub beds and around trees will help decrease the number of pest weeds. If control of annual weeds in pathway or mulched areas is required, the proper pre- or post-emergent low toxicity herbicide will be applied on a spot spray basis. Posting of any plant protectant applications will be carried out according to City ordinance.

Using the 37th and Columbus Flood Pond as a test site, City contractors implemented an organic weed control and site management plan. This organic no-chemical maintenance plan included breaking the site into three zones to monitor success of each of the following methods:

A. Weed control using concentrated vinegar
B. Corn gluten meal & hand pulling/ weed whipping
C. Hand pulling/ weed whipping only

We will continue this management plan in 2018 to get more data on the effectiveness.

**Future Pest Control Issues**
With changes in climate, the environment will be subject to many changes, including the arrival of additional pests within open space areas. Following IPM principles, the City will refer to updates in MPRB policy and practice and will work with the appropriate local, state or national agencies to determine the best control approach for these new pests.

**Prescribed Burns**
Prescribed burns are an intentional ignition and burning of grass, shrub, or forest fuels. Minneapolis Public Works uses prescribed burns as a management tool to maintain the health of native plant

Camden Pond Vegitation Management - Burning

communities. When used as a management tool, fire kills certain weeds and invasive plants, releases dormant seeds in the soil, and adds nutrients to the soil. The frequency that prairies and native grassland areas in the City are burned is dependent on the management needs and weather conditions. Weather conditions such as temperature, humidity, wind speed and direction are taken into consideration before starting a prescribed burn. Prairies and savannas should typically be scheduled for burning once every three years depending on the site conditions.

Many species benefit in the long run from the habitat improvements resulting from a prescribed burn. During the burns most animals find cover by retreating into burrows, flying away, or moving to surrounding areas. Sites are walked through prior to the burn to move animals out of the area and only small sections of a site are burned at any time, allowing safe areas for animals to move into.

Burns are supervised by staff and or contractors that have Minnesota Department of Natural Resources burn certification. The prescribed burns follow a plan that specifies the minimum number of people in the burn crew, the safety equipment that must be on hand, and proper weather conditions such as temperature, wind speed and direction, and humidity. Notification letters are delivered to property owners near the burn site in advance of the burn.

In 2017 weather conditions were such that only two ponds were burned. The City supplemented with a mix of mowing and haying.

*Camden Pond One month after burn*

## MINIMAL CONTROL MEASURE SEVEN: STORMWATER DISCHARGE MONITORING AND ANALYSIS

### PROGRAM OBJECTIVES

The purposes of monitoring and analysis under the MS4 permit are to understand and improve stormwater management program effectiveness, characterize pollutant event mean concentrations, estimate effectiveness of devices and practices, and calibrate and verify stormwater models.

Targeted pollutants include:

Phosphorus

Total Suspended Solids (TSS)

### PROGRAM OVERVIEW

In addition to stormwater monitoring, the Minneapolis Park & Recreation Board carries out an extensive lake monitoring program which is sometimes illustrative of stormwater conditions. For example, Escherichia coli (E. coli) monitoring per the MPCA's inland lakes standard is carried out at the MPRB's 12 official beaches located on six lakes. This monitoring is important for public health and provides almost immediate indications of elevated bacteria issues (see in particular Section 19, Public Beach Monitoring, of the MPRB's Water Resources Report referenced in the next paragraph). E. coli is a bacterium used to indicate the potential presence of waterborne pathogens that can be harmful to human health. Elevated bacteria levels generally occur in aquatic environments after rain events, when bacteria from various sources are washed into the lakes in stormwater runoff. The purposes of monitoring and analysis under the MS4 permit are to understand and improve stormwater management program effectiveness, characterize pollutant event mean concentrations, estimate effectiveness of devices and practices, and calibrate and verify stormwater models.

### PREVIOUS YEARS ACTIVITIES

In 2017, MPRB scientists monitored 11 of the city's most heavily used lakes. The data collected were used to calculate a Trophic State Index (TSI) score for each of the lakes. Lower TSI scores indicate high water clarity, low levels of algae in the water column, and/or low phosphorus concentrations. Changes in lake water quality can be tracked by looking for trends in TSI scores over time. A negative slope indicates improving water quality, while a positive slope indicates declining water quality. These values are especially important for monitoring long-term trends (10+ years). Historical trends in TSI scores are used by lake managers to assess improvement or degradation in water quality. Trends are also used by the Minnesota Pollution Control Agency to assess non-degradation goals.

All the lakes in Minneapolis fall into either the mesotrophic or eutrophic category. Calhoun, Harriet, and Wirth are mesotrophic with moderately clear water and some algae. Brownie, Cedar, Isles, Hiawatha, Loring, and Nokomis are eutrophic with higher amounts of algae. Powderhorn and Spring are hypereutrophic with high nutrient concentrations and the potential for severe algal blooms. Trends in lake water quality can be seen by using the annual average TSI since the early 1990s.

Table 7-1. Water quality trends in Minneapolis lakes from 1991-2017.

| **Lakes with Improving Water Quality Indicators** | **Lakes with Stable Trends** | **Lakes with Declining Water Quality Indicators** |
|---|---|---|
| Lake Calhoun | Brownie Lake | |
| Lake Harriet | Cedar Lake | |
| Lake Nokomis | Lake Hiawatha | |
| Wirth Lake | Lake of the Isles | |
| | Loring Pond | |
| | Powderhorn Lake | |
| | Spring Lake | |

Details on the MPRB monitoring program can be found in Appendix A12.

# COORDINATION AND COOPERATION WITH OTHER ENTITIES

## PROGRAM OBJECTIVE

The objective of this Stormwater Management Program is to maximize stormwater management efforts through coordination and partnerships with other governmental entities.

## PROGRAM OVERVIEW

Coordination and partnerships of the City and the MPRB with other governmental entities include the four watershed organizations in Minneapolis: BCWMC, MWMO, MCWD and SCWMC. Coordination activities and partnerships with other governmental entities also include MnDOT, Hennepin County, MPCA, Minnesota Board of Water and Soil Resources (BWSR), MnDNR, neighboring cities, the Metropolitan Council, the University of Minnesota and various other entities.

The coordination and partnership activities can include the joint review of projects, joint studies, joint water quality projects, stormwater monitoring, water quality education, and investigation or enforcement activities.

### COORDINATION WITH THE BASSETT CREEK WATER MANAGEMENT COMMISSION (BCWMC)

In 2015, the BCWMC adopted its Third Generation Watershed Management Plan, with Minneapolis and the other eight member cities as active partners. Minneapolis provides yearly financial contributions to the BCWMC annual operations budget. The City and the MPRB are also stakeholders with other BCWMC joint power cities in development of several Total Maximum Daily Load (TMDL) studies and implementation plans.

### COORDINATION WITH THE MISSISSIPPI WATERSHED MANAGEMENT ORGANIZATION (MWMO)

The MWMO adopted its Third Generation Watershed Management Plan in 2011. The City and MPRB participated in its planning committees. The MWMO delegates stormwater management requirements for new developments and redevelopments to its member cities and does not provide separate project review and approval. The MWMO receives revenue through direct taxation against properties within its jurisdiction. The City and the MPRB partner with the MWMO on many studies and projects.

### COORDINATION WITH THE MINNEHAHA CREEK WATERSHED DISTRICT (MCWD)

The MCWD adopted its most recent plan in 2017. Minneapolis and other district cities' staff were active as part of the technical advisory committee (TAC). The MCWD receives revenue through direct taxation against properties within its jurisdiction. The City of Minneapolis and the MPRB are stakeholders in development of TMDL studies and implementation plans, in collaboration with the MCWD and other stakeholders.

### COORDINATION WITH THE SHINGLE CREEK WATERSHED MANAGEMENT COMMISSION (SCWMC)

The SCWMC adopted its Third Generation Watershed Management Plan in April 2013, with Minneapolis and the other member cities as active partners. Minneapolis provides yearly financial contributions to the SCWMC annual operations budget. The City of Minneapolis and the MPRB are stakeholders with other SCWMC joint power cities in development of TMDL studies and implementation plans.

**COORDINATION WITH HENNEPIN COUNTY**

In 2016 Hennepin County adopted a Natural Resources Strategic Plan. This plan is intended to guide the county and its partners, including the City, in responding to natural resource issues and developing internal and external policies, programs, and partnerships that improve, protect, and preserve natural resources. City staff and residents provided feedback on this plan through a series of meetings and survey.

**COORDINATION WITH THE MINNESOTA POLLUTION CONTROL AGENCY (MPCA)**

Minneapolis Fire Inspection Services coordinates with the MPCA on Spill Response incidents and investigations and enforcement for incidents of illegal dumping or illicit discharges to the storm drain system.

Minneapolis Public Works coordinates with the MPCA on the various work groups, including the Minnesota Stormwater Manual and surface water/groundwater interactions.

**COORDINATION WITH THE US COAST GUARD, WAKOTA CARE, AND SOUTH METRO RIVER RESPONSE**

Minneapolis Fire Inspection Services coordinates with these agencies on Spill Response issues, training, and spill response drills.

## PREVIOUS YEAR ACTIVITIES AND ONGOING COORDINATION EFFORTS

The Minneapolis Park and Recreation Board (MPRB) and the City of Minneapolis coordinate stormwater management efforts and coordinate with the watershed management organizations, the watershed district, and other governmental agencies on a number of water quality projects. Minneapolis Public Works maintains communications with all watershed management organizations and the watershed district within the City boundaries.

Interactions take several forms to facilitate communication and provide support:

- Attend selected local board and special issues meetings
- Attend selected education and public outreach committee meetings
- Take part in Technical Advisory Committee (TAC) meetings
- Inform the organizations of upcoming City capital projects in an effort to identify projects that may benefit from partnerships
- Provide developers (who submit projects for site plan review) with information and contacts to meet watershed requirements
- Share information and data regarding storm drainage system infrastructure, watershed characteristics, flooding problems, modeling data, etc.
- The MPRB and the City coordinate and partner with the watershed organizations on capital projects and water quality programs. For example:

  - A creek restoration project that is primarily funded by the Bassett Creek Watershed Management Commission and will be implemented by the City is under design and proposed for construction in 2018.

  - In 2014, the City and the MWMO began a three-year project in 2014 to develop hydrologic and hydraulic models (H&H models) for all areas in Minneapolis that are within the MWMO watershed. The MWMO is participating both technically and financially with these models.

  - A multi-year project with the Minnehaha Creek Watershed District is determining capital projects that will be jointly funded that will address localized flooding challenges, while also addressing water quality issues. One key project is to mitigate flooding at the MPRB's Hiawatha Golf Course such as occurred in 2014. The goals of this project are to reduce the risk of localized neighborhood flooding, improve water quality, and improve course conditions.

- The City's Environmental Services section coordinates with the MPCA regarding investigations and enforcement for incidents of illegal dumping or illicit discharges to the storm drain system.

- Erosion and sediment control permit inspections are coordinated with the MCWD.

- The MPRB coordinates with the watershed organizations and the Metropolitan Council on watershed outlet monitoring.

- The MPRB works with the DNR and surrounding suburbs on various capital projects and programs.

- Public Works and MPRB staff coordinates with the MPCA, the watershed organizations and other stakeholders for Total Maximum Daily Load (TMDL) studies and implementation plans.

- Public Works staff participated in the multi-year MPCA's Minimal Impact Development Standards (MIDS) Committee and several of its sub-committees. The MIDS project was essentially completed in 2013, and is a driving force behind ongoing updates to the Minnesota Stormwater Manual.

- Public Works engages with MPRB, MnDOT, Hennepin County, Metropolitan Council, and watershed organizations on those entities' capital projects and infrastructure maintenance within the City in regards to compliance with NPDES issues.

Finally, other sections of this Annual Report provide additional information about other projects or issues on which the permittees have cooperated with other governmental entities.

## CSO REPORTING

### PROGRAM OBJECTIVE

There is a continuing effort to minimize the discharge of pollutants to public waters. This section describes the current focus and outlines the design measures used to control the discharge of pollutants by controlling the volume, loading or rate of stormwater discharged.

Targeted pollutants include:

Total Suspended Solids (TSS)

Phosphorus

### OVERVIEW

In 2017, the City of Minneapolis continued its program to reduce Inflow and Infiltration (I & I) to the combined sewer system. Inflow is stormwater and other clear water sources connected directly to the sanitary sewer, and infiltration is groundwater that enters the sanitary sewer, usually through pipe and system defects. The CSO program is continuing a City focus to work toward eliminating combined sewer overflows. This effort began when the first storm drains were constructed in the 1930s. (Prior to that time, all stormwater discharge was combined with sanitary sewer discharge). The effort to eliminate combined sewer overflows was accelerated in 1960 when the City began a 40-year residential paving program. Separate storm sewers built as part of the paving program accounted for elimination of most of the City's remaining combined sewer areas. More information on the history and progress of the CSO Program can be found **online**.

Currently, the principal work is to continue to make reasonable progress of eliminating known public and private stormwater inlets or rainleaders connected to the sanitary sewer. Additionally, the City is using a targeted sanitary sewer flow metering program and smoke testing program to identify other clear water sources. The smoke testing consists of blowing a smoke-like vapor into the sanitary sewer in order to expose openings where inflow is entering the sanitary sewer. Sewer lining and repairs also contribute to I & I reduction.

The City's success with reducing I & I is transferring a problem from the sanitary sewer system to the stormwater management system, because there is limited storm sewer capacity for the inflow removed from the sanitary sewer. This has contributed to the challenges the City has to manage in the Flood Mitigation Program discussed earlier in this report.

### PREVIOUS YEAR ACTIVITIES

The storm drain project areas for 2017, and associated water quality impacts, are referenced in the following table:

| PROJECT AREA | PROJECT DESCRIPTION | STORMWATER RUNOFF BENEFITS |
|---|---|---|
| CSO Area 142 (Xerxes Ave N &42nd Ave N) | Eliminated cross connection from storm to sanitary sewer | Eliminated CSO drainage area of 1.18 acres |
| CSO Area 162 (1123 Glenwood Ave) | Eliminated cross connection from storm to sanitary sewer | Eliminated CSO drainage area of 0.74 acres |
| CSO Area 175(7th St S and Nicollet Mall | Eliminated cross connection from storm to sanitary sewer | Eliminated CSO drainage area of 0.1 acres |
| CSO Area 190(18th Ave NE and Polk St NE) | Eliminated cross connection from storm to sanitary sewer | Eliminated CSO drainage area of 1.83 acres |

The total drainage area removed from the sanitary sewer in 2017 was 3.85 acres

In 2017, the City installed cured-in-place pipe (CIPP) liners on over 6.5 miles of sanitary sewers and completed 62 I&I repairs

## STREET PROJECTS

For street reconstruction projects, whenever storm drain upgrades are required, installations of volume reduction systems, pollutant load-reducing facilities, and rate reduction BMPs are all considered.

# Appendix A

# Bassett Creek Watershed Management Commission

February 21, 2018

Liz Stout
City of Minneapolis, City of Lake Bldg
309 Second Ave. South
Minneapolis MN 55401

**RE: 2017 Water Education Activities – Letter of Understanding – Appendix A1**

Dear Liz,

This letter is to serve as an official arrangement between the Bassett Creek Watershed Management Commission (BCWMC) and the City of Minneapolis. The City of Minneapolis provides financial contributions to the BCWMC through an annual assessment based on area within the watershed and tax valuation of property in the watershed. In 2017 this assessment was $33,609. Further, watershed commissioners representing Minneapolis and Minneapolis city staff participate in, guide, and help implement the programs of the BWCMC, including its public education program.

Education-related activities of the BCWMC are guided by its 2015 Watershed Management Plan, specifically its education and outreach policies (Section 4.2.9), and its overall Education and Outreach Plan found in Appendix B. http://www.bassettcreekwmo.org/document/wmp-plans. The specific activities of the BCWMC public outreach and education program are set annually by the Commission after recommendations are forwarded by the BCWMC Education and Outreach Committee.

In 2017, the BCWMC performed or participated in the following education and outreach activities:

**BCWMC Website** - The BCWMC maintained its new user-friendly website in 2017 and maintained the information including latest news, contact list, meeting calendar, meeting materials, watershed plan, data, and projects. In 2017, there were approximately 6,945 with 22,849 page views.

**West Metro Water Alliance (WMWA) Membership** – The BCWMC continued its participation in WMWA along with several watershed management and other water-related organizations in the west Metro area. Through WMWA, these organizations collaborated on educational campaigns including the Watershed PREP program aimed at educating 4th grade students about water resources and the impacts of stormwater. In 2017, 121 classes totaling 3,249 students attended Watershed PREP lessons within the WMWA watersheds, including 1,083 students in the Bassett Creek Watershed. In 2017 WMWA published three newsletters called Water Links. The newsletter was sent via email to over one thousand subscribers through Hennepin County. WMWA also continued its "Pledge to Plant" campaign aimed at engaging residents and businesses in converting turf or hard surfaces to native plantings http://www.westmetrowateralliance.org/ .

**Metro WaterShed Partners Membership** —The BCWMC participated as a member of the Metro WaterShed Partners as a general supporter of the program and a financial supporter of the Metro Clean Water Minnesota Media Campaign. Metro Watershed Partners maintains a listserve and a website as forums for information sharing, holds monthly meetings for members to collaborate, and displays an exhibit at the State Fair to educate the public about watersheds. In 2017, the Clean Water Minnesota Media Campaign began featuring monthly, seasonally appropriate stories about metro area residents taking action at home and in their lives to keep water clean. These professionally produced stories and photos were used by partners across a variety of media platforms. The BCWMC used these stories in newsletters, social media, and on it homepage. www.cleanwatermn.org .

**Participation in Community Events and Meetings** – The BCWMC began using its new educational display materials (including watershed map, banners, and bean bag toss game) and participated in the Plymouth Home Expo, the Golden Valley Arts and Music Festival, a restoration event at Westwood Nature Center. Give-aways included dog waste disposal bag dispensers, watershed maps, cups showing the amount of deicer needed for a certain space, and written educational materials.

**Parking Lot & Winter Maintenance Training Course –** The BCWMC hosted a free "Parking Lot and Sidewalk Winter Maintenance Workshop" at Crystal's Community Center. Twenty-one city staff, private applicators, and parks district staff attended the 5-hour course. Most participants took an exam to become certified in level one "smart salting."

**Signs at Creek Crossings** – The BCWMC designed and purchased eight creek identification signs for placement where roads cross Bassett Creek. Two signs were installed on Douglas Drive in Golden Valley, one on each side of the creek. Three more stream crossings in Golden Valley will be posted in 2018.

**Partnership with Metro Blooms for Harrison Neighborhood Project** – The BCWMC continued its partnership and support of Metro Blooms' Harrison Neighborhood Project. The project aims to engage residents, train youth, and install water quality practices in Minneapolis' Near North neighborhood. The BCWMC received a $100,000 grant from the Met Council for this project on behalf of Metro Blooms in 2016 and was awarded a Clean Water Fund grant from the MN Board of Water and Soil Resources that will be executed in 2017.

**Volunteer Monitoring Programs** – The BCWMC entered agreements with the Metropolitan Council and Hennepin County to participate in the Citizen Assisted Monitoring Program (CAMP) and the River Watch Program, respectively.

**Commissioner Training Sponsorship –** The BCWMC reimbursed Commissioners for registration costs to attend the Road Salt Symposium, Water Resources Conference, and the DNR's Aquatic Invasive Species Detection Training.

**Social Media** – The BCWMC started a Facebook page and continues with weekly posts. The page currently has 192 followers. In 2017, the BCWMC made 101 posts and reached 35,010. BWCMC continues to work on growing its Facebook followers.

**Financial Sponsorship for Organizations** – The BCWMC financially sponsored Metro Blooms and the Children's Water Festival.

Due to the City of Minneapolis' financial contributions and close involvement and participation with the BCWMC's activities, the BCWMC's education activities can and should be considered part of the city's implementation of Minimal Control Measures (MCM) 1 and 2 in the MS4 stormwater permit.

Please let me know if you have any questions or require further information.

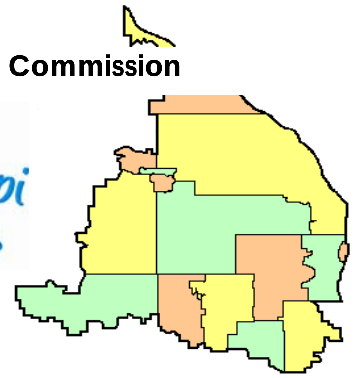
Sincerely,

Laura Jester

Laura Jester, Administrator

Shingle Creek Watershed Management Commission

West Mississippi Watershed Management Commission



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# NPDES Phase II Education and Public Outreach Program
# 2017 Annual Report

The Shingle Creek and West Mississippi Watershed Management Commissions conducted education and public outreach activities in 2017 in fulfillment of their Third Generation Watershed Management Plan Watershed Education and Public Outreach Program goals.

**EDUCATION AND PUBLIC OUTREACH PROGRAM GOALS**

1. All members of the community become knowledgeable about the water resources in the watersheds and take positive action to protect and improve them.
2. All members of the community have a general understanding of watersheds and water resources and the organizations that manage them.
3. All members of the community have a general understanding of the Impaired Waters in the watersheds and take positive actions to implement TMDL requirements.

The Commissions identified the following general education and outreach strategies in the Third Generation Watershed Management Plan. More detailed educational goals by stakeholder groups may be found in Appendix E of that Plan.

- Maintain an active Education and Outreach Committee with representatives from all member cities to advise the Commissions and to assist in program development and implementation
- Participate in the West Metro Water Alliance (WMWA) to promote interagency cooperation and collaboration, pool resources to undertake activities in a cost-effective manner, and promote consistency of messages
- Use the Commissions', member cities', and educational partners' websites and newsletters, and local newspapers and cable TV to share useful information to stakeholders on ways to improve water quality
- Prominently display the Commissions' logos on information and outreach items, project and interpretive signs, and other locations to increase visibility
- Provide opportunities for the public to learn about and participate in water quality activities
- Provide cost-share funding to assist in the installation of small BMPs and demonstration projects
- Educate elected and appointed officials and other decision makers
- Enhance education opportunities for youth
- Each year review and modify or develop and prioritize education and outreach activities and strategies for the coming two years

**Program:** Watershed PREP (Protection, Restoration, Education, and Prevention)

**Audience:** Fourth grade students, educators, and families; the general public

**Program Goals:**

a. Engage elementary students in hands-on learning about the water cycle and how the built environment influences stormwater runoff and downstream water quality.
b. Provide general watershed and water quality education to citizens, lake associations, other civic organizations, youth groups, etc.

**Educational Goals:**

a. Have a general understanding of watersheds, water resources and the organizations that manage them.
b. Understand the connection between actions and water quality and water quantity.

**Specific Activities to Reach Goals:**
Watershed PREP is a program of the West Metro Water Alliance (WMWA), a consortium of four WMOs including the Shingle Creek and West Mississippi WMOs, and stands for Protection, Restoration, Education, and Prevention. 2017 was the fifth year of the program. Two persons with science education backgrounds serve as contract educators to be shared between the member WMOs. The focus of the program is two-fold - to present water resource-based classes to fourth grade students and to provide education and outreach to citizens, lake associations, civic organizations, youth groups, etc.

*Fourth Grade Program.* Three individual classes meeting State of Minnesota education standards have been developed. **Lesson 1*, What is a Watershed and Why do we care?,*** provides an overview of the watershed concept and is specific to each school's watershed. It describes threats to the watershed. **Lesson 2, *The Incredible Journey,*** describes the movement and status of water as it travels through the water cycle. **Lesson 3,** *Stormwater Walk,* investigates movement of surface water on schools grounds. The ultimate goal is to make this program available to all fourth graders in the four WMWA watersheds (Shingle Creek, West Mississippi, Bassett Creek, and Elm Creek), and to other schools as contracted. The program is offered to public, private, parochial, and charter schools.

**Table 1. Watershed PREP Program participation growth.**

| Year | # Classrooms | # Students | # and Type of Schools |
|---|---|---|---|
| *Lesson 1* | | | |
| 2013 | 63 | 1,679 | 13 in six districts; one charter school; one parochial school |
| 2014 | 116 | 3,469 | 30 in seven districts; one magnet school; one parochial school |
| 2015 | 122 | 3,183 | 36 in nine districts; two charter schools; five parochial schools |
| 2016 | 107 | 2,850 | 29 in seven districts, one charter school, 5 parochial schools |
| 2017 | 121* | 3,249 | 12 in seven districts, one charter school, one parochial school |
| *Lesson 2* | | | |
| 2013 | 14 | 390 | Three in three districts; one charter school; one parochial school |
| 2014 | 22 | 645 | Five in three districts |
| 2015 | 27 | 859 | Six in five districts |
| 2016 | 20 | 524 | Five in three districts, one parochial school |
| 2017 | 38 | 1,072 | Seven in three districts, one parochial school |

*Includes four classrooms in the Minnehaha Creek Watershed District paid for by others.

## Table 2. 2017 schools and students participating in Lesson 1: What is a Watershed?

| | Date | School | School District | City | Watershed | Classes | Students |
|---|---|---|---|---|---|---|---|
| 1 | 1/10 | Hassan | Elk River | Rogers | Elm | 8 | 220 |
| 2 | 1/12 | Jackson MS (8th gr.) Expert day | Anoka-Hennepin | Champlin | W. Miss | 2 | 51 |
| 3 | 1/31 | Zanewood Elementary | Osseo | Brooklyn Park | Shingle | 3 | 65 |
| 4 | 2/17 | Forest Elementary | Robbinsdale | Crystal | Shingle | 4 | 102 |
| 5 | 2/21 | Noble Academy | Charter | Brooklyn Park | W. Miss | 2 | 48 |
| 6 | 3/7 | Kimberly Lane | Wayzata | Plymouth | Bassett | 4 | 112 |
| 7 | 3/8 | Sunset Hill | Wayzata | Plymouth | Bassett | 4 | 111 |
| 8 | 3/23 | Oakwood | Wayzata | Plymouth | Minnehaha | | |
| 9 | 3/27 | Gleason Lake | Wayzata | Plymouth | Minnehaha | 4 | 100 |
| 10 | 3/28 | Plymouth Creek | Wayzata | Plymouth | Bassett | 5 | 125 |
| 11 | 4/19 | Palmer Lake | Osseo | Brooklyn Park | Shingle | 4 | 88 |
| 12 | 4/18 | Good Shepherd | Parochial | St. Louis Park | Bassett | 2 | 48 |
| 13 | 5/1 | Zachary Lane Elementary | Robbinsdale | Plymouth | Bassett | 4 | 110 |
| 14 | 5/25 | Rush Creek | Osseo | Maple Grove | Elm | 5 | 140 |
| 15 | 5/22 | Birchview | Wayzata | Plymouth | Bassett | 4 | 90 |
| 16 | 5/18 | Meadow Ridge Elementary** | Wayzata | Plymouth | Elm | 5 | 137 |
| 17 | 4/10 | Greenwood Elementary | Wayzata | Plymouth | Bassett | 5 | 127 |
| 18 | 5/16 | Northport Elementary | Robbinsdale | Brooklyn Ctr | Shingle | 5 | 107 |
| 19 | 5/31 | Meadowbrook Elementary | Hopkins | Golden Valley | Bassett | 4 | 112 |
| 20 | 10/7 | Sacred Heart | Parochial | Robbinsdale | Shingle | 1 | 24 |
| 21 | 4/25 | Mary Queen Of Peace | Parochial | Rogers | Elm | 1 | 8 |
| 22 | 10/12 | Basswood Elementary | Osseo | Maple Grove | Elm | 3 | 89 |
| 23 | 10/17 | Palmer Lake | Osseo | Brooklyn Park | Shingle | 3 | 88 |
| 24 | 10/16 | Champlin Brooklyn Park Academy | Anoka-Hennepin | Champlin | W. Miss | 6 | 163 |
| 25 | 11/17 | Rogers Elementary School | Elk River | Rogers | Elm | 4 | 132 |
| 26 | 10/26 | Oxbow Creek Elementary | Anoka-Hennepin | Champlin | W. Miss | 7 | 208 |
| 27 | 10/6 | School of Engineering and Arts (SEA) | Robbinsdale | Golden Valley | Bassett | 3 | 129 |
| 28 | 10/12 | Monroe Elementary | Anoka-Hennepin | Brooklyn Park | W. Miss | 4 | 130 |
| 29 | 10/4 | Sonnesyn Elementary | Robbinsdale | New Hope | Shingle | 3 | 71 |
| 30 | 12/20 | Robbinsdale Spanish Imm. | Robbinsdale | Plymouth | Bassett | 5 | 119 |
| 31 | 11/21 | Zanewood Elementary | Osseo | Brooklyn Park | Shingle | 3 | 75 |
| 32 | 9/11 | Weaver Lake Science Math & Tech | Osseo | Maple Grove | Elm | 4 | 120 |
| | | | | | **Total:** | **121** | **3249** |

**Table 3. 2017 schools and students participating in Lesson 2: The Incredible Journey**

| | Date | School | School District | | Watershed | Classes | Students |
|---|---|---|---|---|---|---|---|
| 1 | 1/26 | Zanewood Elementary | Osseo | Brooklyn Park | Shingle | 3 | 66 |
| 2 | 4/13 | Palmer Lake | Osseo | Brooklyn Park | Shingle | 4 | 88 |
| 3 | 5/11 | Rush Creek | Osseo | Maple Grove | Elm | 5 | 140 |
| 4 | 5/17 | Meadowbrook Elementary | Hopkins | Golden Valley | Bassett | 4 | 112 |
| 5 | 10/6 | School of Engrg & Arts (SEA) 1st grade | Robbinsdale | Golden Valley | Bassett | 1 | 42 |
| 6 | 10/16 | Palmer Lake | Osseo | Brooklyn Park | Shingle | 3 | 87 |
| 7 | 10/18 | Basswood Elementary | Osseo | Maple Grove | Elm | 3 | 90 |
| 8 | 10/30 | Rogers Elementary | Elk River | Rogers | Elm | 7 | 212 |
| 9 | 11/2 | Sacred Heart | Parochial | Robbinsdale | Shingle | 1 | 24 |
| 10 | 10/3 | Sonnesyn Elementary | Robbinsdale | New Hope | Shingle | 3 | 72 |
| 11 | 11/14 | Zanewood Elementary | Osseo | Brooklyn Park | Shingle | 3 | 75 |
| 12 | 10/5 | Jackson MS-Water Day (6th gr) | Anoka-Hennepin | Champlin | W. Miss | 4 | 130 |
| | 11/21 | Sonnesyn Elementary | Robbinsdale | | Shingle | 2 | 75 |
| | | | | | **Total** | **38** | **1072** |

*Community Education and Outreach.* The PREP educators provided outreach at nine community and school events. Because of the nature of these events, it is difficult to keep a tally of the number of contacts made and citizens engaged. One of the largest of these events is the Plymouth Home Expo. WMWA and its four WMOs staff adjoining booths to do combined outreach to the 1,000+ visitors to the Expo. Events are detailed in Table 4.

**Table 4. 2017 Watershed PREP community education and outreach participation**

| Date | Event | City | Participants |
|---|---|---|---|
| 3/4 | Basswood Science Night | Maple Grove | Elm Creek |
| 4/8 | Plymouth Expo | Plymouth | BC, SC, EC |
| 10/5 | Sonnesyn Field Trip-Raingardens | Robbinsdale | Shingle |
| 8/8 | Plymouth Kids Fest | Plymouth | BC, SC, EC |
| 10/17 | New Hope City Days | New Hope | Shingle |
| 3/4 | Basswood Science Night | Maple Grove | Elm Creek |
| 4/8 | Plymouth Expo | Plymouth | BC, SC, EC |
| 10/5 | Sonnesyn Field Trip-Raingardens | Robbinsdale | Shingle |
| 8/8 | Plymouth Kids Fest | Plymouth | BC, SC, EC |
| 10/17 | New Hope City Days | New Hope | Shingle |

**Evaluation:**
The educators evaluate the success of the Fourth Grade Program by surveying students and teachers about the quality of the program, the learning that was observed, and the performance of the educators. Much of the feedback occurs during and right after the presentations in spontaneous comments.

**Program:** Distribute Educational Materials

**Audience:** Multiple

**Program Goals:**

a. Inform various stakeholders about the watershed organizations and their programs.
b. Provide useful information to a variety of stakeholders on priority topics.
c. Engage stakeholders and encourage positive, water-friendly behaviors.

**Educational Goals:**

a. Property owners maintain properties and best management practices (BMPs) to protect water resources.
b. Property owners adopt practices that protect water resources.
c. Stakeholders support and engage in protection and restoration efforts.

**Specific Activities to Reach Goals:**

Maintain Your Property the Watershed Friendly Way
This handbook is targeted to small businesses, multi-family housing properties, and common ownership communities such as homeowners' associations. It contains tips for specifying and hiring turf and snow maintenance contractors, and includes checklists for BMP inspections. Electronic copies have been provided to Shingle Creek and West Mississippi cities for their use and to be displayed on their websites. The handbook also appears on the WMWA website. Print copies are available for distribution.

Press Releases and Newspaper Articles

- The Commissions contribute to the WMWA eNewsletter *Water Links*, which has about 2,200 subscribers and has been published and distributed by Hennepin County. At year-end the County advised WMWA that it could no longer provide this service. As a result, WMWA has switched its email distribution system MailChimp and returning and new subscribers have been advised to go to westmetrowateralliance.org/contact.html to sign up for future eNewsletters.
- Aside from general interest pieces and announcements, *Water Links* articles specific to SCWM included:
    - Testing a promising new method for removing pollutants – Iron and Bio-char Enhanced Sand Filters Research Project.
    - WaterShed Prep
    - Smart Salting
    - TwinLake Carp Monitoring and Movement
    - Pledge to Plant
    - 16th annual Shingle Creek Clean-Up.
- *Camden Community News* articles on the bio-char project
- *Camden Community News* on the Ryan Lake Park, **"**Behind the Victory Flagpole**,"** including pictures from the 1920's and 30's.
- *Sun Post* articles about Wetland 639W and the adjoining wildlife area
- Staff interviewed by Minnesota Public Radio regarding the use of chloride. "Salt is polluting our water. Here's how we can fix it," *MPR News*.

Web Site
The Commissions maintained a joint web site, shinglecreek.org, which includes information about the watersheds, the Commissions, and the water resources in the watersheds. In 2015 the website was refreshed and significantly updated. Commission staff worked to develop a new site using the free web building tool Weebly. This allows staff complete control over the website and its content and the ability to add things such as interactive mapping, blogging, and a calendar. These web building sites use

templates that are easy to use and which also can automatically generate mobile-friendly versions of the site. They are also search engine optimized and there are additional analytics that Staff can access to better track how often the site is being accessed. In 2017 the site received over 9522 pageviews.

Social Media. The Commission established a Facebook page in May 2016. During 2017 there were 106 "likes" and 9,225 "reaches." A reach is logged when a timeline post is seen by a viewer. Viewers were "engaged" 815 times. An engagement is a click to open a post, view a photo or video, make a comment, or click on a reaction emoji.

Seed Packets

One of the priority messages in 2017 was the pledge to plant for pollinators and clean water. To help promote this message, the Commissions handed out 400 packets of native seeds. A short educational message was printed on the seed packets.

**Evaluation:**

Evaluation measures are as noted above: number of brochures and handbooks distributed; number of website hits; number of link-throughs on the eNewsletter; social media engagement. The new website uses Google Analytics to better track page views and unique visitors. The 2017 website activity is shown on the last page of this report.

**Program:** Public Outreach

**Audience:** Residents, youth

**Program Goals:**

a. Provide opportunities for people of all ages to participate in hands-on activities to protect and improve waters.
b. Provide opportunities for people to learn about ways they can protect and improve waters.

**Educational Goals:**

a. Maintain their properties and best management practices (BMPs) to protect water resources.
b. Adopt practices that protect water resources.
c. Support and engage in protection and restoration efforts.
d. Participate in volunteer activities.

**Specific Activities to Reach Goals:**

Pledge to Plant Campaign. At WMWA's request, Metro Blooms/Blue Thumb submitted a proposal for a project that would encourage residents to replace impervious surface and turf grass with native plantings


to benefit clean water by reducing stormwater runoff. The project includes the additional benefit of creating habitat for pollinators. An agreement between Metro Blooms and the Shingle Creek Commission, as fiscal agent, to move the project forward was approved.

Phase one of the project began with creation of a name, tag line and logo. The project was promoted in the Blue Thumb space at the State Fair where the public voted to name the campaign, *Pledge to Plant for Clean Water and Pollinators.*

Phase two included a roll out of the Pledge campaign on the Metro Blooms and WMWA websites where citizens can enter the square footage of their new plantings, creation of a Pledge to Plant banner for events, and a social media campaign that began in May 2016. The Campaign was promoted at the State Fair and other area events.

As of December 31, 2017, over 571 people had submitted the Pledge online covering over 401 acres, though several submissions did not specify area to be planted, so it may be more. The total includes a handful of larger prairie restoration projects but the median pledge covers 200 square feet. Most of the Pledges come from the metro area, but Pledges have been received from 17 other states: Arkansas, California, Illinois, Indiana, Kansas, Michigan, Missouri, Montana, New Jersey, New York, North Dakota, Ohio, Oklahoma, Tennessee, Virginia, Wisconsin, and Wyoming.

Another focus of the 2017 campaign was native plant sales at events such as local garden expos and farmers markets. The July 13 Camden Farmers Market had over 230 visitors. Many visited the WMWA table and purchased plants from Minnesota Native Landscapes. The vendor from MNL said he sold about 200 units, over half of which were 6-packs, for $10 each.

Rain Garden Workshops

The Commissions partnered with WMWA to sponsor four Rain Garden workshops through Metro Blooms in 2017. Metro Blooms is a non-profit organization whose mission is to promote and celebrate gardening, to beautify our communities and help heal and protect our environment. The three-hour workshop *Learn How to Create a Weather-Resilient Yard* provided an overview of Minnesota's changing weather patterns and ways to mitigate the impact in your own yard. The presenters offered recommendations for individual properties and options for establishing mowable, native alternatives to "grass" turf, raingarden basics, and other resilient yard practices. Attendees also received one-on-one design assistance from landscape professionals and Master Gardeners. The locations and number of participants are shown in Table 5.

**Table 5. 2017 Rain garden workshop locations and participation.**

| Location | Date | # Participants |
|---|---|---|
| Brooklyn Park – Autumn Ridge Apartments | Sept 26 | 150 |
| Champlin – Champlin City Hall | April 6 | 14 |
| Crystal in partnership w/Golden Valley, New Hope, Robbinsdale – Crystal Community Center | May 4 | 47 |
| Plymouth – St Barnabas Church | April 11 | 50 |

Shingle Creek Cleanup

The 16th Annual Great Shingle Creek Cleanup was held the week of April 17-24, 2017. Each city sponsored its own cleanup, which could be a special event or simply a request that the existing Adopt-a-Park volunteers schedule their spring cleanup during that week.

Volunteer Monitoring

The Commissions provide opportunities for high school students and adults to gain hands-on experience monitoring lakes, streams, and wetlands.

*Lakes*. Volunteer lake monitoring is performed through the Met Council's Citizen Assisted Lake Monitoring Program (CAMP). The Met Council provides the monitoring equipment and the laboratory work and data analysis while the Shingle Creek Commission staff recruit and train volunteers to perform sampling, collect the volunteers' water quality samples, and get them to the Met Council. In 2017, volunteer monitoring was completed on Bass Lake.

*Streams.* Routine stream macroinvertebrate monitoring in both watersheds is conducted by volunteers through Hennepin County's River Watch program. This program was initiated in 1995 to provide hands-on environmental education for high school and college students, promote river stewardship, and obtain water quality information on the streams in Hennepin County. Hennepin County coordinates student and adult volunteers who use the River Watch protocols to collect physical, chemical, and biological data to help determine the health of streams in the watershed. Two sites on Shingle Creek were monitored in 2017 – the long-term (22 years) site next to Park Center High School in Brooklyn Park, monitored by students from Park Center High School; and a site in Lions Park in Brooklyn Center, monitored by students from Calvin Christian Academy of Fridley.

*Wetlands.* Two sites in the Shingle Creek watershed and two sites in the West Mississippi watershed were monitored through the Hennepin County Environmental Services' Wetland Health Evaluation Program (WHEP). The WHEP program uses trained adult volunteers to monitor and assess wetland plant and animal communities in order to score monitored wetlands on an Index of Biological Integrity for macroinvertebrates and vegetation. In 2017 the monitored sites in Shingle Creek were in Brookdale Park in Brooklyn Park and Three Ponds Park in Plymouth. The sites in West Mississippi were in Bartusch Park in Champlin and Oxbow Ponds north of Oxbow Lake in Brooklyn Park.

**Evaluation:**
Evaluation of these programs is based on participation.

**Program:** Collaborative Efforts

**Audience:** Multiple

**Program Goals:**

a. Promote interagency cooperation and collaboration, pool resources to undertake activities in a cost-effective manner, and promote consistency of messages.
b. Share information and ideas with other partners.

**Educational Goals:**

a. All people have a general understanding of watersheds, water resources and the organizations that manage them.
b. All people understand the connection between actions and water quality and water quantity.

**Specific Activities to Reach Goals:**

<u>WMWA</u>
The Commissions partner with the Bassett Creek WMO and the Elm Creek WMO and other interested parties as the West Metro Water Alliance (WMWA). Other participating parties include the Freshwater Society, Hennepin County Environment and Energy, and Three Rivers Park District. The Mississippi WMO also participates but is not a formal member. Each member watershed organization contributes funds to

WMWA, which sponsors programs such as Watershed PREP, the eNewsletter *Water Links*, standardized brochures and booklets, and the Planting for Clean Water Program. WMWA publishes an annual report on its activities.

Other Partnerships

The Commissions are also members of:

- WaterShed Partners, a coalition of agencies, educational institutions, WMOs, Watershed Districts, and Soil and Water Conservation Districts that coordinate water resources education and public outreach planning in the Metro area;
- BlueThumb, a consortium of agencies and vendors partnering to increase outreach and awareness; and
- NEMO (Nonpoint Education for Municipal Officials), a program that provides educational and skill-building programming to elected and appointed officials and community leaders to increase their knowledge of the connection of land use and management decisions to water quality and natural resources.

**Evaluation:**

No specific evaluation of this programing has been completed.

**Program:** Continuing Education

**Audience:** Commissioners, Technical Advisory Committee (TAC)

**Program Goals:**

a. Effectively and efficiently manage the water resources in the watershed.
b. Increase awareness and knowledge of broader water resources issues and trends.

**Educational Goals:**

a. Commissioners and TAC understand watershed management, water quality and quantity conditions and issues in the watershed, regulatory requirements and the current standards and practices.
b. Commissioners and TAC aware of broader water management issues and trends in Minnesota and elsewhere.

**Specific Activities to Reach Goals:**

Staff Presentations

- 2016 Annual Water Quality Monitoring report findings.
- Results of fish surveys on Lake Magda in Brooklyn Park and Meadow Lake in New Hope
- Twin Lake Carp Management Project update
- The Importance of TMDL Adaptive Management: Lessons from Shingle Creek.

Guest Speakers

Artist **Cecelia Schiller** displayed a mock-up of her alternative design for the art aeration structure at the Brooklyn Center City Hall site and described how the structure will work. (Due to prohibitive anticipated costs, this project did not move forward to the art structure phase.)

**Steve Woods,** Executive Director of The Freshwater Society. Woods recapped ***35 years of metro watersheds.*** He discussed how the numerous failures of the Metropolitan Surface Water Management Act have added up to success. This unique-to-Minnesota law has brought funding and focus to urban water management that have helped municipalities and watershed organizations prove that an ounce of prevention beats a pound of cure (or taxes).

**Ranjan Muthukrishnan, PhD,** Dept. of Fisheries, Wildlife and Conservation Biology at the University of Minnesota, presented, "Where is starry stonewort going: prediction of invasion risks using lake level ecological niche models." Muthukrishnan has been working on biological invasions, focusing on the properties that make communities susceptible to invasive species and the community consequences of the displacement of native foundation species.

<u>Other</u>

- The Commissions made a contribution toward the Clean Water Minnesota Campaign sponsored by Watershed Partners.
- The Commission made contributions to funding the annual Road Salt Symposium, the MOOS Lecture Series, and the State of Water Conference sponsored by the Freshwater Society.

**Evaluation:**

No specific evaluation of this programming has been completed

# NPDES MS4 Annual Report for 2017 Activities
# Public Comments

## CEAC

June 15, 2018

City of Minneapolis, Department of Public Works

Surface Water & Sewer Division c/o Liz Stout

RE: Stormwater Management Program Comments

Dear Liz Stout and City Staff:

Thank you for the opportunity to comment on the draft Stormwater Management Program (SWMP) for the City of Minneapolis.

Members of the Community Environmental Advisory Commission (CEAC) would like to offer a few suggestions to enhance the strengths of the report.

1. p2 NPDES Stormwater Permit, and p97 SMP 6.1.0:
    a. Clearly outline the NPDES water quality monitoring and analysis requirements and determination of sampling locations as listed in Table 1 in the NPDES permit.

2. p27, SMP 2.1, Engage a Diverse Public:
    a. Consider adding stormwater and erosion control reporting tools to the 311 mobile app to allow the public to report violations and add photos. This can help with sediment, erosion control, illicit discharges, and other stormwater issues.
    b. Think about how training on stormwater issues is provided to 311 operators, especially those with multilingual skills. As the first line of contact, ensuring that operators understand how to talk about the problems community members are seeing is vital.
    c. Make sure to include an activity to educate the public about impaired waters within the jurisdiction and the total maximum daily loads developed to address the impairments.

3. p45, SMP 3.7, Source Control Education and Outreach Program:
    a. Continue to develop and act on a Community Engagement Plan to communicate opportunities and look for partnerships.
    b. Work with translators to create multilingual versions of Leave It On The Lawn practices and various fertilizer, pesticide, and chemical brochures, especially for locations in more diverse areas of the city.

4. p45, SMP 3.7, Source Control Education and Outreach Program:
    a. Consider active participation in chlorine management discussions with the MPCA and other stakeholder groups including public works transportation staff, Freshwater Society, BOMA, MnDOT, the University of Minnesota.
    b. Make sure to include an item about educating public and commercial applicators on the

proper management and application of deicing and anti-icing compounds for winter maintenance.

5. p65, SMP 5.4, Private Development and Redevelopment Projects:
    a. Continue to prioritize green infrastructure early in project scoping and development reviews in order to get stacked benefits from infrastructure projects, especially when public works is coordinating with another lead transportation department.
    b. Consider using the ISI Envision rating system for green infrastructure when comparing project alternatives to evaluate triple bottom line benefits and life cycle analysis.

6. p75, SMP 5.9, Pilot Projects:
    a. Create a storyboard or mapping tool to communicate to residents about existing stormwater projects and pilot projects within the city.

7. p75, SMP 5.9, Pilot Projects:
    a. Consider implementing more stormwater reuse pilot projects within the city.

8. p99, SMP 6.1.11, Electronic Inventory and Mapping:
    a. Continue to work to develop this map to communicate data to residents.
    b. Consider using storyboards and other GIS tools to make data easy for the general public to access. Also consider using this tool to communicate locations of all the stormwater BMP sites the city has implemented. People might not even be aware of a lot of these installations.

9. p103, SMP 6.3 Parking Lot and Equipment Yard management:
    a. Consider stormwater or rainwater reuse for vehicle washing.

10. p105, SMP No. 6.4: Application of Snow and Ice Control for Streets:
    a. Work with MPCA and other stakeholders on smart salt application and chloride management. (see comment 3)

11. p107, SMP 6.5, Application of Snow and Ice Control for Properties:
    a. Sweeping up of excess deicers when an excess occurs should be included in the practice.

12. p142, Appendix A-5 City goals:
    a. Work to prioritize the implementation of projects located in the two newly established Green Zones in the city, especially projects that benefit stormwater quality or reduce flooding.

13. p146, Appendix A-6, Public Education by other Entities:
    a. p147 and p152: Please update CEAC name to Community Environmental Advisory Commission. It may be worthwhile to update the contact name with the staff liaison's

information as the CEAC chair typically changes every year.

b. p148: Please update the Minnehaha Creek Watershed District contact
c. p155: Please add the Master Water Stewards Program under Freshwater and MCWD for a potential project partner or BMP implementation.

Again, thank you for the opportunity to comment on the city's Stormwater Management Program. We look forward to the opportunity to work with city staff to continue to improve stormwater quality and quantity in Minneapolis.

Community Environmental Advisory Commission (CEAC)

Erin Niehoff, Chair

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## MPRB

**To: Elizabeth Stout:** *Water Resources Regulatory Coordinator*
City of Minneapolis, Department of Public Works
Surface Water & Sewer Division

**Subject: Minneapolis Park and Recreation Board 2018 Comments on the Minneapolis Stormwater Management Program Document**

Thank you for the opportunity to comment on the Minneapolis Stormwater Management program document. MPRB has environmental, financial, and quality of life interests in the water quality of our parkland and surface waters, and we look forward to working with the City of Minneapolis in further integration and implementation of this work.

MPRB comments on the 2018 Stormwater Water Management Program are as follows:

| page | comment |
|---|---|
| 10 | Modify to state "The MPRB plan is a visioning document that guides planning, development of their parks including environmental operations." |
| 14 | Why does the budget only go through 2015? |
| General | Correct MaryLynn Pulscher's title to Environmental Education Manager throughout the document |
| General | Add a list of each of the SMP sheets to the TOC or other relevant location and hyperlink them within the document |

| | |
|---|---|
| 104 | Modify SMP 6.3 to have Lisa Beck, Director of Asset Management, named as MPRB contact. Remove Debra Pilger. |
| 108 | Modify SMP 6.3 to have Lisa Beck, Director of Asset Management, named as MPRB contact. Remove Debra Pilger. |

Thank you again for the opportunity to review and comment on the program.

Sincerely,

Rachael Crabb, Water Resources Supervisor

Cc: Debra Pilger, MPRB
Jeremy Barrick, MPRB
Michael Schroeder, MPRB

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## Friends of Lake Hiawatha

City of Minneapolis, Department of Public Works

Surface Water & Sewer Division c/o Liz Stout

STORMWATER MANAGEMENT PLAN COMMENTS

Hello Liz,

Thanks for the opportunity to comment on stormwater management.

As our culture and our city has changed over the decades we have seen dramatic increases in the amount of styrofoam and plastic trash littering our waters. Lake Hiawatha has borne the brunt of this cultural shift. Lake Hiawatha is littered with tons of trash that arrive directly from the streets of South Minneapolis. A minimum of 2,000 lbs of plastic and styrofoam trash gets removed from Lake Hiawatha annually by volunteers, yet this extraordinary effort is not enough to clean Lake Hiawatha of the trash that is spread throughout this important resource and habitat. For years, Friends of Lake Hiawatha have been asking for the implementation of effective mitigation for the 43rd street pipeshed (north pipe). This is a 900 plus acre pipeshed that brings tons of pollution into the Lake, unfortunately the mitigation of the north pipe has become mired in the debate about groundwater pumping and golf. This has resulted in delays in the process of developing a solution for the aged infrastructure of the north pipe. The north pipe brings 570 lbs. of phosphorous annually to impaired Lake Hiawatha. A massive delta of sediment has formed in the Lake in front of the pipe, dramatically altering the Lake bottom. The litter of a huge swath of urban streets dumps directly into the Lake creating hazardous conditions and impairing and in some cases killing wildlife residents. In addition the Lake receives all of the other chemical contaminants associated with urban environments.

The MPRB and the City of Minneapolis have been presented with an opportunity to implement an effective mitigation system that can effectively address all of the aforementioned pollutants by using green infrastructure and other stormwater management techniques. However this process has been delayed repeatedly by extended and divisive community debate about groundwater pumping and golf. This divisiveness has also extended to include the park commissioners and has so far impaired their ability to address this egregious source of pollution. Since the mitigation of the north pipe became tied to this debate about golf and groundwater pumping, the commissioners decided to delay the closure of the golf course for five years. If stormwater management and golf were not bound together this would not be a problem, however the delay of five years now means 10,000 lbs. of trash for Lake Hiawatha. We urge the City of Minneapolis and the MPRB to move forward with addressing these critical infrastructure needs regardless of the continued debate about golf. Infrastructure needs need to be prioritized over these other public use considerations and should have never been tied together.

The MPRB is charged with keeping the parkland free of trash, yet they make no effort to remove the trash from the shores of Lake Hiawatha. It is only extensive volunteer efforts that work to stem the tide of trash. If the MPRB continues to delay the implementation of mitigation at Lake Hiawatha we (FOLH) will be asking the MPRB to meet its obligation to keep the parkland free of trash instead of relying on volunteer efforts.

We have created this calculation based on our survey of trash in Lake Hiawatha:

- At least 6,000 lbs. trash from the shores of Lake Hiawatha verified collected from 2015-2017.
- That is 2,000 lbs. every year. One ton of mostly plastic and styrofoam trash.
- A minimum of 10,000 lbs. of trash will accumulate on the shores of Lake Hiawatha in 5 years.
- It takes three to four hours of focused labor to remove 20 lbs of trash from the shores of Lake Hiawatha.
- Minimum 300 hours of direct labor to remove the trash per year.
- Totaling 12 weeks to clean up the trash if working 5 days per week.
- 5 hours daily of direct cleanup and add two hours daily for prep, travel, accounting and disposal etc.= 7 hours per day.
- Cleanup season is six months long. April 15 - October 15
- Yearly employee estimate: 60 days working and 420 hours of labor

It should be noted that if effective mitigation is implemented this will not be necessary and that isolated and captured trash can be much more easily disposed of. Also, costs of trash disposal need not be added in accounting, as the park is already paying for the disposal of this trash.

Thank you!

Sean Connaughty and Friends of Lake Hiawatha

612 226 5126

Friends of Lake Hiawatha are also working to get a water quality standard in place for trash as it is clearly a pollutant even though it is not listed as such. Here is our letter to the MPCA:

**Subject: 2017 Triennial Standards Review Process Comments – let's reduce trash too!**

From –


Sean Connaughty and Friends of Lake Hiawatha

4053 23rd ave s. Minneapolis, MN 55407

Email: friendsoflakehiawatha@gmail.com


To minnrule7050.pca@state.mn.us

Catherine O'Dell, Minnesota Pollution Control Agency, 520 Lafayette Road North, Saint Paul, MN 55155-4194

**Subject: 2017 Triennial Standards Review Process Comments**

Dear Catherine O'Dell:

Thank you for the opportunity to provide comments during the State of Minnesota's 2017 Triennial Standards Review (TSR) Process.

As Friends of Lake Hiawatha we hope to reduce the large volume of trash flowing into our lake after each rain event.

We are writing to ask the MPCA to include a trash-specific water quality standard (WQS) in Minnesota Administrative Rules Chapter 7050, Waters of the State.

Minnesota Administrative Rules Chapter 7050 includes a system of beneficial uses for the various waters of the state, narrative and numeric water quality standards to protect the beneficial uses of our water resources for aquatic life, wildlife, recreation, aesthetic enjoyment and navigation.

Currently, the Minnesota Administrative Rules do not contain a water quality standard specific for trash. Rather, the Minnesota Administrative Rules contain a general standard for the state related to nuisance conditions that may be interpreted to include trash.

Currently the majority of trash enters water bodies through wind or storm water runoff transport of trash from littering or illegal dumping - including cigarette butts, paper, fast food containers, plastic grocery bags, glass/plastic/metal cans and bottles, used diapers, construction site debris, old tires, and appliances, clothing, etc. Many of the trash items are actually toxic materials that negatively impact water quality. The presence of trash in our water bodies adversely affects beneficial uses including, but not limited to, threats to human health, aquatic life, and wildlife.

To advance local anti-littering ordinances and programs we need a regulatory mechanism to incentivize agencies to properly enforce their ordinances or address trash via other mechanisms (installation of mitigation systems, green infrastructure, street sweeping, storm drain system catch basin cleanings, clean-up events, anti-littering/dumping signage).

We are asking the MPCA to add trash-specific water quality standard that directly identifies trash as a pollutant. An example of a narrative WQS that could be added to Section 7050.0210 of the Minnesota Administrative Rules is provided below:

> ***Discharge of Trash Prohibited.*** *Trash shall not be present in surface waters and along shorelines or adjacent areas in amounts that adversely affect beneficial uses or cause nuisance.*

Having a trash-specific water quality standard in Minnesota (like other states, including California) will allow for further regulatory actions such as development of trash total maximum daily loads (TMDLs) and/or inclusion of trash management actions in National Pollution Discharge Elimination System (NPDES) Phase I and Phase II Municipal Separate Storm Sewer System (MS4) Permits.

There is a need to address trash in Minnesota to protect and enhance our water bodies. Adding a trash-specific WQS to Section 7050.0210 of the Minnesota Administrative Rules is a good first step to better address trash pollution in Minnesota waterways.

Thank you for your time.

Sincerely,

Sean Connaughty and Friends of Lake Hiawatha

Website: www.friendsoflakehiawatha.org

Email: friendsoflakehiawatha@gmail.com

**CITY OF MINNEAPOLIS**
**PUBLIC WORKS DEPARTMENT**
Street Maintenance Division
**Standard Operating Procedure for Vehicle Related Spills (VRS)**
May, 2010

The purpose of this document is to provide detailed standard operating procedures for the Clean up of VRS sites and the management/disposal of the impacted spill debris.

## DEFINITION of TERMS

**MPCA:** Minnesota Pollution Control Agency

**MEM:** Minneapolis Environmental Management (also historically known as Minneapolis Pollution Control)

**MSMD:** Minneapolis (Public Works) Street Maintenance Division

**VRM:** Vehicle Related Material: Petroleum products or other vehicle fluids that are inherently related to vehicular operations. This does not include materials that are being transported by a vehicle, unless the material is clearly labeled as being one of the aforementioned products.

**VT:** Volumetric Threshold: Minnesota has a 5 gallon minimum quantity for reporting petroleum spills. Spill of all other chemical or material in any quantity is reportable.

**Spill debris:** Sand that has been placed to absorb VRM and subsequently recovered for disposal.

## Scenario Number 1: MPCA informs MEM of VRS

The driver of a vehicle involved in a spill is responsible for notifying the MPCA Duty Officer, if the VT is exceeded. The Duty Officer will immediately notify the MPCA Emergency Response Unit. If the spill is of the size and nature that the Emergency Response Unit determines should be handled by MEM, the MPCA will notify MEM and provide them with the details relating to the spill incident. The MEM representative will make a determination based on the information provided by the MPCA on how to proceed, and if appropriate (typically VRM in manageable quantities), contacts MSMD.

The MSMD will dispatch personnel with appropriate equipment to apply sand to the spill site. The sand will be given a period of time in which to absorb the VRM. The sand (spill debris) will then be removed by means of a street sweeper, and deposited at the established disposal site in a designated VRM spill debris pile. If a secondary sanding is required, the procedure will remain the same. Since the volume of the spill is greater than 5 gallons, a Hazardous Material Spill Data form (see Appendix A) must be completed as soon as possible (i.e. within 24 hours or the next business day). The completed form will be sent to the MEM as soon as possible. A final report on the action(s) taken will be sent to the MPCA from MEM.

**Spill Debris Pile Management**

Arrangements for disposal of the spill debris pile will be a collaborative effort by the MSMD and the Engineering Laboratory. As the spill debris pile reaches a size that becomes difficult to manage within the boundaries of the disposal site, the Engineering Laboratory will be contacted. The spill debris pile will be mechanically blended and the Laboratory will select representative samples for laboratory analysis, as required by MPCA regulations. The sampling and testing will require approximately one week to complete. After receiving the laboratory analysis data, the spill debris will be disposed of in a manner pre-approved by the MPCA and the Minneapolis Procurement Division.

## Scenario Number II: The MSMD discovers a VRS

MSMD personnel discover a spill or are informed of a potential VRM spill from sources other than MEM or MPCA. After arriving at the scene, they will determine whether the incident is a VRM spill, (possibly from a vehicle collision, a spill from a labeled container, etc.) and will determine if the volume of the spill is greater than the VT (5 gallons).

- <u>Less than 5 gallons:</u> If the spill quantity is judged to be less than 5 gallons, no contact with MEM is necessary. Sand will be applied and the procedure will continue as described in Scenario I (i.e. subsequent sanding/sweeping and stockpiling into the spill debris pile). A Hazardous Materials Spill Data form must be completed for record and documentation purposes and retained at MSMD, <u>but is not to be sent to MEM.</u>

- <u>5 gallons or more:</u> If the MSMD representative determines that a volume of 5 gallons or more of VRM has been spilled, MSMD must contact MEM or MPCA. The same procedures for clean up and reporting (using the Hazardous Material Spill Data form) as in Scenario I will be followed. This form <u>must</u> be sent to MEM.

For both cases, the disposal of the VRM spill debris pile is as detailed in Scenario I.

***Potential Modification to Scenario I and II***

Regulatory officials may require separate stockpiling of spill debris from specific spill incidents. Separate sampling and laboratory analysis will be required in these cases. This may also be requested to create a distinct tracking mechanism of a given spill of significant quantities and/or from a billable source. This scenario will be determined on a case-by-case basis. The process for disposal will be the same as previous scenarios.

**Scenario Number III: The MSMD becomes aware of a spill of unknown material or composition**

The MSMD shall contact MEM before taking any action to clean up a spill of unknown composition. MEM will manage these spills through their contracts with private entities specializing in these activities, or manage and coordinate the cleanup with the MSMD. If MEM cannot be contacted, the MPCA Duty Officer should be contacted immediately.

**ADDITIONAL INFORMATION**

1. Currently the disposal site for spill debris is at the Linden Yards site. The material shall be placed in two 20 cubic-yard leak-proof roll-off containers with a counter-balanced lockable lids at the City Site.

2. List of Potential Contacts:
   - **Minnesota Pollution Control Agency (MPCA)**
     Duty Officer: 651-649-5451; 24 hours a day, seven days a week
   - **Minneapolis Environmental Management (MEM)**
     Steve Kennedy: 612-685-8528 (work)
     Tom Frame: 612-673-8501 (work)
     Emergency after-hours contacts:
     Tom Frame: 612-754-0762
   - **Engineering Laboratory**
     Paul Ogren: 612-673-2456
     Stephanie Malmberg: 612-673-3365
   - **Minneapolis Street Maintenance Division (MSMD)**
     Steve Collin: 612-673-5720 (work)
     Rick Jorgensen: 612-673-5720 (work)
     24 hours a day, 7 days a week: 612-673-5720

3. MSMD will be responsible for any billing of outside parties for services rendered for the clean up/disposal of a spill event. The MSMD, MEM and the Engineering Laboratory will develop a system for tracking cost associated with these operations. This information will be distributed, as it becomes available.

4. This is a statement of policies and procedures, which will be revised and updated as new information becomes available.

## STORM DRAINAGE AREAS BY RECEIVING WATER BODY
## (within Minneapolis City Limits)

| Surface Water | Area (acres) | Impervious % | Population 2010 | Single Family / Duplex % | Multi Family % | Inst. % | Comm. % | Ind. % | R.O.W. % | Golf Course % | Park, Rec., or Preserve % | Rail % | Airport % | Open Water % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bassett Creek | 1,621.2 | 40.6% | 15,766 | 43.1% | 1.2% | 3.5% | 2.1% | 3.9% | 24.2% | 0.0% | 20.4% | 1.6% | 0.0% | 0.0% |
| Bde Maka Ska | 1,250.2 | 45.3% | 14,482 | 34.9% | 8.7% | 1.7% | 5.9% | 0.1% | 20.6% | 4.7% | 15.6% | 0.0% | 0.0% | 0.0% |
| Birch Pond | 38.8 | 10.3% | 4 | 0.1% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 99.9% | 0.0% | 0.0% | 0.0% |
| Brownie Lake | 93.9 | 40.3% | 321 | 30.9% | 0.0% | 0.0% | 28.6% | 0.0% | 18.6% | 0.0% | 18.2% | 3.1% | 0.0% | 0.6% |
| Cedar Lake | 287.8 | 31.5% | 1,853 | 38.0% | 1.1% | 2.2% | 0.4% | 0.0% | 18.6% | 0.1% | 37.8% | 0.7% | 0.0% | 1.3% |
| Crystal Lake | 420.9 | 41.7% | 5,728 | 62.0% | 1.7% | 2.6% | 0.7% | 0.0% | 30.3% | 0.0% | 2.7% | 0.0% | 0.0% | 0.0% |
| Diamond Lake | 663.7 | 47.8% | 6,291 | 45.6% | 4.0% | 2.2% | 3.6% | 7.9% | 27.8% | 0.0% | 8.9% | 0.0% | 0.0% | 0.0% |
| Grass Lake | 324.7 | 43.3% | 2,707 | 59.0% | 0.1% | 3.2% | 2.3% | 0.0% | 29.9% | 0.0% | 4.9% | 0.0% | 0.0% | 0.6% |
| Hart Lake | 3.3 | 51.2% | 21 | 24.8% | 0.0% | 0.0% | 19.2% | 0.0% | 52.7% | 0.0% | 0.0% | 3.3% | 0.0% | 0.0% |
| Lake Harriet | 1,120.5 | 38.6% | 9,867 | 46.6% | 1.8% | 2.8% | 1.5% | 0.0% | 20.2% | 0.0% | 26.1% | 0.0% | 0.0% | 1.1% |
| Lake Hiawatha | 1,243.4 | 42.9% | 16,515 | 49.8% | 2.9% | 2.9% | 2.0% | 0.0% | 26.9% | 10.4% | 5.1% | 0.0% | 0.0% | 0.0% |
| Lake Nokomis | 695.8 | 35.1% | 5,776 | 47.7% | 0.1% | 2.1% | 0.4% | 0.0% | 22.9% | 0.0% | 26.6% | 0.0% | 0.0% | 0.2% |
| Lake of the Isles | 769.8 | 44.5% | 11,516 | 42.6% | 10.0% | 2.3% | 3.2% | 0.3% | 23.8% | 0.0% | 17.5% | 0.0% | 0.0% | 0.3% |
| Legion Lake | 2.1 | 43.0% | 23 | 60.5% | 0.0% | 0.0% | 0.0% | 0.0% | 39.5% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Loring Pond | 27.2 | 16.2% | 36 | 0.0% | 3.1% | 3.5% | 0.1% | 0.0% | 1.3% | 0.0% | 91.5% | 0.0% | 0.0% | 0.5% |
| Minnehaha Creek | 3,347.4 | 38.6% | 32,559 | 53.0% | 0.8% | 3.2% | 1.5% | 0.2% | 24.2% | 0.7% | 15.9% | 0.0% | 0.0% | 0.0% |
| Mississippi River | 20,313.0 | 57.7% | 237,734 | 29.2% | 6.0% | 6.5% | 6.1% | 12.0% | 28.8% | 1.5% | 7.8% | 2.5% | 0.1% | 0.1% |
| Mother Lake | 30.5 | 45.4% | 112 | 25.3% | 0.0% | 1.5% | 0.1% | 0.0% | 63.9% | 0.0% | 0.0% | 0.0% | 9.2% | 0.0% |
| Powderhorn Lake | 322.7 | 43.5% | 6,483 | 44.3% | 5.7% | 3.7% | 1.6% | 0.0% | 27.1% | 0.0% | 17.5% | 0.0% | 0.0% | 0.1% |
| Richfield Lake | 57.6 | 65.0% | 356 | 27.2% | 3.4% | 1.0% | 27.7% | 0.1% | 40.6% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Ryan Lake | 60.6 | 42.3% | 506 | 50.3% | 0.0% | 0.0% | 0.0% | 10.0% | 28.3% | 0.0% | 2.2% | 8.8% | 0.0% | 0.5% |
| Shingle Creek | 1,457.7 | 44.7% | 11,571 | 40.5% | 1.2% | 2.3% | 1.1% | 8.8% | 19.9% | 1.2% | 22.2% | 3.8% | 0.0% | 0.3% |
| Silver Lake | 25.0 | 41.2% | 206 | 66.1% | 3.4% | 0.0% | 2.2% | 0.0% | 28.3% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Spring Lake | 50.0 | 32.6% | 208 | 40.2% | 0.3% | 6.4% | 0.0% | 0.0% | 15.7% | 0.0% | 37.1% | 0.0% | 0.0% | 0.2% |
| Taft Lake | 138.9 | 45.1% | 1,228 | 57.6% | 0.0% | 0.0% | 0.0% | 0.0% | 42.1% | 0.0% | 0.2% | 0.0% | 0.0% | 0.0% |
| Wirth Lake | 40.6 | 6.1% | 25 | 0.2% | 0.0% | 0.0% | 0.0% | 0.0% | 0.2% | 0.0% | 99.6% | 0.0% | 0.0% | 0.0% |
| **Grand Total** | **34,407.3** | **50.9%** | **381,894** | **36.2%** | **4.6%** | **4.9%** | **4.5%** | **7.8%** | **26.7%** | **1.6%** | **11.7%** | **1.7%** | **0.0%** | **0.2%** |

Appendix A5 - Storm Drainage Areas by Receiving Water Body
Source: Minneapolis Public Works - Surface Water & Sewers

# Mitigating Trash Upstream of Lake Hiawatha - Manhole Pilot Project

In November 2017 Surface Water and Sewer Staff retrofitted three manholes upstream of Lake Hiawatha with trash screens as part of ongoing pilot efforts to improve the water quality in lake. The selection of the manholes was informed by a litter surveyed completed earlier in 2017 by staff from the Solid Waste and Recycling Division of Public Works. The three manholes are located in relative proximity to commercial and retail properties where higher volumes of litter have been observed. Consideration was also given to the configuration of the connected storm pipes to minimize the likelihood of street flooding if the pilot failed and caused an obstruction in the pipe.

The trash screens were fabricated by City staff and designed to capture floatable trash and debris that could wash through the city's storm sewer system. City crews are able to access and maintain the manholes by vactoring out all of the debris and trash before it enters Lake Hiawatha. Crews are tracking debris removed to assess the success of the pilot project and to inform future water quality improvement efforts.

## Photos

## Integrated Pest Management (IPM) Vegetation Management Policy

**Goals**

- Public safety
- Prevent erosion
- Protect and improve water quality and ecological function
- Slow water movement, hold or convert pollutants, and enhance infiltration and evapotranspiration
- Conduct preventive maintenance for longevity of infrastructure
- Control invasive species (non-native and selected native species) growth and prevent the production and dispersal of seed
- Create wildlife habitat
- Provide a neat appearance

**Herbicide Policy**

Public Works – Surface Water & Sewers Division (PW-SWS) has adopted the Integrated Pest Management (IPM) Policy formulated by the Minneapolis Park and Recreation Board (MPRB) to guide the use of herbicides on public lands under their charge. Herbicide use shall be limited as directed in this document.

**Management Guidelines**

- Perpetuate the original intent of the species planted. On many sites the original intent was to establish a simplified native grassland community. Plant species were selected for their resilience, habitat value and beauty. These plants shall be managed for their proliferation.
- Control [1] all species listed on the MN Noxious Weed List and comply with the MN Noxious Weed Law.
- Control invasive species in order to prevent Public Works sites from becoming sources of invasive weed seed that can disperse and establish on neighboring properties. An example is Canada thistle, which produces copious amounts of wind-blown seed that can easily become a problem on nearby public and private lands.
- Control aggressive species that if allowed to exist on a site will quickly spread and overwhelm the site. Aggressive native species include but are not limited to Canada goldenrod, sandbar willow and cottonwood. Non-native species include but are not limited to Canada thistle,

[1] **Control means manage or prevent the maturation and spread of propagating parts of noxious weeds from one area to another by a lawful method that does not cause unreasonable adverse effects on the environment.** *MN Noxious Weed Law 2013 MS 18.75-18.91*

crown vetch, bird's-foot trefoil, reed canary grass, *Phragmites australis*, spotted knapweed, smooth brome, sweet clover, purple loosestrife, Siberian elm, buckthorn, and Tartarian honeysuckle.

- Control non-native cattails (hybrid and narrow-leaf). They are common weeds in stormwater treatment facilities that may clog inlet and outlet structures, and they reduce habitat function. They are to be controlled when a threat to structures occurs, primarily by cutting the plant below the water surface. Where this is not feasible, as a last resort wick application of an aquatic-safe herbicide may be warranted, however herbicide application over water shall be avoided where practicable.
- Control fast growing, rank, woody species such as willow, Siberian elm and box elder that can quickly establish and form a thicket around stormwater treatment facilities or can cause a public safety issue.
- Control species that are allelopathic [2]. These include but are not limited to spotted knapweed, garlic mustard, and leafy spurge.

**Invasive Plant Management Tools** (where feasible, use mechanical means such as pulling and mowing, in order to minimize chemical usage)

- Herbaceous Plantings
  - Pulling (preferred)
  - Mowing (preferred)
    - Flail mowing
    - Spot mowing
  - Herbicide application
    - Spot spraying
    - Wick application
- Woody Plants
  - Pulling (preferred)
  - Cutting with stump application of herbicide

[2] **Allelopathic means to produce a chemical in plant tissue that releases into the soil and prevents the growth of most other species**

**INTEGRATED PEST MANAGEMENT – ADAPTED FROM MINNEAPOLIS PARK AND RECREATION BOARD POLICY (Revised July 24, 2008)**

Integrated Pest Management (IPM) is a pest management strategy that focuses on long-term prevention or suppression of pest problems with minimum impact on human health, the environment and non-target organisms. In most cases, IPM is directed at controlling pests that have an economic impact on commercial crops; however, in the instance of mosquito control, IPM is used to control nuisance and potentially dangerous mosquito populations. The guiding principles, management techniques and desired outcomes are similar in all cases.

A number of concepts are vital to the development of a specific IPM policy goal:

1. Integrated pest management is not a predetermined set of practices, but a gradual stepwise process for improving pest management.
2. Integrated pest management programs use a combination of approaches, incorporating the judicious application of ecological principles, management techniques, cultural and biological controls, and chemical methods to keep pests below levels where they cause economic damage. (Laws of MN, 1989)
3. Implementing an integrated pest management program requires a thorough understanding of pests, their life histories, their environmental requirements and natural enemies, as well as establishment of a regular, systematic program for surveying pests, their damage and/or other evidence of their presence. When treatments are necessary, the least toxic and most target-specific plant protectants are chosen.

The four basic principles of IPM used in designing a specific program are:

1. Know your key pests.
2. Plan ahead.
3. Scout regularly.
4. Implement management practices.

**Selection of Management Strategies**

Selection of Management Strategies pest management techniques include:

- Encouraging naturally occurring biological control.
- Adoption of cultural practices that include cultivating, pruning, fertilizing, maintenance and irrigation practices that reduce pest problems.
- Changing the habitat to make it incompatible with pest development.
- Using alternate plant species or varieties that resist pests.
- Limiting monoculture plantings where possible.
- Selecting plant protectants with a lower toxicity to humans or non-target organisms

The criteria used for selecting management options include:

- Minimization of health risk to employees and users.
- Minimization of environmental impacts (e.g. water quality, non-target organisms).
- Risk reduction (losses to pests, or nuisance/threshold level).
- Ease with which the technique can be incorporated into existing management approaches.
- Cost-effectiveness of the management technique.

**Posting of Plant Protectant Applications**

Comply with the City of Minneapolis ordinance regarding pesticide application (Minneapolis Code of Ordinances Title 11 [Health and Sanitation] Chapter 230 [Pesticide Control])

**Recordkeeping**

Produce and maintain the necessary records of all pest management activities as required by the Minnesota Department of Agriculture.

**Weed Control in Upland Plantings, Shrub Beds and Around Trees**

Plants are selected and/or replaced in order to provide disease and insect resistant plantings, thereby reducing plant protectant applications. Weeds listed on the State of Minnesota's Noxious Weed List must be controlled as per state statute, and species will be controlled as listed in Management Guidelines above. Mechanical or manual means of weed control will be tried first when feasible. However, due to global climate change, increasing populations of tap-rooted and other perennial weeds are being transported by birds and other means. Pulling or digging of these weeds is usually not successful. Spot spraying of these tap-rooted weeds with a low toxicity herbicide will help prevent flowering, seeding and further dispersal of these pest weeds. Appropriate mulching of upland plantings, shrub beds and around trees will help decrease the number of pest weeds. If control of annual weeds in pathway or mulched areas is required, the proper pre- or post-emergent low toxicity herbicide will be applied on a spot spray basis. Posting of any plant protectant applications will be carried out according to City ordinance.

**Turf Areas**

PW-SWS follows the Minneapolis Park and Recreation Board's General Parks and Parkways threshold of 50% for broadleaf and/or grassy weeds in turf areas. When it has been determined that this percentage has been reached or exceeded, the appropriate post emergent or pre-emergent herbicide may be applied, preferably on a spot spray basis. Selection of the appropriate herbicide of choice will be determined by trained staff after evaluating the site, the hazard rating of the product and the specific location.

**Future Pest Control Issues**

With changes in climate, the environment will be subject to many changes, including the arrival of additional pests within open space areas. Following IPM principles, the City will refer to updates in MPRB policy and practice and will work with the appropriate local, state or national agencies to determine the best control approach for these new pests.

**RESOLUTION OF
THE CITY OF
MINNEAPOLIS
RESOLUTION
2015R-501**

**By
Quincy**

**Designating the utility rates for water, sewer, stormwater, solid waste, and recycling service effective with water meters read on and after January 1, 2016.**

Resolved by The City Council of The City of Minneapolis:

Effective with utility billings for water meters read from and after **January 1, 2016**, the meter rates for water are hereby fixed and shall be collected as follows:

Charges commence when the street valve is turned on for water service.

1. **Three dollars and forty five cents ($3.45)** per one hundred (100) cubic feet for customers not otherwise mentioned.

2. **Three dollars and sixty cents ($3.60)** per one hundred (100) cubic feet to municipalities, municipal corporations, villages and customers outside the corporate limits of the city where service is furnished through individual customer meters.

3. Rates for municipalities, municipal corporations and villages, which are established by contract, shall continue on the existing contract basis.

4. In addition to the above rates a fixed charge based on meter size will be billed each billing period or fraction thereof as follows:

| Meter Size | Fixed Charge |
|---|---|
| 5/8-inch | **$ 3.50** |
| 3/4-inch | **5.25** |
| 1-inch | **8.75** |
| 1 1/2-inch | **17.50** |
| 2-inch | **28.00** |
| 3-inch | **56.00** |
| 4-inch | **87.50** |
| 6-inch | **175.00** |
| 8-inch | **280.00** |
| 10-inch | **402.50** |
| 12-inch | **1,155.00** |

5. The fixed charge for a property serviced by a combined fire/general service line shall be based on the small side register of the combined meter, provided the volume of water used on the large side register

does not exceed 45,000 gallons per year. The volume of water used on the large side register in the previous year will be used to establish the fixed rate in the current year. In addition to the fixed charge, a fire line rate shall be assessed according to the size of the large side register at the annual rates established in provision (f) of this section. The fixed charge for a property serviced by a combined fire/general service line shall be based on the large side register of the combined meter, when volume of water used on the large side register exceeds 45,000 gallons per year. The volume of water used on the large side register in the previous year will be used to establish the fixed rate in the current year.

The fixed charge for a combined fire/general service line shall remain in place for the entire year.

6. All fire standpipes, supply pipes and automatic sprinkler pipes with detector meters, direct meters or non-metered, shall be assessed according to size of connection at the following rates each per annum for the service and inspection of the fire protection pipes and meters installed, as follows:

1½ inch pipe connection ……….$ 30.00

2 inch pipe connection . . . ……..$ 30.00

3 inch pipe connection . . . …….$ 40.00

4 inch pipe connection . . . ….. $ 60.00

6 inch pipe connection . . . …..$120.00

8 inch pipe connection . . . ….. $190.00

10 inch pipe connection . . . …..$275.00

12 inch pipe connection . . . …..$790.00

When the seal of any of the valves connecting with such fire protection pipes shall be broken, it shall be forthwith resealed by a Public Works - Water Division representative. All connections for fire systems must have a post indicator valve installed at the curb if ordered by the superintendent of the waterworks. (Code 1960, As Amend., § 606.030; Ord. of 12-28-73, § 1)

7. Rates for other services and materials provided shall be fixed as follows:

| Description | Materials (*before sales tax*) | Hourly Servicing Fee | Flat Rate |
|---|---|---|---|
| **Install new equipment requested by customer or replace damaged or lost equipment:** | | | |
| 5/8" water meter | $75.00 | $53.00 | N/A |
| 3/4" water meter | $100.00 | $53.00 | N/A |
| 1" water meter | $145.00 | $53.00 | N/A |
| 1 1/2" water meter | $360.00 | $53.00 | N/A |

| | | | |
|---|---|---|---|
| 2" water meter | $460.00 | $53.00 | N/A |
| 3" water meter | $1,090.00 | $53.00 | N/A |
| 4" water meter | $1,476.00 | $53.00 | N/A |
| 6" water meter | $2,430.00 | $53.00 | N/A |
| Encoder Receiver Transmitter (ERT) | $87.00 | $53.00 | N/A |
| Encoder 5/8" - 1" | $25.00 | $53.00 | N/A |
| Encoder 1 1/2" or greater | $80.00 | $53.00 | N/A |
| Meter couplings | $10.00 | $53.00 | N/A |
| | | | |
| Remove or drain a water meter | N/A | $53.00 | N/A |
| | | | |
| Water meter testing | N/A | $53.00 | N/A |
| | | | |
| Water meter reading, missed appointments, and posting fees | N/A | Minimum Charge $26.50 | N/A |
| Shut Off Valve Flush Fee | N/A | $20.00 | N/A |
| Private meter sales | Cost + 10% Overhead | $53.00 | N/A |
| Water turn-on or shut-off - delinquent or at customer's request | N/A | $53.00 | N/A |
| **Description** | **Materials (*before sales tax*)** | **Hourly Servicing Fee** | **Flat Rate** |
| Winter Surcharge (December 1st - April 1st) | N/A | N/A | $25.00 |
| | | | |
| Water main shut down for contractor | N/A | N/A | $646.00 |
| | | | |
| **Penalties:** | | | |
| Water meter tampering violation penalty | N/A | N/A | $200.00 |
| | | | |
| Water meter bypass valve tampering penalty | N/A | N/A | $500.00 |
| | | | |
| Unauthorized water service turn-on penalty | N/A | N/A | $500.00 |
| | | | |
| Water system valve tampering penalty | N/A | N/A | $500.00 |
| | | | |
| Violation of water emergency declaration penalty | N/A | N/A | $25.00 |
| | | | |
| Water Service Tap Cutoff or Extension Permit | N/A | N/A | $50.00 |
| | | | |

| | | | |
|---|---|---|---|
| **Water Hydrant Usage:** | | | |
| Permit | N/A | N/A | $50.00 |
| Installation of equipment for construction, demolition, and special event usage | N/A | N/A | $200.00 |
| Hydrant sanitation for potable water usage | N/A | N/A | $160.00 |
| Equipment deposit for residential demolition usage | N/A | N/A | $1,200.00 |
| Equipment deposit for commercial construction and demolition usage | N/A | N/A | $3,200.00 |
| Water usage charged at 2016 in city rate - $3.45/ Unit (100 cubic feet) | N/A | N/A | $3.45/Unit |
| Water usage Fee for Residential demolition | N/A | N/A | $50.00 |
| | | | |
| **Temporary Water Meter for Construction Usage:** | | | |
| Permit | N/A | N/A | $50.00 |
| Temporary water meter usage fee | N/A | N/A | $200.00 |
| Equipment and water usage deposit | N/A | N/A | $2,500.00 |
| Water usage charged at 2016 in city rate - $3.45/ Unit (100 cubic feet). Usage will be subtracted from initial deposit until deposit is depleted. | N/A | N/A | $3.45/Unit |
| | | | |
| **Large Water Main Tap by Tap Size *** | | | |
| 6x4" | N/A | N/A | $1,974.35 |
| 6x6" | N/A | N/A | $2,223.09 |
| | | | |
| 8x4" | N/A | N/A | $2,121.37 |
| 8x6" | N/A | N/A | $2,191.18 |
| 8x8" | N/A | N/A | $2,927.64 |
| | | | |
| 10x4" | N/A | N/A | $2,413.38 |
| 10x6" | N/A | N/A | $2,428.87 |
| 10x8" | N/A | N/A | $2,682.26 |
| | | | |
| 12x4" | N/A | N/A | $2,137.95 |
| 12x6" | N/A | N/A | $2,288.37 |
| | | | |
| **Description** | **Materials (*before sales tax*)** | **Hourly Servicing Fee** | **Flat Rate** |
| 12x8" | N/A | N/A | $3,101.02 |
| 12x12" | | | $5,173.88 |
| | | | |

| Description | Materials (*before sales tax*) | Hourly Servicing Fee | Flat Rate |
|---|---|---|---|
| 16x4" | N/A | N/A | $2,742.34 |
| 16x6" | N/A | N/A | $2,462.04 |
| 16x8" | N/A | N/A | $3,818.13 |
| 16x12" | N/A | N/A | $5,065.03 |
| 24x4" | N/A | N/A | $2,417.34 |
| 24x6" | N/A | N/A | $3,000.42 |
| 24x8" | N/A | N/A | $4,074.35 |
| 24x12" | N/A | N/A | $5,787.74 |
| | | | |
| 30x4" | N/A | N/A | $3,504.50 |
| 30x6" | N/A | N/A | $3,710.99 |
| 30x8" | N/A | N/A | $5,168.75 |
| 30x12" | N/A | N/A | $8,556.31 |
| | | | |
| 36x4" | N/A | N/A | $3,766.39 |
| 36x6" | N/A | N/A | $3,878.74 |
| 36x8" | N/A | N/A | $4,900.95 |
| 36x12" | N/A | N/A | $7,934.67 |
| | | | |
| **Small Water Main Tap by Size *** | | | |
| 3/4x3/4" | N/A | N/A | $213.00 |
| 1x1" | N/A | N/A | $223.00 |
| 1x1¼" | N/A | N/A | $238.00 |
| | | | |
| **Water Main Tap Discontinue by Size *** | | | |
| 6x2" | N/A | N/A | $1,799.03 |
| 6x3" | N/A | N/A | $1,799.03 |
| 6x4" | N/A | N/A | $2,093.07 |
| 6x6" | N/A | N/A | $2,093.07 |
| | | | |
| 8x2" | | | $1,831.99 |
| 8x3" | N/A | N/A | $1,831.99 |
| 8x4" | N/A | N/A | $1,831.98 |
| 8x6" | N/A | N/A | $2,298.73 |
| 8x8" | N/A | N/A | $2,298.73 |
| | | | |
| 10x2" | N/A | N/A | $1,898.91 |
| 10x3" | N/A | N/A | $1,898.91 |
| 10x4" | N/A | N/A | $1,898.91 |
| 10x6" | N/A | N/A | $2,985.14 |
| 10x8" | N/A | N/A | $2,985.14 |
| 10x10" | N/A | N/A | $2,985.14 |
| | | | |
| 12x2" | N/A | N/A | $1,964.24 |

| | | | |
|---|---|---|---|
| 12x3" | N/A | N/A | $1,964.24 |
| 12x4" | N/A | N/A | $1,964.24 |
| 12x6" | N/A | N/A | $1,964.24 |
| 12x8" | N/A | N/A | $3,052.28 |
| | | | |
| 12x12" | N/A | N/A | $3,052.28 |
| | | | |
| 16x2" | N/A | N/A | $2,491.72 |
| 16x3" | N/A | N/A | $2,491.72 |
| 16x4" | N/A | N/A | $2,491.72 |
| 16x6" | N/A | N/A | $2,491.72 |
| 16x8" | N/A | N/A | $2,491.72 |
| 16x12" | N/A | N/A | $4,187.85 |
| | | | |
| 24x2" | N/A | N/A | $2,898.91 |
| 24x3" | N/A | N/A | $2,898.91 |
| 24x4" | N/A | N/A | $2,898.91 |
| 24x6" | N/A | N/A | $2,898.91 |
| 24x8" | N/A | N/A | $2,898.91 |
| 24x12" | N/A | N/A | $2,898.91 |
| | | | |
| **Mechanical Plug Pricing*** | | | |
| 4" Plug | N/A | N/A | $1,799.04 |
| 6" Plug | N/A | N/A | $1,810.79 |
| 8" Plug | N/A | N/A | $1,851.88 |
| 12" Plug | N/A | N/A | $1,899.03 |
| **When site specific circumstances preclude the use of standard methods, the fee will based on the City's estimate for time and materials. Standard fee includes installation and $50 permit fee but not excavation.* | | | |

**The sanitary sewer rates and stormwater service rate shall be applied to utility billings for water meters read from and after <u>January 1, 2016</u>.**

**Sanitary Sewer Rate**

The sanitary sewer rates to be charged properties within and outside the City of Minneapolis that are served directly by the City of Minneapolis sewer system and that are all served either directly or indirectly by the sewage disposal system constructed, maintained and operated by the Metropolitan Council Environmental Services under and pursuant to Minnesota Statutes Sections 473.517, 473.519 and 473.521, Sub. 2, are hereby set as follows:

1. The sanitary sewer rate applicable inside the City of Minneapolis is **<u>three dollars and thirty-nice cents ($3.39)</u>** per one hundred (100) cubic feet.

2. In addition, a fixed charge based on water meter size will be billed each billing period or fraction thereof as follows:

Meter Fixed

| Size | Charge |
|---|---|
| 5/8-inch | **$ 4.30** |
| 3/4-inch | **6.45** |
| 1-inch | **10.75** |
| 1 1/2-inch | **21.50** |
| 2-inch | **34.40** |
| 3-inch | 68.80 |
| 4-inch | 107.50 |
| 6-inch | 215.00 |
| 8-inch | 344.00 |
| 10-inch | 494.50 |
| 12-inch | 1,419.00 |

3. The sanitary sewer rate applicable outside the City of Minneapolis for all sewage flow generated is **three dollars and thirty-nine cents ($3.39)** per one hundred (100) cubic feet when the City of Minneapolis also provides water. In addition, the fixed charge sanitary sewer rate shall be based on meter size per section (b).

4. Sanitary sewer only service outside the City of Minneapolis shall be twenty dollars ($20.00) per month.

5. The sanitary sewer charge for residential property not exceeding three (3) residential units shall be based on the volume of water used during the winter season which is defined as a four (4) month period between November 1 and March 31.

6. The sanitary sewer charge for residential property exceeding three (3) residential units and all other commercial and industrial property shall be based on measured sewage volume or the total water volume used during the billing period as is appropriate.

**Stormwater Rate**

The stormwater rate, subject to the provisions in Chapter 510, of the Minneapolis Code of Ordinances, is imposed on each and every Single-Family Residential Developed Property, Other Residential Developed Property, Non-Residential Developed Property, and Vacant Property, other than Exempt Property, and the owner and non-owner users, and is hereby set as follows:

1. The Equivalent Stormwater Unit (ESU) rate is **eleven dollars and ninety-four cents ($11.94).** The ESU measurement is 1,530 square feet of impervious area.

2. The stormwater rate imposed on Single-Family Residential Developed Properties shall be categorized into three tiers based on the estimated amount of impervious area as follows:

High – Single-Family Residential Developed Property – greater than one thousand five hundred and seventy-eight (1,578) square feet of estimated impervious area. The ESU shall be 1.25 and the stormwater rate set at **fourteen dollars and ninety-three cents ($14.93).**

Medium – Single-Family Residential Developed Property – equal to or greater than one thousand four hundred and eighty-five (1,485) square feet and less than or equal to one thousand five hundred and seventy-eight (1,578) square feet of estimated impervious area. The ESU shall be 1.00 and the stormwater rate set at **eleven dollars and ninety-four cents ($11.94).**

Low – Single-Family Residential Developed Property – less than one thousand four hundred and eighty-five (1,485) square feet of estimated impervious area. The ESU shall be .75 and the stormwater rate set at **eight dollars and ninety-six cents ($8.96).**

3. Stormwater charges for all other properties will be based on the following calculation:

(Gross Lot Size in sq.ft. X Runoff Coefficient) ÷ 1,530 sq. ft.= # of ESU

# of ESU X **$ 11.94** = Monthly Fee

The runoff coefficient assumed for each land use category is shown below.

| Land Use | Coefficient Applied |
|---|---|
| Bar-Rest.-Entertainment | .75 |
| Car Sales Lot | .95 |
| Cemetery w/Monuments | .20 |
| Central Business District | 1.00 |
| Common Area | .20 |
| Garage or Misc. Res. | .55 |
| Group Residence | .75 |
| Ind. Warehouse-Factory | .90 |
| Industrial railway | .85 |
| Institution-Sch.-Church | .90 |
| Misc. Commercial | .90 |
| Mixed Comm.-Res-Apt | .75 |
| Multi-Family Apartment | .75 |
| Multi-Family Residential | .40 |
| Office | .91 |
| Parks & Playgrounds | .20 |
| Public Accommodations | .91 |
| Retail | .91 |
| Single Family Attached | .75 |
| Single Family Detached | ESU |
| Sport or Rec. Facility | .60 |
| Utility | .90 |
| Vacant Land Use | .20 |
| Vehicle Related Use | .90 |

**Solid waste and recycling variable rate charges associated with water meter read dates from and after January 1, 2016, the charges shall be as follows:**

1. The base unit charge shall be **twenty-two dollars and eighty-nine cents ($22.89)** per dwelling unit per month.

2. The cart disposal charge shall be two dollars ($2.00) per month for each small cart.

3. The cart disposal charge shall be five dollars ($5.00) per month for each large cart assigned to a dwelling unit.

# Minneapolis Stormwater Utility Fee FAQ

## What is Stormwater?

Stormwater is runoff from a rainstorm or melting snow. City landscapes - unlike forests, wetlands, and grasslands that trap water and allow it to filter slowly into the ground - contain great areas of impermeable asphalt and concrete surfaces that prevent water from seeping into the ground. Because of this, large amounts of water accumulate above the surface. This water will run off before eventually entering into our lakes, rivers and streams.

## Why is it important to manage stormwater?

Minneapolis, like other communities, needs to manage stormwater to protect people's homes and properties, the environment, lakes, streams & rivers. If this is not done, stormwater will cause flooding, erosion and pollution. Heavy rains that flood streets and yards can result in property damage. Stormwater runoff also picks up pollutants and debris from streets, parking lots & yards, carrying them into our lakes, rivers and streams.

## What is the stormwater utility fee on my bill?

The stormwater utility fee pays for the City's current stormwater system and annual maintenance costs. This helps to prevent and correct stormwater runoff problems in Minneapolis. All properties within City limits (with very limited exceptions) are charged a monthly stormwater utility fee. This fee had existed prior to 2005, but was included as part of the combined sanitary sewer/stormwater fee.

Because the stormwater utility fee is a user fee and not a tax, all properties regardless of ownership are required to pay for the services provided by the Minneapolis stormwater management system. This includes non-profit entities such as churches, schools and institutions, as well as properties owned by the City of Minneapolis, the State of Minnesota, and the federal government.

## How is the stormwater fee calculated?

The stormwater utility fee is based on impervious area and is charged on a per unit basis. Each ESU ( **E**quivalent **S**tormwater **U**nit) is 1,530 square feet of impervious area on a property. The impervious area is calculated based on the size of the property, as well as the current use. Single family properties are billed using one of the following rates:

| | | |
|---|---|---|
| High | 1.25 ESU | $15.89 |
| Medium | 1.00 ESU | $12.71 |
| Low | .75 ESU | $ 9.27 |

All other properties are billed as follows: Gross Lot Size in square ft. X Runoff Coefficient (based on Land Use class) divided by 1,530 square ft = # of ESU's.

## What is impervious area?

Surfaces where water can not flow through freely. Examples of impervious surfaces include, but are not limited to the following:

- House footprints
- Driveways
- Parking Lots
- Sidewalks
- Patios
- Decks
- Detached garages
- Sheds
- Concrete air conditioner pads
- Brick pavers

It also includes all non-improved (vegetated or grass cover) areas that are used for parking storage or are driven upon. In an urban environment such as Minneapolis, a property's impervious area is the most significant factor affecting both stormwater quality and quantity.

## Is there a way to reduce my stormwater fee?

Yes. Stormwater fees can be reduced through the City of Minneapolis Stormwater Credits Program. The credits program offers a reduction in fees to property owners who use approved methods to manage stormwater runoff on their property. Fees can also be reduced through the replacement of excess impervious area (such as unused parking lots) with landscaped green space.

## How does the City's Stormwater Credits Program encourage helpful environmental practices?

The stormwater fee incorporates opportunities for property owners to reduce their stormwater bill by taking environmentally friendly steps. Stormwater utility fee reductions, also called credits, are available to those who are using or installing stormwater management tools/practices on their properties. Installing rain gardens or other materials, such as impervious pavers, allows stormwater to soak into the ground, rather than run into storm sewers.

## How can I get a stormwater credit on my utility bill?

Credit guidelines and application forms can be found on the on the CityofMinneapolis StormwaterFeewebsite . If you need additional information, please contact (612) 673-2965.

Last updated Mar 3, 2015

# 2017 Grit Chamber Inspection and Cleaning

| Grit ID | Location | Date Inspected | Floatables Y/N | Volume Of Sediment Removed | Date Cleaned |
|---|---|---|---|---|---|
| 1 | UPTON AVE N & 53RD AVE N | 3/31/17 | Y | 1 | 3/31/17 |
| 2 | UPTON AVE N & 53RD AVE N | 3/31/17 | Y | 0.5 | 3/31/17 |
| 5 | PENN AVE N & 52ND AVE N | 4/4/17 | Y | 1 | 4/4/17 |
| 6 | PENN AVE N & 52ND AVE N | 3/31/17 | Y | 0.25 | 3/31/17 |
| 7 | OLIVER AVE N & 52ND AVE N | 4/4/17 | Y | 0.5 | 4/4/17 |
| 8 | NEWTON AVE N & SHINGLE CREEK | 4/4/17 | Y | 0.25 | 4/4/17 |
| 9 | OLIVER AVE N & 51ST AVE N | 3/31/17 | Y | 0.25 | 3/31/17 |
| 10 | MORGAN AVE N & 51ST AVE N | 4/5/17 | N | 0.33 | 4/5/17 |
| 11 | KNOX AVE N & 51ST AVE N | 4/5/17 | Y | 1.5 | 4/5/17 |
| 13 | IRVING AVE N & 50TH AVE N | 6/19/17 | N | 1 | 6/19/17 |
| 14 | JAMES AVE N, NORTH OF 49TH AVE N | 6/29/17 | Y | 1.5 | 6/26/17 |
| 17 | XERXES AVE N & GLENWOOD AVE | 6/5/17 | Y | 3 | 6/5/17 |
| 18 | MORGAN AVE N & CHESNUT AVE | 4/7/17 | Y | 1.5 | 4/7/17 |
| 63 | 33RD AVE N & 1ST ST N/RAILROAD TRACKS | 4/11/17 | N | 0.33 | 4/11/17 |
| 64 | 26TH AVE N & PACIFIC (N TRANSFER STATION) | 7/17/17 | N | 1.5 | 7/17/17 |
| 70 | ROYALSTON & 5TH AVE N | 7/21/17 | N | 4 | 7/21/17 |
| 78 | SHINGLE CREEK WETLAND - W SIDE | 8/22/17 | Y | 6 | 8/22/17 |
| 79 | SHINGLE CREEK WETLAND - EAST SIDE | 8/15/17 | Y | 8 | 8/15/17 |
| 88 | ACROSS THE STREET FROM 702, NO. BD. VAN WHITE BLVD. | 3/28/17 | Y | 0.25 | 3/28/17 |
| | | 12/1/17 | Y | 1.5 | 12/1/17 |
| 89 | ACROSS THE STREET FROM 706, NO. BD. VAN WHITE BLVD. | 3/28/17 | Y | 0.25 | 3/28/17 |
| 90 | 10TH AVE. NO. & ALDRICH AVE. NO. (S.W.C.) | 3/3/17 | Y | 0.25 | 3/3/17 |
| 91 | SO. BD. VAN WHITE BLVD., 200' SO. OF 8TH AVE. NO. | 3/29/17 | Y | 0.25 | 3/29/17 |
| 92 | ACROSS THE STREET FROM 701, SO. BD. VAN WHITE BLVD. | 3/9/17 | Y | 0.5 | 3/9/17 |
| 93 | SO. BD. VAN WHITE BLVD., 250' SO. OF 10TH AVE. NO | 3/7/17 | Y | 1.5 | 3/7/17 |
| | | 11/29/17 | Y | 2.5 | 11/29/17 |
| 94 | 10TH AVE. NO. & NO. BD. VAN WHITE BLVD. (S.W.C.) | 3/7/17 | Y | 2 | 3/7/17 |
| | | 11/20/17 | Y | 2.5 | 11/20/17 |
| 95 | WEST SIDE OF ALDRICH AVE. NO. & 9TH AVE. NO. | 2/28/17 | Y | 0.25 | 2/28/17 |
| | | 11/20/17 | Y | 2 | 11/20/17 |
| 96 | 8TH AVE. NO. & NO. BD. VAN WHITE BLVD. (N.E.C.) | 2/28/17 | Y | 0.25 | 2/28/17 |
| 97 | 29TH AVE. & LOGAN AVE. - NO. STORM WATER DET. POND (E & W) #1 | 3/21/17 | Y | 3 | MS |
| 97 | 29TH AVE. & LOGAN AVE. - NO. STORM WATER DET. POND (E & W) #2 | 3/21/17 | Y | 5 | MS |
| 97 | 29TH AVE. & LOGAN AVE. - NO. STORM WATER DET. POND (E & W) #3 | 3/21/17 | Y | 2 | MS |
| 98 | MALMQUIST LN. & HUMBOLDT NO. | 6/29/17 | Y | 2 | 6/29/17 |
| 99 | SHINGLE CREEK DR. & HUMBOLDT NO. | 8/2/17 | Y | 4 | 8/2/17 |
| 100 | SO. OF 49TH AVE. NO. & HUMBOLDT NO. | 8/2/17 | Y | 5 | 8/2/17 |
| 109 | 22ND AVE N AND W RIVER ROAD | 4/11/17 | Y | 0.33 | 4/11/17 |
| 113 | 20' EAST OF VAN WHITE MEM. BLVD (N.B.) AND 5TH AVE N (1016 - 5TH AVE N) | 4/10/17 | Y | 0.33 | 4/10/17 |
| 114 | DUPONT AVE. NO. & 4TH AVE. NO. | 3/6/17 | Y | 1 | 3/6/17 |
| 115 | VAN WHITE MEM. BLVD (S.B.) AND 4TH AVE N | 4/10/17 | Y | 0.33 | 4/10/17 |
| | | 11/22/17 | Y | 1.5 | 11/22/17 |
| 116 | 400' NORTH (60' INTO POND) VAN WHITE MEM. BLVD (S.B.) AND 4TH AVE N | 4/7/17 | Y | 0.25 | 4/7/17 |
| 117 | 300' NORTH (WEST SIDE) OF VAN WHITE MEM. BLVD (S.B.) AND 4TH AVE N | 8/30/17 | Y | 2 | 8/30/17 |
| 118 | 200' NORTH (POND SIDE) OF VAN WHITE MEM. BLVD (S.B.) AND 10TH AVE N | 3/29/17 | Y | 0.25 | 3/29/17 |
| 119 | 11TH AVE N AND VAN WHITE BLVD (N.B.) | 3/29/17 | Y | 0.25 | 3/29/17 |
| | | 11/22/17 | Y | 1 | 11/22/17 |
| 120 | VAN WHITE MEM. BLVD (S.B.) (160' so. of fremont ave. no. on the e. side of the | 3/30/17 | Y | 0.25 | 3/30/17 |
| 121 | 50' NORTH (EAST SIDE) OF VAN WHITE MEM. BLVD (S.B.) AND FREMONT AVE N | 3/28/17 | Y | 0.25 | 3/28/17 |
| 136 | 111 22ND AVE N (ALLEY BETWEEN 1ST ST N AND 2ND ST N AT VACATED 21ST | 7/11/17 | Y | 1 | 7/11/17 |
| 139 | EWING AVE S @ W FRANKLIN AVE - Pending as-built info | 6/29/17 | Y | 1 | 6/29/17 |
| 146 | E LAKE ST AND 46TH AVE S 12' W OF THE W CURB AND 9' SO OF THE N CURB | 3/7/17 | Y | 0.5 | 3/7/17 |
| 152 | 3RD AVE. SO. & 2ND ST. S. | 6/30/17 | Y | 1 | 6/30/17 |
| 159 | 2ND AVE N & 7TH ST N (Target Center) | 12/19/17 | Y | 2 | 12/19/17 |
| 160 | 2ND AVE N & 6TH ST N | 12/19/17 | N | 1 | 12/19/17 |
| 161 | 3RD AVE N & WASHINGTON AVE N | 6/19/17 | Y | 1 | 6/19/17 |
| 165 | 1409 Washington Ave N | 7/31/17 | N | 1.5 | 7/31/17 |
| 171 | Newton Ave N at Dowling Ave N sump MH | 3/7/17 | Y | 0.25 | 3/7/17 |

# Appendix A12
## Stormwater Monitoring Results and Data Analysis

In 2017, MPRB scientists monitored 11 of the city's most heavily used lakes. The data collected were used to calculate a Trophic State Index (TSI) score for each of the lakes. Lower TSI scores indicate high water clarity, low levels of algae in the water column, and/or low phosphorus concentrations. Changes in lake water quality can be tracked by looking for trends in TSI scores over time (**Table 1 and Figure 1**). A negative slope **Figure X-X** indicates improving water quality, while a positive slope indicates declining water quality. These values are especially important for monitoring long-term trends (10+ years). Historical trends in TSI scores are used by lake managers to assess improvement or degradation in water quality. Trends are also used by the Minnesota Pollution Control Agency to assess non-degradation goals.

All the lakes in Minneapolis fall into either the mesotrophic or eutrophic category. Calhoun, Harriet, and Wirth are mesotrophic with moderately clear water and some algae. Brownie, Cedar, Isles, Hiawatha, Loring, and Nokomis are eutrophic with higher amounts of algae. Powderhorn and Spring are hypereutrophic with high nutrient concentrations and the potential for severe algal blooms. Trends in lake water quality can be seen by using the annual average TSI since the early 1990s.

**Table 1. Water quality trends in Minneapolis lakes from 1991-2017.**

| Lakes with Improving Water Quality Indicators | Lakes with Stable Trends | Lakes with Declining Water Quality Indicators |
|---|---|---|
| Lake Calhoun | Brownie Lake | |
| Lake Harriet | Cedar Lake | |
| Lake Nokomis | Lake Hiawatha | |
| Wirth Lake | Lake of the Isles | |
| | Loring Pond | |
| | Powderhorn Lake | |
| | Spring Lake | |

There has been a significant improvement in water quality indicators in Lake Calhoun since the early 1990s (linear regression, $p < 0.001$); however, TSI scores have stabilized since 2006. The TSI score at Lake Calhoun in 2017 was higher than the last few years, but it was still below pre-2000 scores. The water quality indicators in Lake Harriet have been improving since 1991 (linear regression, $p < 0.1$). Lake Harriet experienced a few years with lower TSI scores following a littoral alum treatment in the mid-2000s but has remained stable the last 10 years. Lake Nokomis experienced higher algal concentrations in 2016 and 2017, especially in the fall, but has seen a significant improvement in water quality in the past few years following a biomanipulation project (linear regression, $p < 0.05$). The water quality improvement at Wirth Lake has been occurring since 1992, going from a eutrophic system dominated by algal growth to a moderately clear mesotrophic system (linear regression, $p < 0.001$). The TSI score at Wirth Lake in 2017 was slightly above the last few years due to higher chlorophyll-*a* concentrations.

Most of the Minneapolis lakes have no directional trend in water quality indicators since the early 1990s. The water quality in Brownie Lake has been relatively stable, with no significant trend since 1993. Brownie Lake is monitored every other year and was not monitored in 2016. The water quality in Cedar Lake showed improvement following restoration efforts through the late 1990s, had a slow decline in the 2000s, and have remained stable since. The 2017 Cedar Lake TSI score was the highest it's been since the early 1990s due to higher chlorophyll-*a* concentrations. The TSI scores in Lake Hiawatha have remained stable over the past 24 years. Lake Hiawatha is heavily influenced by the inflow from Minnehaha Creek and the lake has poorer water quality during drought years. The last few years have had above average spring and summer precipitation leading to low TSI scores, with 2017 being the third lowest recorded at Lake Hiawatha. The water quality in Lake of the Isles varies from year to year, with a higher TSI score in 2017 compared to the previous few years, but there is no significant trend in any direction since 1991. Loring Pond experienced decreased water quality immediately following a dredging project in 1997; however, conditions have slowly returned to levels similar to pre-1997. Powderhorn Lake has experienced large swings in water quality, with the worst TSI scores in the late 1990s and the best scores in the late 2000s. Powderhorn has had poor water quality the past 5 years, with blue green algae blooms leading to low water clarity. The water quality in Spring Lake is variable, but there is no significant trend in any direction since 1994. Spring Lake is also monitored every other year and was monitored in 2017.

Diamond Lake and Grass Lake are not included in this analysis, since TSI scores are only appropriate for deeper lake systems and water clarity measurement are not accurate in these shallow systems. There are no lakes in Minneapolis with significant decline in water quality indicators since the early 1990s.

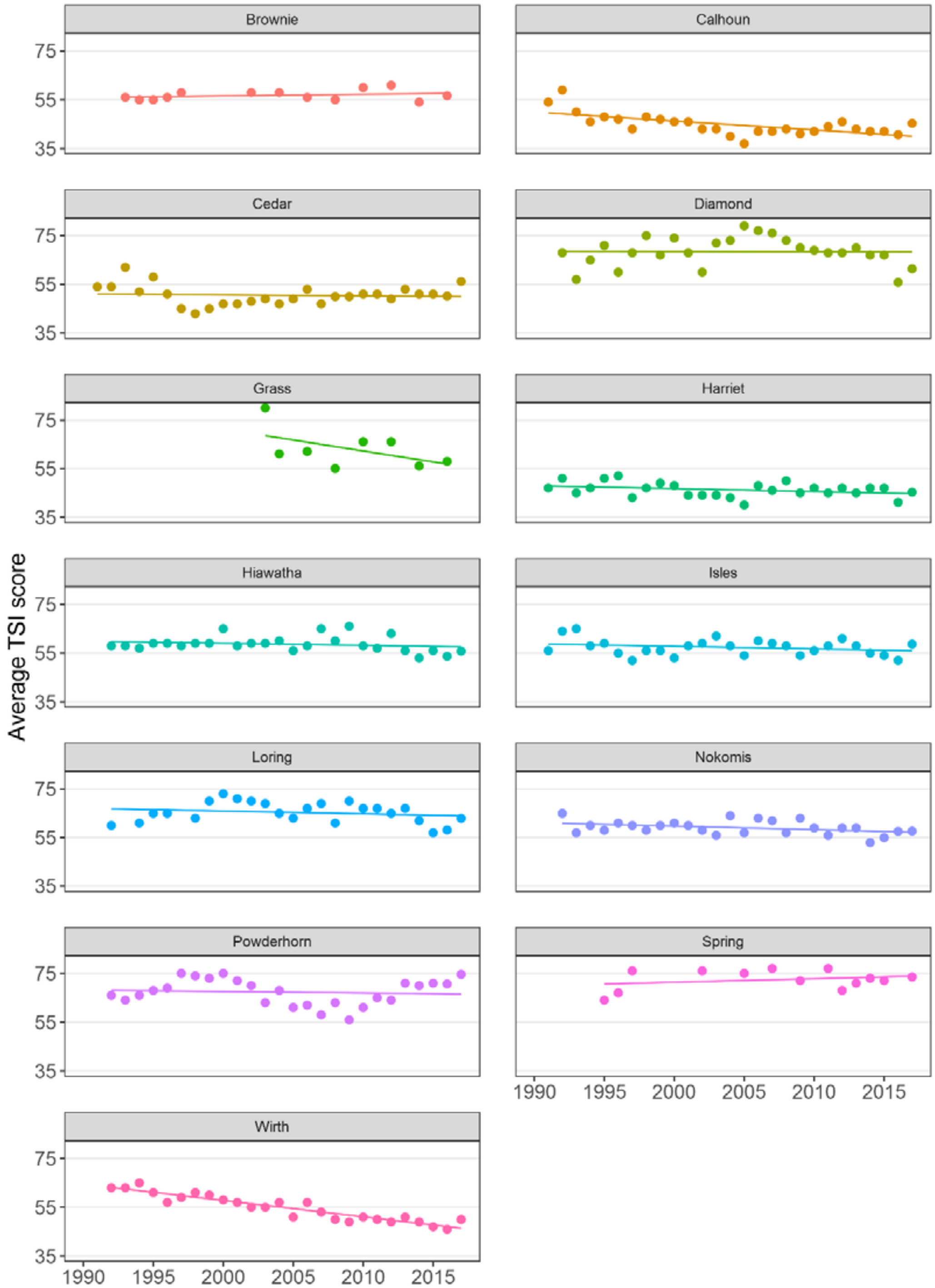



**Figure 1. TSI scores and regression analysis for selected Minneapolis lakes 1991–2017. Lower TSI scores indicate high water clarity, low levels of algae in the water column, and/or low phosphorus concentrations. A negative slope indicates improving water quality, while a positive slope indicates declining water quality. Only Calhoun, Nokomis, and Wirth have statistically significant trends (p <0.05).**

## NPDES Land Use Sites Monitoring Results (Stormwater Runoff Monitoring)

In 2017, stormwater runoff monitoring was carried out at four sites representative of multi-family residential, recreational/parkland, commercial/high-rise, and commercial/industrial land uses. (In previous Annual Reports, the following material appeared in Appendix A as A4.)

### Background

As part of the federal Clean Water Act, the Minneapolis Park and Recreation Board (MPRB) and the City of Minneapolis are co-signatories on the Environmental Protection Agency (EPA) issued National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit. As a Phase I City, the Minneapolis NPDES permit has a stormwater monitoring requirement. The MPRB has performed the NPDES MS4 stormwater monitoring requirement since 2001. Monitoring has included four different land uses (parkland, residential, mixed use, commercial/industrial) as well as Best Management Practice (BMP) devices. BMPs are devices (e.g. grit chambers, CDS units, ponds, etc.) or practices (e.g. street sweeping, public education) used to treat and clean stormwater. The purpose of the MPRB NPDES stormwater monitoring is to characterize the quantity and quality of runoff from small areas representing various types of land use under a no-BMP scenario. The results do not represent actual conditions for either runoff quantity or quality because there are numerous BMPs and, other structural controls, and management practices that reduce pollutants in stormwater runoff and/or temper stormwater runoff quantity in the larger watershed.

At the beginning of the first NPDES MS4 permit (2001-2004), the MPRB and City of Minneapolis partnered with the City of St. Paul to fulfill the NPDES monitoring requirements outlined in the permit. Five sites in Minneapolis and St. Paul were jointly monitored between 2001–2004. In 2005, the MPRB stopped monitoring stormwater in St. Paul, and four new sites in Minneapolis were selected for monitoring. In 2006, new sites were chosen in Minneapolis to comply with the NPDES permit and to assist with modeling and load allocation efforts. These four sites represent the major land uses in Minneapolis: residential, commercial/industrial, mixed use, and parkland.

In 2017, four representative Minneapolis land use sites: Site 6 (22nd/Aldrich, residential), Site 7 (14th/Park, mixed use), Site 8a (Pershing Park, parkland), and Site 9 (61st/Lyndale, commercial) were monitored for stormwater runoff quantity and quality. While, again, the results do not represent actual impacts of stormwater discharge to receiving waters because they do not reflect the positive effects of structural BMP controls and management practices. They are nevertheless useful for comparing land uses and to create baseline conditions for water quality modeling exercises. The BMP sites monitored (Winter Infiltration Basin, 24th & Elm Infiltration Basin, and Lowry Sand Filter) provide information as to their functioning and efficacy. The Minneapolis NPDES monitoring allows the City to characterize its stormwater for pollutants and judge how effective the BMP’s installed are at removing the pollutants.

### Methods

The summary below includes descriptions of equipment installation at each site, parameters monitored, field quality assurance sampling, computer models used, data handling, validation, and reporting.

### Site Installation

The ISCO equipment installed at each site included a 2150 datalogger, a low-profile area velocity (AV) probe, 2105 interface module, either a 2105ci or 2103ci cell phone modem, and a 3700 sampler. Site 9 ($61^{st}$/Lyndale) had an additional 2160 laser probe installed on 4/25/17. The 3700-sampler collected stormwater through 3/8" inner-diameter vinyl intake tubing complete with a strainer. The dataloggers flow-paced the samplers to collect flow-weighted stormwater samples over the entire storm hydrograph. Each site automatically uploaded data, via cell phone modem, to the database server from Monday through Friday. Each site could also be communicated with remotely using Flowlink Pro software to adjust pacing, enable or disable samplers, and to see if a site had triggered.

Equipment installation began when freezing spring temperatures were no longer a concern to prevent AV probe damage. Freezing conditions can damage the pressure transducer in an area velocity probe. See **Figure 22-1** for a map of site locations. Site 6 (22nd/Aldrich) and Site 7 (14th/Park) were installed on 4/24/17. Site 8a (Pershing Park) was installed on 4/20/17. Site 9 (61st/Lyndale) was installed on 4/17/17. All sites, except Site 9, were uninstalled on 11/2/17 or 11/3/17. At Site 9, the sampler was removed, but all other equipment was left installed for winter monitoring. See **Table 22-1** for site characteristics.

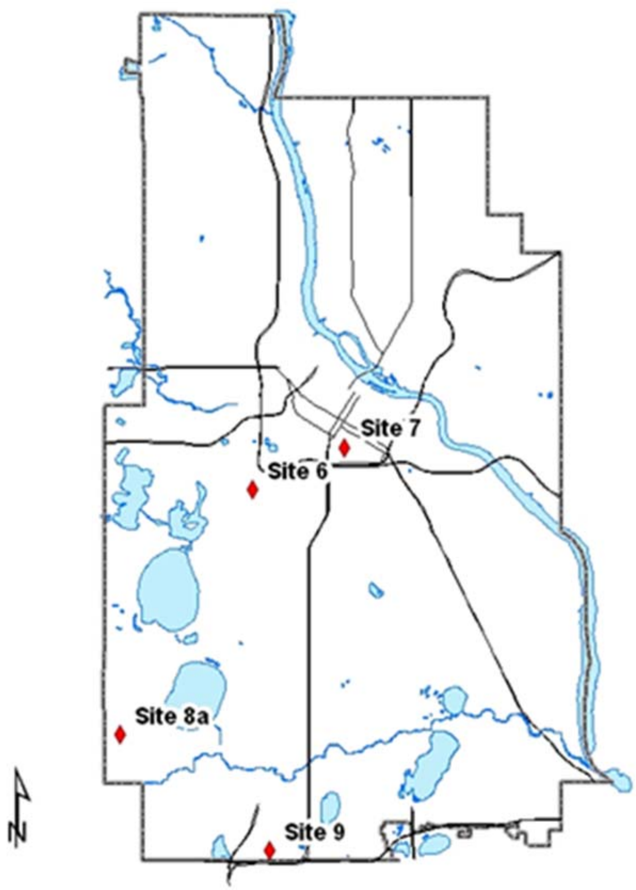



*Figure 14-1 Map of the 2017 NPDES Sites Located within Minneapolis*

*Table 14-1. 2017 NPDES stormwater monitoring sites for Minneapolis.*

| Site ID | Site 6 | Site 7 | Site 8a | Site 9 |
|---|---|---|---|---|
| **Location** | 22nd St and Aldrich Ave S | E 14th St and Park Ave S | Pershing Field east of 49th St and Chowen Ave | 335 ft. east of 61st St and Harriet Ave S |
| **Land Use** | Multi–Family Residential | Commercial/Industrial/ High Rise Residential | Recreational/Parkland | Commercial/Industrial |
| **Area** | 8.9 acres | 13.1 acres | 2.5 acres | 34.9 acres |
| **Pipe Diameter** | 18 inches | 42 inches | 12 inches | 36 inches |
| **Outfall ID#** | 10 – 430J | 10 – 430D | 57 – 100A/B | 71 – 070 |

Sample Collection and Monitored Parameters

The MS4 permit target frequency for storm event sample collection was 10 samples per site, per year. Ideally, two snowmelt grab samples and two to three flow-paced composite storms were collected per month per site from May through November, for a total of ten composite samples annually. If a sample was missed for one month due to lack of precipitation events, then additional samples were taken the following month.

**Table 14-2** shows the parameters tested as part of the MS4 permit for each sample collected. **Table 14-3** shows approved methods, reporting limits, and holding times for each parameter as reported by the contract laboratory Instrumental Research, Inc. (IRI). Pace Laboratory analyzed all metals samples.

***Table 14-2. The list of monitored chemical parameters for the NPDES permit. BOD is biochemical oxygen demand.***

| **Parameter** | **Abbreviation** | **Units** | **Sample Type** |
|---|---|---|---|
| BOD –carbonaceous, 5 Day | cBOD | mg/L | Composite |
| Chloride, Total | Cl | mg/L | Composite |
| Specific Conductivity | Sp. Cond | µmhos/cm | Composite |
| *E. coli* (*Escherichia Coli*) | *E. coli* | MPN/100mL | Grab (4X year) |
| Hardness | Hard | mg/L | Composite |
| Copper, Total | Cu | µg/L | Composite |
| Lead, Total | Pb | µg/L | Composite |
| Zinc, Total | Zn | µg/L | Composite |
| Nitrite+Nitrate, Total as N | $NO_3NO_2$ | mg/L | Composite |
| Ammonia, Un-ionized as N | $NH_3$ | mg/L | Composite |
| Kjeldahl Nitrogen, Total | TKN | mg/L | Composite |
| pH | pH | standard unit | Grab/Comp (4X year) |
| Phosphorus, Ortho-P | Ortho-P | mg/L | Composite |
| Phosphorus, Total Dissolved | TDP | mg/L | Composite |
| Phosphorus, Total | TP | mg/L | Composite |
| Solids, Total Dissolved | TDS | mg/L | Composite |
| Solids, Total Suspended | TSS | mg/L | Composite |
| Solids, Volatile Suspended | VSS | mg/L | Composite |
| Sulfate | $SO_4$ | mg/L | Composite |

***Table 14-3. Analysis method, reporting limit, and holding times for parameters used by Instrumental Research, Inc and Pace Laboratories. *Sulfate samples were spiked with 10 mg/L, and the spike was later subtracted to lower the reporting limit to 5 mg/L. ‡Metals were analyzed by Pace Laboratories.***

| **Parameter** | **Method** | **Reporting Limit** | **Holding Times** |
| --- | --- | --- | --- |
| cBOD, carbonaceous, 5 Day (20°C) | SM 5210 B-01 | 1.0 mg/L | 24 hours |
| Chloride, Total | SM 4500-$Cl^-$ B | 2.0 mg/L | 28 days |
| Specific Conductivity | SM 2510 B-97 | 10 µmhos/cm | 28 days |
| *E. coli* (*Escherichia Coli*) | SM 9223 B | 1 MPN per 100mL | < 24hrs |
| Hardness | SM 2340 C | 5.0 mg/L | 6 months |
| Copper, Total‡ | EPA 200.8 | 1 µg/L | 6 months |
| Lead, Total‡ | EPA 200.8 | 0.5 µg/L | 6 months |
| Zinc, Total‡ | EPA 200.7 | 20 µg/L | 6 months |
| Nitrite+Nitrate, Total as N | SM 4500-$NO_3$ E | 0.030 mg/L | 28 days |
| Ammonia, Un-ionized as N | USGS I-3520-85 | 0.250 mg/L | 7 days |
| Kjeldahl Nitrogen, Total | ASTM D3590 A-02 | 0.500 mg/L | 7 days |
| pH | SM 4500 $H^+$ B | 0.01 units | 15 minutes |
| Phosphorus, Ortho-P | SM 4500-PE | 0.003 mg/L | 48 hours |
| Phosphorus, Total Dissolved | SM 4500-PE | 0.010 mg/L | 48 hours |
| Phosphorus, Total | SM 4500-PE | 0.010 mg/L | 48 hours |
| Solids, Total Dissolved | SM 2540 C | 5.0 mg/L | 7 days |
| Solids, Total Suspended | SM 2540 D | 1.0 mg/L | 7 days |
| Solids, Volatile Suspended | EPA 160.4 | 2.0 mg/L | 7 days |
| Sulfate* | ASTM D516-90 | 5 mg/L | 28 days |

Field Quality Assurance Samples

A variety of quality control quality assurance measures were taken to insure defensible data. Ten percent of the samples were laboratory quality assurance samples (e.g. duplicates, spikes). A field blank was also generated for each sampling trip and was analyzed for all NPDES parameters. Field blanks consisted of deionized water which accompanied samples from the field sites to the analytical laboratory. All field blank parameters were below the reporting limits in 2017. As part of the overall QA/QC program, blind monthly performance samples of known concentration were made for all monitored parameters and delivered to IRI.

One equipment blank was also collected in 2017. An equipment blank (~ 2 L sample) was collected at Site 8a (Pershing) on 11/03/17. This site has a standard NPDES stormwater monitoring equipment set up. To collect the equipment blank, a large bottle of deionized water was placed at the strainer end of the sampler tubing. The intake line was filled and flushed with deionized water, simulating the pre-sample flush. After the flush was pumped to waste, a sample of deionized water was collected through the equipment. The sample taken was of sufficient volume to allow analysis of all parameters. All analytes in the equipment blank came back from the laboratory below the reporting limits except Cu (3.1 µg/L) and Pb (0.13 µg/L). These metal samples were rerun and confirmed. Due to the extremely small numbers these values were not subtracted from the data set but were noted.

Field measurements were recorded on a Field Measurement Form in the 2017 Field Log Book. Electronic data from the laboratory were forwarded to the MPRB in preformatted spreadsheets via email. Electronic data from the laboratory were checked and passed laboratory quality assurance procedures. Protocols for data validity followed those defined in the Storm Water Monitoring Program Manual (MPRB, 2001). For data reported below the reporting limit, the reporting limit value was divided in half for use in statistical calculations.

Manual transcription of data was minimized to reduce error introduction. A minimum of 10% of the final data were checked by hand against the raw data sent by the laboratory to ensure there were no errors entering, manipulating, or transferring the data. See **Section 29**, Quality Assurance Assessment Report for details.

A Chain of Custody form accompanied each set of sample bottles delivered to the lab. Each ISCO sampler tray or container was iced and labeled indicating the date and time of collection, the site location, and the field personnel initials. The collection date and time assigned to the composite sample was the time when the last sample of the composite was collected. The time that each composite sample was collected was recorded from the ISCO sampler onto field sheets. A complete description of methods can be found in the Storm Water Monitoring Program Manual (MPRB, 2001). Common statistics were calculated using Microsoft Excel.

## Computer Models used (P-8 and Flux)

The computer model P8 (v3.4) was calibrated and verified for each site, each using five different storms ranging from 0.10 inches to 1.47 inches. P8 was used to estimate daily cubic feet per second (cfs) snowmelt runoff from January through May. Daily temperature and hourly precipitation files used as P8 inputs were obtained from the National Oceanic and Atmospheric Administration (NOAA) National Data Center (NDC). Data from a heated rain gauge located at the Minneapolis/St. Paul International Airport was used for snowmelt water equivalent.

A description of P8 as described in the software's introduction:

P8 is a model for predicting the generation and transport of stormwater runoff pollutants in small urban catchments. Simulations are driven by hourly rainfall and daily air-temperature time series.

A description of Flux32 as described in the help menu (US Army Corps, 2014):

Flux32 is interactive software designed for use in estimating the transport (load) of nutrients or other water quality constituents past a tributary sampling station over a given period of time. The basic approach of Flux32 is to use several calculation techniques to map the flow/concentration relationship developed (modeled) from the sample record onto the entire flow record. This provides an estimate of total mass transport for the whole period of study with associated error statistics. Note that this approach does NOT focus on estimating changes in loads over time (i.e. time series).

An important option within Flux32 is the ability to stratify the data into groups based upon flow, date, and/or season. This is a key feature of the FLUX approach and one of its greatest strengths. In many (most) cases, stratifying the data increases the accuracy and precision of loading estimates.

The P8 model calculated daily average snowmelt runoff, the ISCO Flowlink software calculated daily average runoff. The water chemistry data were put into Flux32 (v3.10) to calculate flow-weighted mean concentrations. In Flux32, all the chemical parameters were run unstratified and, if possible, also run stratified by flow and month. A minimum of three data points are required to group the data for any stratification. Flux32 methods 2 and 6 were recorded for each parameter run (per Bruce Wilson, MPCA). The modeled concentration value with the lowest coefficient of variation was generally chosen and used for the final event mean concentration.

## Results & Discussion

The total volume sampled for each site and total recorded volumes in 2017 are given in **Table 14-4** along with the percentage collected in each season. Although the 2017 fall percentage sampled was low, there were no large differences in comparing event mean concentrations to previous years. All snowmelt and *E. coli* samples were grab samples, all other samples were flow-weighted composites. Flow-weighted composites were either analyzed with the fully required NPDES chemical parameters or analyzed with partial chemical parameters. A limited number of chemical parameters were analyzed when either the sample had expired for some of the chemical holding times (e.g. TDP, cBOD) or when the sample aliquot was too small for a full chemical analysis.

Sampling events are shown in **Table 14-5.** In 2017, samples with limited parameters were collected 11 times.

*Table 14-4. NPDES site volume totals and seasonal percentages collected for the sampling period 4/25/17 – 10/31/17.*

| **Volumes for 2017 (cf) and Seasonal Percentage Collected** | **Site 6 22nd/Aldrich** | **Site 7 14th/Park** | **Site 8a Pershing** | **Site 9 61st/Lyndale** |
|---|---|---|---|---|
| **Total volume recorded (with Flowlink) for 2017 (cf)** | 205,286 | 682,293 | 58,410 | 1,618,680 |
| **Total volume of sampled events (cf)** | 57,172 | 233,575 | 20,690 | 307,045 |
| **% sampled ANNUAL** | 28% | 34% | 35% | 19% |

| | | | | |
|---|---|---|---|---|
| **% sampled SPRING (May- June)** | 74% | 65% | 39% | 22% |
| **% sampled SUMMER (July- September)** | 26% | 41% | 60% | 78% |
| **% sampled FALL (October- November)** | 0% | 4% | 1% | 0.1% |

*Table 14-5. 2017 precipitation event data and samples collected for NDPES sites. A precipitation event is defined as being greater than 0.10 inches and separated by 8 hours. The rain gage is located at 3800 Bryant Ave. S., Minneapolis, MN. Grab = full chemistry, Full = full chemistry parameters, Partial = partial chemistry parameters (due to low volume or expired holding times), E. coli = grab, - = no data.*

| Event Start Date | Start Time | Event End Date | End Time | Rain (inches) | Duration (hours) | Intensity (in/hr) | Hours since last Rain. | Site 6 22nd/Aldrich | Site 7 14th/Park | Site 8a Pershing | Site 9 61st/Lyndale |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/17/2018 | 14:45 | - | - | - | - | - | - | - | - | - | Grab, *E. coli* |
| 1/18/2017 | 14:15 | - | - | - | - | - | - | Grab, *E. coli* | Grab, *E. coli* | - | Grab, *E. coli* |
| 2/14/2018 | 13:25 | - | - | - | - | - | - | - | - | Grab, *E. coli* | - |
| 4/25/2017 | 14:45 | 4/26/2017 | 8:30 | 0.89 | 17.75 | 0.05 | 128 | Full, *E. coli* | Full, *E. coli* | Full | *E. coli* |
| 5/15/2017 | 12:15 | 5/15/2017 | 13:30 | 0.31 | 1.25 | 0.25 | 158 | Full, *E. coli* | Full, *E. coli* | Full | Full, *E. coli* |
| 5/16/2017 | 3:30 | 5/16/2017 | 10:15 | 0.42 | 6.75 | 0.06 | 4 | Full | Full | Full | Full |
| 5/17/2017 | 0:15 | 5/17/2017 | 5:00 | 0.85 | 4.75 | 0.18 | 14 | Full | Full | Full | - |
| 5/17/2017 | 14:45 | 5/18/2017 | 4:15 | 1.59 | 13.50 | 0.12 | 10 | Full | Full | Full | - |
| 6/11/2017 | 7:45 | 6/11/2017 | 9:45 | 0.90 | 2.00 | 0.45 | 501 | Partial | Partial | - | - |
| 6/12/2017 | 13:45 | 6/12/2017 | 16:15 | 0.32 | 2.50 | 0.13 | 28 | Full | Full | - | Full |
| 7/17/2017 | 21:30 | 7/18/2017 | 18:30 | 1.11 | 21.00 | 0.05 | 405 | - | - | Full | Full |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7/19/2017 | 14:45 | 7/19/2017 | 21:45 | 0.27 | 7.00 | 0.04 | 20 | Partial | Full | Full | - |
| 7/25/2017 | 17:00 | 7/26/2017 | 7:15 | 1.25 | 14.25 | 0.09 | 139 | Full | Full | Full | - |
| 8/3/2017 | 5:45 | 8/3/2017 | 23:00 | 0.35 | 17.25 | 0.02 | 191 | Full | Full, *E. coli* | Full | *E. coli* |
| 8/5/2017 | 16:45 | 8/5/2017 | 17:30 | 0.13 | 0.75 | 0.17 | 42 | - | - | Partial | - |
| 8/6/2017 | 18:00 | 8/7/2017 | 4:45 | 0.09 | 10.75 | 0.01 | 25 | - | - | Partial | - |
| 8/9/2017 | 10:45 | 8/10/2017 | 16:15 | 1.10 | 29.50 | 0.04 | 54 | Full | Full | Full | Full |
| 8/16/2017 | 2:15 | 8/16/2017 | 6:15 | 0.52 | 4.00 | 0.13 | 50 | - | Full | Full | Full |
| 8/16/2017 | 18:30 | 8/17/2017 | 5:15 | 1.44 | 10.75 | 0.13 | 12 | - | Full | Full | - |
| 8/25/2017 | 5:00 | 8/25/2017 | 6:00 | 0.13 | 1.00 | 0.13 | 192 | - | - | - | Full |
| 9/18/2017 | 3:15 | 9/18/2017 | 14:00 | 0.35 | 10.75 | 0.03 | 323 | - | - | - | Full |
| 9/20/2017 | 1:30 | 9/20/2017 | 2:00 | 0.34 | 0.50 | 0.68 | 35 | - | - | - | Full |
| 9/25/2017 | 1:45 | 9/25/2017 | 9:30 | 0.19 | 7.75 | 0.02 | 120 | - | - | - | Full |
| 9/25/2017 | 19:15 | 9/26/2017 | 5:15 | 0.19 | 10.00 | 0.02 | 10 | Partial | Partial | - | Partial |
| 10/21/2017 | 6:15 | 10/21/2017 | 20:15 | 0.43 | 14.00 | 0.03 | 147 | - | Partial | Partial | Partial |

Surcharge events happen during high precipitation or high intensity storm events that exceed the drainage capacity of the pipes. Surcharges occur when water backs up in pipes and creates a hydrostatic pressure head, beyond the diameter of the pipe, which can result in inaccurate daily flow calculations and must be considered when evaluating flow-weighted mean concentrations. If surcharged water inundates the ISCO sampler, the samples are considered contaminated and not analyzed.

**Table 14-6** shows the 2017 surcharge event dates at each site. Except for Site 8a, most of the events that caused pipes to surcharge were storms with greater than 1 inch of precipitation.

***Table 14-6. Surcharge events in 2017 at the NPDES sites.***

| **Site** | **Surcharge Dates** |
|---|---|
| Site 6 (22nd and Aldrich)<br>18" pipe | 5/18, 6/11, 8/14, 8/17, 10/3 |
| Site 7 (14th and Park)<br><br>42" pipe | None |
| Site 8a (Pershing)<br><br>12" pipe | 5/1, 5/8, 5/16, 5/17, 6/11, 6/14, 6/29, 7/17, 7/19, 7/25, 7/26, 8/9, 8/13, 8/15, 8/26, 9/20, 10/1, 10/2 |
| Site 9 (61st and Lyndale)<br>42" pipe | None |

Site 8a (Pershing) had 18 surcharges in 2017. At this site, storms as small as 0.28 inches or as large as 3.32 inches caused pipe surcharging. At this site, two pipes and overland flow enter the manhole basin/vault and exit the outlet, a 12 inch PVC pipe. The Site 8a (Pershing) watershed/area of Minneapolis is lower in elevation than the surrounding areas, causing a regular back up of many stormsewers in the system. Minneapolis Public Works is aware of this problem. Surcharges at this site do not appear to have caused any flooding problems. Site 8a (Pershing) samples appear to not be significantly affected by surcharging because the sampler is secured in an above ground enclosure. Site 6 (22nd and Aldrich) had five surcharges that were not of significant concern.

As required by the MS4 permit, *Escherichia Coli* (*E. coli*) grab and pH samples were attempted to be collected quarterly. A total of 13 *E. coli* grab samples were collected in 2017. At Site 7 (14th and Park) and Site 9 (61st and Lyndale), *E. coli* grab samples were collected four times. At Site 6 (22nd and Aldrich), *E. coli* grab samples were collected three times, and at Site 8a (Pershing), *E. coli* grab samples were collected once. The pH of a stormwater sample from each site was measured at least quarterly by the IRI laboratory.

Required 2017 quarterly *E. coli* grab and pH sampling was not accomplished at all sites. The fall *E. coli* samples at all sites were unable to be collected due to low or no flow. Grab samples were not collected at Site 8a after snowmelt. Site 8a was inaccessible for grab sampling after installation due to the sites shallowness requiring monitoring equipment to be installed on top of the manhole.

Seasonal statistics (snowmelt, spring, summer, and fall) of the data for all NPDES sites were calculated and are listed in **Table 14-7**. The geometric mean was chosen for comparison purposes because it best handles data with outlier's present. Seasonal patterns are evident in the data. Snowmelt had the highest geometric mean concentrations for seventeen of the parameters: TP, TDP, Ortho-P, TKN, $NH_3$, $NO_3NO_2$, Cl, Hardness, TSS, VSS, TDS, cBOD, Sulfate, Sp. Cond., and pH. Snowmelt had the lowest geometric mean for one parameter, *E. coli*. The *E. coli* concentrations are temperature dependent because bacteria do not survive well in cold conditions. Spring stormwater had the highest geometric mean concentrations for one parameter, Pb. It had the lowest geometric mean concentrations for two parameters: Ortho-P and Hardness. Summer had the highest geometric mean concentrations for one parameter, *E. coli*. It had the lowest geometric mean for eight parameters: TKN, CL, TDS, cBOD, Sulfate, Sp. Cond., Cu, and Zn. Fall had the lowest geometric mean concentrations for eight parameters: TP, TDP, $NH_3$, $NO_3NO_2$, TSS, VSS, pH, and Pb.

**Table 14-8** shows the 2017 chemistry data for the sampled storms. These data generally show peaks during snowmelt and early spring for many parameters. Stormwater concentrations can be extremely variable because there are multiple factors affecting the concentrations like the amount or intensity of precipitation or BMP presence and maintenance.

The bold June $SO_4$ data in **Table 14-8** are data that failed a blind laboratory monthly performance standard. Internal QAQC procedures flag the data for an entire month for any parameter if the blind standard fails ± 20% recovery. It was deemed the data can be used with caution, noting that performance standards were outside the 80-120% recovery standards.

***Table 14-7. 2017 statistical summary of concentrations by season from all sites (6 –9). STDEV= standard deviation, COV= coefficient of variation, ND = no data. Blue highlighted cells have the highest seasonal geometric mean, orange cells have the lowest seasonal geometric means.***

| 2017 Season | Statistical Function | TP mg/L | TDP mg/L | Ortho-P mg/L | TKN mg/L | $NH_3$ mg/L | $NO_3NO_2$ mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µhmos | pH std units | *E. coli MPN/100mL* | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SNOWMELT (January-March) | **MEAN (geometric)** | 0.606 | 0.093 | 0.260 | 5.20 | 1.52 | 0.360 | 1668 | 193 | 161 | 67 | 3940 | 44 | 28 | 4064 | 8.6 | 37 | 34 | 10 | 138 |
| | **MEAN (arithmetic)** | 0.646 | 0.145 | 0.334 | 5.67 | 1.64 | 0.627 | 4430 | 231 | 213 | 75 | 7710 | 48 | 33 | 11809 | 8.7 | 85 | 41 | 16 | 216 |
| | **MAX** | 1.07 | 0.444 | 0.798 | 9.69 | 2.90 | 1.19 | 6785 | 500 | 384 | 111 | 11836 | 98 | 46 | 19020 | 10.3 | 201 | 54 | 31 | 299 |
| | **MIN** | 0.412 | 0.040 | 0.106 | 2.83 | 0.849 | 0.079 | 15 | 80 | 33 | 27 | 118 | 28 | 7 | 218 | 7.3 | 7 | 8 | 1 | 10 |
| | **MEDIAN** | 0.499 | 0.069 | 0.192 | 5.18 | 1.51 | 0.725 | 5025 | 200 | 222 | 85 | 8579 | 38 | 37 | 16190 | 8.3 | 24 | 50 | 16 | 264 |
| | **STDEV** | 0.269 | 0.171 | 0.279 | 2.63 | 0.76 | 0.526 | 2625 | 161 | 137 | 33 | 4542 | 28 | 15 | 10138 | 1.3 | 97 | 19 | 11 | 118 |
| | **NUMBER** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | 5 | 5 | 5 |
| | **COV** | 0.417 | 1.18 | 0.834 | 0.465 | 0.461 | 0.839 | 0.593 | 0.696 | 0.644 | 0.448 | 0.589 | 0.582 | 0.456 | 0.858 | 0.153 | 1.14 | 0.469 | 0.685 | 0.548 |
| SPRING (April-May) | **MEAN (geometric)** | 0.272 | 0.054 | 0.037 | 2.25 | 0.943 | 0.292 | 4 | 22 | 80 | 29 | 41 | 7 | 5 | 74 | 7.1 | 481 | 22 | 11 | 54 |
| | **MEAN (arithmetic)** | 0.348 | 0.066 | 0.047 | 2.83 | 1.09 | 0.359 | 9 | 24 | 110 | 42 | 63 | 11 | 6 | 90 | 7.1 | 1810 | 25 | 25 | 92 |
| | **MAX** | 1.46 | 0.213 | 0.091 | 10.5 | 2.83 | 0.665 | 44 | 56 | 334 | 144 | 157 | 49 | 12 | 247 | 8.4 | 6488 | 56 | 98 | 358 |
| | **MIN** | 0.076 | 0.017 | 0.005 | 0.684 | 0.428 | 0.015 | 1 | 12 | 15 | 6 | 3 | 1 | 3 | 28 | 6.5 | 47 | 11 | 2 | 10 |
| | **MEDIAN** | 0.288 | 0.059 | 0.046 | 2.21 | 0.924 | 0.348 | 2 | 20 | 94 | 32 | 49 | 7 | 6 | 66 | 7.1 | 242 | 22 | 13 | 58 |
| | **STDEV** | 0.314 | 0.047 | 0.028 | 2.32 | 0.647 | 0.172 | 14 | 13 | 87 | 37 | 52 | 12 | 3 | 66 | 0.5 | 2681 | 12 | 32 | 92 |
| | **NUMBER** | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 14 | 16 | 17 | 17 | 17 | 6 | 17 | 17 | 17 |
| | **COV** | 0.902 | 0.710 | 0.580 | 0.819 | 0.595 | 0.480 | 1.48 | 0.523 | 0.786 | 0.894 | 0.818 | 1.12 | 0.493 | 0.738 | 0.067 | 1.48 | 0.507 | 1.27 | 1.01 |
| SUMMER (June-August) | **MEAN (geometric)** | 0.193 | 0.055 | 0.077 | 0.906 | 0.459 | 0.206 | 2 | 23 | 43 | 17 | 39 | 4 | 5 | 70 | 6.7 | 3316 | 15 | 5 | 36 |
| | **MEAN (arithmetic)** | 0.212 | 0.069 | 0.092 | 1.25 | 0.539 | 0.293 | 5 | 25 | 48 | 19 | 50 | 6 | 5 | 80 | 6.7 | 4445 | 16 | 8 | 48 |
| | **MAX** | 0.377 | 0.222 | 0.235 | 2.85 | 1.19 | 0.649 | 46 | 46 | 124 | 48 | 135 | 22 | 13 | 212 | 7.3 | 9208 | 29 | 43 | 145 |
| | **MIN** | 0.068 | 0.020 | 0.029 | 0.250 | 0.125 | 0.015 | 1 | 8 | 16 | 6 | 9 | 1 | 3 | 29 | 6.3 | 1515 | 7 | 1 | 10 |
| | **MEDIAN** | 0.214 | 0.048 | 0.068 | 1.13 | 0.533 | 0.355 | 1 | 24 | 41 | 16 | 41 | 5 | 5 | 67 | 6.7 | 2613 | 14 | 4 | 45 |
| | **STDEV** | 0.087 | 0.050 | 0.058 | 0.861 | 0.263 | 0.183 | 9 | 11 | 24 | 9 | 36 | 6 | 3 | 47 | 0.3 | 4161 | 6 | 11 | 34 |
| | **NUMBER** | 27 | 23 | 23 | 26 | 24 | 24 | 27 | 27 | 27 | 27 | 23 | 22 | 23 | 27 | 24 | 3 | 25 | 25 | 25 |
| | **COV** | 0.413 | 0.716 | 0.624 | 0.691 | 0.488 | 0.625 | 1.89 | 0.425 | 0.496 | 0.488 | 0.726 | 1.00 | 0.575 | 0.584 | 0.039 | 0.936 | 0.367 | 1.28 | 0.711 |
| FALL (Sept-Nov) | **MEAN (geometric)** | 0.162 | 0.027 | 0.039 | 1.11 | 0.437 | 0.146 | 7 | 31 | 40 | 17 | 74 | 5 | 8 | 113 | 6.5 | ND | 17 | 4 | 52 |
| | **MEAN (arithmetic)** | 0.181 | 0.028 | 0.042 | 1.17 | 0.441 | 0.241 | 13 | 34 | 46 | 19 | 80 | 7 | 9 | 126 | 6.5 | ND | 17 | 6 | 59 |
| | **MAX** | 0.331 | 0.039 | 0.066 | 1.70 | 0.489 | 0.673 | 24 | 68 | 85 | 38 | 104 | 14 | 10 | 222 | 6.6 | ND | 26 | 15 | 107 |
| | **MIN** | 0.066 | 0.018 | 0.029 | 0.697 | 0.356 | 0.015 | 1 | 16 | 16 | 8 | 42 | 2 | 6 | 45 | 6.2 | ND | 12 | 1 | 24 |
| | **MEDIAN** | 0.176 | 0.028 | 0.030 | 1.03 | 0.478 | 0.140 | 16 | 34 | 45 | 15 | 94 | 4 | 10 | 127 | 6.6 | ND | 16 | 5 | 48 |
| | **STDEV** | 0.088 | 0.011 | 0.021 | 0.423 | 0.074 | 0.231 | 10 | 16 | 25 | 10 | 33 | 6 | 2 | 59 | 0.2 | ND | 5 | 5 | 31 |
| | **NUMBER** | 9 | 3 | 3 | 8 | 3 | 9 | 8 | 8 | 9 | 9 | 3 | 3 | 3 | 8 | 3 | ND | 8 | 8 | 8 |
| | **COV** | 0.485 | 0.371 | 0.506 | 0.361 | 0.167 | 0.957 | 0.762 | 0.473 | 0.542 | 0.537 | 0.416 | 0.924 | 0.286 | 0.468 | 0.033 | ND | 0.291 | 0.775 | 0.530 |

*Table 14-8. 2017 NDPES sampled event data by site. ND=no data.*

| Date Sampled | Time | Site Location | Sample Type | TP mg/L | TDP mg/L | OrthoP mg/L | TKN mg/L | NH3 mg/L | NO3NO2 mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µhmos | pH std units | E. Coli MPN | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/18/2017 | 14:15 | 22nd & Aldrich | Grab | 0.763 | 0.132 | 0.386 | 6.56 | 2.90 | 0.084 | 5905 | 500 | 222 | 85 | 10376 | 98 | 42 | 19020 | 7.8 | 24 | 50 | 31 | 299 |
| 4/26/2017 | 8:27 | 22nd & Aldrich | Composite | 0.226 | 0.017 | 0.067 | 1.6 | 0.88 | 0.301 | 10.0 | 20 | 77 | 35 | 34 | 7 | <5.00 | 55 | 6.9 | 6488 | 18 | 35 | 65 |
| 5/15/2017 | 14:10 | 22nd & Aldrich | Grab | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 3654 | ND | ND | ND |
| 5/15/2017 | 14:11 | 22nd & Aldrich | Composite | 1.46 | 0.213 | 0.08 | 10.5 | 2.83 | <0.030 | 4.4 | 40 | 334 | 144 | 116 | 49 | 12 | 134 | 6.5 | ND | 56 | 98 | 358 |
| 5/16/2017 | 9:32 | 22nd & Aldrich | Composite | 0.450 | 0.118 | 0.089 | 3.83 | 1.09 | 0.336 | 2.5 | 20 | 154 | 55 | 65 | 11 | 6 | 71 | 7.0 | ND | 33 | 68 | 129 |
| 5/17/2017 | 4:32 | 22nd & Aldrich | Composite | 0.288 | 0.081 | 0.078 | 3.02 | 1.19 | 0.464 | <2.00 | 12 | 106 | 104 | 32 | 6 | 5 | 52 | 7.2 | ND | 15 | 33 | 58 |
| 5/17/2017 | 19:31 | 22nd & Aldrich | Composite | 0.298 | 0.073 | 0.047 | 2.17 | 0.462 | 0.171 | <2.00 | 16 | 124 | 35 | ND | 4 | 5 | 46 | 7.0 | ND | 23 | 93 | 84 |
| 6/11/2017 | 10:44 | 22nd & Aldrich | Composite | 0.371 | ND | ND | 2.16 | ND | ND | <2.00 | 24 | 68 | 32 | ND | ND | ND | 63 | 6.3 | ND | 14 | 20 | 59 |
| 6/12/2017 | 17:35 | 22nd & Aldrich | Composite | 0.287 | 0.100 | 0.121 | 1.85 | 0.820 | 0.376 | 0.9 | 20 | 56 | 28 | 34 | 5 | **6** | 60 | 6.5 | ND | 16 | 24 | 65 |
| 7/19/2017 | 22:36 | 22nd & Aldrich | Composite | 0.344 | ND | ND | ND | ND | 0.533 | <2.00 | 32 | 124 | 48 | ND | ND | ND | 90 | ND | ND | ND | ND | ND |
| 7/25/2017 | 20:00 | 22nd & Aldrich | Composite | 0.271 | 0.085 | 0.053 | 2.39 | 0.885 | 0.368 | <2.00 | 24 | 76 | 32 | 50 | 8 | 9 | 67 | 6.7 | ND | 23 | 36 | 74 |
| 8/3/2017 | 8:15 | 22nd & Aldrich | Composite | 0.318 | 0.108 | 0.167 | 2.85 | 0.516 | 0.037 | <2.00 | 18 | 49 | 21 | 53 | 16 | 7 | 63 | 6.3 | ND | 28 | 43 | 99 |
| 8/3/2017 | 8:55 | 22nd & Aldrich | Grab | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 9208 | ND | ND | ND |
| 8/10/2017 | 1:19 | 22nd & Aldrich | Composite | 0.152 | 0.047 | 0.054 | 1.48 | 0.550 | 0.193 | <2.00 | 16 | 41 | 18 | 41 | 3 | <5.00 | 45 | 6.8 | ND | 19 | 3 | 56 |
| 9/26/2017 | 6:43 | 22nd & Aldrich | Composite | 0.189 | ND | ND | 0.898 | ND | <0.030 | <2.00 | 32 | 21 | 12 | ND | ND | ND | 80 | ND | ND | 13 | 10 | 38 |
| 1/18/2017 | 14:05 | 14th & Park | Grab | 0.412 | 0.069 | 0.190 | 4.09 | 1.51 | 0.725 | 5025 | 144 | 131 | 56 | 8579 | 38 | 34 | 16190 | 8.3 | 179 | 38 | 15 | 225 |
| 4/26/2017 | 8:33 | 14th & Park | Composite | 0.076 | 0.021 | 0.049 | 0.684 | 0.547 | 0.203 | 10.0 | 16 | 15 | 6 | 49 | 8 | 6 | 67 | 7.0 | 256 | 11 | 3 | 34 |
| 5/15/2017 | 13:50 | 14th & Park | Grab | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 228 | ND | ND | ND |
| 5/15/2017 | 14:27 | 14th & Park | Composite | 0.523 | 0.080 | 0.039 | 5.25 | 1.97 | 0.348 | 18.7 | 28 | 124 | 56 | 120 | 29 | 11 | 159 | 6.6 | ND | 45 | 13 | 192 |
| 5/16/2017 | 9:27 | 14th & Park | Composite | 0.241 | 0.071 | 0.029 | 2.27 | 0.924 | 0.556 | 4.9 | 16 | 94 | 28 | 59 | 9 | 6 | 69 | 7.3 | ND | 23 | 17 | 113 |
| 5/17/2017 | 4:17 | 14th & Park | Composite | 0.315 | 0.047 | 0.070 | 2.21 | 1.07 | 0.373 | <2.00 | 20 | 185 | 32 | 50 | 5 | <5.00 | 66 | 8.4 | ND | 22 | 10 | 42 |
| 5/17/2017 | 21:42 | 14th & Park | Composite | 0.159 | 0.028 | 0.023 | 1.22 | 0.428 | 0.221 | 2.5 | 12 | 63 | 18 | ND | 3 | 5 | 45 | 7.1 | ND | 20 | 12 | 56 |
| 6/11/2017 | 10:25 | 14th & Park | Composite | 0.214 | ND | ND | 1.45 | ND | ND | 2.28 | 16 | 39 | 16 | ND | ND | ND | 55 | 6.3 | ND | 17 | 4 | 34 |
| 6/12/2017 | 17:13 | 14th & Park | Composite | 0.150 | 0.033 | 0.063 | 1.36 | 0.650 | 0.610 | 5.0 | 20 | 28 | 16 | 41 | 7 | **6** | 78 | 6.6 | ND | 19 | 6 | 54 |
| 7/19/2017 | 22:40 | 14th & Park | Composite | 0.215 | 0.025 | 0.048 | 2.65 | 1.185 | 0.649 | 12.1 | 44 | 41 | 22 | 122 | 22 | 13 | 155 | 6.9 | ND | 29 | 8 | 107 |
| 7/26/2017 | 4:56 | 14th & Park | Composite | 0.133 | 0.048 | 0.033 | 0.975 | 0.585 | 0.350 | <2.00 | 16 | 39 | 14 | 27 | 5 | <5.00 | 46 | 6.9 | ND | 14 | 7 | 40 |
| 8/3/2017 | 8:26 | 14th & Park | Composite | 0.263 | 0.071 | 0.164 | 2.04 | 0.666 | 0.365 | 4.1 | 44 | 80 | 30 | 61 | 17 | 7 | 75 | 6.6 | ND | 25 | 14 | 145 |
| 8/3/2017 | 8:40 | 14th & Park | Grab | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 1515 | ND | ND | ND |
| 8/10/2017 | 1:20 | 14th & Park | Composite | 0.106 | 0.022 | 0.036 | 0.725 | 0.630 | 0.340 | <2.00 | 14 | 35 | 14 | 43 | <1.00 | <5.00 | 47 | 6.9 | ND | 14 | 6 | 55 |
| 8/16/2017 | 7:32 | 14th & Park | Composite | 0.075 | 0.029 | 0.029 | <0.500 | <0.250 | 0.172 | <2.00 | 10 | 25 | 9 | 22 | <1.00 | <5.00 | 32 | 6.7 | ND | 11 | 5 | 32 |
| 8/16/2017 | 21:22 | 14th & Park | Composite | 0.068 | 0.021 | 0.030 | <0.500 | <0.250 | 0.132 | <2.00 | 8 | 23 | 8 | 9 | <1.00 | <5.00 | 29 | 6.7 | ND | 9 | 6 | 28 |
| 9/26/2017 | 4:33 | 14th & Park | Composite | 0.066 | ND | ND | ND | ND | 0.106 | ND | ND | 24 | 13 | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 10/21/2017 | 9:37 | 14th & Park | Composite | 0.279 | ND | ND | 1.70 | ND | 0.105 | 2.97 | 24 | 75 | 38 | ND | ND | ND | 76 | ND | ND | 26 | 15 | 100 |

*Table 14-8. 2017 NDPES sampled event data by site. (Continued) ND=no data*

| Date Sampled | Time | Site Location | Sample Type | TP mg/L | TDP mg/L | OrthoP mg/L | TKN mg/L | NH3 mg/L | NO3NO2 mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µhmos | pH std units | E. Coli MPN | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2/14/2017 | 13:25 | Pershing | Grab | 1.07 | 0.444 | 0.798 | 5.18 | 1.52 | 0.079 | 14.5 | 80 | 33 | 27 | 118 | 46 | 7 | 218 | 7.3 | 201 | 8 | 1 | <20.0 |
| 4/26/2017 | 7:36 | Pershing | Composite | 0.094 | 0.034 | 0.046 | 0.821 | 0.674 | 0.376 | 10.0 | 16 | 27 | 10 | 20 | <1.00 | <5.00 | 28 | 7.2 | ND | 19 | 2 | <20.0 |
| 5/15/2017 | 14:21 | Pershing | Composite | 0.353 | 0.078 | 0.005 | 3.81 | 2.09 | 0.630 | 2.48 | 40 | 30 | 20 | <5.00 | ND | 6 | 86 | 6.5 | ND | 24 | 2 | 35 |
| 5/16/2017 | 8:37 | Pershing | Composite | 0.162 | 0.031 | 0.008 | 1.75 | 0.992 | 0.373 | <2.00 | 16 | 27 | 11 | 11 | 7 | <5.00 | 44 | 6.9 | ND | 13 | 2 | <20.0 |
| 5/17/2017 | 4:23 | Pershing | Composite | 0.152 | 0.033 | 0.038 | 1.43 | 0.845 | 0.348 | <2.00 | 20 | 45 | 11 | 19 | 3 | 6 | 57 | 7.4 | ND | 14 | 2 | <20.0 |
| 5/17/2017 | 16:37 | Pershing | Composite | 0.267 | 0.092 | 0.091 | 1.32 | 0.462 | 0.196 | <2.00 | 24 | 46 | 14 | | 3 | 7 | 62 | 7.3 | ND | 12 | 4 | <20.0 |
| 7/18/2017 | 0:06 | Pershing | Composite | 0.321 | 0.048 | 0.055 | 1.69 | 0.885 | <0.030 | <2.00 | 28 | 49 | 28 | 46 | 7 | 5 | 75 | 6.7 | ND | 14 | 2 | <20.0 |
| 7/19/2017 | 23:09 | Pershing | Composite | 0.233 | 0.119 | 0.151 | 0.823 | 0.585 | 0.360 | <2.00 | 32 | 28 | 10 | 38 | 4 | 7 | 74 | 7.3 | ND | 13 | 1 | <20.0 |
| 7/25/2017 | 18:44 | Pershing | Composite | 0.224 | 0.126 | 0.141 | 1.057 | 0.735 | 0.391 | <2.00 | 24 | 46 | 16 | 18 | 5 | <5.00 | 67 | 7.3 | ND | 13 | 2 | <20.0 |
| 8/3/2017 | 8:29 | Pershing | Composite | 0.377 | 0.222 | 0.235 | 2.73 | 0.470 | <0.030 | 6.9 | 38 | 30 | 16 | 105 | ND | 6 | 109 | ND | ND | ND | ND | ND |
| 8/5/2017 | 18:13 | Pershing | Composite | 0.255 | ND | ND | 1.72 | 0.411 | ND | <2.00 | 32 | 28 | 14 | | ND | ND | 84 | ND | ND | 14 | 2 | 31 |
| 8/10/2017 | 1:03 | Pershing | Composite | 0.151 | 0.089 | 0.106 | <0.500 | 0.426 | 0.166 | <2.00 | 18 | 34 | 16 | 9 | <1.00 | <5.00 | 46 | 6.6 | ND | 7 | 2 | <20.0 |
| 8/16/2017 | 7:15 | Pershing | Composite | 0.168 | 0.114 | 0.125 | <0.500 | 0.470 | 0.137 | <2.00 | 18 | 16 | 6 | 15 | <1.00 | <5.00 | 48 | 6.4 | ND | 10 | 1 | <20.0 |
| 8/16/2017 | 21:18 | Pershing | Composite | 0.138 | 0.058 | 0.079 | 0.501 | <0.250 | 0.110 | <2.00 | 16 | 40 | 12 | 22 | <1.00 | <5.00 | 34 | 6.7 | ND | 9 | 4 | <20.0 |
| 10/21/2017 | 10:18 | Pershing | Composite | 0.176 | ND | ND | 0.898 | ND | 0.140 | <2.00 | 16 | 50 | 19 | ND | ND | ND | 45 | ND | ND | 16 | 3 | 24 |
| 1/17/2017 | 14:45 | 61st & Lyndale | Grab | 0.491 | 0.042 | 0.106 | 2.83 | 0.849 | 1.19 | 6785 | 232 | 297 | 95 | 11836 | 28 | 46 | >19990 | 9.9 | 12 | 54 | 16 | 264 |
| 1/18/2017 | 13:45 | 61st & Lyndale | Grab | 0.499 | 0.040 | 0.192 | 9.69 | 1.44 | 1.05 | 4422 | 200 | 384 | 111 | 7639 | 33 | 37 | >19990 | 10.3 | 7 | 53 | 17 | 280 |
| 4/26/2017 | 11:35 | 61st & Lyndale | Grab | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 189 | ND | ND | ND |
| 5/15/2017 | 13:30 | 61st & Lyndale | Grab | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 47.1 | ND | ND | ND |
| 5/15/2017 | 17:55 | 61st & Lyndale | Composite | 0.431 | 0.051 | 0.030 | 3.35 | 1.12 | 0.531 | 43.8 | 56 | 217 | 68 | 157 | 19 | 11 | 247 | 7.2 | ND | 37 | 14 | 180 |
| 5/16/2017 | 8:43 | 61st & Lyndale | Composite | 0.426 | 0.059 | 0.018 | 2.94 | 0.890 | 0.665 | 43.8 | 44 | 207 | 61 | 148 | 13 | 9 | 240 | 7.9 | ND | 33 | 14 | 174 |
| 6/12/2017 | 20:40 | 61st & Lyndale | Composite | 0.185 | 0.020 | 0.088 | 1.20 | 0.422 | 0.427 | 45.6 | 40 | 65 | 20 | 135 | 7 | **9** | 209 | 6.8 | ND | 19 | 5 | 80 |
| 7/18/2017 | 5:40 | 61st & Lyndale | Composite | 0.171 | 0.024 | 0.045 | 1.00 | 0.666 | 0.378 | 9.3 | 28 | 49 | 15 | 49 | 7 | 7 | 101 | 6.8 | ND | 13 | 3 | 30 |
| 8/3/2017 | 8:15 | 61st & Lyndale | Grab | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 2613 | ND | ND | ND |
| 8/10/2017 | 7:55 | 61st & Lyndale | Composite | 0.120 | 0.026 | 0.054 | <0.500 | 0.450 | 0.439 | 9.33 | 26 | 42 | 13 | 57 | 3 | 5 | 97 | 6.9 | ND | 15 | 3 | 45 |
| 8/16/2017 | 3:46 | 61st & Lyndale | Composite | 0.153 | 0.044 | 0.068 | <0.500 | <0.250 | 0.076 | 10.3 | 20 | 89 | 24 | 37 | <1.00 | <5.00 | 92 | 6.9 | ND | 15 | 4 | 51 |
| 8/25/2017 | 8:57 | 61st & Lyndale | Composite | 0.251 | 0.116 | 0.182 | <0.500 | 0.426 | 0.401 | 4.7 | 46 | 46 | 15 | 121 | 5 | 11 | 212 | 6.9 | ND | 12 | 3 | 56 |
| 9/18/2017 | 16:11 | 61st & Lyndale | Composite | 0.237 | 0.039 | 0.030 | 1.58 | 0.356 | 0.145 | 22.3 | 40 | 85 | 31 | 104 | 4 | 10 | 175 | 6.2 | ND | 21 | 7 | 107 |
| 9/20/2017 | 7:11 | 61st & Lyndale | Composite | 0.120 | 0.018 | 0.029 | 0.697 | 0.489 | 0.419 | 14.4 | 20 | 45 | 11 | 42 | 2 | 6 | 110 | 6.6 | ND | 12 | 3 | 42 |
| 9/25/2017 | 7:55 | 61st & Lyndale | Composite | 0.143 | 0.028 | 0.066 | 1.17 | 0.478 | 0.503 | 22.8 | 36 | 34 | 15 | 94 | 14 | 10 | 159 | 6.6 | ND | 17 | 3 | 54 |
| 9/26/2017 | 8:25 | 61st & Lyndale | Composite | 0.091 | ND | ND | 0.756 | ND | 0.673 | 18.2 | 38 | 16 | 8 | ND | ND | ND | 143 | ND | ND | 12 | 1 | 34 |
| 10/22/2017 | 0:15 | 61st & Lyndale | Composite | 0.331 | ND | ND | 1.68 | ND | 0.064 | 24.3 | 68 | 67 | 27 | ND | ND | ND | 222 | ND | ND | 22 | 7 | 71 |

### *Median Comparison*

**Table 14-9** shows a comparison of MPRB and Nationwide Urban Runoff Program (NURP) median residential, mixed use, and composite land use stormwater values. The MPRB data are split into 2017 and 2001-2016 data in order to compare them.

In 2017, the three MPRB land use categories were significantly lower or had similar values in the median concentrations of almost all chemical parameters when compared to the NURP data. The exception is TKN in all land uses. It is unknown why some of the MPRB TKN median data are higher than the NURP data. A possible explanation is that there is more decaying vegetative material (e.g. leaf litter) in the Minneapolis watersheds than in the NURP watersheds that were studied from 1979 to 1983.

When the NURP study data were collected, lead (Pb) was widely used in gasoline (from the 1920s to 1990s). The significant lead reduction in the environment is clearly seen in the MPRB data sets since it was collected after lead in gas was banned in 1996.

It is important to note that the MPRB sites monitored in 2001-2004 were in different watersheds and have similar but not identical land uses to those monitored in 2005-2017. It is not believed this effected comparison results.

***Table 14-9. Typical Median stormwater concentrations from MPRB and NURP data.***

| **Land Use** | **Residential** | | | **Mixed** | | | **Composite** | | |
|---|---|---|---|---|---|---|---|---|---|
| **Location** | MPRB[1] | MPRB[2] | NURP | MPRB[3] | MPRB[4] | NURP | MPRB[5] | MPRB[6] | NURP |
| **Year(s)** | 2017 | 2001–2016 | 1980's | 2017 | 2001–2016 | 1980's | 2017 | 2001–2016 | 1980's |
| **TP (mg/L)** | 0.298 | 0.387 | 0.383 | 0.187 | 0.222 | 0.263 | 0.235 | 0.321 | 0.330 |
| **TKN (mg/L)** | 2.28 | 2.42 | 1.9 | 1.70 | 1.55 | 1.29 | 1.70 | 2.03 | 1.5 |
| **$NO_3NO_2$ (mg/L)** | 0.319 | 0.358 | 0.736 | 0.348 | 0.424 | 0.558 | 0.360 | 0.424 | 0.68 |
| **cBOD (mg/L)** | 7 | 11 | 10 | 8 | 10 | 8 | 7 | 9 | 9 |
| **TSS (mg/L)** | 77 | 82 | 101 | 40 | 56 | 67 | 47 | 80 | 100 |
| **Cu (µg/L)** | 21 | 18 | 33 | 20 | 17 | 27 | 17 | 18 | 30 |
| **Pb (µg/L)** | 34 | 30 | 144 | 8 | 11 | 114 | 6 | 12 | 140 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Zn (µg/L)** | 69 | 77 | 135 | 55 | 80 | 154 | 59 | 77 | 160 |

[1] Site 6 data.
[2] Sites 1 and 2 data, (Site 6, 2005-2017).
[3] Site 7 data.
[4] Sites 5 and 5a data, (Site 7, 2005-2017).
[5] Sites 6 – 9 data.
[6] Sites 1 – 5a data, (Site 6 – 9, 2005-2017).

### *Geometric Mean Comparison*

**Table 14-10** lists statistical calculations for all measured parameters for each individual land use site, and then all land use sites combined. Stormwater data have a significant amount of variance and outliers in the data set. The geometric mean calculation is the best statistical tool to understand data that have outliers and extreme outliers.

Site 6 (22nd and Aldrich) is an older residential watershed with a dense tree canopy. It had the highest geometric means for: TP, Ortho-P, TKN, $NH_3$, TSS, VSS, cBOD, *E. coli*, Cu, Pb, and Zn. The cause of the higher TP values may be either pet waste or dense leaf canopy in the watershed adding to the organic load. The higher Pb is likely the result of vehicular wear inputs (e.g. brake dust, tire weights) or legacy exterior lead paint. The geometric mean concentration of Pb has been persistently high at this site compared to the other monitored sites and is possibly a remnant of lead-based paints shedding from the older houses and the soils. The low $NO_2NO_3$ values are likely due to plant uptake in the watershed.

Site 7 (14th and Park) is a dense mixed-use watershed. None of the highest geometric mean concentrations were found at this site. Site 7 (14th and Park) had the lowest geometric mean for TP, Ortho-P, and Hardness. It is unknown why these parameters were low in this watershed. This is likely the result of the hard surface landscape, with minimal vegetation in this mixed-use watershed.

Site 8 (Pershing) is a Minneapolis park. It had the highest geometric means for TDP. The TDP is likely coming from the soils and vegetation decomposing in the park. Site 8 (Pershing) had the lowest geometric means for most parameters: Cl, TSS, VSS, TDS, cBOD, Sulfate, Sp. Cond., Cu, Pb, and Zn. This is likely due to the park's less developed and more vegetated watershed. The *E. coli* sample was collected during snowmelt and not used for analysis since it was the only sample collected at the site.

Site 9 (61st and Lyndale) is a commercial/industrial watershed. It had the highest geometric mean for seven parameters: $NO_2NO_3$, Cl, Hardness, TDS, Sulfate, Sp. Cond., and pH. Site 9 (61st and Lyndale) had the lowest geometric mean values for four parameters: TDP, TKN, $NH_3$, and *E. coli*. This watershed is a light industrial site (cement factory, natural gas facility, City maintenance facility, etc.) and it is expected that many of the parameters would be higher than other watersheds due to extensive industrial activities.

***Table 14-10. 2017 statistics on chemical parameter by site and aggregated. All = all 4 sites, STDEV = standard deviation, COV = coefficient of variation. Blue boxes are the highest geometric mean chemical parameter. Orange boxes are the lowest geometric mean chemical parameter. NA = data not available.***

| Site ID | Statistical Function | TP mg/L | TDP mg/L | Ortho-P mg/L | TKN mg/L | $NH_3$ mg/L | $NO_3NO_2$ mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. μmhos | pH std units | E. coli MPN/100mL | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6, 22nd Aldrich | MEAN (geometric) | 0.342 | 0.082 | 0.091 | 2.61 | 0.989 | 0.144 | 3 | 28 | 87 | 39 | 88 | 10 | 6.68 | 102 | 6.8 | 1510 | 23 | 29 | 89 |
| 6, 22nd Aldrich | MEAN (arithmetic) | 0.417 | 0.097 | 0.114 | 3.28 | 1.213 | 0.241 | 456 | 60 | 112 | 50 | 1200 | 21 | 9.70 | 1527 | 6.8 | 4843 | 26 | 41 | 115 |
| 6, 22nd Aldrich | MAX | 1.46 | 0.213 | 0.386 | 10.5 | 2.90 | 0.533 | 5905 | 500 | 334 | 144 | 10376 | 98 | 42.2 | 19020 | 7.8 | 9208 | 56 | 98 | 358 |
| 6, 22nd Aldrich | MIN | 0.152 | 0.017 | 0.047 | 0.898 | 0.462 | 0.015 | 1 | 12 | 21 | 12 | 32 | 3 | 2.50 | 45 | 6.3 | 24 | 13 | 3 | 38 |
| 6, 22nd Aldrich | MEDIAN | 0.298 | 0.093 | 0.079 | 2.28 | 0.883 | 0.247 | 1 | 20 | 77 | 35 | 50 | 7 | 5.99 | 63 | 6.8 | 5071 | 21 | 34 | 69 |
| 6, 22nd Aldrich | STDEV | 0.348 | 0.053 | 0.102 | 2.71 | 0.904 | 0.180 | 1637 | 133 | 86 | 39 | 3441 | 30 | 11.7 | 5256 | 0.4 | 3933 | 14 | 30 | 103 |
| 6, 22nd Aldrich | NUMBER | 13 | 10 | 10 | 12 | 10 | 12 | 13 | 13 | 13 | 13 | 9 | 10 | 10 | 13 | 11 | 4 | 12 | 12 | 12 |
| 6, 22nd Aldrich | COV | 0.835 | 0.542 | 0.895 | 0.826 | 0.745 | 0.748 | 3.59 | 2.23 | 0.768 | 0.777 | 2.87 | 1.47 | 1.21 | 3.44 | 0.062 | 0.812 | 0.546 | 0.741 | 0.895 |
| 7, 14th Park | MEAN (geometric) | 0.170 | 0.038 | 0.049 | 1.33 | 0.621 | 0.293 | 5 | 21 | 50 | 19 | 68 | 6 | 5.43 | 92 | 7.0 | 355 | 20 | 8 | 66 |
| 7, 14th Park | MEAN (arithmetic) | 0.206 | 0.043 | 0.062 | 1.81 | 0.801 | 0.350 | 340 | 29 | 64 | 23 | 765 | 11 | 7.69 | 1146 | 7.0 | 545 | 22 | 9 | 84 |
| 7, 14th Park | MAX | 0.523 | 0.080 | 0.190 | 5.25 | 1.97 | 0.725 | 5025 | 144 | 185 | 56 | 8579 | 38 | 33.5 | 16190 | 8.4 | 1515 | 45 | 17 | 225 |
| 7, 14th Park | MIN | 0.066 | 0.021 | 0.023 | 0.250 | 0.125 | 0.105 | 1 | 8 | 15 | 6 | 9 | 1 | 2.50 | 29 | 6.3 | 179 | 9 | 3 | 28 |
| 7, 14th Park | MEDIAN | 0.187 | 0.033 | 0.039 | 1.45 | 0.650 | 0.348 | 3 | 16 | 40 | 17 | 49 | 7 | 5.90 | 67 | 6.9 | 242 | 20 | 8 | 55 |
| 7, 14th Park | STDEV | 0.131 | 0.022 | 0.053 | 1.39 | 0.527 | 0.203 | 1296 | 34 | 48 | 15 | 2461 | 12 | 8.43 | 4162 | 0.6 | 648 | 10 | 5 | 62 |
| 7, 14th Park | NUMBER | 16 | 13 | 13 | 15 | 13 | 15 | 15 | 15 | 16 | 16 | 12 | 13 | 13 | 15 | 14 | 4 | 15 | 15 | 15 |
| 7, 14th Park | COV | 0.637 | 0.510 | 0.862 | 0.766 | 0.658 | 0.580 | 3.82 | 1.17 | 0.758 | 0.660 | 3.22 | 1.06 | 1.10 | 3.63 | 0.088 | 1.19 | 0.468 | 0.496 | 0.741 |
| 8, Pershing | MEAN (geometric) | 0.228 | 0.084 | 0.072 | 1.17 | 0.629 | 0.157 | 2 | 25 | 34 | 14 | 22 | 3 | 4.13 | 63 | 6.9 | 201 | 12 | 2 | 13 |
| 8, Pershing | MEAN (arithmetic) | 0.276 | 0.114 | 0.144 | 1.62 | 0.763 | 0.238 | 3 | 28 | 35 | 15 | 35 | 7 | 4.59 | 72 | 7.0 | 201 | 13 | 2 | 14 |
| 8, Pershing | MAX | 1.07 | 0.444 | 0.798 | 5.18 | 2.09 | 0.630 | 15 | 80 | 50 | 28 | 118 | 46 | 7.42 | 218 | 7.4 | 201 | 24 | 4 | 35 |
| 8, Pershing | MIN | 0.094 | 0.031 | 0.005 | 0.250 | 0.125 | 0.015 | 1 | 16 | 16 | 6 | 3 | 1 | 2.50 | 28 | 6.4 | 201 | 7 | 1 | 10 |
| 8, Pershing | MEDIAN | 0.224 | 0.089 | 0.091 | 1.32 | 0.630 | 0.181 | 1 | 24 | 33 | 14 | 20 | 3 | 5.41 | 62 | 7.0 | 201 | 13 | 2 | 10 |
| 8, Pershing | STDEV | 0.234 | 0.112 | 0.206 | 1.36 | 0.508 | 0.177 | 4 | 17 | 10 | 6 | 38 | 13 | 2.09 | 46 | 0.4 | NA | 4 | 1 | 9 |
| 8, Pershing | NUMBER | 15 | 13 | 13 | 15 | 14 | 14 | 15 | 15 | 15 | 15 | 12 | 11 | 13 | 15 | 12 | 1 | 14 | 14 | 14 |
| 8, Pershing | COV | 0.847 | 0.978 | 1.43 | 0.843 | 0.665 | 0.744 | 1.39 | 0.595 | 0.289 | 0.407 | 1.07 | 1.81 | 0.456 | 0.642 | 0.052 | NA | 0.337 | 0.430 | 0.618 |
| 9, 61st Lyndale | MEAN (geometric) | 0.224 | 0.037 | 0.059 | 1.16 | 0.545 | 0.379 | 41 | 47 | 79 | 26 | 183 | 7 | 9.89 | 157 | 7.3 | 72 | 21 | 5 | 80 |
| 9, 61st Lyndale | MEAN (arithmetic) | 0.261 | 0.042 | 0.076 | 1.97 | 0.643 | 0.498 | 820 | 64 | 117 | 37 | 1702 | 11 | 13.6 | 167 | 7.4 | 574 | 24 | 7 | 105 |
| 9, 61st Lyndale | MAX | 0.499 | 0.116 | 0.192 | 9.69 | 1.44 | 1.19 | 6785 | 232 | 384 | 111 | 11836 | 33 | 45.7 | 247 | 10.3 | 2613 | 54 | 17 | 280 |
| 9, 61st Lyndale | MIN | 0.091 | 0.018 | 0.018 | 0.250 | 0.125 | 0.064 | 5 | 20 | 16 | 8 | 37 | 1 | 2.50 | 92 | 6.2 | 7 | 12 | 1 | 30 |
| 9, 61st Lyndale | MEDIAN | 0.211 | 0.040 | 0.060 | 1.19 | 0.484 | 0.433 | 23 | 40 | 66 | 22 | 113 | 7 | 9.61 | 167 | 6.9 | 47 | 18 | 4 | 64 |
| 9, 61st Lyndale | STDEV | 0.147 | 0.026 | 0.058 | 2.44 | 0.369 | 0.326 | 2079 | 66 | 113 | 34 | 3859 | 10 | 13.4 | 58 | 1.3 | 1142 | 15 | 6 | 85 |
| 9, 61st Lyndale | NUMBER | 14 | 12 | 12 | 14 | 12 | 14 | 14 | 14 | 14 | 14 | 12 | 12 | 12 | 12 | 12 | 5 | 14 | 14 | 14 |
| 9, 61st Lyndale | COV | 0.562 | 0.626 | 0.768 | 1.24 | 0.575 | 0.655 | 2.54 | 1.03 | 0.965 | 0.912 | 2.27 | 0.925 | 0.981 | 0.349 | 0.176 | 1.99 | 0.611 | 0.787 | 0.812 |
| All | MEAN (geometric) | 0.229 | 0.055 | 0.065 | 1.44 | 0.664 | 0.228 | 5 | 28 | 57 | 22 | 69 | 6 | 6.11 | 95 | 7.0 | 292 | 18 | 7 | 49 |
| All | MEAN (arithmetic) | 0.284 | 0.074 | 0.099 | 2.11 | 0.836 | 0.335 | 396 | 44 | 80 | 30 | 907 | 12 | 8.75 | 729 | 7.1 | 1759 | 21 | 14 | 78 |
| All | MAX | 1.46 | 0.444 | 0.798 | 10.5 | 2.90 | 1.19 | 6785 | 500 | 384 | 144 | 11836 | 98 | 45.7 | 19020 | 10.3 | 9208 | 56 | 98 | 358 |
| All | MIN | 0.066 | 0.017 | 0.005 | 0.250 | 0.125 | 0.015 | 1 | 8 | 15 | 6 | 3 | 1 | 2.50 | 28 | 6.2 | 7 | 7 | 1 | 10 |
| All | MEDIAN | 0.235 | 0.050 | 0.065 | 1.59 | 0.666 | 0.348 | 2 | 24 | 47 | 20 | 49 | 6 | 5.92 | 74 | 6.9 | 215 | 17 | 6 | 54 |
| All | STDEV | 0.233 | 0.071 | 0.125 | 2.06 | 0.604 | 0.249 | 1444 | 74 | 79 | 29 | 2792 | 18 | 9.94 | 3320 | 0.8 | 2859 | 12 | 21 | 81 |
| All | NUMBER | 58 | 48 | 48 | 56 | 49 | 55 | 57 | 57 | 58 | 58 | 45 | 46 | 48 | 55 | 49 | 14 | 55 | 55 | 55 |
| All | COV | 0.818 | 0.971 | 1.26 | 0.973 | 0.723 | 0.741 | 3.65 | 1.67 | 0.991 | 0.938 | 3.08 | 1.42 | 1.14 | 4.55 | 0.111 | 1.63 | 0.578 | 1.49 | 1.03 |

### *Mean Comparison*

The 2017 MPRB mean data are shown in **Table 14-11** along with urban stormwater data from other studies. These studies include the Nationwide Urban Runoff Program (NURP, USEPA 1996), Center for Watershed Protection (CWP, 2000), the Monroe study area by Bannerman *et al.* (1993), stormwater studies done by Minneapolis public works (1992), St. Paul (1994), and the MPRB (2001-2016).

Data set from MPRB Sites 1–5a (2001–2004) and 6–9 (2005–2016) were partially similar to Sites 6–9 in 2017. The MPRB 2017 mean TP, TDP, NO3NO2, NH3, TSS, and Pb were lower when compared to the 2001-2016 mean data. The 2017 mean increase in Cl and TDS are likely related to the timing of when snowmelt samples were taken. The 2007 mean Pb was significantly lower when compared to all other studies. The exact cause for this 2017 mean Pb decrease is welcome but unknown. Overall, the MPRB mean stormwater data are comparable to the five-other urban stormwater studies.

***Table 14-11. Typical Mean urban stormwater concentrations. " -- " = not reported.***

| Parameter | NURP | CWP | Bannerman et al. | Mpls PW | St. Paul | MPRB 2001–2016 | MPRB 2017 |
|---|---|---|---|---|---|---|---|
| TP (mg/L) | 0.5 | 0.3 | 0.66 | 0.417 | 0.484 | 0.443 | 0.284 |
| TDP (mg/L) | -- | -- | 0.27 | 0.251 | -- | 0.144 | 0.074 |
| TKN (mg/L) | 2.3 | -- | -- | -- | 2.46 | 2.73 | 2.38 |
| $NO_3NO_2$ (mg/L) | 0.86 | -- | -- | -- | 0.362 | 0.584 | 0.361 |
| $NH_3$ (mg/L) | -- | -- | -- | 0.234 | -- | 0.584 | 0.361 |
| Cl (mg/L) | -- | 230 (winter) | -- | -- | -- | 284 | 682 |
| BOD (mg/L) | 12 | -- | -- | 14.9 | 25 | 16 | 15 |
| TDS (mg/L) | -- | -- | -- | 73.3 | 78 | 546 | 928 |
| TSS (mg/L) | 239 | 80 | 262 | 77.6 | 129 | 121 | 80 |
| Cu (µg/L) | 50 | 10 | 16 | 26.7 | 30 | 23.6 | 20.9 |
| Pb (µg/L) | 240 | 18 | 32 | 75.5 | 233 | 22.5 | 13.8 |
| Zn (µg/L) | 350 | 140 | 204 | 148 | 194 | 115 | 95 |

### *Flow-weighted Mean Comparison*

The flow-weighted comparison removes the variability of dilution and is a more accurate comparison. Flow-weighted mean concentrations for Cl and TDS were difficult to estimate using FLUX32 due to large outliers from the snowmelt samples; therefore, these estimates should be used with caution. When samples were below the reporting limit, half of the reporting limit was used for calculations. The flow-weighted mean concentrations presented in **Table 14-12** were calculated using FLUX32. Sample chemistry concentrations and associated daily average flows were used as inputs for these calculations. The data were run unstratified and stratified by flow or month to achieve the lowest coefficient of variation, producing the most accurate and precise results. The methods (2 or 6) event mean concentration with the lowest coefficient of variation was almost always chosen as the final concentration value. If a statistical anomaly occurred in Flux32, where the lowest coefficient of variation was an obvious and extreme outlier, then the next value was chosen.

*Table 14-12. 2017 flow-weighted mean concentrations and related statistics. Flow-weighted mean concentrations for Cl and TDS were difficult to estimate using FLUX32 due to large outliers from the two snowmelt samples; these estimates should be used with caution. STANDEV= standard deviation. Blue highlighted data are the highest and orange highlighted data are the lowest.*

| Site | TP (mg/L) | TDP (mg/L) | Ortho-P (mg/L) | TKN (mg/L) | $NH_3$ (mg/L) | $NO_3NO_2$ (mg/L) | Cl* (mg/L) | Hardness (mg/L) | TSS (mg/L) | VSS (mg/L) | TDS* (mg/L) | cBOD (mg/L) | Sulfate (mg/L) | Cu (mg/L) | Pb (mg/L) | Zn (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6, 22nd Aldrich | 0.163 | 0.065 | 0.073 | 2.23 | 0.779 | 0.309 | 2 | 21 | 73 | 40 | 42 | 7 | 4.0 | 0.018 | 0.035 | 0.068 |
| 7, 14th Park | 0.212 | 0.043 | 0.052 | 1.63 | 0.723 | 0.331 | 3 | 18 | 107 | 24 | 42 | 5 | 3.7 | 0.017 | 0.007 | 0.053 |
| 8a, Pershing | 0.191 | 0.085 | 0.092 | 0.962 | 0.668 | 0.235 | 1 | 21 | 35 | 13 | 19 | 3 | 4.0 | 0.012 | 0.002 | 0.011 |
| 9, 61st Lyndale | 0.255 | 0.046 | 0.067 | 0.940 | 0.471 | 0.502 | 22 | 34 | 115 | 35 | 92 | 8 | 8.0 | 0.022 | 0.005 | 0.097 |
| **MEAN** | **0.205** | **0.060** | **0.071** | **1.44** | **0.660** | **0.344** | **7** | **23** | **83** | **28** | **49** | **6** | **4.9** | **0.017** | **0.012** | **0.057** |
| **MEDIAN** | **0.202** | **0.056** | **0.070** | **1.30** | **0.696** | **0.320** | **2** | **21** | **90** | **30** | **42** | **6** | **4.0** | **0.018** | **0.006** | **0.061** |
| **STANDEV** | **0.039** | **0.020** | **0.017** | **0.616** | **0.134** | **0.113** | **10** | **7** | **37** | **12** | **31** | **2** | **2.1** | **0.004** | **0.015** | **0.036** |

Site 6 (22nd and Aldrich) has a multi-family residential watershed. Site 6 had the highest modeled concentrations of TKN, $NH_3$, VSS, TDS (tied), cBOD, Sulfate, and Pb. Site 6 had the lowest modeled concentration of TP. It is hypothesized that this may be due to its location between two heavily traveled thoroughfares (Hennepin and Lyndale) where a mature dense leaf canopy may collect airborne material and deposit it following precipitation. The decaying leaf litter may be the cause of the increased nitrogen and cBOD.

Site 7 (14th and Park) has a densely developed mixed use watershed. Site 7 had the highest TDS (tied) modeled parameter. Site 7 had the lowest modeled TDP, Ortho-P, and Sulfate. These are all likely due to the dense, highly developed, and low vegetation nature of the watershed.

Site 8a (Pershing) has a parkland watershed. Site 8a had the highest TDP and Ortho-P modeled event mean concentrations. Site 8a had the lowest modeled $NO_3NO_2$, Cl, TSS, VSS, TDS, cBOD. This is likely due to the more natural vegetative state of the watershed and an absence of street runoff.

Site 9 (61st and Lyndale) has a commercial/industrial watershed. Site 9 had the highest modeled concentration of TP, $NO_3NO_2$, Cl, Hardness, TSS, Cu, and Zn. Site 9 had the of the lowest modeled event mean concentrations of TKN and $NH_3$. Industrial activities in this watershed likely explain the higher pollutant loads. Site 9 is located adjacent to a large cement aggregate mixing facility which may explain the higher TSS values. This site sometimes had a very small baseflow.

**Table 14-13** includes flow-weighted mean pollutant concentrations of data collected in the 1980s and reported by the U.S. Geological Survey (USGS) for various sites within the Twin Cities (as cited in MPCA, 2000). The Yates watershed was a stabilized residential area, the Iverson site was a residential watershed under development, and the Sandberg watershed was predominantly a light industrial land use area, as reported by the USGS. Site 6 (22nd and Aldrich) is more closely related to the Yates residential watershed land use characteristics and is shaded blue in the table. Site 7 (14th and Park) and

Site 9 (61st and Lyndale) are more comparable to the Sandberg light industrial watershed land use characteristics and is shaded orange in the table.

*Table 14-13. 2017 flow-weighted mean stormwater pollutant concentrations (mg/L) and ranges as reported by the USGS (as cited in MPCA, 2000).*

| Pollutant (Range) | Yates area (stabilized residential) | Site 6 (22nd Aldrich) | Iverson area (developing residential) | Sandburg area (light industrial) | Site 7 (14th Park) | Site 9 (61st Lyndale) |
|---|---|---|---|---|---|---|
| **TSS** | 133 (2 – 758) | 73 (21 – 334) | 740 (17-26,610) | 337 (7 – 4,388) | 107 (15 – 185) | 115 (15 – 384) |
| **Pb** | 0.23 (0.015 –1.8) | 0.035 (0.003 -0.098) | 0.02 (0.008-0.31) | 0.19 (0.003 –1.5) | 0.007 (0.003 – 0.017) | 0.005 (0.001 – 0.098) |
| **Zn** | 0.198 (0.02 – 2.2) | 0.068 (0.038 -0.358) | 0.235 (0.028-0.53) | 0.185 (0.02 –0.81) | 0.053 (0.028 – 0.225) | 0.097 (0.010 – 0.358) |
| **TKN** | 3.6 (0.6 – 28.6) | 2.23 (0.898 – 10.5) | 1.2 (1.0 – 29.2) | 2.5 (0.4 – 16.0) | 1.63 (0.250 – 5.25) | 0.940 (0.250 – 10.5) |
| **TP** | 0.63 (0.10 –3.85) | 0.163 (0.153 – 1.46) | 0.62 (0.2 – 13.1) | 0.63 (0.07 – 4.3) | 0.212 (0.066 – 0.523) | 0.255 (0.066 – 1.46) |

When comparing the USGS flow-weighted mean concentrations to the MPRB sites in **Table 14-13**, Site 6 (22nd and Aldrich) was significantly lower than Yates for all parameters. The Iverson data are shown only for comparison purposes of a developing residential neighborhood.

Compared to Sandberg, Sites 7 and 9 have lower flow-weighted mean concentrations for all parameters and are well within the ranges shown in **Table 14-13**. Site 7 (14th and Park) had significantly lower values than Sandberg for all parameters. Site 9 (61st and Lyndale) had roughly half (or lower) of the Sandberg values.

The overall flow-weighted mean comparison of **Table 14-13** to MPRB water quality values at sites 6, 7, and 9 shows that the Minneapolis sites were the same or roughly half of the values for the compared parameters. The Minneapolis mean Pb values are much lower than the Yates and Sandburg studies.

**Table 14-14** shows the flow-weighted mean concentrations in 2017 compared to 2005 through 2016 flow-weighted mean concentrations. Many parameters have decreasing concentration for this time period: TP, TDP, TKN, $NO_2NO_3$, Hardness, TSS, TDS, Sulfate, Cu, Pb, and Zn.

***Table 14-14. MPRB flow-weighted mean concentration compared to previous years. Each year is the average flow-weighted mean concentration of all sites monitored that year. ND = data not collected. NA= data not analyzed for.***

| Parameter | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TP (mg/L) | 0.354 | 0.548 | 0.472 | 0.486 | 0.583 | 0.341 | 0.355 | 0.368 | 0.369 | 0.313 | 0.337 | 0.297 | 0.205 |
| TDP (mg/L) | 0.123 | 0.135 | 0.108 | 0.139 | 0.249 | 0.063 | 0.126 | 0.123 | 0.157 | 0.121 | 0.089 | 0.088 | 0.060 |
| Ortho-P (mg/L) | ND | ND | ND | ND | ND | ND | 0.179 | 0.097 | 0.194 | 0.129 | 0.109 | 0.093 | 0.071 |
| TKN (mg/L) | 3.48 | 3.54 | 4.43 | 3.22 | 3.61 | 1.53 | 1.74 | 2.00 | 2.34 | 2.40 | 1.68 | 1.72 | 1.44 |
| $NH_3$(mg/L) | 1.74 | 1.64 | 0.970 | 0.966 | 1.64 | 0.666 | 0.922 | 0.719 | 0.747 | 1.00 | 0.262 | 0.430 | 0.660 |
| $NO_3NO_2$ (mg/L) | 0.448 | 0.638 | 0.496 | 0.582 | 0.755 | 0.414 | 0.498 | 0.397 | 0.402 | 0.937 | 0.396 | 0.290 | 0.344 |
| Cl (mg/L) | 18 | 91 | 412 | 139 | 803 | 60 | 213 | 14 | 72 | 205 | 229 | 12 | 7 |
| Hardness (mg/L) | NA | ND | ND | ND | ND | NA | 48.0 | 37 | 41 | 41 | 30 | 32 | 23 |
| TSS (mg/L) | 108 | 156 | 180 | 148 | 121 | 107 | 104 | 101 | 95 | 123 | 87 | 90 | 83 |
| VSS (mg/L) | ND | ND | ND | ND | ND | ND | 30 | 31 | 29 | 34 | 31 | 32 | 28 |
| TDS (mg/L) | 252 | 183 | 737 | 507 | 3323 | 124 | 693 | 97 | 301 | 359 | 59 | 62 | 49 |
| cBOD (mg/L) | 9 | 9 | 17 | 25 | 53 | 7 | 11 | 13 | 13 | 10 | 8 | 7 | 6 |
| Sulfate (mg/L) | ND | ND | ND | ND | ND | ND | 15 | 18 | 8 | 7 | 6 | 6 | 5 |
| Cd (µg/L) | 2.50 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Cu (µg/L) | 19 | 29 | 36 | 16 | 40 | 23 | 25 | 16 | 19 | 13 | 8 | 9 | 17 |
| Pb (µg/L) | 41 | 31 | 34 | 28 | 23 | 24 | 18 | 15 | 22 | 16 | 8 | 13 | 12 |
| Zn (µg/L) | 86 | 94 | 133 | 132 | 204 | 100 | 103 | 90 | 79 | 68 | 62 | 58 | 57 |

**Note:** Cadmium (Cd) was discontinued from monitoring in 2006 because Cd concentrations had typically been below detection for the Minneapolis/St. Paul area and it was not useful information. It should also be noted the detection limit for Cd has changed over time. In 2002 it was <0.500 µg/L; in 2003 it was <2.00 µg/L and in 2004 it was <5.00 µg/L. In 2011, ortho-P (or TDP), hardness (for metals toxicity calculations), and sulfate were added.

Chemical concentrations in stormwater are highly variable. Climatological factors such as precipitation amount and intensity, or physical factors like street sweeping type and frequency, BMP maintenance frequency can cause fluctuations in chemical concentrations. **Table 14-14** illustrates the variability of stormwater from year to year.

The variability from year to year is likely due to three causes. In 2005 two sites were different than monitored in subsequent years. The timing between street sweeping, BMP maintenance, and the storms sampled probably affect variability within the monitoring year and between years. Also, precipitation frequency, intensity, and duration also affect results.

## Best Management Practices Monitoring Results

Best management practices (BMPs) include procedures and structures designed to help reduce pollutants in stormwater runoff. The City and the MPRB carry out BMP monitoring as part of the effort to determine and improve system/BMP effectiveness through adaptive management.

In 2017, baseline monitoring was continued with multiple BMP projects. These included:

Lowry Sand Filter.

Winter Infiltration Basin.

24th & Elm Infiltration Chamber.

## Background

Best management practices (BMPs) include procedures and structures designed to help reduce water pollution through good housekeeping practices like street sweeping. Monitoring of BMPs in Minneapolis is done as a part of the NPDES MS4 stormwater permit activities (permit #MN0061018).

### *Lowry Sand Filter*

The Lowry Sand Filter (LSF) is a large underground BMP (Best Management Practice) used to treat stormwater, **Figure 14-2**. The tributary area is 120.5 acres and the majority land uses are residential (66%) and industrial/commercial (22%). Stormwater from the watershed in a 30 inch RCP pipe under Lowry Ave. and is diverted by a flow splitter weir to shunt water to the LSF 15 inch inlet RCP pipe, **Figure 14-3**. The structure has three chambers: a sedimentation chamber, a sand filtration chamber, and a discharge chamber. The purpose of this study is to measure the efficacy of the LSF at removing solids and large particle pollutants.

The LSF sedimentation chamber dimensions are 40 feet by 40 feet with a standing 3 foot water depth. The LSF sand filter chamber dimensions are 40 feet by 52 feet. The base of the sand filter chamber consists of five rows of perforated 6 inch PVC pipes to carry away filtered stormwater to the 15 inch outlet RCP to the Mississippi River. On top of the PVC pipes is a 10 inch layer of filter aggregate covered with filter fabric. On top of that is a bed of 22 to 25 inches of sand. The discharge chamber is 40 feet long and 6 feet wide. There is an internal bypass weir that maintains a 4 foot depth of stormwater to infiltrate through the sand filter bed. Once water depth exceeds 4 feet, it bypass's over the internal weir directly to the outlet. The sand filter is designed to drain within 40 hours of rainfall. If the sand filter bed should become plugged there is a bypass valve and pipe assembly that can be opened to drain standing water from the sand bed. The maintenance manual states that cleaning and maintenance activity is to occur every 3 to 5 years. It was designed by SRF Engineering and constructed in 2012 with Hennepin County Public Works overseeing construction.

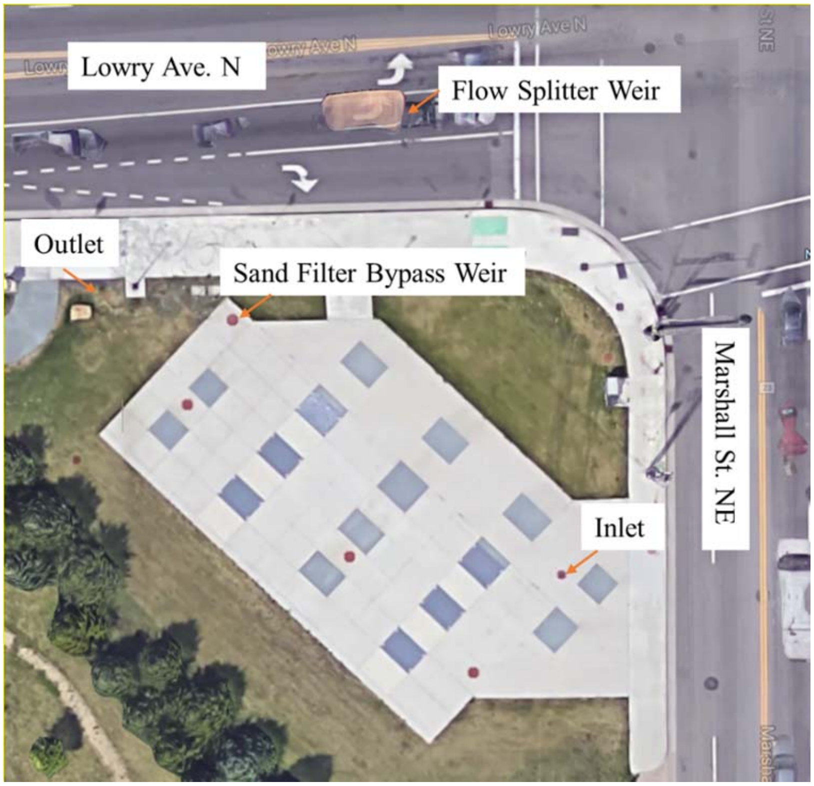



***Figure 14-2. Aerial photo of The Lowry Sand Filter with the flow splitter weir, inlet, sand filter bypass weir, and outlet.***


***Figure 14-3. Downstream Photo of the flow splitter weir to the Lowry Sand Filter.***

*Methods*

### Site Installation

Equipment needed to be installed at the flow splitter weir, inlet, sand filter bypass weir, and outlet. In 2017, the sampling equipment could not be installed at the splitter weir, inlet, or sand filter bypass weir due to deep standing water in the LSF which backed up water through the inlet to the flow splitter weir. Equipment was installed at the outlet on 5/9/17 and was removed on 10/2/17. Eye bolts were installed to hang equipment at the inlet and the sand filter bypass weir on 6/27/17, but equipment could not be installed due to deep standing water in the LSF. No eye bolts or equipment were installed at the flow splitter weir due to pipe-full conditions upstream of the weir. The flow splitter weir in the Lowry Avenue turn lane was extremely busy and required significant traffic control measures to safely open the manhole.

Monitoring equipment at the outlet site included an ISCO 2150 datalogger, 2105ci interface module cell phone modem, a low-profile AV probe, and a 3700 ISCO sampler. Equipment at the outlet was hung from eye-bolts below grade at the access manhole. The datalogger used the cell phone modem to upload data to a database server Monday through Friday. The datalogger could also be remotely called up and programmed to turn samplers on or off, and adjust the level, pacing, or triggers.

### Sample Collection

The LSF was plugged, a full equipment set up could not be installed, therefore there was no sample collection in 2017. When the LSF is cleaned and functioning, the inlet, bypass, and outlet will be metered, and the samplers will be flow-paced and multiplexed.

## RESULTS & DISCUSSION

## Sample Collection

In 2017, there were no samples collected, therefore there are no chemistry data. The outlet was metered, and the stage and discharge are shown in **Figure 14-4**. Only the storm on May 17$^{th}$, 2017 had a pipe full condition, all others were below 15 inches of flow in the outlet pipe.

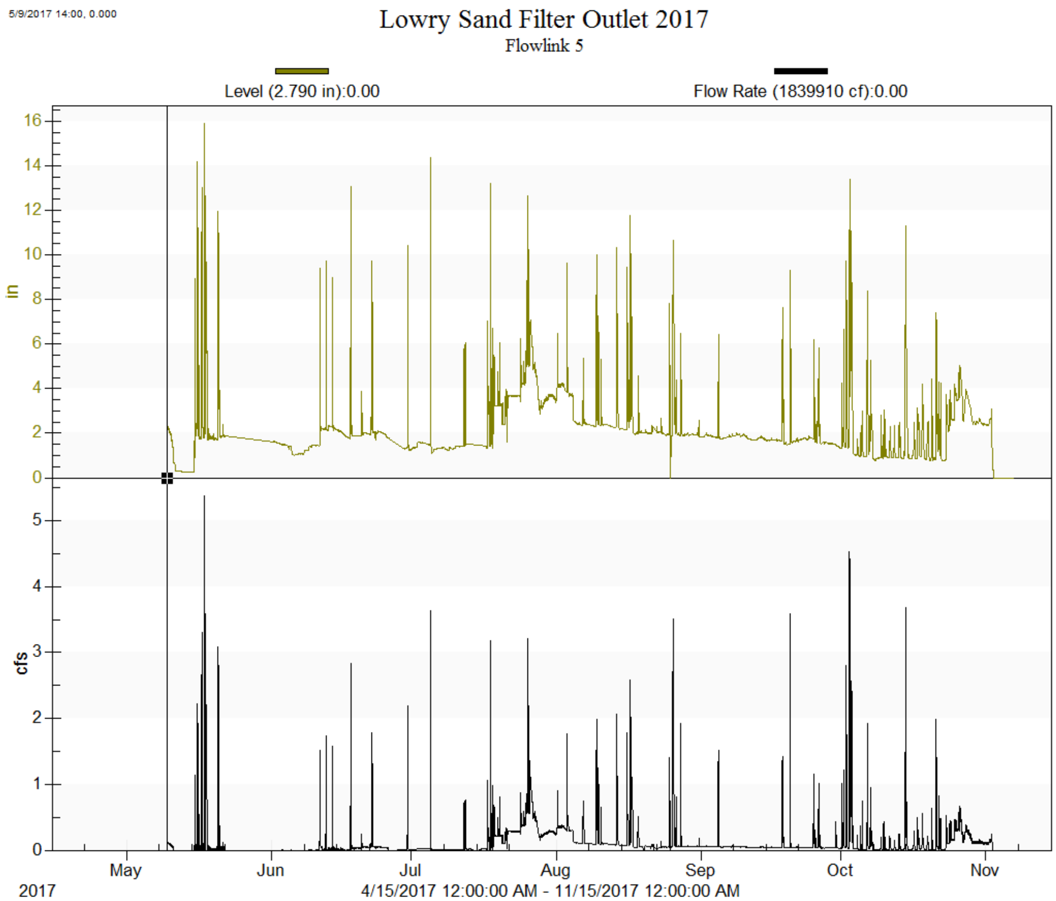



***Figure 14-4. 2017 Lowry Sand Filter outlet stage and discharge for the period of record.***

## Conclusion

In conclusion, the Lowry Sand Filter is plugged. Equipment cannot be installed until it is cleaned and maintained. When the BMP is functioning, it will be thoroughly monitored for its ability to filter and treat stormwater. The sand filter is currently scheduled to be cleaned in 2018.

## Winter Infiltration Basin

### BACKGROUND

The Winter Infiltration Basin (WIB) Best Management Practice (BMP) was built to infiltrate and treat stormwater from the surrounding neighborhood, **Figure 14-5**. It was built in 2015 by Meyer Contracting Inc. The total drainage area the WIB treats is 31.32 acres. The west inlet drains 1.17 acres and the major land use in this drainage area is 51% industrial and 27% residential. The south inlet drains 30.15 acres and the major land use is 57% industrial and 20% residential in this drainage area. The south inlet has hydrodynamic separator to help remove solids prior to discharging into the WIB. If the outlet discharges under large or intense storms, the water goes to the Mississippi River.

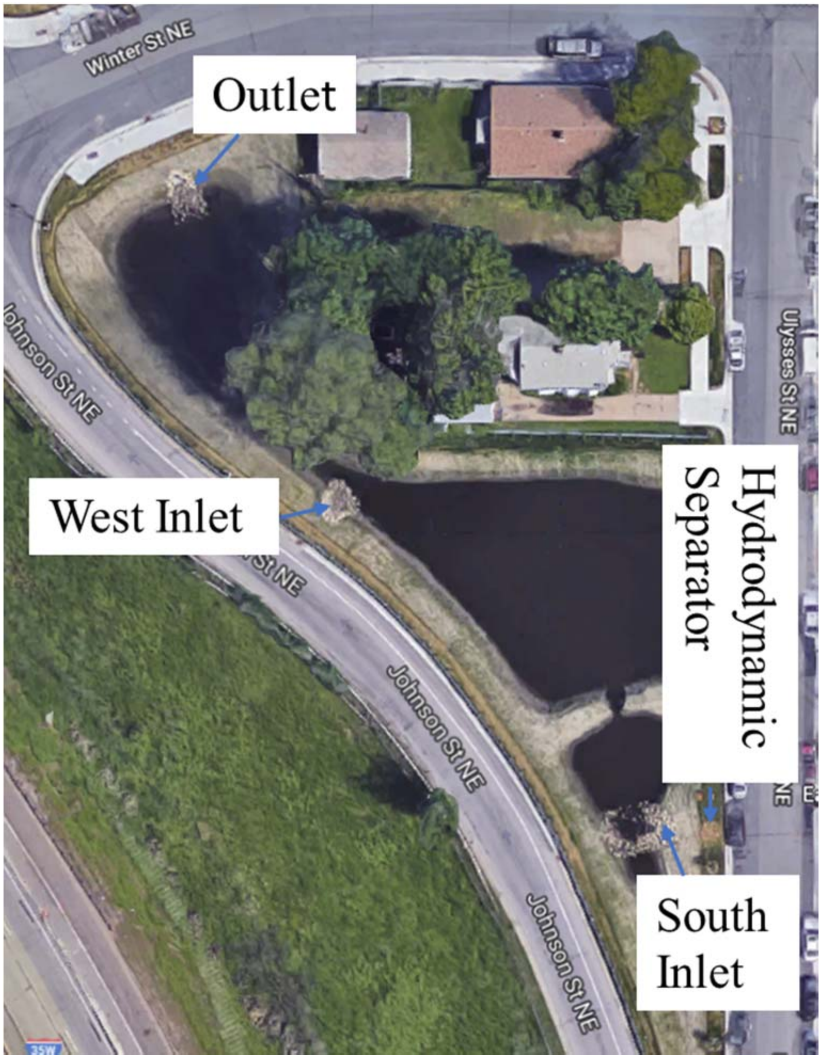



***Figure 14-5. Aerial photo of the Winter Infiltration Basin. It has two inlets and one outlet.***

## Methods

### *Site Installation*

In 2017, equipment at the west inlet and at the outlet was installed on 6/5/17 and equipment at the south inlet was installed on 6/6/17. The WIB west inlet is a 12 inch RCP pipe, the south inlet is a 24 inch RCP pipe, and the outlet is a 20 inch RCP pipe. All equipment was removed on 11/6/17.

Monitoring equipment at each site included: an ISCO 2150 datalogger, a 2105 interface module, a 2105ci or a 2103ci cell phone modem, an antenna, a low-profile AV probe, and a 3700 ISCO sampler. The AV probes were secured with a stainless steel plate or a stainless steel spring ring. All sites required secure above ground doghouse monitoring boxes and flexible conduit to protect the AV-cable and sampler tubing.

Each datalogger used a cell phone modem to remotely upload data to a Flowlink database server Monday through Friday. All dataloggers could also be remotely called up and programmed to turn samplers on or off, adjust the level, pacing, or triggers.

The samplers were flow-paced and equipped with 24 one-liter bottles, 3/8" ID (inner diameter) vinyl tubing, and an intake strainer. The sampler was programmed to multiplex, taking four flow-paced samples per bottle, allowing for 96 flow-paced samples per storm.

### *Sample Collection*

With all new sites sample collection parameters need to be adjusted from initial assumptions. The west inlet was initially set to trigger at 0.8 inches and initially paced at 10 cubic feet, but the pacing was changed on 6/23/17 to 25 cubic feet. The south inlet was initially set without a trigger and initially paced at 150 cubic feet, but the pacing was changed on 10/16/17 to 300 cubic feet. The outlet was set without a trigger and paced at 100 cubic feet.

## RESULTS & DISCUSSION

### *Sample Collection*

In 2017, twenty events were collected at the west inlet, nine events were collected at the south inlet, and two events were collected at the outlet. The sample bottle containing the composite outlet event of 8/26/17 was cracked and the event sample was lost, **Table 14-15**.

The south inlet delivered most of the water to the WIB. It had a hydrodynamic separator that was either undersized or in need of maintenance, as large amounts of debris were caught in the south inlet trash rack. The debris needed to be cleaned several times to prevent water from backing up the pipe.

***Table 14-15. The 2017 precipitation events captured at Winter Infiltration Basin. The rain gauge was located at the MPRB SSSC at 38th and Bryant Ave. S. A precipitation event was defined as a storm greater than 0.10 inches and separated by eight hours or more from other precipitation. Full = all chemical parameters. Partial = some chemical parameters were not run due to low volume or expired holding times.***

| Start Date | Start Time | End Date | End Time | Rain (inches) | Duration (hours) | Intensity (in/hr.) | Hours since last Rain. | Winter Basin south inlet | Winter Basin west inlet | Winter Basin outlet |
|---|---|---|---|---|---|---|---|---|---|---|
| 6/22/2017 | 5:45 | 6/22/2017 | 15:30 | 0.43 | 9.75 | 0.04 | 47 | - | Full | - |
| 6/28/2017 | 3:00 | 6/28/2017 | 9:15 | 0.61 | 6.25 | 0.10 | 131 | Partial | Full | - |
| 6/30/2017 | 15:00 | 7/1/2017 | 0:15 | 0.44 | 9.25 | 0.05 | 54 | Partial | - | - |
| 7/17/2017 | 21:30 | 7/18/2017 | 18:30 | 1.11 | 21.00 | 0.05 | 405 | - | Full | - |
| 7/19/2017 | 14:45 | 7/19/2017 | 21:45 | 0.27 | 7.00 | 0.04 | 20 | Partial | - | - |
| 7/25/2017 | 17:00 | 7/26/2017 | 7:15 | 1.25 | 14.25 | 0.09 | 139 | Partial | - | - |
| 8/9/2017 | 10:45 | 8/10/2017 | 16:15 | 1.10 | 29.50 | 0.04 | 54 | - | Full | - |
| 8/16/2017 | 2:15 | 8/16/2017 | 6:15 | 0.52 | 4.00 | 0.13 | 50 | - | Full | - |
| 8/16/2017 | 18:30 | 8/17/2017 | 5:15 | 1.44 | 10.75 | 0.13 | 12 | - | Full | - |
| 8/25/2017 | 21:30 | 8/26/2017 | 15:15 | 1.48 | 17.75 | 0.08 | 16 | - | Full | Sample Lost |
| 9/20/2017 | 1:30 | 9/20/2017 | 2:00 | 0.34 | 0.50 | 0.68 | 35 | - | Full | - |
| 9/25/2017 | 1:45 | 9/25/2017 | 9:30 | 0.19 | 7.75 | 0.02 | 120 | - | Partial | - |
| 10/1/2017 | 0:15 | 10/3/2017 | 9:30 | 3.32 | 57.25 | 0.06 | 115 | Partial | Full | Partial |
| 10/6/2017 | 13:15 | 10/7/2017 | 12:00 | 0.46 | 22.75 | 0.02 | 76 | Partial | Partial | - |
| 10/14/2017 | 13:30 | 10/15/2017 | 3:00 | 0.43 | 13.50 | 0.03 | 170 | Partial | Partial | - |
| 10/21/2017 | 6:15 | 10/21/2017 | 20:15 | 0.43 | 14.00 | 0.03 | 147 | Partial | Partial | - |

The two WIB inlets stage and discharge can be seen in **Figure 14-6** and **Figure 14-7**. The WIB outlet stage and discharge can be seen in **Figure 14-8**. The outlet figure shows that the WIB infiltrates most storms. Only large storms greater than 1.44 inches result in the WIB discharging any stormwater.

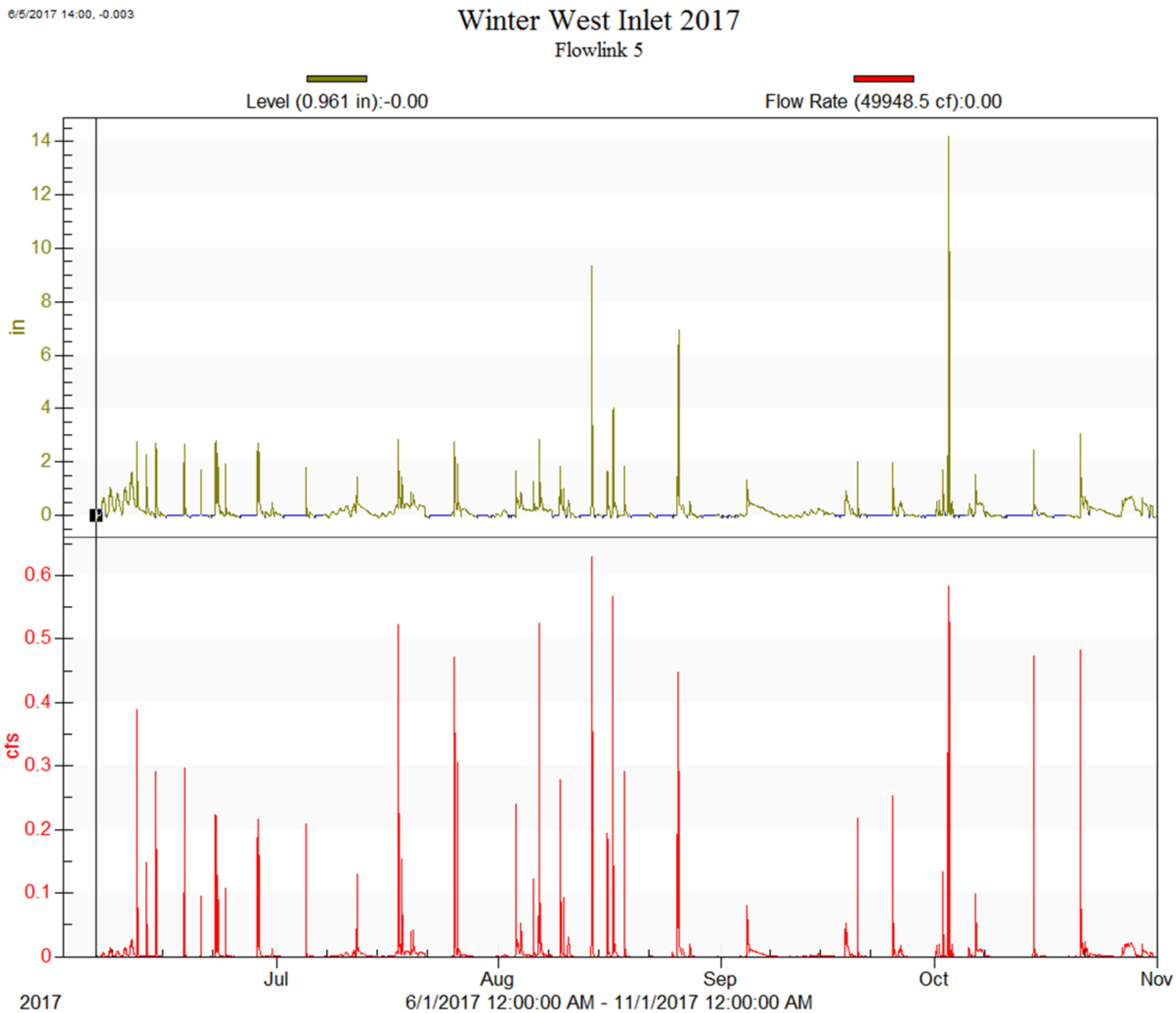



***Figure 14-6. The 2017 winter west inlet stage and discharge.***

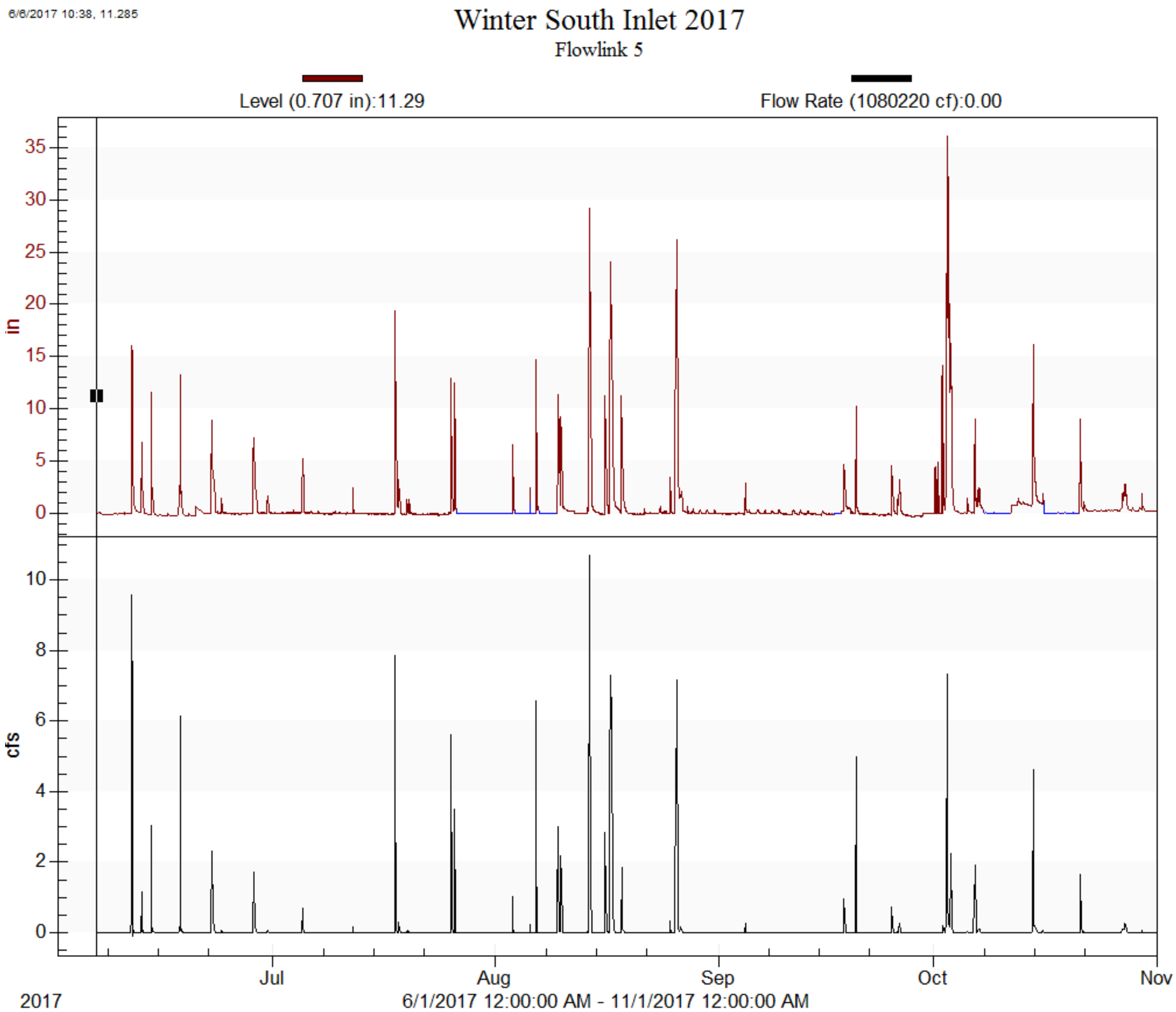



***Figure 14-7. The 2017 winter south inlet stage and discharge.***

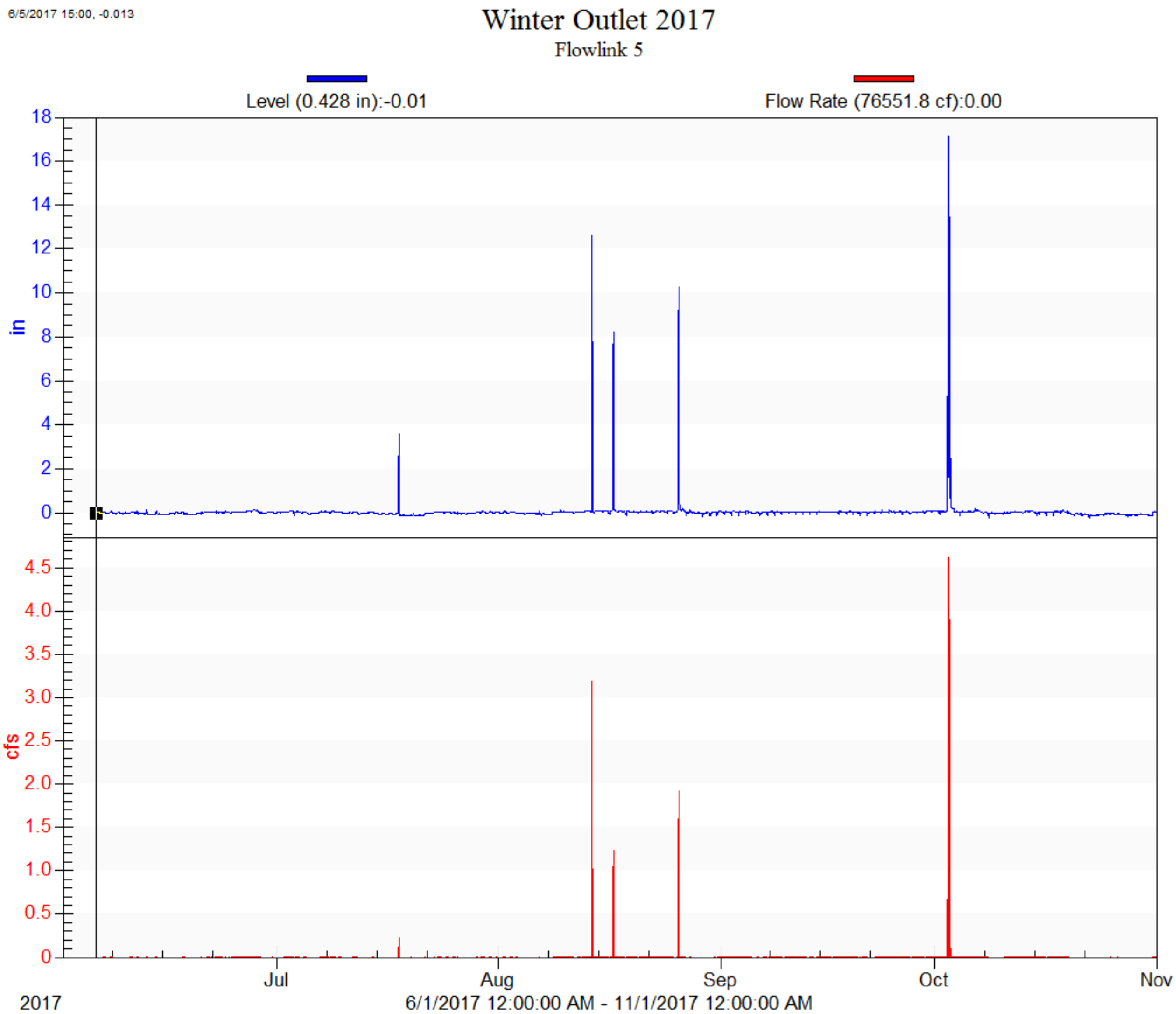



***Figure 14-8. The 2017 winter outlet stage and discharge.***

### *Storm Event Data and Statistics*

**Table 14-16** shows the 2017 Winter Infiltration Basin chemistry data. Some of the events collected were analyzed for limited parameters because of low volume or expired holding times. The south inlet experienced significant software issues in July and August and was unable to collect flow-paced hydrograph samples. New equipment installed was installed 9/29/18 and the south inlet began collecting flow-paced samples. Two outlet storms were collected, and both were of very low volume.

The June sulfate failed the MPRB blind monthly performance standard and the effected sulfate data in **Table 24-2** are marked in bold. It was deemed the data can be used with caution, noting that performance standards were outside the 80-120% recovery standards, **Section 29**, Quality Assurance Assessment Report.

**Table 14-17** shows the 2017 statistics from the Winter Infiltration Basin inlets and outlet. When statistical analysis was performed on the data sets and values below the reporting limit were present, half of the reporting limit was used in the calculations.

The geometric means of inlets vs outlet cannot be compared since the outlet only had one sample. In 2017, the outlet produced only five events, one was captured. The one outlet event that was able to be successfully captured was a very small aliquot and only limited parameters were run.

The south inlet had more pollutants than the west inlet. The majority of the stormwater comes from the south inlet.

***Table 14-16. 2017 Winter Infiltration Basin water chemistry events data. ND = data not available due to expired holding time or low volume. Data that are bold had a blind performance standard failure for that month, for that parameter.***

| Date Sampled | Time | Site Location | Sample Type | TP mg/L | TDP mg/L | OrthoP mg/L | TKN mg/L | NH3 mg/L | NO3NO2 mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µhmos | pH std units | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/28/2017 | 9:30 | Winter Basin In S | Composite | 0.183 | 0.043 | ND | ND | ND | 0.442 | ND | 24 | 48 | 17 | ND | ND | **5** | ND | 7.4 | ND | ND | ND |
| 7/17/2017 | 22:15 | Winter Basin In S | Composite | 0.465 | ND | ND | ND | ND | 0.040 | ND | ND | 113 | 40 | 219 | ND | ND | 332 | ND | ND | ND | ND |
| 9/20/2017 | 3:19 | Winter Basin In S | Composite | 0.340 | ND | ND | ND | ND | 0.412 | ND | ND | 234 | 61 | ND | ND | ND | ND | ND | ND | ND | ND |
| 9/25/2017 | 3:19 | Winter Basin In S | Composite | 0.344 | ND | ND | ND | ND | 0.464 | ND | ND | 254 | 73 | ND | ND | ND | ND | ND | ND | ND | ND |
| 10/1/2017 | 15:39 | Winter Basin In S | Composite | 1.14 | ND | ND | 1.27 | ND | 0.439 | 6.3 | 28 | 25 | 10 | ND | ND | ND | 94 | ND | 18 | 3 | 113 |
| 10/2/2017 | 2:29 | Winter Basin In S | Composite | 1.22 | 0.758 | 0.900 | 0.874 | <0.250 | 0.244 | 9.1 | 22 | 140 | 39 | 45 | <1.00 | 6 | 92 | 6.9 | 45 | 13 | 256 |
| 10/6/2017 | 17:18 | Winter Basin In S | Composite | 0.195 | ND | ND | 0.981 | ND | 0.324 | 2.9 | 22 | 61 | 19 | ND | ND | ND | 67 | ND | 25 | 7 | 142 |
| 10/14/2017 | 20:02 | Winter Basin In S | Composite | 0.248 | ND | ND | 1.04 | ND | 0.270 | 4.9 | 28 | 116 | 35 | ND | ND | ND | 79 | ND | 38 | 12 | 241 |
| 10/21/2017 | 21:24 | Winter Basin In S | Composite | 0.397 | ND | ND | 1.76 | ND | 0.334 | 3.4 | 36 | 168 | 51 | ND | ND | ND | 106 | ND | 37 | 13 | 306 |
| 6/22/2017 | 11:36 | Winter Basin In W | Composite | 0.103 | 0.03 | 0.043 | 1.33 | 0.824 | 0.423 | 5.0 | 20 | 20 | 10 | 53 | 7 | **8** | 71 | 7.2 | 20 | 2 | 69 |
| 6/28/2017 | 7:29 | Winter Basin In W | Composite | 0.096 | 0.046 | 0.034 | 0.590 | 0.353 | 0.193 | 2.2 | 16 | 15 | 8 | 30 | 5 | **5** | 42 | 7.3 | 12 | 2 | 51 |
| 7/17/2017 | 23:30 | Winter Basin In W | Composite | 0.153 | 0.033 | 0.041 | 1.11 | 0.654 | 0.418 | 2.3 | 16 | 20 | 11 | 27 | 5 | 7 | 51 | 6.7 | 17 | 2 | 76 |
| 8/10/2017 | 1:19 | Winter Basin In W | Composite | 0.088 | 0.022 | 0.037 | 0.690 | 0.626 | 0.280 | <2.00 | 12 | 22 | 12 | 28 | 3 | <5.00 | 44 | 6.8 | 19 | 22 | 47 |
| 8/16/2017 | 7:59 | Winter Basin In W | Composite | 0.063 | 0.016 | 0.024 | <0.500 | 0.265 | 0.201 | 2.4 | 10 | 14 | 7 | 20 | 3 | <5.00 | 36 | 6.6 | 16 | 1 | 38 |
| 8/16/2017 | 23:30 | Winter Basin In W | Composite | 0.036 | 0.015 | 0.024 | <0.500 | <0.250 | 0.208 | <2.00 | 6 | 8 | 4 | 10 | <1.00 | <5.00 | 27 | 6.7 | 9 | 1 | 21 |
| 8/26/2017 | 4:23 | Winter Basin In W | Composite | 0.041 | ND | ND | <0.500 | ND | 0.273 | <2.00 | 8 | 5 | 3 | ND | ND | ND | 31 | ND | 8 | 1 | 23 |
| 9/20/2017 | 3:14 | Winter Basin In W | Composite | 0.162 | 0.031 | 0.028 | 1.25 | 0.678 | 0.312 | <2.00 | 10 | 64 | 22 | 23 | 4 | 9 | 56 | 6.4 | 18 | 4 | 104 |
| 9/25/2017 | 3:16 | Winter Basin In W | Composite | 0.201 | ND | ND | 1.50 | ND | 0.697 | 3.8 | 20 | 68 | 27 | ND | ND | ND | 76 | ND | 31 | 6 | 151 |
| 10/2/2017 | 2:20 | Winter Basin In W | Composite | 0.067 | ND | ND | 0.544 | ND | 0.184 | <2.00 | 12 | 22 | 11 | ND | ND | ND | 32 | ND | 11 | 2 | 45 |
| 10/3/2017 | 0:07 | Winter Basin In W | Composite | 0.067 | 0.012 | 0.024 | <0.500 | <0.250 | 0.194 | <2.00 | 10 | 25 | 9 | 10 | <1.00 | <5.00 | 35 | 6.7 | 12 | 2 | 51 |
| 10/6/2017 | 16:59 | Winter Basin In W | Composite | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 18 | 2 | 36 |
| 10/14/2017 | 19:38 | Winter Basin In W | Composite | 0.089 | ND | ND | 0.331 | ND | 0.190 | <2.00 | 8 | 32 | 14 | ND | ND | ND | 29 | ND | 15 | 3 | 66 |
| 10/21/2017 | 7:26 | Winter Basin In W | Composite | 0.185 | ND | ND | 1.28 | ND | 0.752 | 2.5 | 20 | 43 | 23 | ND | ND | ND | 73 | ND | 21 | 3 | 115 |
| 8/26/2017 | 2:31 | Winter Outlet | Composite | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 10/2/2017 | 23:47 | Winter Outlet | Composite | 0.210 | ND | ND | ND | ND | <0.030 | ND | ND | 77 | 26 | ND | ND | ND | ND | ND | ND | ND | ND |

***Table 14-17. 2017 Winter Infiltration Basin data showing statistics for the inlets and outlet. COV=Coefficient of Variation. ND=no data. The outlet only had one sample, so statistics were not able to be calculated. All data below the reporting limit were transformed into half the reporting limit for statistical calculations (e.g. Cl <2 becomes 1).***

| Site ID | Statistical Function | TP mg/L | TDP mg/L | OrthoP mg/L | TKN mg/L | $NH_3$ mg/L | $NO_3NO_2$ mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µhmos | pH std units | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | MEAN (geometric) | 0.400 | 0.181 | 0.900 | 1.15 | ND | 0.280 | 4.9 | 26.3 | 103 | 32 | 100 | ND | 5.5 | 108 | 7.1 | 30.9 | 8.0 | 198 |
| | MEAN (arithmetic) | 0.503 | 0.401 | 0.900 | 1.18 | ND | 0.330 | 5.3 | 26.7 | 129 | 38 | 132 | ND | 5.5 | 128 | 7.1 | 32.5 | 9.4 | 212 |
| | MAX | 1.22 | 0.758 | 0.900 | 1.76 | ND | 0.464 | 9.1 | 36.0 | 254 | 73 | 219 | ND | 5.8 | 332 | 7.4 | 45.0 | 12.9 | 306 |
| **Winter Basin In S** | MIN | 0.183 | 0.043 | 0.900 | 0.874 | ND | 0.040 | 2.9 | 22.0 | 25 | 10 | 45 | ND | 5.3 | 67 | 6.9 | 18.0 | 2.5 | 113 |
| | MEDIAN | 0.344 | 0.401 | 0.900 | 1.04 | ND | 0.334 | 4.9 | 26.0 | 116 | 39 | 132 | ND | 5.5 | 93 | 7.1 | 36.5 | 11.8 | 241 |
| | STDEV | 0.394 | 0.506 | ND | 0.353 | ND | 0.134 | 2.5 | 5.3 | 80 | 21 | 123 | ND | 0.4 | 101 | 0.4 | 10.7 | 4.5 | 81.1 |
| | NUMBER | 9 | 2 | 1 | 5 | 0 | 9 | 5 | 6 | 9 | 9 | 2 | 0 | 2 | 6 | 2 | 5 | 5 | 5 |
| | COV | 0.783 | 1.26 | ND | 0.298 | ND | 0.407 | 0.5 | 0.2 | 1 | 1 | 1 | ND | 0.1 | 1 | 0.1 | 0.3 | 0.5 | 0.4 |
| | MEAN (geometric) | 0.091 | 0.035 | 0.045 | 1.02 | 0.527 | 0.280 | 3.8 | 15.8 | 41 | 17 | 30 | 4 | 6.4 | 60 | 6.9 | 18.6 | 3.4 | 79.4 |
| | MEAN (arithmetic) | 0.104 | 0.101 | 0.128 | 1.08 | 0.567 | 0.318 | 4.2 | 17.6 | 72 | 23 | 47 | 4 | 6.6 | 75 | 6.9 | 21.0 | 5.7 | 108 |
| | MAX | 0.201 | 0.758 | 0.900 | 1.76 | 0.824 | 0.697 | 9.1 | 36.0 | 254 | 73 | 219 | 7 | 8.7 | 332 | 7.4 | 45 | 21.8 | 306 |
| **Winter Basin In W** | MIN | 0.036 | 0.012 | 0.024 | 0.544 | 0.265 | 0.040 | 2.2 | 6.0 | 5 | 3 | 10 | 3 | 4.9 | 27 | 6.4 | 8.1 | 0.66 | 20.7 |
| | MEDIAN | 0.089 | 0.031 | 0.034 | 1.08 | 0.640 | 0.296 | 3.6 | 16.0 | 37 | 15 | 28 | 4 | 6.3 | 56 | 6.8 | 18.2 | 2.3 | 72.3 |
| | STDEV | 0.054 | 0.231 | 0.289 | 0.369 | 0.213 | 0.143 | 2.2 | 8.3 | 75 | 20 | 62 | 2 | 1.5 | 71 | 0.3 | 11.0 | 6.1 | 88.8 |
| | NUMBER | 13 | 10 | 9 | 12 | 6 | 20 | 10 | 17 | 20 | 20 | 10 | 6 | 6 | 17 | 10 | 16 | 16 | 16 |
| | COV | 0.522 | 2.30 | 2.26 | 0.343 | 0.376 | 0.450 | 0.5 | 0.5 | 1 | 1 | 1 | 0 | 0.2 | 1 | 0.0 | 0.5 | 1.1 | 0.8 |
| | MEAN (geometric) | 0.210 | ND | ND | ND | ND | ND | ND | ND | 77 | 26 | ND | ND | ND | ND | ND | ND | ND | ND |
| | MEAN (arithmetic) | 0.210 | ND | ND | ND | ND | ND | ND | ND | 77 | 26 | ND | ND | ND | ND | ND | ND | ND | ND |
| | MAX | 0.210 | ND | ND | ND | ND | ND | ND | ND | 77 | 26 | ND | ND | ND | ND | ND | ND | ND | ND |
| **Winter Outlet** | MIN | 0.210 | ND | ND | ND | ND | ND | ND | ND | 77 | 26 | ND | ND | ND | ND | ND | ND | ND | ND |
| | MEDIAN | 0.210 | ND | ND | ND | ND | ND | ND | ND | 77 | 26 | ND | ND | ND | ND | ND | ND | ND | ND |
| | STDEV | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| | NUMBER | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | COV | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

**Table 14-18** shows the 2017 infiltration volume and load reductions for the WIB. The load calculations used the geometric mean of the chemical parameter as the final concentration. Loads were only calculated where there were data for the inlets and outlet. Only one sample was collected at the outlet. The sample collected from the outlet was from a significant storm, 3.32 inches. When more samples from the outlet are collected it is believed the calculated performance of the WIB would likely improve.

***Table 14-18. Calculates the infiltration and load calculations for the performance of the Winter Infiltration Basin.***

| Site | Total Vol. (L) | TP (Lbs.) | TSS (Lbs.) |
|---|---|---|---|
| Winter Basin In S | 30,588,374 | 27.0 | 6,953 |
| Winter Basin In W | 1,414,368 | 0.28 | 129 |
| Winter Outlet | 2,167,679 | 1.0 | 370 |
| Percent removed | 93% | 96% | 95% |

**Conclusion**

The WIB needs maintenance. Trash appears to be building up inside the trash racks at both inlet outfalls and should be removed. Sand is accumulating by the outfalls and needs to be removed. The hydrodynamic separator at the south inlet may also need to be cleaned.

The challenges at this site were parking for site access/sample collection, determining appropriate pacing for the inlets and outlet, ISCO datalogger software failures, the limited number of outlet events, and paper wasps building nests in the above ground outlet monitoring box.

In conclusion, the WIB appears to infiltrate and treat 100% of the storms under 1.44 inches. The load table (**Table 24-4**) shows the WIB is 90+% effective at infiltration as well as TP and TSS removal. There is a need to collect samples from more storms and larger events to verify the WIB is working. Specifically, more samples need to be collected at the outlet to help determine if resuspension is occurring during large storms.

## 24$^{th}$ & Elm Infiltration Chamber

### BACKGROUND

The 24$^{th}$ & Elm Infiltration Chamber (EIC) (**Figure 14-9)** drains a total of 14.27 acres and was built to infiltrate stormwater from a light industrial and mixed-use watershed**.** The EIC stormwater Best Management Practice (BMP) was constructed in 2016 by the City of Minneapolis Public Works. The EIC was constructed to both treat stormwater by infiltrating it, and to reduce stormwater volume discharging to the Mississippi River. Reducing volume alleviates hydraulic pressure on downstream stormwater conveyance infrastructure.

The EIC is a large cement infiltration box that is open at the bottom to promote infiltration and buried under 24th Ave. SE. The chamber is 12 feet wide, 462 feet long and 10 feet high. The EIC has the unique feature of having the outlet also function as an inlet when hydraulic relief is needed from the downstream Elm Street SE pipe. The BMP has two main inlets: The north inlet is a 36 inch RCP and drained 3.93 acres, and the south inlet is a 36 inch RCP and drained 10.34 acres. Both inlets have hydrodynamic separators pretreat stormwater by removing solids from prior to discharge to the EIC. The outlet and north inlet are the same pipe (36 inch RCP); therefore, dataloggers and samplers were placed at different locations to capture inflow to the EIC and outflow from the EIC through this pipe. Under normal conditions, most of the water entering the EIC infiltrates, but under a large or intense storm it can produce outflow that drains to the Mississippi River via the Elm St. SE pipe.


***Figure 14-9. Aerial photo of 24th & Elm Infiltration Chamber. Blue arrows show the direction of flow.***

## Methods

### *Site Installation*

On 5/8/17, both the north and south inlet monitoring equipment was installed upstream of the hydrodynamic separators. Access to the inlets at 24th & Elm was very tight, **Figure 14-10**. The outlet monitoring equipment was installed on 5/2/17. All equipment was removed on 11/3/17.

Monitoring equipment at each of the sites included: ISCO 2150 datalogger, 2105 interface module, 2103ci cell phone modem or 2015ci combined interface/modem, low-profile AV probe, and a 3700 ISCO sampler. The equipment at the north inlet and outlet was hung from eye-bolts below grade at each access manhole. Installation at the south inlet required a cross hanger due to its shallowness. The datalogger used the cell phone modem to remotely upload data to a MPRB database server from Monday through Friday. The datalogger could also be remotely called up and programmed to turn samplers on or off, adjust the level, pacing, or triggers.

The samplers were flow-paced and equipped with 24 one-liter bottles, 3/8" ID (inner diameter) vinyl tubing, and an intake strainer. The sampler was programmed to multiplex, taking four flow-paced samples per bottle, allowing for 96 flow-paced samples per storm.


***Figure 14-10. Photograph of the 36 inch south inlet at 24th & Elm prior to equipment installation. Note the hydrodynamic separator downstream on the left. The blue arrow shows the direction of flow.***

### *Sample Collection*

With all new sites sample collection, parameters need to be adjusted from initial assumptions. In 2017, both the north and south inlets were set to trigger at 0.80 inches of flow and paced at 150 cubic feet. On 6/22/17, the north inlet pacing was changed to 100 cubic feet. The outlet trigger was initially set for 0.8 inches and paced at 1 cubic foot. On 6/12/17 the outlet pacing was changed to 10 cubic feet.

## RESULTS & DISCUSSION

### *Sample Collection*

Sample collection was difficult for most of the summer due to trucks parking on top of manholes **Figure 14-11**. Requests were made starting May 31st for parking services to install no parking signs in small stretches where access was needed. The no parking signs were finally installed in late September.

***Figure 14-11. Truck parked over the outlet manhole cover at 24th & Elm.***

In 2017, at both the north and south inlets, samples from fourteen events were collected. Four events were sampled at the outlet, as shown in **Table 14-19**. The table shows the start and end dates and times as well as the rain amount, duration, intensity, and the hours since last rain. The largest storm event sampled was on 10/1-3/17 and had 3.32 inches of precipitation.

*Table 14-19. The 2017 precipitation events captured at 24th & Elm Infiltration BMP. The rain gauge was on the roof of the MPRB SSSC, 3800 Bryant Ave. S. Minneapolis, MN. A precipitation event was defined as a storm greater than 0.10 inches and separated by eight hours or more from other precipitation. Full = all chemical parameters run. Partial = some chemical parameters were not run due to low volume or expired holding times. - = storm not sampled.*

| Start Date | Start Time | End Date | End Time | Rain (inches) | Duration (hours) | Intensity (in/hr.) | Hours since last Rain. | 24th & Elm north inlet | 24th & Elm south inlet | 24th & Elm outlet |
|---|---|---|---|---|---|---|---|---|---|---|
| 6/11/2017 | 7:45 | 6/11/2017 | 9:45 | 0.90 | 2.00 | 0.45 | 501 | Partial | Partial | Partial |
| 6/12/2017 | 13:45 | 6/12/2017 | 16:15 | 0.32 | 2.50 | 0.13 | 28 | Full | Full | - |
| 6/22/2017 | 5:45 | 6/22/2017 | 15:30 | 0.43 | 9.75 | 0.04 | 47 | Full | Full | - |
| 6/28/2017 | 3:00 | 6/28/2017 | 9:15 | 0.61 | 6.25 | 0.10 | 131 | Full | Full | - |
| 7/17/2017 | 21:30 | 7/18/2017 | 18:30 | 1.11 | 21.00 | 0.05 | 405 | Partial | - | - |
| 7/19/2017 | 14:45 | 7/19/2017 | 21:45 | 0.27 | 7.00 | 0.04 | 20 | - | Partial | - |
| 7/25/2017 | 17:00 | 7/26/2017 | 7:15 | 1.25 | 14.25 | 0.09 | 139 | Full | Full | Full |
| 8/3/2017 | 5:45 | 8/3/2017 | 23:00 | 0.35 | 17.25 | 0.02 | 191 | - | Full | Partial |
| 8/5/2017 | 16:45 | 8/5/2017 | 17:30 | 0.13 | 0.75 | 0.17 | 42 | Partial | Partial | - |
| 8/6/2017 | 18:00 | 8/7/2017 | 4:45 | 0.09 | 10.75 | 0.01 | 25 | Partial | Partial | Partial |
| 8/25/2017 | 5:00 | 8/25/2017 | 6:00 | 0.13 | 1.00 | 0.13 | 192 | Partial | Partial | - |
| 8/25/2017 | 21:30 | 8/26/2017 | 15:15 | 1.48 | 17.75 | 0.08 | 16 | Partial | Partial | - |
| 9/4/2017 | 15:45 | 9/4/2017 | 16:45 | 0.16 | 1.00 | 0.16 | 192 | Partial | Partial | - |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 9/18/2017 | 3:15 | 9/18/2017 | 14:00 | 0.35 | 10.75 | 0.03 | 323 | Full | - | - |
| 9/20/2017 | 1:30 | 9/20/2017 | 2:00 | 0.34 | 0.50 | 0.68 | 35 | Full | Full | - |
| 9/25/2017 | 1:45 | 9/25/2017 | 9:30 | 0.19 | 7.75 | 0.02 | 120 | Full | Full | - |
| 9/25/2017 | 19:15 | 9/26/2017 | 5:15 | 0.19 | 10.00 | 0.02 | 10 | Partial | Partial | - |
| 10/1/2017 | 0:15 | 10/3/2017 | 9:30 | 3.32 | 57.25 | 0.06 | 115 | Full | Full | Full |
| 10/6/2017 | 13:15 | 10/7/2017 | 12:00 | 0.46 | 22.75 | 0.02 | 76 | Partial | Partial | - |
| 10/14/2017 | 13:30 | 10/15/2017 | 3:00 | 0.43 | 13.50 | 0.03 | 170 | Partial | Partial | - |
| 10/21/2017 | 6:15 | 10/21/2017 | 20:15 | 0.43 | 14.00 | 0.03 | 147 | Partial | Partial | - |

**Figure 14-12** and **Figure 14-13** show the north inlet and south inlet stage and discharge for 2017. Both inlets yielded roughly the same volume of water in 2017. **Figure 14-14** shows the outlet stage and discharge for 2017. The outlet had fewer events due to the infiltration chamber infiltrating all smaller storms. At the outlet, stormwater can go both into and out of the BMP during large events. This phenomenon is shown as by the area velocity probe having both positive and negative velocities during the same event.

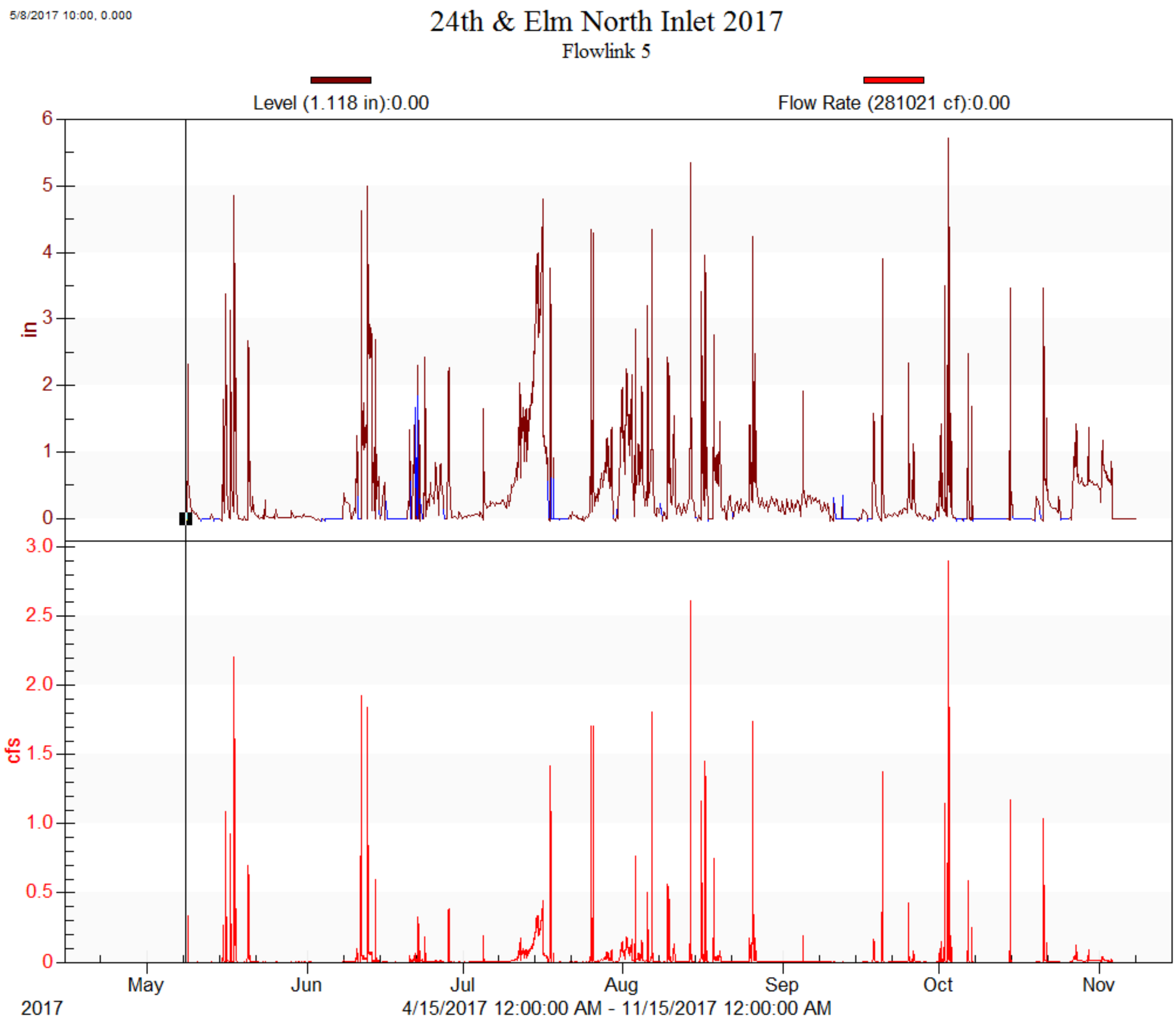



***Figure 14-12. 2017 24th & Elm north inlet stage and discharge.***

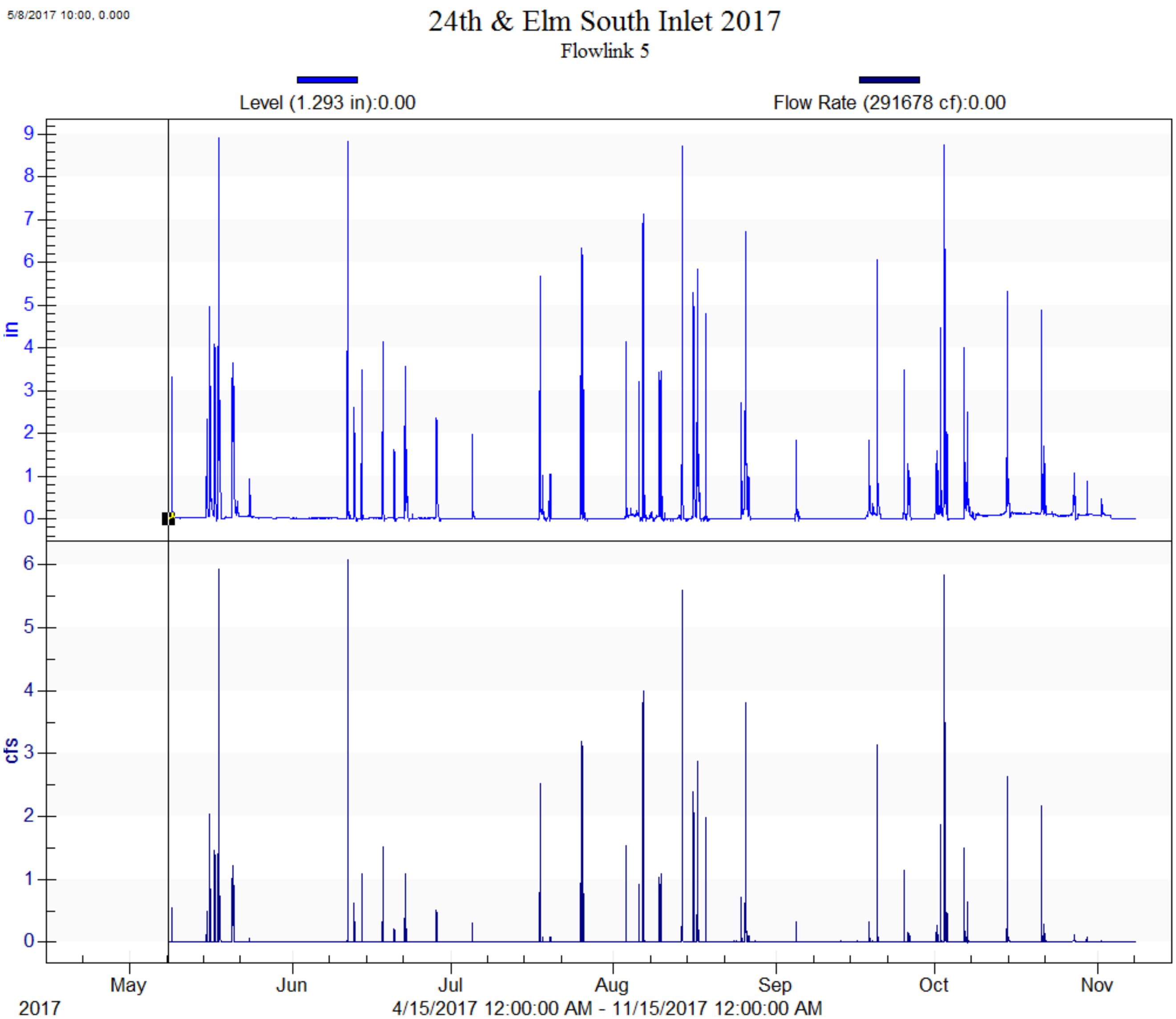



***Figure 14-13. 2017 24th & Elm south inlet stage and discharge.***

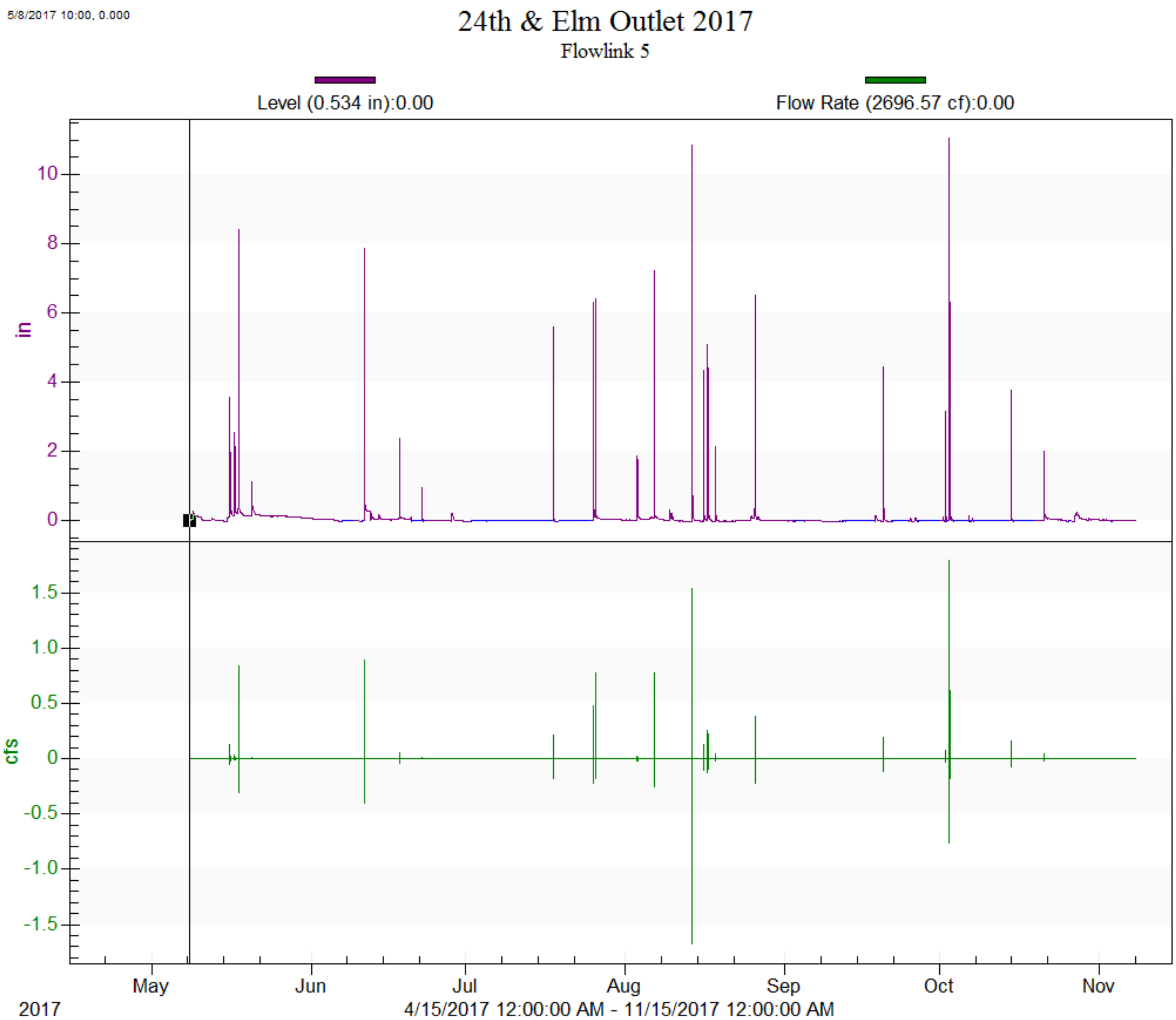



***Figure 14-14. 2017 24th & Elm outlet stage and discharge.***

### *Storm Event Data and Statistics*

**Table 14-20** shows the 2017 24th & Elm stormwater water chemistry data. Some of the events collected were analyzed for limited parameters because of low volume or expired holding times.

The June sulfate data that are bold in **Table 14-20** failed MPRB's blind monthly performance standard for that month. It was deemed the data can be used with caution, noting that performance standards were outside the 80-120% recovery standards, **Section 29**, Quality Assurance Assessment Report.

***Table 14-20. 2017 24th & Elm Stormwater chemistry events data. Cells with less than values indicate that the concentration of that parameter was below reporting limit. ND = no data due to expired holding time or low volume. Data that are bold had a blind performance standard failure for that month, for that parameter.***

| Date Sampled | Time | Site Location | Sample Type | TP mg/L | TDP mg/L | OrthoP mg/L | TKN mg/L | NH3 mg/L | NO3NO2 mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µhmos | pH std units | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/11/2017 | 11:07 | 24th & Elm in N | Composite | 0.213 | ND | ND | 1.75 | ND | ND | 8.2 | 32 | 74 | 25 | ND | ND | ND | 117 | 6.6 | 9 | 3 | 57 |
| 6/12/2017 | 17:44 | 24th & Elm in N | Composite | 0.155 | 0.021 | 0.061 | 2.39 | 0.831 | 0.482 | 6.4 | 36 | 50 | 15 | 87 | 6 | **33** | 122 | 7.0 | 20 | 4 | 49 |
| 6/22/2017 | 12:33 | 24th & Elm in N | Composite | 0.193 | 0.029 | 0.087 | 1.08 | 0.297 | 0.366 | 4.1 | 44 | 85 | 18 | 90 | 8 | **6** | 118 | 7.8 | 20 | 6 | 70 |
| 6/28/2017 | 8:37 | 24th & Elm in N | Composite | 0.129 | 0.027 | 0.044 | 0.65 | <0.250 | 0.320 | 2.7 | 32 | 30 | 14 | 67 | 24 | **5** | 89 | 7.1 | 12 | 6 | 40 |
| 7/18/2017 | 11:01 | 24th & Elm in N | Composite | 0.124 | ND | ND | ND | ND | ND | ND | 76 | ND | ND | ND | ND | ND | 204 | ND | ND | ND | ND |
| 7/26/2017 | 5:52 | 24th & Elm in N | Composite | 0.186 | 0.035 | 0.062 | 0.987 | 0.643 | 0.344 | 3.2 | 40 | 113 | 36 | 59 | 5 | 6 | 104 | 7.6 | 22 | 7 | 60 |
| 8/5/2017 | 19:02 | 24th & Elm in N | Composite | 0.202 | ND | ND | 1.58 | 0.204 | ND | 6.0 | 48 | 77 | 31 | ND | ND | ND | 146 | ND | 29 | 5 | 77 |
| 8/6/2017 | 14:19 | 24th & Elm in N | Composite | 0.180 | ND | ND | 0.867 | 0.249 | ND | <2.00 | 28 | 100 | 31 | ND | ND | ND | 91 | ND | 19 | 7 | 68 |
| 8/25/2017 | 7:10 | 24th & Elm in N | Composite | 0.121 | ND | ND | 1.77 | ND | <0.030 | 17.8 | 50 | 31 | 14 | ND | ND | ND | 198 | ND | 9 | 2 | 54 |
| 8/26/2017 | 2:41 | 24th & Elm in N | Composite | 0.051 | ND | ND | 0.673 | ND | 0.212 | 2.4 | 24 | 37 | 14 | ND | ND | ND | 69 | ND | 12 | 2 | 31 |
| 9/4/2017 | 17:45 | 24th & Elm in N | Composite | 0.169 | ND | ND | 1.92 | ND | <0.030 | 15.3 | ND | 26 | 18 | ND | ND | ND | 227 | ND | ND | ND | ND |
| 9/18/2017 | 15:02 | 24th & Elm in N | Composite | 0.162 | 0.034 | 0.062 | 1.08 | 0.667 | 0.369 | 6.1 | 50 | <1.00 | <2.00 | 85 | 4 | 7 | 143 | 6.3 | 19 | 3 | 48 |
| 9/20/2017 | 3:49 | 24th & Elm in N | Composite | 0.207 | 0.031 | 0.060 | 0.886 | 0.423 | 0.343 | 2.4 | 30 | 142 | 20 | 49 | <1.00 | 7 | 105 | 6.6 | 19 | 6 | 75 |
| 9/25/2017 | 6:06 | 24th & Elm in N | Composite | 0.151 | 0.031 | 0.044 | 1.12 | 0.578 | 0.426 | 3.3 | 44 | 56 | 19 | 75 | 13 | 8 | 120 | 6.4 | 24 | 4 | 66 |
| 9/26/2017 | 6:30 | 24th & Elm in N | Composite | 0.072 | ND | ND | 0.473 | ND | 0.251 | 4.2 | 48 | 7 | 6 | ND | ND | ND | 114 | ND | 17 | 1 | <20.0 |
| 10/1/2017 | 14:25 | 24th & Elm in N | Composite | 0.078 | ND | ND | 0.626 | ND | 0.371 | 3.4 | 42 | 9 | 3 | ND | ND | ND | 109 | ND | 12 | 1 | <20.0 |
| 10/2/2017 | 4:58 | 24th & Elm in N | Composite | 0.078 | ND | ND | <0.500 | ND | 0.229 | <2.00 | 24 | 30 | 6 | ND | ND | ND | 68 | ND | 12 | 3 | 36 |
| 10/2/2017 | 19:25 | 24th & Elm in N | Composite | 0.130 | 0.012 | 0.039 | 0.709 | <0.250 | 0.261 | <2.00 | 30 | 90 | 15 | 30 | <1.00 | <5.00 | 83 | 7.2 | 14 | 5 | 52 |
| 10/6/2017 | 17:15 | 24th & Elm in N | Composite | | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 8 | 2 | 29 |
| 10/14/2017 | 20:11 | 24th & Elm in N | Composite | 0.133 | ND | ND | 0.768 | ND | 0.292 | <2.00 | 34 | 86 | 23 | ND | ND | ND | 94 | ND | 10 | 5 | 56 |
| 10/21/2017 | 21:32 | 24th & Elm in N | Composite | 0.110 | ND | ND | 0.886 | ND | 0.431 | 3.9 | 36 | 55 | 19 | ND | ND | ND | 97 | ND | 16 | 3 | 57 |

***Table 14-20 (continued). 2017 24th & Elm stormwater chemistry events data. Cells with less than values indicate that the concentration of that parameter was below reporting limit. ND = no data due to expired holding time or low volume.  Data that are bold had a blind performance standard failure for that month, for that parameter.***

| Date Sampled | Time | Site Location | Sample Type | TP mg/L | TDP mg/L | OrthoP mg/L | TKN mg/L | NH3 mg/L | NO3NO2 mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µmhos | pH std units | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6/11/2017 | 10:46 | 24th & Elm in S | Composite | 0.337 | ND | ND | 2.27 | ND | ND | 8.2 | 28 | 136 | 55 | ND | ND | ND | 110 | 6.5 | 22 | 8 | 75 |
| 6/12/2017 | 17:28 | 24th & Elm in S | Composite | 0.187 | 0.026 | 0.047 | 2.03 | 0.695 | 0.504 | 5.0 | 24 | 45 | 21 | 74 | 5 | **9** | 101 | 6.7 | 15 | 3 | 49 |
| 6/22/2017 | 16:06 | 24th & Elm in S | Composite | 0.112 | 0.026 | 0.042 | 0.899 | 0.376 | 0.400 | 2.7 | 24 | 31 | 14 | 56 | 7 | **6** | 77 | 7.3 | 12 | 2 | 41 |
| 6/28/2017 | 8:46 | 24th & Elm in S | Composite | 0.138 | 0.059 | 0.034 | 0.549 | <0.250 | 0.193 | 2.2 | 24 | 18 | 8 | 53 | 7 | **6** | 68 | 7.2 | 12 | 1 | 37 |
| 7/19/2017 | 22:46 | 24th & Elm in S | Composite | 0.146 | ND | ND | ND | ND | <0.030 | 12.6 | 60 | 18 | 13 | ND | ND | ND | 219 | ND | ND | ND | ND |
| 7/26/2017 | 5:41 | 24th & Elm in S | Composite | 0.167 | 0.054 | 0.034 | 1.13 | 0.654 | 0.287 | 2.7 | 20 | 77 | 26 | 34 | 5 | 6 | 76 | 7.1 | 17 | 5 | 58 |
| 8/3/2017 | 8:32 | 24th & Elm in S | Composite | 0.231 | 0.058 | 0.067 | 1.35 | 0.654 | 0.236 | 2.3 | 28 | 66 | 22 | 68 | 15 | 9 | 88 | 6.7 | 19 | 5 | 84 |
| 8/5/2017 | 18:56 | 24th & Elm in S | Composite | 0.211 | ND | ND | 1.64 | 0.088 | ND | 4.6 | 30 | 52 | 23 | ND | ND | ND | 100 | ND | 18 | 4 | 61 |
| 8/6/2017 | 14:45 | 24th & Elm in S | Composite | 0.169 | ND | ND | 1.30 | 0.183 | ND | 2.3 | 18 | 31 | 11 | ND | ND | ND | 63 | ND | 17 | 7 | 67 |
| 8/25/2017 | 6:40 | 24th & Elm in S | Composite | 0.128 | ND | ND | 1.15 | ND | 0.145 | 6.6 | 36 | 19 | 10 | ND | ND | ND | 121 | ND | 11 | 1 | 36 |
| 8/26/2017 | 2:55 | 24th & Elm in S | Composite | 0.054 | ND | ND | 0.556 | ND | 0.167 | <2.00 | 16 | 18 | 7 | ND | ND | ND | 48 | ND | 8 | 1 | 22 |
| 9/4/2017 | 18:13 | 24th & Elm in S | Composite | 0.168 | ND | ND | 1.50 | ND | <0.030 | 10.6 | ND | 16 | 12 | ND | ND | ND | 182 | ND | ND | ND | ND |
| 9/20/2017 | 3:38 | 24th & Elm in S | Composite | 0.217 | 0.049 | 0.058 | 1.15 | <0.250 | 0.178 | <2.00 | 22 | 122 | 29 | 25 | 3 | <5.00 | 80 | 6.3 | 23 | 7 | 112 |
| 9/25/2017 | 4:58 | 24th & Elm in S | Composite | 0.227 | 0.066 | 0.088 | 1.42 | 0.645 | 0.167 | 4.7 | 32 | 49 | 20 | 83 | 13 | 8 | 105 | 6.3 | 15 | 3 | 60 |
| 9/26/2017 | 6:23 | 24th & Elm in S | Composite | 0.179 | ND | ND | 0.993 | ND | 0.315 | 5.1 | 38 | 8 | 5 | ND | ND | ND | 114 | ND | ND | ND | ND |
| 10/1/2017 | 14:20 | 24th & Elm in S | Composite | 0.192 | ND | ND | 0.650 | ND | 0.208 | 5.3 | 34 | 7 | 6 | ND | ND | ND | 113 | ND | 10 | 1 | <20.0 |
| 10/2/2017 | 3:40 | 24th & Elm in S | Composite | 0.06 | ND | ND | <0.500 | ND | 0.191 | <2.00 | 16 | 22 | 9 | ND | ND | ND | 48 | ND | 11 | 2 | 27 |
| 10/2/2017 | 18:25 | 24th & Elm in S | Composite | 0.129 | 0.026 | 0.023 | 0.508 | <0.250 | 0.294 | <2.00 | 18 | 52 | 17 | 19 | <1.00 | <5.00 | 58 | 6.8 | 14 | 4 | 46 |
| 10/6/2017 | 17:47 | 24th & Elm in S | Composite | 0.071 | ND | ND | <0.500 | ND | 0.171 | <2.00 | 18 | 17 | 7 | ND | ND | ND | 54 | ND | 8 | 1 | 26 |
| 10/7/2017 | 7:56 | 24th & Elm in S | Composite | 0.054 | ND | ND | <0.500 | ND | 0.048 | <2.00 | 26 | 4 | 3 | ND | ND | ND | 65 | ND | 7 | 0 | <20.0 |
| 10/14/2017 | 20:57 | 24th & Elm in S | Composite | 0.119 | ND | ND | 1.30 | ND | 0.209 | <2.00 | 20 | 34 | 13 | ND | ND | ND | 67 | ND | 14 | 2 | 42 |
| 10/21/2017 | 21:40 | 24th & Elm in S | Composite | 0.120 | ND | ND | 0.886 | ND | 0.155 | 2.0 | 24 | 41 | 19 | ND | ND | ND | 74 | ND | 16 | 3 | 46 |
| 6/11/2017 | 10:02 | 24th & Elm Out | Composite | 1.79 | ND | ND | 5.52 | ND | ND | 100 | 36 | 1132 | 22 | ND | ND | ND | 684 | 6.6 | 93 | 53 | 240 |
| 7/26/2017 | 4:33 | 24th & Elm Out | Composite | 0.338 | 0.064 | 0.115 | 1.49 | 0.550 | 0.456 | 10.2 | 40 | 269 | 68 | 64 | 5 | 9 | 143 | 7.7 | 29 | 14 | 109 |
| 8/3/2017 | 8:16 | 24th & Elm Out | Composite | 0.571 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | 409 | ND | ND | ND | ND |
| 8/6/2017 | 14:02 | 24th & Elm Out | Composite | 0.297 | ND | ND | 1.60 | 0.220 | ND | <2.00 | 32 | 246 | 70 | ND | ND | ND | 116 | ND | 30 | 13 | 146 |
| 10/2/2017 | 20:16 | 24th & Elm Out | Composite | 0.481 | 0.053 | 0.179 | 1.22 | <0.250 | 0.254 | 3.4 | 42 | 338 | 63 | 80 | <1.00 | 7 | 148 | 7.4 | 33 | 17 | 110 |

**Table 14-21** shows the 2017 statistics from the 24th & Elm inlets and outlet. Statistics were only calculated for a chemical parameter if there were two or more measured values. When statistical analysis was performed on the data sets and values below the reporting limit were present, half of the reporting limit was used in the calculations.

When comparing the geometric means of the inlets and outlet, the outlet pollutant concentration was higher than the inlets for many parameters. The higher outlet pollutant concentration is likely from large storms causing resuspension or scour in the EIC. It is important to remember that the outlet events were of very low volume, and from both a limited number of events and only 5 large storms.

**Table 14-22** shows the 2017 water balance and chemical load calculations for the 24th & Elm Infiltration Chamber. The load calculations used the geometric mean of the chemical parameter as the final concentration. Conversions were made to express the concentration in pounds.

*Table 14-21. 2017 24th & Elm stormwater data showing statistics of the inlets and outlet. All data below the reporting limit were transformed into half the reporting limit for statistical calculations (e.g. Zn <20 becomes 10).*

| Site ID | Statistical Function | TP mg/L | TDP mg/L | OrthoP mg/L | TKN mg/L | NH3 mg/L | NO3NO2 mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µhmos | pH std units | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24th & Elm in N | MEAN (geometric) | 0.133 | 0.026 | 0.056 | 0.946 | 0.340 | 0.222 | 3.5 | 37.8 | 39 | 13 | 64 | 5 | 7.0 | 114 | 6.9 | 15.1 | 3.4 | 43.9 |
| | MEAN (arithmetic) | 0.142 | 0.028 | 0.057 | 1.08 | 0.414 | 0.295 | 4.9 | 39.4 | 58 | 17 | 68 | 8 | 9.3 | 121 | 6.9 | 16.0 | 3.8 | 49.6 |
| | MAX | 0.213 | 0.035 | 0.087 | 2.39 | 0.831 | 0.482 | 17.8 | 76.0 | 142 | 36 | 90 | 24 | 33.1 | 227 | 7.8 | 29.2 | 6.8 | 76.7 |
| | MIN | 0.051 | 0.012 | 0.039 | 0.250 | 0.125 | 0.015 | 1.0 | 24.0 | 1 | 1 | 30 | 1 | 2.5 | 68 | 6.3 | 8.2 | 1.1 | 10.0 |
| | MEDIAN | 0.142 | 0.030 | 0.061 | 0.886 | 0.360 | 0.332 | 3.4 | 36.0 | 55 | 18 | 71 | 6 | 6.5 | 112 | 7.0 | 16.4 | 3.8 | 53.6 |
| | STDEV | 0.048 | 0.008 | 0.015 | 0.556 | 0.252 | 0.133 | 4.6 | 12.3 | 39 | 9 | 21 | 8 | 9.7 | 44 | 0.5 | 5.7 | 1.9 | 19.5 |
| | NUMBER | 20 | 8 | 8 | 19 | 10 | 16 | 19.0 | 19.0 | 19 | 19 | 8 | 8 | 8 | 20 | 9.0 | 19 | 19 | 19 |
| | COV | 0.338 | 0.278 | 0.266 | 0.517 | 0.607 | 0.449 | 0.933 | 0.311 | 0.671 | 0.545 | 0.309 | 0.974 | 1.047 | 0.361 | 0.074 | 0.353 | 0.488 | 0.394 |
| 24th & Elm in S | MEAN (geometric) | 0.140 | 0.042 | 0.045 | 0.880 | 0.273 | 0.155 | 2.7 | 25.1 | 28 | 13 | 46 | 5 | 5.5 | 85 | 6.8 | 13.4 | 2.3 | 40.5 |
| | MEAN (arithmetic) | 0.155 | 0.046 | 0.049 | 1.05 | 0.367 | 0.205 | 3.8 | 26.5 | 40 | 16 | 52 | 7 | 6.1 | 92 | 6.8 | 14.1 | 3.1 | 47.8 |
| | MAX | 0.337 | 0.066 | 0.088 | 2.27 | 0.695 | 0.504 | 12.6 | 60.0 | 136 | 55 | 83 | 15 | 9.0 | 219 | 7.3 | 22.8 | 8.1 | 112 |
| | MIN | 0.054 | 0.026 | 0.023 | 0.250 | 0.088 | 0.015 | 1.0 | 16.0 | 4 | 3 | 19 | 1 | 2.5 | 48 | 6.3 | 7.1 | 0.35 | 10 |
| | MEDIAN | 0.157 | 0.052 | 0.045 | 1.13 | 0.280 | 0.191 | 2.5 | 24.0 | 31 | 13 | 54 | 6 | 6.1 | 79 | 6.7 | 14.1 | 2.5 | 45.7 |
| | STDEV | 0.068 | 0.017 | 0.021 | 0.561 | 0.266 | 0.121 | 3.3 | 10.0 | 35 | 11 | 23 | 5 | 2.6 | 42 | 0.4 | 4.5 | 2.3 | 25.6 |
| | NUMBER | 22 | 8 | 8 | 21 | 10 | 19 | 22.0 | 21.0 | 22 | 22 | 8 | 8 | 8 | 22 | 9.0 | 19 | 19 | 19 |
| | COV | 0.438 | 0.370 | 0.429 | 0.535 | 0.725 | 0.590 | 0.858 | 0.379 | 0.868 | 0.712 | 0.455 | 0.689 | 0.418 | 0.454 | 0.055 | 0.317 | 0.735 | 0.536 |
| 24th & Elm Out | MEAN (geometric) | 0.548 | 0.058 | 0.143 | 2.00 | 0.247 | 0.340 | 7.7 | 37.3 | 399 | 51 | 72 | 2 | 8.1 | 233 | 7.2 | 40.6 | 20.4 | 143 |
| | MEAN (arithmetic) | 0.695 | 0.059 | 0.147 | 2.46 | 0.298 | 0.355 | 28.7 | 37.5 | 496 | 56 | 72 | 3 | 8.1 | 300 | 7.3 | 46.5 | 24.5 | 151 |
| | MAX | 1.79 | 0.064 | 0.179 | 5.52 | 0.550 | 0.456 | 100 | 42.0 | 1132 | 70 | 80 | 5 | 9.2 | 684 | 7.7 | 93.3 | 53.3 | 240 |
| | MIN | 0.297 | 0.053 | 0.115 | 1.22 | 0.125 | 0.254 | 1.0 | 32.0 | 246 | 22 | 64 | 1 | 7.1 | 116 | 6.6 | 29.2 | 13.4 | 109 |
| | MEDIAN | 0.481 | 0.059 | 0.147 | 1.55 | 0.220 | 0.355 | 6.8 | 38.0 | 304 | 66 | 72 | 3 | 8.1 | 148 | 7.4 | 31.7 | 15.7 | 128 |
| | STDEV | 0.620 | 0.008 | 0.045 | 2.05 | 0.223 | 0.143 | 47.7 | 4.4 | 426 | 23 | 11 | 3 | 1.4 | 245 | 0.6 | 31.3 | 19.3 | 61.6 |
| | NUMBER | 5 | 2 | 2 | 4 | 3 | 2 | 4.0 | 4.0 | 4 | 4 | 2 | 2 | 2 | 5 | 3.0 | 4 | 4 | 4 |
| | COV | 0.893 | 0.133 | 0.308 | 0.834 | 0.748 | 0.402 | 1.67 | 0.118 | 0.858 | 0.406 | 0.157 | 0.957 | 0.178 | 0.818 | 0.083 | 0.673 | 0.787 | 0.407 |

*Table 14-22. 2017 24th & Elm stormwater water balance, chemical load calculations in pounds, and percent removed. Decimals were used to show removal rates between 99% and 100%.*

| Site | Vol Liters | TP lbs. | TDP lbs. | OrthoP lbs. | TKN lbs. | $NH_3$ lbs. | $NO_3NO_2$ lbs. | Cl lbs. | Hardness lbs. | TSS lbs. | VSS lbs. | TDS lbs. | cBOD lbs. | Sulfate lbs. | Cu lbs. | Pb lbs. | Zn lbs. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 24th & Elm in N | 7,957,615 | 2.33 | 0.461 | 0.977 | 16.6 | 5.96 | 3.90 | 61.0 | 663 | 680 | 236 | 1,127 | 86.8 | 123 | 0.265 | 0.059 | 0.770 |
| 24th & Elm in S | 8,259,388 | 2.55 | 0.773 | 0.826 | 16.0 | 4.96 | 2.82 | 49.6 | 456 | 516 | 234 | 838 | 99.7 | 100 | 0.244 | 0.042 | 0.738 |
| 24th & Elm Out | 76,370 | 0.092 | 0.010 | 0.024 | 0.337 | 0.042 | 0.057 | 1.30 | 6.28 | 67.2 | 8.52 | 12.1 | 0.383 | 1.36 | 0.007 | 0.003 | 0.024 |
| Percent removed | 99.5% | 98% | 99% | 99% | 99% | 99.6% | 99% | 99% | 99% | 94% | 98% | 99% | 99.8% | 99% | 99% | 97% | 98% |

## Conclusions

In conclusion, the problem of trucks parking on top of manholes appears to have been largely solved with traffic control installing no parking signs. These sites were very tight to work in to both install and uninstall. With the flow-pacing set, antennas buried in the street, eye bolts and anchor hardware set, 2018 monitoring should be easier to accomplish.

In reviewing **Table 14-22,** the 24$^{th}$ & Elm Infiltration Chamber infiltrated 99.5% of the stormwater and 94% to 99.6% of the nutrients and chemicals found in the stormwater it received. Decimal percents were used to show removal rates between 99% and 100%. The EIC is working very well, as most other BMPs (e.g. ponds) only achieve a 50% to 80% reduction in most chemical parameters. Caution must be noted as this is the first year of monitoring following construction and additional monitoring should be done after years of service have passed.

### *ESTIMATES OF ANNUAL AND SEASONAL POLLUTANT LOADS*

Statistics for event mean concentrations were calculated using Microsoft Excel spreadsheets. FLUX32 (v.3.1) and P8 (v.3.4) were used to calculate flow-weighted mean concentrations and snowmelt runoffs, respectively.

All flow-weighted mean concentrations were calculated using the model FLUX32. FLUX32 calculates total mass discharge and associated error statistics based on six different calculation methods. Calculation methods 1-Direct Mean Loading and 5-Regression, Second-Order were ignored because they are inappropriate for storm sewer applications where the daily flow file contains a significant number of zero flows (Bruce Wilson, personal communication, 2001). Sample concentrations and associated daily average flows were used as input for these calculations. In order to achieve the most accurate and precise results, the data was often stratified by flow or by season. The calculation methods used were: not stratified, methods 2 and 6, if the data were able to be stratified. Generally, the method and associated concentration value with the lowest coefficient of variation was chosen.

The model P8 was used to calculate daily flows for the snowmelt events during January through April. Daily average temperature, winter water equivalent snowpack (using a heated tipping bucket rain gauge), and hourly precipitation files obtained from the National Oceanic and Atmospheric Administration (NOAA) National Data Center (NNDC) were used as input for P8.

A description of FLUX32 as described in the help menu (US Army Corps, 2009):

The theory and the file formats described in this original manual, as well as much of the software's operation and menu structure, is still applicable to Flux.

This version of FLUX for the Win32 environment is a major revision to the original DOS/FORTRAN program authored by William W. Walker Ph.D.

Flux32 is interactive software designed for use in estimating the transport (load) of nutrients or other water quality constituents past a tributary sampling station over a given period of time.

The basic approach of Flux32 is to use several calculation techniques to map the flow/concentration relationship developed (modeled) from the sample record onto the entire flow record. This provides an estimate of total mass transport for the whole period of study with associated error statistics. Note that this approach does NOT focus on estimating changes in loads over time (i.e. time series).

An important option within Flux32 is the ability to stratify the data into groups based upon flow, date, and/or season. This is a key feature of the FLUX approach and one of its greatest strengths. In many (most) cases, stratifying the data increases the accuracy and precision of loading estimates.

A description of P8 as described in the software's introduction: "P8 is a model for predicting the generation and transport of stormwater runoff pollutants in small urban catchments. Simulations are driven by hourly rainfall and daily air-temperature time series."

The following formula was used to calculate the total annual pollutant load. Conversion factors were used to convert acres to square meters and adjust units for concentration.

$$L = [(P)\ (Pj)\ (Rv)\ (C/1000)\ (A*4046.9)]$$

where: L = seasonal pollutant load, kilograms/season

P = seasonal precipitation, inches/season (meters/season)

Pj = correction factor for storms which do not produce runoff = 0.85

Rv = runoff coefficient

C = median event mean concentration of pollutants, mg/L

A = area, acres

Conversion factors 4046.9 for acres to square meters

1000 for liters to cubic meters

The flow-weighted mean concentration (FWMC) expressed as a mean of all sites was used for the annual load estimation calculations as it most accurately reflects storm water loadings on an annual basis. The seasonal loadings were calculated from the pooled data using the median event mean concentration as there were too few data points from each watershed to use FLUX32 to determine with a reasonable degree of accuracy a seasonal FWMC for each site. The median of the data set is a better representation of the runoff data than the mean values (Bannerman et al., 1992). The annual load and a summation of the seasonal loads will not be equal due to this difference in calculation methods.

Seasonal loads were calculated on the following basis:

| Season | Inclusive Dates | Precipitation for Period |
|---|---|---|
| Winter/snowmelt | 01/01/17 – 03/31/17 | 2.30 inches (0.058 m) |
| Spring | 04/01/17 – 05/31/17 | 9.25 inches (0.235 m) |
| Summer | 06/01/17 – 08/31/17 | 14.10 inches (0.358 m) |

| | | |
|---|---|---|
| Fall | 09/01/17 – 12/31/17 | 6.71 inches (0.170 m) |
| Total | 01/01/17 – 12/31/17 | 32.36 inches (0.822 m) |

*Flow-weighted mean concentrations and related statistics for NPDES parameters in 2017. *Flow-weighted mean concentrations for Cl and TDS were difficult to estimate using FLUX32 due to large outliers from the two snowmelt samples; these estimates should be used with caution. STANDEV= standard deviation. Blue highlighted data are the highest and orange highlighted data are the lowest.*

| Site | TP (mg/L) | TDP (mg/L) | Ortho-P (mg/L) | TKN (mg/L) | $NH_3$ (mg/L) | $NO_3NO_2$ (mg/L) | Cl* (mg/L) | Hardness (mg/L) | TSS (mg/L) | VSS (mg/L) | TDS* (mg/L) | cBOD (mg/L) | Sulfate (mg/L) | Cu (mg/L) | Pb (mg/L) | Zn (mg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6, 22nd Aldrich | 0.163 | 0.065 | 0.073 | 2.23 | 0.779 | 0.309 | 2 | 21 | 73 | 40 | 42 | 7 | 4.0 | 0.018 | 0.035 | 0.068 |
| 7, 14th Park | 0.212 | 0.043 | 0.052 | 1.63 | 0.723 | 0.331 | 3 | 18 | 107 | 24 | 42 | 5 | 3.7 | 0.017 | 0.007 | 0.053 |
| 8a, Pershing | 0.191 | 0.085 | 0.092 | 0.962 | 0.668 | 0.235 | 1 | 21 | 35 | 13 | 19 | 3 | 4.0 | 0.012 | 0.002 | 0.011 |
| 9, 61st Lyndale | 0.255 | 0.046 | 0.067 | 0.940 | 0.471 | 0.502 | 22 | 34 | 115 | 35 | 92 | 8 | 8.0 | 0.022 | 0.005 | 0.097 |
| **MEAN** | **0.205** | **0.060** | **0.071** | **1.44** | **0.660** | **0.344** | 7 | **23** | **83** | **28** | **49** | **6** | **4.9** | **0.017** | **0.012** | **0.057** |
| **MEDIAN** | **0.202** | **0.056** | **0.070** | **1.30** | **0.696** | **0.320** | **2** | **21** | **90** | **30** | **42** | **6** | **4.0** | **0.018** | **0.006** | **0.061** |
| **STANDEV** | **0.039** | **0.020** | **0.017** | **0.616** | **0.134** | **0.113** | **10** | **7** | **37** | **12** | **31** | **2** | **2.1** | **0.004** | **0.015** | **0.036** |

***Statistical summary for event mean concentrations by season in 2017. Statistics were calculated from all sites (6-9). STDEV= standard deviation, COV= coefficient of variance.***

| 2017 Season | Statistical Function | TP mg/L | TDP mg/L | Ortho-P mg/L | TKN mg/L | $NH_3$ mg/L | $NO_3NO_2$ mg/L | Cl mg/L | Hardness mg/L | TSS mg/L | VSS mg/L | TDS mg/L | cBOD mg/L | Sulfate mg/L | Sp.Cond. µhmos | pH std units | *E. coli MPN/100mL* | Cu ug/L | Pb ug/L | Zn ug/L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SNOWMELT (January-March) | **MEAN (geometric)** | 0.606 | 0.093 | 0.260 | 5.20 | 1.52 | 0.360 | 1668 | 193 | 161 | 67 | 3940 | 44 | 28 | 4064 | 8.6 | 37 | 34 | 10 | 138 |
| | **MEAN (arithmetic)** | 0.646 | 0.145 | 0.334 | 5.67 | 1.64 | 0.627 | 4430 | 231 | 213 | 75 | 7710 | 48 | 33 | 11809 | 8.7 | 85 | 41 | 16 | 216 |
| | **MAX** | 1.07 | 0.444 | 0.798 | 9.69 | 2.90 | 1.19 | 6785 | 500 | 384 | 111 | 11836 | 98 | 46 | 19020 | 10.3 | 201 | 54 | 31 | 299 |
| | **MIN** | 0.412 | 0.040 | 0.106 | 2.83 | 0.849 | 0.079 | 15 | 80 | 33 | 27 | 118 | 28 | 7 | 218 | 7.3 | 7 | 8 | 1 | 10 |
| | **MEDIAN** | 0.499 | 0.069 | 0.192 | 5.18 | 1.51 | 0.725 | 5025 | 200 | 222 | 85 | 8579 | 38 | 37 | 16190 | 8.3 | 24 | 50 | 16 | 264 |
| | **STDEV** | 0.269 | 0.171 | 0.279 | 2.63 | 0.76 | 0.526 | 2625 | 161 | 137 | 33 | 4542 | 28 | 15 | 10138 | 1.3 | 97 | 19 | 11 | 118 |
| | **NUMBER** | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | 5 | 5 | 5 |
| | **COV** | 0.417 | 1.18 | 0.834 | 0.465 | 0.461 | 0.839 | 0.593 | 0.696 | 0.644 | 0.448 | 0.589 | 0.582 | 0.456 | 0.858 | 0.153 | 1.14 | 0.469 | 0.685 | 0.548 |
| SPRING (April-May) | **MEAN (geometric)** | 0.272 | 0.054 | 0.037 | 2.25 | 0.943 | 0.292 | 4 | 22 | 80 | 29 | 41 | 7 | 5 | 74 | 7.1 | 481 | 22 | 11 | 54 |
| | **MEAN (arithmetic)** | 0.348 | 0.066 | 0.047 | 2.83 | 1.09 | 0.359 | 9 | 24 | 110 | 42 | 63 | 11 | 6 | 90 | 7.1 | 1810 | 25 | 25 | 92 |
| | **MAX** | 1.46 | 0.213 | 0.091 | 10.5 | 2.83 | 0.665 | 44 | 56 | 334 | 144 | 157 | 49 | 12 | 247 | 8.4 | 6488 | 56 | 98 | 358 |
| | **MIN** | 0.076 | 0.017 | 0.005 | 0.684 | 0.428 | 0.015 | 1 | 12 | 15 | 6 | 3 | 1 | 3 | 28 | 6.5 | 47 | 11 | 2 | 10 |
| | **MEDIAN** | 0.288 | 0.059 | 0.046 | 2.21 | 0.924 | 0.348 | 2 | 20 | 94 | 32 | 49 | 7 | 6 | 66 | 7.1 | 242 | 22 | 13 | 58 |
| | **STDEV** | 0.314 | 0.047 | 0.028 | 2.32 | 0.647 | 0.172 | 14 | 13 | 87 | 37 | 52 | 12 | 3 | 66 | 0.5 | 2681 | 12 | 32 | 92 |
| | **NUMBER** | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 17 | 14 | 16 | 17 | 17 | 17 | 6 | 17 | 17 | 17 |
| | **COV** | 0.902 | 0.710 | 0.580 | 0.819 | 0.595 | 0.480 | 1.48 | 0.523 | 0.786 | 0.894 | 0.818 | 1.12 | 0.493 | 0.738 | 0.067 | 1.48 | 0.507 | 1.27 | 1.01 |
| SUMMER (June-August) | **MEAN (geometric)** | 0.193 | 0.055 | 0.077 | 0.906 | 0.459 | 0.206 | 2 | 23 | 43 | 17 | 39 | 4 | 5 | 70 | 6.7 | 3316 | 15 | 5 | 36 |
| | **MEAN (arithmetic)** | 0.212 | 0.069 | 0.092 | 1.25 | 0.539 | 0.293 | 5 | 25 | 48 | 19 | 50 | 6 | 5 | 80 | 6.7 | 4445 | 16 | 8 | 48 |
| | **MAX** | 0.377 | 0.222 | 0.235 | 2.85 | 1.19 | 0.649 | 46 | 46 | 124 | 48 | 135 | 22 | 13 | 212 | 7.3 | 9208 | 29 | 43 | 145 |
| | **MIN** | 0.068 | 0.020 | 0.029 | 0.250 | 0.125 | 0.015 | 1 | 8 | 16 | 6 | 9 | 1 | 3 | 29 | 6.3 | 1515 | 7 | 1 | 10 |
| | **MEDIAN** | 0.214 | 0.048 | 0.068 | 1.13 | 0.533 | 0.355 | 1 | 24 | 41 | 16 | 41 | 5 | 5 | 67 | 6.7 | 2613 | 14 | 4 | 45 |
| | **STDEV** | 0.087 | 0.050 | 0.058 | 0.861 | 0.263 | 0.183 | 9 | 11 | 24 | 9 | 36 | 6 | 3 | 47 | 0.3 | 4161 | 6 | 11 | 34 |
| | **NUMBER** | 27 | 23 | 23 | 26 | 24 | 24 | 27 | 27 | 27 | 27 | 23 | 22 | 23 | 27 | 24 | 3 | 25 | 25 | 25 |
| | **COV** | 0.413 | 0.716 | 0.624 | 0.691 | 0.488 | 0.625 | 1.89 | 0.425 | 0.496 | 0.488 | 0.726 | 1.00 | 0.575 | 0.584 | 0.039 | 0.936 | 0.367 | 1.28 | 0.711 |
| FALL (Sept-Nov) | **MEAN (geometric)** | 0.162 | 0.027 | 0.039 | 1.11 | 0.437 | 0.146 | 7 | 31 | 40 | 17 | 74 | 5 | 8 | 113 | 6.5 | ND | 17 | 4 | 52 |
| | **MEAN (arithmetic)** | 0.181 | 0.028 | 0.042 | 1.17 | 0.441 | 0.241 | 13 | 34 | 46 | 19 | 80 | 7 | 9 | 126 | 6.5 | ND | 17 | 6 | 59 |
| | **MAX** | 0.331 | 0.039 | 0.066 | 1.70 | 0.489 | 0.673 | 24 | 68 | 85 | 38 | 104 | 14 | 10 | 222 | 6.6 | ND | 26 | 15 | 107 |
| | **MIN** | 0.066 | 0.018 | 0.029 | 0.697 | 0.356 | 0.015 | 1 | 16 | 16 | 8 | 42 | 2 | 6 | 45 | 6.2 | ND | 12 | 1 | 24 |
| | **MEDIAN** | 0.176 | 0.028 | 0.030 | 1.03 | 0.478 | 0.140 | 16 | 34 | 45 | 15 | 94 | 4 | 10 | 127 | 6.6 | ND | 16 | 5 | 48 |
| | **STDEV** | 0.088 | 0.011 | 0.021 | 0.423 | 0.074 | 0.231 | 10 | 16 | 25 | 10 | 33 | 6 | 2 | 59 | 0.2 | ND | 5 | 5 | 31 |
| | **NUMBER** | 9 | 3 | 3 | 8 | 3 | 9 | 8 | 8 | 9 | 9 | 3 | 3 | 3 | 8 | 3 | ND | 8 | 8 | 8 |
| | **COV** | 0.485 | 0.371 | 0.506 | 0.361 | 0.167 | 0.957 | 0.762 | 0.473 | 0.542 | 0.537 | 0.416 | 0.924 | 0.286 | 0.468 | 0.033 | ND | 0.291 | 0.775 | 0.530 |

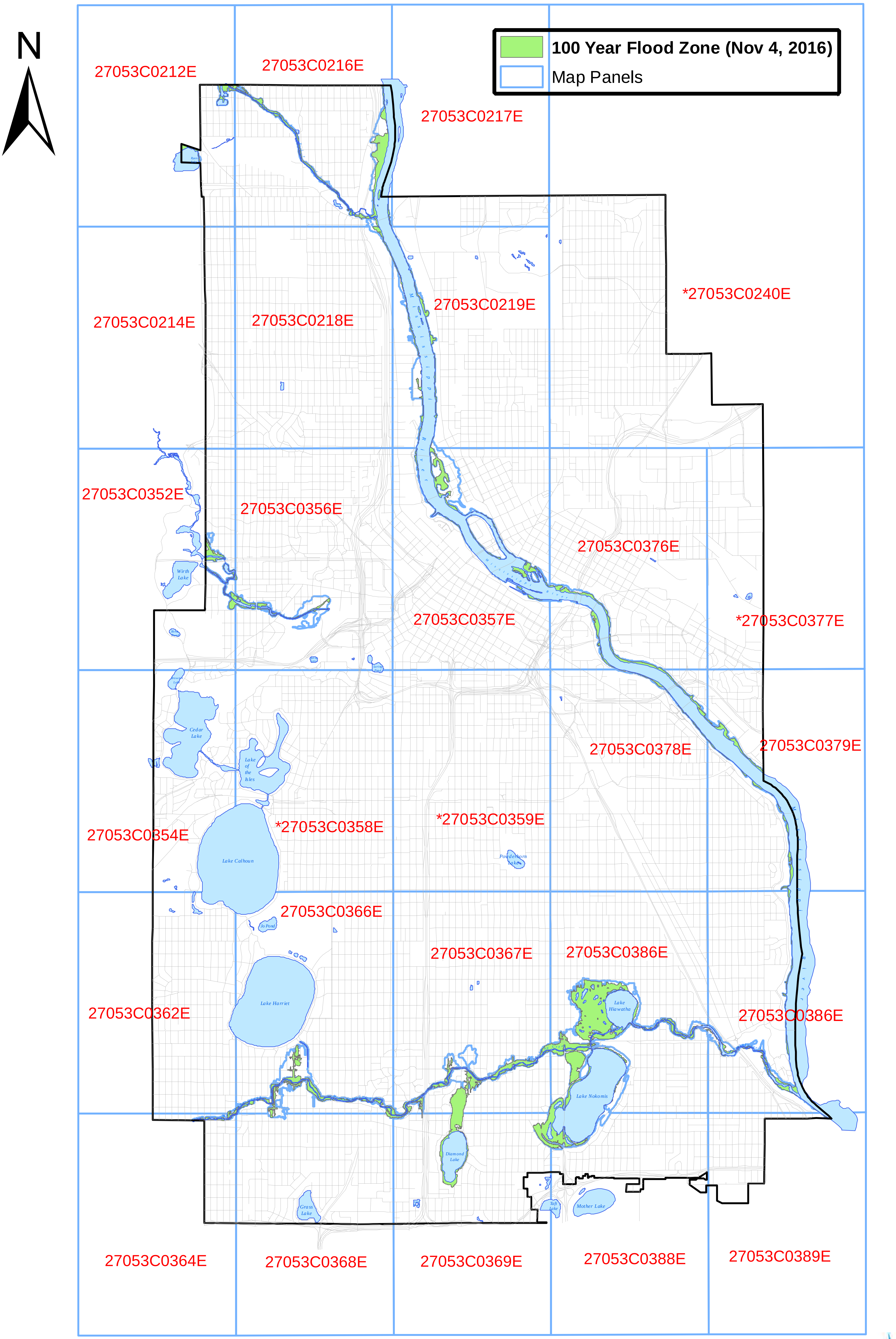
**Supporting Documents**

Bannerman, R.T., D.W. Owens, R. Dodds, and P. Hughes. 1992. Sources of Pollutants in Wisconsin Stormwater. WI Dept. of Natural Resources, Madison, WI.

Walker, W. W., 1996. *Simplified Procedures for Eutrophication Assessment and Prediction: User Manual*. Instruction Report W-96-2, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

# Appendix B

# F.E.M.A. DESIGNATED FLOOD ZONES

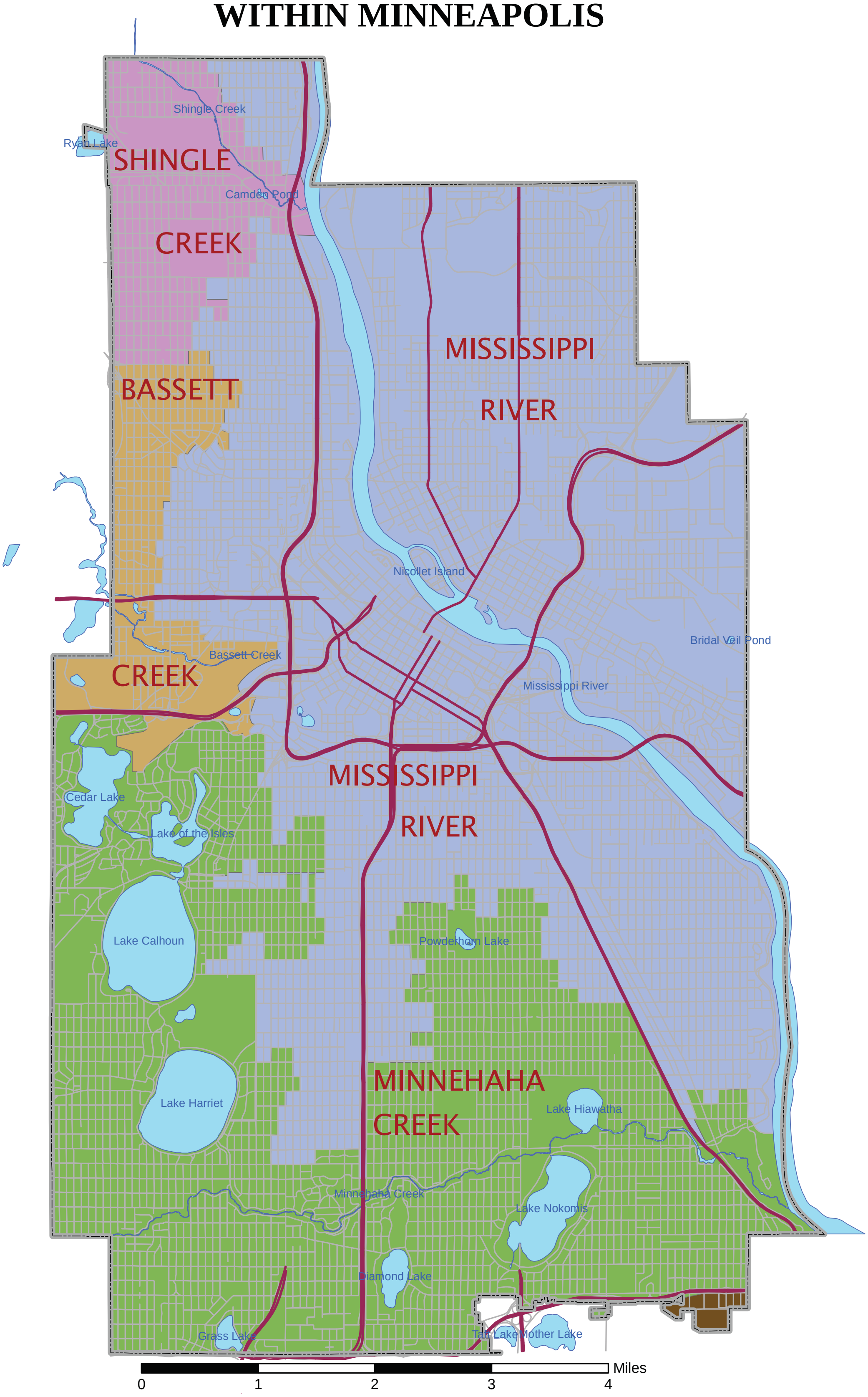



**EFFECTIVE DATE FOR MAP PANELS: NOVEMBER 4, 2016**



Minneapolis
City of Lakes

# WATERSHED MANAGEMENT BOUNDARIES WITHIN MINNEAPOLIS




- Lakes & Streams
- Bassett Creek Water Management Commission
- Minneapolis/St. Paul International Airport
- Minnehaha Creek Watershed District
- Mississippi Watershed Management Organization
- Shingle Creek Watershed Management Commission

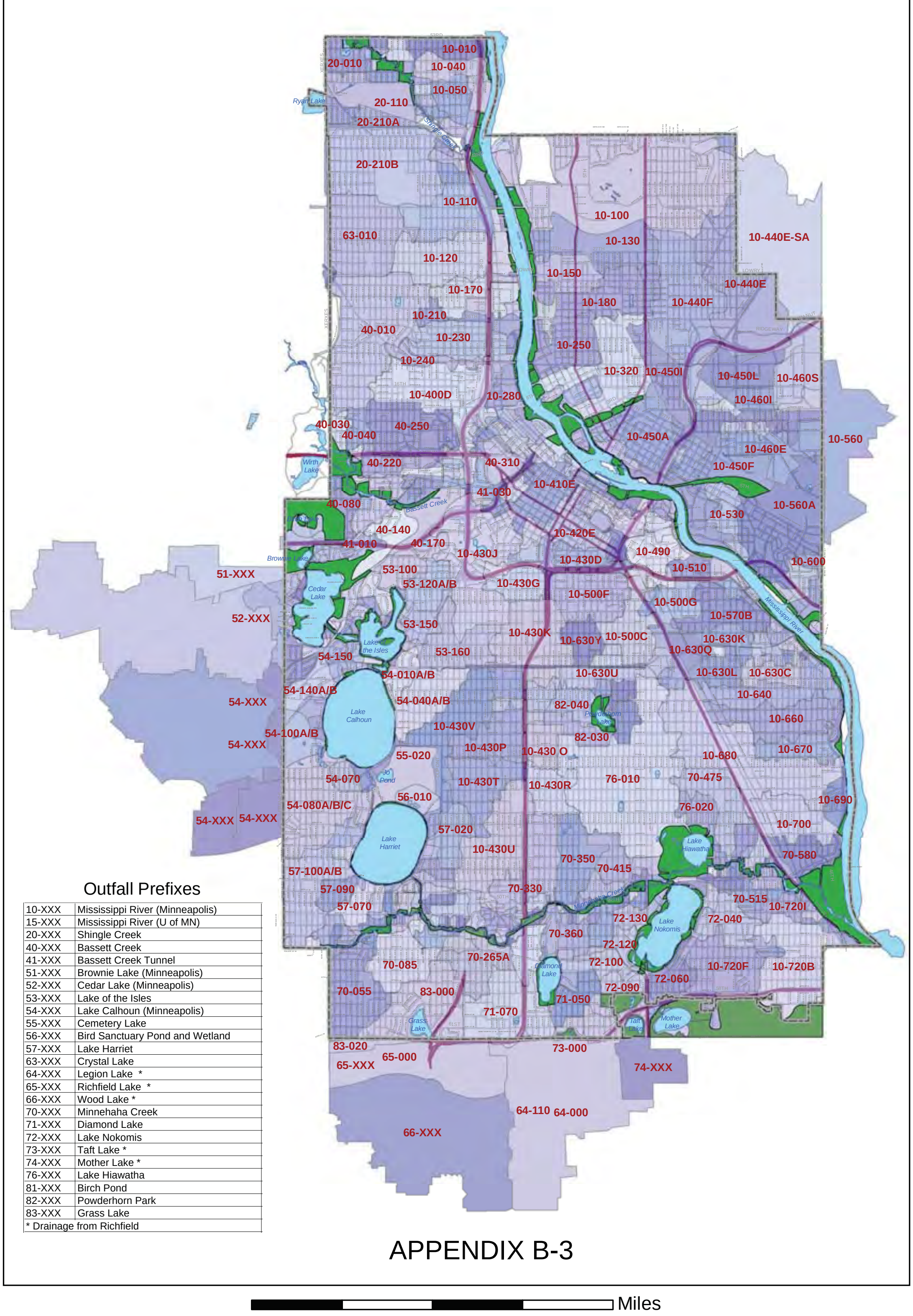
**MINNEAPOLIS PUBLIC WORKS**
**SURFACE WATER & SEWERS DIVISION**

March, 2008

APPENDIX B-2

This Map was created from the City of Minneapolis Public Work's Geographic Information System (GIS), it is a compilation of information and data from various sources. This Map is not a surveyed or legally recorded document and is intended to be used as a reference. The City of Minneapolis and its Public Works Department is not responsible for any inaccuracies contained herein or any consequences resulting from the user's use of or reliance on this GIS data.

# MINNEAPOLIS STORMWATER RUNOFF
# DRAINAGE SUB-AREA BOUNDARIES




## Outfall Prefixes

| | |
|---|---|
| 10-XXX | Mississippi River (Minneapolis) |
| 15-XXX | Mississippi River (U of MN) |
| 20-XXX | Shingle Creek |
| 40-XXX | Bassett Creek |
| 41-XXX | Bassett Creek Tunnel |
| 51-XXX | Brownie Lake (Minneapolis) |
| 52-XXX | Cedar Lake (Minneapolis) |
| 53-XXX | Lake of the Isles |
| 54-XXX | Lake Calhoun (Minneapolis) |
| 55-XXX | Cemetery Lake |
| 56-XXX | Bird Sanctuary Pond and Wetland |
| 57-XXX | Lake Harriet |
| 63-XXX | Crystal Lake |
| 64-XXX | Legion Lake * |
| 65-XXX | Richfield Lake * |
| 66-XXX | Wood Lake * |
| 70-XXX | Minnehaha Creek |
| 71-XXX | Diamond Lake |
| 72-XXX | Lake Nokomis |
| 73-XXX | Taft Lake * |
| 74-XXX | Mother Lake * |
| 76-XXX | Lake Hiawatha |
| 81-XXX | Birch Pond |
| 82-XXX | Powderhorn Park |
| 83-XXX | Grass Lake |
| * Drainage from Richfield | |

APPENDIX B-3

March, 2008

MINNEAPOLIS PUBLIC WORKS
SURFACE WATER & SEWERS DIVISION

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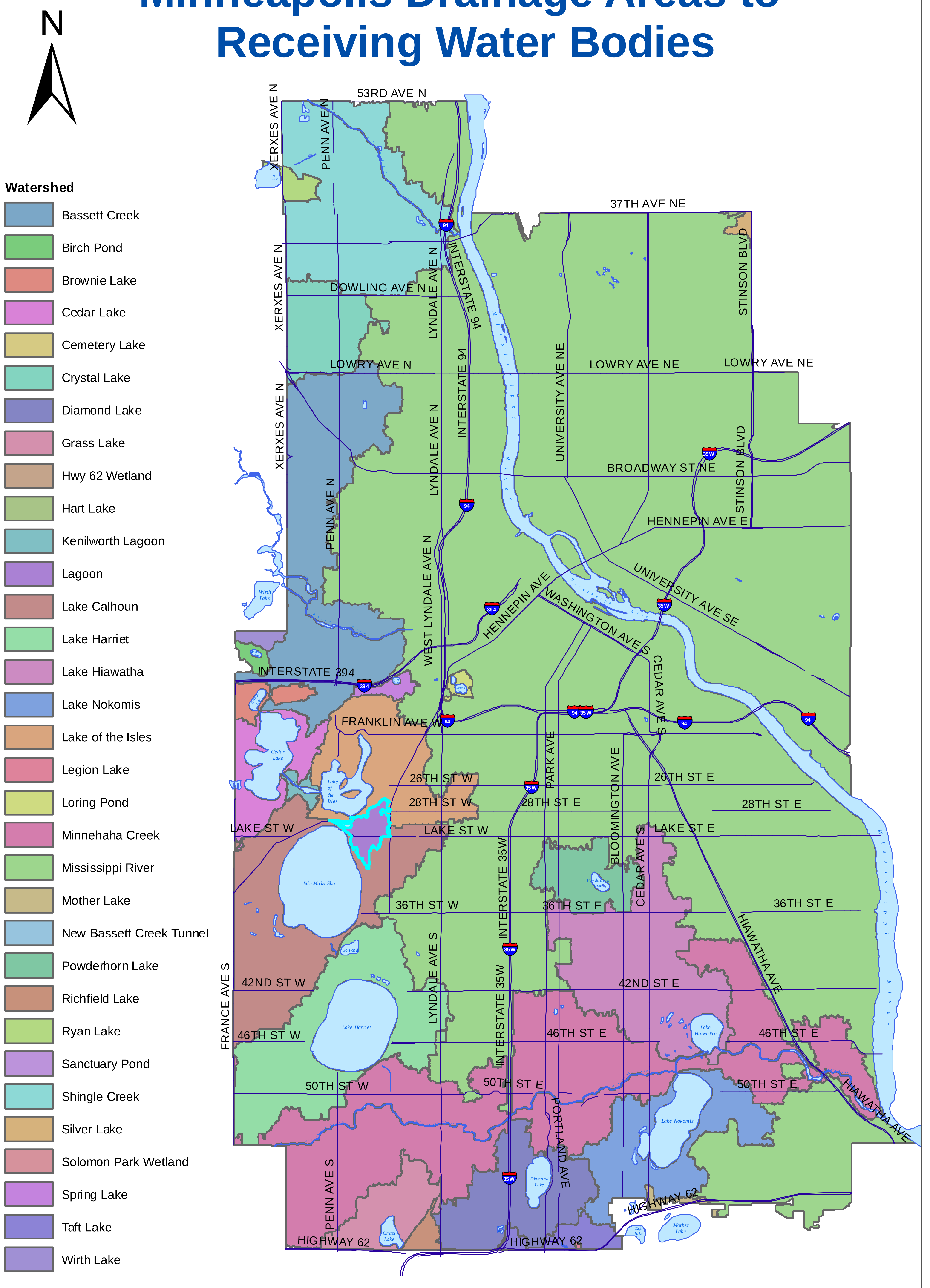
# Minneapolis Drainage Areas to Receiving Water Bodies

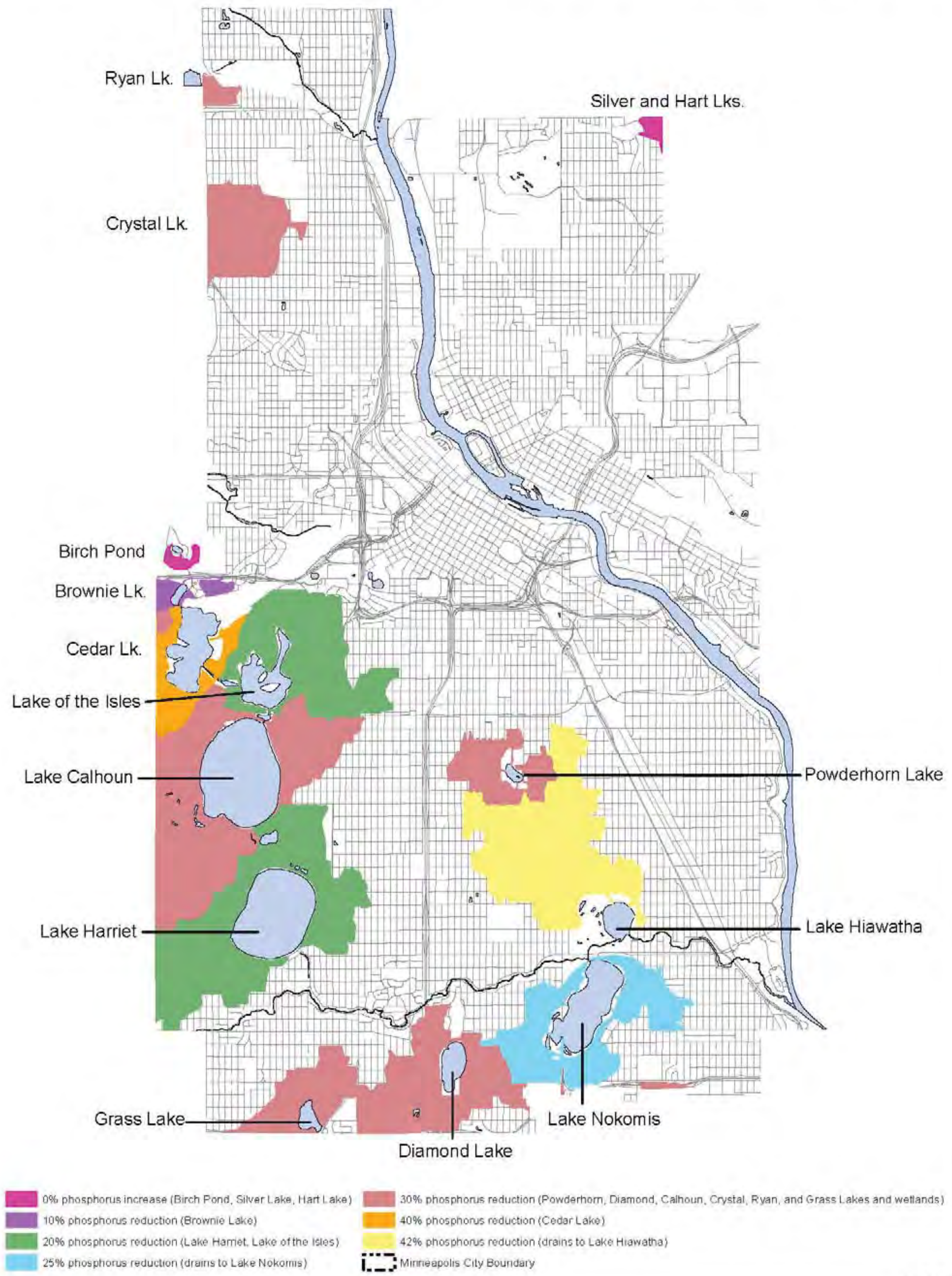



**APPENDIX B-4**

***JUNE 2018***

Minneapolis
City of Lakes

## Appendix B5: Phosphorus Load Reductions for Lakes and Wetlands



**Appendix B6:** Drainage Areas By River/Creeks OR Lakes/Wetlands