NPDES MS4 Phase I Permit No. MN0061018

Annual Report for 2015 Activities

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

June 30, 2016

Minneapolis
City of Lakes

NPDES MS4 Phase I Permit
Annual Report for 2015 Activities

July 31, 2016

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 6/30/2016 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 the File No. 16-00508, adopted by the Minneapolis City Council at a meeting held on June 17, 2016, 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.

IN WITNESS WHEREOF, I have signed and affixed the City seal on June 27, 2016.

Casey Joe Carl, City Clerk

Resolution No. 2016R-244 City of Minneapolis File No. 16-00508

By Reich

Adopting the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase I Permit Stormwater Management Program and Annual Report for 2015 Activities.

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

Whereas, on Jan. 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 7, 2016; and

Whereas, the ANNUAL REPORT FOR 2015 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 2015 ACTIVITIES.

Committee: TPW Public Hearing: 6/7/2016 Publication: JUN 25 2016

RECORD OF COUNCIL VOTE				
MEMBER	AYE	NAY	ABSTAIN	ABSENT
REICH	X			
GORDON	X			
FREY	X			
8. JOHNSON	X			
YANG	X			
WARSAME	X			
GOODMAN	X			
GLIDDEN	X			
CANO	X			
8ENDER	X			
QUINCY	X			
A. JOHNSON				X
PALMISANO	X			
DATE:	JUN 17 2016			

☒ APPROVED ☐ VETOED

MAYOR HODGES

JUN 22 2016

DATE

Certified an official action of the City Council

ATTEST:

CITY CLERK

Presented to the Mayor:	JUN 17 2016	Received from the Mayor:	JUN 23 2016

Acknowledgements

Minneapolis Public Works - Surface Water & Sewers Division

Nico Cantarero

Paul Chellsen

Lane Christianson

Kevin Danen

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Jeremy Strehlo

Karl Westermeyer

Minneapolis Public Works - Transportation Maintenance & Repair

Steve Collin

Minneapolis Health Department - Environmental Services

Tom Frame

Patrick Hanlon

Minneapolis Park & Recreation Board

Rachael Crabb

Michael Perniel

MaryLynn Pulscher

Minneapolis Regulatory Services

Steve Kennedy

Table of Contents

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

Acronyms

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

I. Executive Summary

Report Objective

This Report provides documentation and analysis of the Minneapolis Stormwater Management Program (SWMP) activities conducted during the previous year, 2015. The City and Minneapolis Park & Recreation Board departments that are responsible for the SWMP activities are jointly responsible for the completion of the required Permit submittals. 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 216R-244 was passed on June 17, 2016.

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. The Permit requires the implementation of approved stormwater management activities, referred to Stormwater Management Practices (SMPs), also known as Best Management Practices (BMPs).

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 activities and construction, and this report is related to the municipal program.

As required under the 2011 reissued permit, a new SWMP that describes the City and MPRB SMPs was submitted to the MPCA in September 2011 for review and approval. Subsequent to the MPCA's public comment period on the SWMP, revisions were submitted by the City to MPCA in May 2013, and the MPCA approved the SWMP in 2013. 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 were made and submitted to the MPCA in 2014. The 2014 revisions were primarily responsive to a 3-day field inspection in August 2013 by an EPA Inspection Team. The inspection, or audit, helped to identify opportunities for improvement regarding comprehensive training, written procedures and documentation, and availability of staff resources.

In July 2015, an application for permit reissuance was submitted to the MPCA, as required by the 2011 permit. The application was timely made and was accompanied by an updated version of the SWMP. As of this annual report, the version of the SWMP dated July 22, 2015 is the current version.

II. 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. Targeted pollutants include:

Total Suspended Solids (TSS)

Nutrients

Floatable Trash

Drainage Areas and Discharges

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 population, size of drainage area, land uses, distribution, and runoff coefficients by body of receiving water are listed in Appendix A1.

Program Overview

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

Since 2012, the Operations section has been working on development of an Asset Management System (AMS) to help the City meet water quality targets and regulatory requirements, along with other city objectives. The EPA became aware of the City's AMS project during an inspection audit of the Minneapolis MS4 in 2013, and developed the project as a Case Study, stating "EPA is encouraged by the progress demonstrated by the City and hopes to work with other municipalities and regulators to achieve similar success." (The document titled, "EPA Case Study: City of Minneapolis Stormwater Asset Management System" can be found in the Appendix.) The City's goals in implementing the AMS include:

- Identifying current state of assets and asset attributes (e.g., age, condition, etc.).
- Develop a standardized rating process for assets and asset attributes (e.g., National Association of Sewer Services Companies (NASSCO) Pipeline Assessment and Certification Program (PACP)).
- Identifying risk areas.
- Identifying criticality of system.
- Identify life-cycle costs.
- 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.
- Use 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 authorized staffing level of the Operations section is approximately 106 full-time employees, up from 75 in 2013. This increase is helping to bring about the more proactive approach, including pollution prevention that the City is striving for. Of these, there are currently 70 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.

NPDES MS4 Phase I Permit Annual Report for 2015 Activities

Storm Drain System Operational Management and Maintenance

Previous Year Activities

Some of the noteworthy 2015 cleaning and repair statistics are summarized in the following list:

- Responded to 160 complaints of plugged or backed-up catch basins and cave-ins around catch basins and manholes.
- Cleaned 113.9 miles of storm drain utilizing hydro-jet washing and removed 721 cubic yards of sediment/material
- Televised and condition assessed 100 miles of storm drain pipes
- Performed inspection of 30,000 feet of deep stormwater drainage tunnels
- Continued repairs of 1,200 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.

Removing sediment and eroded sandstone/limestone from 72" storm tunnel

Inspecting a deep drainage tunnel, about 80 ft. underground

Photo of catch basin – an inlet to the storm drain system

Cleaning debris from a plugged catch basin

III. Structural Controls 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 structural controls within the City's storm drain system that affect system flow rates and water quality discharges.

Structural controls include:

- Stormwater Ponds, Bio-(in)filtration (Rain Gardens, Infiltration Trenches)
- Grit Removal Chambers (Hydrodynamic Separators, Sumps, SAFL baffles)
- Outfall Structures
- Pump Stations and Level Control Weirs
- Catch Basins

Targeted pollutants include:

Total Suspended Solids (TSS)

Nutrients

Floatable Trash

Program Overview

Structural controls 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 Minneapolis Park & Recreation Board, 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.

Structural controls are separated into five separate categories:

Stormwater Ponds, Bio-(in)filtration (Rain Gardens, Infiltration Trenches, Sand Filters)

These are structural devices that detain (hold and slowly release) or retain (hold for infiltration or evapotranspiration) stormwater runoff and improve water quality. They are regularly maintained for volume and functionality, and some sites provide park-like amenities including native plantings, turf grass, pathways, benches, and lighting. Based on current level of experience, the need for dredging ponds of sediment buildup appears to be in a 15- to 20-year cycle. The goal is to manage these ponds so they can continue improve stormwater function in the City of Minneapolis and serve as assets to the community and residents that interact with them.

Structural Controls Operational Management and Maintenance

Vegetation Management Goals for Stormwater Ponds and Bio infiltration

- 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
- Public education and awareness
- Create pollinator and wildlife habitat
- Provide a neat appearance

16th Avenue Rain Garden

Grit Removal Structures

These are devices that have been installed for sediment, debris, and oil collection. The City continues with its effort to increase the number of grit chambers installed. The devices are inspected in the spring and fall of each year, and then cleaned, if required. The amount of sediment removed, the presence of floatables, and the dates that devices were cleaned are recorded on log sheets, and then added to a database. Appendix A35 contains a list of these devices, and maintenance dates.

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 where 20% of the outfalls are inspected each year. 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 Duty Officer and 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 A36 contains outfall maintenance information.

Structural Controls Operational Management and Maintenance

Hydrodynamic separator grit chamber being installed

Grit chamber being vacuumed to remove sediments, oil and grease, trash and other debris

Removing invasive plants from stormwater pond at S 37th St and Columbus Av

Large stormwater outfall to Mississippi River

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.

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.

Structural Controls Operational Management and Maintenance

Previous Year Activities

- Maintained 59 stormwater ponds and bio-infiltration facilities.
- Cleaned 120 grit chambers, removing a total of 506 cubic yards of material. The majority of the grit chambers are both maintained and owned/operated by Public Works, however some are owned and operated by others, but cleaned by Public Works under contract.
- Inspected 85 of 455 storm drain outfalls in 2015 inspection program (93 in 2014).
- Monitored and maintained 25 pump stations.

IV. 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

Minneapolis Public Works

Materials are removed from grit removal structures, catch basins, system piping, and deep drainage tunnels. Removed substances are screened for visual or olfactory indications of contamination. If contamination of the material is suspected, the 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 Minnesota Pollution Control Agency (MPCA). Non-contaminated targeted pollutants are disposed of the same way as street sweepings, as reported in **Section VI. Roadways**. During cleaning and disposing operations, erosion control measures are applied when needed to prevent removed material from re-entering the storm drain system.

The process for 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 2015, Minneapolis Public Works crews removed approximately 506 cubic yards of sediment and debris from grit chambers, and approximately 721 cubic yards from storm drains during hydro-jet washing operations.

V. Stormwater Management Requirements for Development/Redevelopment

Program Objective

The objective of this stormwater management program is to minimize the discharge of pollutants through the regulation of construction projects. Regulation includes erosion and sediment control, and approval of stormwater management including ongoing operation and maintenance commitments. Minneapolis Code of Ordinances Title 3 Air Pollution and Environmental Protection, Chapter 52 (Erosion and Sediment Control and Drainage) and Chapter 54 (Stormwater Management) contain erosion and sediment control requirements and stormwater management instructions for developments and other land-disturbing construction activities.

Targeted pollutants include:

Phosphorus

Total Suspended Solids (TSS)

Erosion and Sediment Control

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)*.

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 & 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, demolition and construction sites also require an approved erosion control plan before the ESC Permit can be issued.

Enforcement

Ongoing site inspections are performed by 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

A summary of the 2015 inspections is as follows:

- Permits issued: 388
- Erosion and sediment control cases inspected: 1,832

- Number of inspections completed: 2,880
- Enforcement actions issued for site compliance: 250
- Citations for non-compliance after enforcement action: 77

Construction site inspections also target concrete washout violations

Stormwater Management for Development

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.

The ordinance sets standards according to the receiving 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
- Provision for on-site or regional stormwater facilities
- Maximizing infiltration by minimizing the amount of impervious surface
- Employing natural drainage and vegetation

Stormwater Management Requirements for Development/Redevelopment

Requirements

Redevelopment of existing sites provides an opportunity to lessen the impacts of urbanization on the Mississippi River and other Minneapolis water resources. Stormwater management plans are required for all construction projects on 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. Once constructed and inspected for compliance with approved plans, the BMP stormwater devices are registered with the City of Minneapolis Environmental Services, with an annual permit required for each stormwater device registered. Inspections and document checks are carried out annually or as needed, to ensure that the BMPs continue to function as approved.

Previous Year Activities

During 2015, Minneapolis Public Works took part in the preliminary review of 131 projects. Of those 131 site plans, 96 projects with a total of 75 BMPs received final approval, with the appropriate permits issued. These BMPs will provide rate control and water quality for approximately 58 acres of land, including 50+ 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

Saint Mary's Greek Orthodox Church

Rain Gardens Under Construction

Underground Infiltration Galleries

Pervious Pavement Sub Grade

First Bank Stadium (Minnesota Viking Multi-Purpose Stadium)

144" (12') diameter Corrugated perforated Pipe
Underground Infiltration, Volume Reduction, Rate Control, Suspended Sediment and Phosphorus Removal

Stormwater Management Requirements for Development/Redevelopment

Coloplast Minneapolis Campus 1601 West River Road

Landscaping and Green Swales above Underground Infiltration

VI. 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

BOD_5

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 every year in the spring and fall. At those times, all City streets and alleys are swept systematically, 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.

Roadways

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 most notable activities related to stormwater runoff are operation of sweepers for gutters and sidewalks throughout the 120 block district.

Snow and Ice Control

The 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 reduce costs, required maintenance, and environmental impact. The most obvious cost savings is realized in a reduction of the overall amount of materials used.

Roadways

Reduced material amounts 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.

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. Since then a Twin Cities Metro chloride study by the MPCA is nearing completion. Within Minneapolis, the Shingle Creek chloride TMDL and the metro-wide TMDL applies to the following lakes and creeks:

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

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 2015-2016 winter season began early, with numerous snow events in the early part of the season, ten drier and warmer in the later season. There were 26 notable events with 36.7 inches for the season, as compared to an average of 48 inches. The most snowfall was observed in February. There were two declared snow emergency, compared to the annual average of four, and there were 124 days of temperatures at or below freezing. 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:

- Tons of salt applied to roadways: 5,500
- Tons of sand applied to roadways: 435
- Tons of materials reclaimed during spring and summer street sweeping operations: 13,655
- Tons of leaves collected for composting during the fall citywide sweeping: 4,820
- Staff members attended eight-hour refresher for 40-hour hazardous materials training class: 29
- Staff members attended training on the use of salt as presented by watershed organizations: 6

All division shift–staff attended the annual review of procedures. 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.

Roadways

MPCA Level 1 Certification: Snow and Ice Control Best Practices

The Minneapolis Park and Recreation Board 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).

Performance Measures

- Amount of materials recovered as a percentage of materials applied: 230%
- Amount of salt and sand applied relative to total snowfall: 162 tons/inch

VII. Flood Mitigation

Program Objective

The primary objective of the Flood Mitigation Program is to reduce flood risks and ongoing property damages that occur due to inadequate capacity of the public drainage system. But there are additional benefits to this program that help reduce stormwater runoff pollutant loads. Flood mitigation projects can reduce soil/vegetation washouts and their associated sediment and nutrient loads that would be released. Flood mitigation also reduces exposure of flood flows to pollutants, debris, and organic matter lying around on parking lots, people's lawns, driveways, storage areas, and other areas, including petrochemical products, bacteria, fertilizers.

Targeted pollutants include:

All pollutants

Program Overview

Historically, areas that have experienced localized flooding due to system capacity challenges have been reported by residents or field crews. In 2014, a 3-year plan was initiated to complete detailed hydrologic / hydraulic models of the storm sewer system that will span the entire City. Models developed as a part of this work will be used to better identify, prioritize, and design the City's flood mitigation projects. Expected completion of the modeling effort is currently in early 2018.

Flood mitigation projects have included strategies such as enlarging or rerouting pipes, or installing detention or retention systems. With increasing emphasis on stormwater runoff water quality, flood mitigation projects sometimes incorporate "green infrastructure" to reduce stormwater runoff volumes or reduce pollutant loads discharged to public waters through natural processes that break down pollutants using soil or vegetation.

In addition to the work done under this Program, many other activities performed by the City reduce flood risks. Some of these activities include:

- Operation of backup generators for existing pump stations during power outages
- Inspection and maintenance of catch basin inlets and storm drains that are located within flood-sensitive areas
- Inclusion of various rate control or volume control Best Management Practices (BMPs) on public projects
- City stormwater regulations that require rate control and/or volume control BMPs for most private development projects
- Inspection and maintenance work on major tunnel systems that reduce system failure risks that could lead to flooding

Previous Year Activities

2015 was a continuation of the effort to complete the city-wide models. Multiple larger area models were started including:

The south and east portions of Northeast Minneapolis

All of North Minneapolis from I-394 to the City Limit at 53rd Ave N

These models are planned to be completed in 2016 and multiple other models will be started.

Performance Measures

The primary performance measures for this program are to identify, prioritize, design, and construct flood mitigation projects that are able to reduce the risk of flooding to habitable buildings. While most citizens will measure success by whether there is reduced neighborhood flooding, success is also achieved by reduction in runoff of sedimentation and nutrients from soil/vegetation washout, and exposure to lawn chemicals, pet waste, auto fluids, litter and other products from water flowing over parking lots, lawns, and storage areas. Flood mitigation projects may also improve surface water quality by incorporating stormwater volume control and stormwater treatment features.

VIII. 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 heavily used are the Cowles Conservatory, 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.

MPRB Staff Pesticide Applicator Licensing and Continuing Education

All new hires for position 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, offered and coordinated by the University of Minnesota. This effort is in conjunction with the Agronomy Services Division of the Minnesota Department of Agriculture.

Use of Pesticides and Fertilizers on Park Lands

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

Pesticide Use

Use of pesticides to control turf weeds is not a regular practice of park maintenance. 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 fields are included in the MPRB's General Operating Procedures.

Vegetation Management: Pesticides and Fertilizer Control

The MPRB actively manages Eurasian watermilfoil and purple loosestrife, which are two non-native, invasive plant species. Eurasian watermilfoil, an 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. In its General Operating Procedures, the MPRB has established that no chemical application will be used to control aquatic weeds. Eurasian watermilfoil is mechanically harvested with a permit 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.

The MPRB does use herbicides to control certain problem invasive species in natural areas, but reduces herbicide use through the use of biocontrols on targeted species. The MPRB natural resources staff works with the Minnesota Department of Agriculture to stay current with approved biocontrol methods.

MPRB maintenance and environmental staff use biocontrol in place of pesticides to control purple loosestrife, spotted knapweed and leafy spurge. Purple loosestrife is controlled using a leaf-feeding beetle. Populations of released beetles in Minneapolis parks maintain themselves, thereby eliminating the need for chemical spraying. In particular situations where the biocontrol agent is not as effective in controlling purple loosestrife, hand-pulling is done by volunteers. In 2004, biocontrol was released for two other species: spotted knapweed, with the seed head-eating weevil (Larinus minutus) and the root-eating weevil (Cyphocleonus achales), and leafy spurge with the root-, flower- and foliage-eating black beetle (Aphthona lacertosa).

Common and glossy buckthorn are two woody invasive species controlled in woodlands through herbicide applications. Control of these species is done on a limited basis by Environmental Stewardship staff. Park Maintenance, Forestry and Environmental Operations staff document chemical applications made through our electronic database “PF Manager”.

MPRB staff produce and maintain the necessary records of all pest management activities as required by the Minnesota Department of Agriculture. Annual paper records are kept by the District or Golf Course office. Electronic records of all applications began in 2008.

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 1980’s, following a chemical company fire in north Minneapolis that resulted in the contamination of Shingle Creek.

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, Lawn Fertilizer. Under the ordinance, since 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, except as allowed by Minnesota Statute 18C.60 Phosphorus Turf Fertilizer Use Restrictions. 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 are instructed that no phosphorus can be used for turf fertilization 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.

Previous Year Activities

Staff Pesticide Applicator Licensing and Continuing Education

Currently 179 MPRB employees hold pesticide applicator licenses, through the Minnesota Department of Agriculture (MDA).

Use of Pesticides and Fertilizers on Park Lands

Pesticide Use

The MPRB maintenance and environmental staff continue to reduce the use of pesticides through biocontrol with the purple loosestrife beetle, spotted knapweed weevils, and leafy spurge black beetle. Populations of released purple loosestrife beetles in Minneapolis parks continue to maintain themselves at most sites, thereby reducing the need for chemical spraying.

Fertilizer Use

The MPRB included zero phosphorus turf fertilizers beginning with the 2002 fertilizer bid. This was done in response to the City/State regulation changes regarding phosphorus turf fertilizers. A wide range of fertilizers was offered to allow park maintenance and golf course foremen to pick the highest performing fertilizer (based on soil test results).

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, and the reduction of 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. Additionally, the program 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

By completing projects in each of the above, the golf course receives national recognition as a Certified Audubon Cooperative Sanctuary. MPRB Operations staff, working with all MPRB Golf Course foremen, received the ACSP certification for all courses. Certified courses are Columbia, Gross, Hiawatha, Meadowbrook, and Wirth. MPRB water quality staff conducts yearly water quality and aquatic vegetation monitoring at the courses.

Performance Measures

Currently 179 MPRB staff have a certified pesticide applicator license and 27 MPRB staff have attended classes and obtained a chloride application certificate.

Vegetation Management: Pesticides and Fertilizer Control

Program Overview – City of Minneapolis Properties

The vegetation management policy for the City of Minneapolis stormwater treatement facilities was adapted from the Minnepaolis Park and Recreation Board Integrated Pest Management Policy. This policy addresses goals of the program, policies for herbicide and fertilizer use, management guidelines, and specific selection of management strategies.

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:

- Integrated pest management is not a predetermined set of practices, but a gradual stepwise process for improving pest management.
- 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)
- 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.

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.

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.

Vegetation Management: Pesticides and Fertilizer Control

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.

37th Avenue Greenway

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.

A copy of the city's Vegetation Management Policy can be found in Appendix A16.

Vegetation Management: Pesticides and Fertilizer Control

Prescribed Burns

Prescribed burns are used as a management tool to maintain the health of native plant 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.

Camden Pond Vegitation Management- Burning

Camden Pond - Post Burn

Camden Pond One month after burn

IX. Illicit Discharges and Improper Disposal to Storm Sewer System

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

Typical Hazardous Spill Response

The immediate goals of 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 and 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.

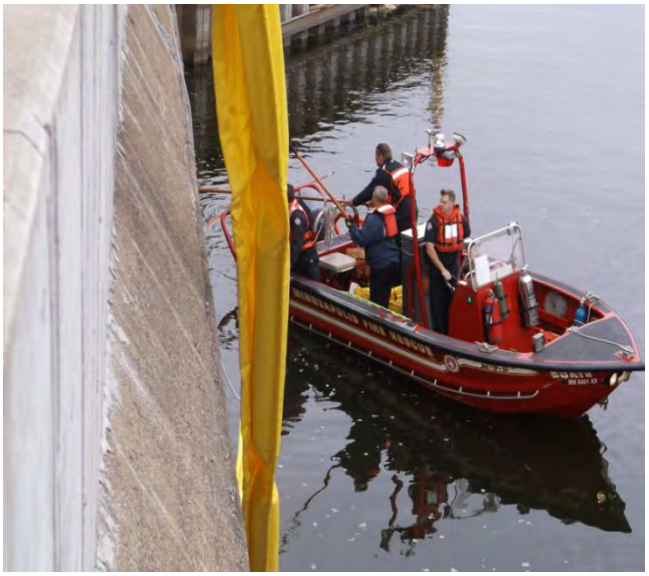
Spills are reported to the MPCA Public Safety Duty Officer, 911 Emergency Communications and, for qualified spills, to the National Duty Officer as required by law.

The protocol used by the Street Maintenance section for handling spills is documented in Appendix 32: 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 level of protection for our precious natural resources.

2015 Boom Deployment Drill



2015 Boom Deployment Drill

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 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.

Previous Year Activities

- Fire Inspection Services responded to 82 Emergency Response requests. 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.
- Conducted 42 days of outfall sampling, 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.
- Responded to 4 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.
- Responded to 1 incident on Minnehaha Creek where containment boom was deployed. Minneapolis Fire Inspection Services, Minneapolis Fire Department, Minneapolis Public Works and the MPCA participated in this effort.
- Responded to 1 spill incident on a Minneapolis lake where spill response equipment was deployed.
- Fire Inspection Services conducted 3 days of formal River Spill Response/Containment Boom Deployment training on the Mississippi River for the Minneapolis Fire Department and Minneapolis Public Works. Spill response strategies and Standard Operating Procedures were discussed; storm sewer outfall map reading was reviewed. Boats and containment booms were deployed at Minneapolis Waterworks to protect the water intakes.
- Minneapolis Fire Inspection Services assisted in a spill response overview of the Mississippi River in Minneapolis for MPCA Emergency Response staff. Boat launches and river points of access, major outfalls, and potential pollution sources were visited. Response boat was deployed and Fire Inspection and MPCA staff reviewed spill response strategies at various outfalls.
- 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.

Illicit Discharges and Improper Disposal to Storm Sewer System

Unauthorized Discharges

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
- Direct contact to Environmental Services staff at 612-673-3867

Previous Year Activities

- Addressed 131 calls for emergency response (containment of spills, chemical dumping, illegal disposal or handling of regulated or hazardous materials). These spills ranged from transformer leaks to spilled automotive fluids.
- Investigated 520 water and land pollution complaints (illegal dumping, improper storage of material, and chemical storage).
- Carried out brownfield maintenance, monitoring and treatment activities. Sites include:
    - Superfund sites
    - Leaking petroleum sites
    - Remediation systems
        - Pump, treat and discharge groundwater
        - Soil venting
    - Wells
        - Monitoring wells – water samples taken to monitor the level of contamination
        - Recovery wells – contaminated groundwater is pumped from the ground. It is typically treated prior to discharge usually to the sanitary sewer.
- Approved 20 limited duration sanitary sewer and storm drain discharge permits.
- Approved 12 temporary water discharge permits.
- Approved 80 storage tank permits:
    - Above ground - 0 abandoned-in-place, 5 installed, 52 removed
    - Underground - 13 abandoned-in-place, 0 installed, 38 removed

Brownfields

At the end of 2015 there were 8 locations with 10 listings that would qualify as superfund sites. Minneapolis is also tracking 15 properties that are identified as petroleum leak sites that require additional work and monitoring before they can be closed. Over the course of 2015 there were several sites where a tank removal or an environmental site investigation identified low level petroleum contamination. These sites were reported to the state duty officer and with additional work were closed within the same calendar year, and not recorded in this number.

For the existing open sites along with voluntary clean-up efforts there are 16 sites with 21 operating remediation systems for cleanup of impacted soils and groundwater. Throughout the city there are 81 properties with 630 active monitoring wells checking the performance of the cleanup activities and site conditions. Samples are obtained from these wells and analyzed for contaminants of concern.

Ongoing chemical storage is occurring at 796 locations with an identified quantity of 1,664 items. The chemical storage areas and the land use activities are monitored to eliminate the risks future site problems.

Permits were issued for specific tasks and projects related to brownfield sites. These tasks and projects were for the maintenance, monitoring and treatment. Overall 188 individual permits were issued.

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 Department 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.

Previous Year Activities

Conducted inspections on 60 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.

Reviewed 352 Emergency Response plans for TIER II Hazardous Materials Facilities. Reviews include hazardous materials storage and spill response plans.

X. Storm Sewer Design for New Construction

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

CSO Program

Overview

In 2015, 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 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.

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 2015, and associated water quality impacts, are referenced in the following table:

PROJECT AREA	PROJECT DESCRIPTION	STORMWATER RUNOFF BENEFITS
CSO Area 7 (Sheridan Ave N &29th Ave N)	Eliminated cross connection from storm to sanitary sewer	Eliminated CSO area of 6.8 acres
CSO Area 160 (Minnehaha Ave &25th St E)	Eliminated cross connection from storm to sanitary sewer	Eliminated CSO area of 0.9 acres
CSO Area 174 (Main St NE & 7th Ave NE)	Eliminated cross connection from storm to sanitary sewer	Eliminated CSO area of 1.26 acres
CSO Area 182 (46th St W & Dupont Ave S)	Eliminated cross connection from storm to sanitary sewer	Eliminated CSO area of 10.27 acres

In addition to separating the sanitary and storm drains, the CSO 7 project installed a hydrodynamic separator to improve water quality of the discharge from the project area.

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.

Previous Year Activities

In 2015, the CSO 7 project was completed. Planning and design were carried out for several projects that are expected to be constructed in 2016.

XI. Public Education and Outreach

Program Objective

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, streams 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 following City of Minneapolis Stormwater web site: http://www.minneapolismn.gov/publicworks/stormwater/.

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

City of Minneapolis Activities and Events

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 also 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 education days and exposure to green career paths, this year's crews worked and learned alongside National Park Service Rangers, Minneapolis Park & Recreation Board gardeners, Three Rivers Park District naturalists, Minnesota Conservation Corps members, and a public artist who celebrates quaking bogs. The team members also toured the City of Minneapolis water treatment plant, met scientists at the St. Anthony Falls Laboratory, and explored the University of Minnesota Monarch Lab.

Public Education and Outreach

In 2015 the Green Team continued to serve as citizen scientists for the Minnesota Dragonfly Society, formerly known as the Minnesota Odonata Survey Project. Each week the teens caught and identified dragonflies at North Mississippi Regional Park. The crew also surveyed Heritage Park. Dragonflies are an indicator species for assessing habitat and water quality in wetlands, riparian forests, and lakeshore habitats. You can read more about the 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.

2015 yielded a number of opportunities for our vegetation management contractor to work with the Green Team. Most of the work WHR did with the Green Team this past season revolved around weed management and mulching across a diversity of sites. Each site offered an opportunity to work with different native plant material, identify invasive species, and learn about various stormwater best management practices. Before each event, WHR provided a tour of the site to discuss the stormwater strategies being used and identified some of the management challenges present. This produced healthy conversations about urban design, stormwater runoff, pollinator habitat, and aesthetic perception of native plantings.

Mulching trees at a stormwater site with staff from Wetland Habitat Restorations, Inc.

WHR hosted the group at their shop and office to show the students the diversity of work that ecological design and restoration embodies. During the visit the Green Team was introduced to the full spectrum of equipment and tools that are used in vegetation management, including the use of Goats as a type of buckthorn management! Working with our contractor also exposed students to the diversity of career paths that are possible with an interest in ecological restoration.

Other summer work sites included Lake Nokomis, Mill Ruins Park, B F Nelson Park, Heritage Park and Sumner Field, Audubon Park, JD Rivers' Children's Garden, Lake Harriet, Minnehaha Park, and Powderhorn Park. The Green Team also worked with staff from Wetland Habitat Restorations, Inc. at several stormwater holding ponds owned by the City of Minneapolis including Camden Central Pond, Central Avenue Pond at Columbia Golf Course, Columbus Ave pond at 37th Street, Heritage Park, and the Park Avenue ponds. The teens removed invasive species and weed trees, picked up trash, and mulched trees and shrub beds

Public Education and Outreach

Educational Sign Installation

The City of Minneapolis has developed a program to install educational signage around public Best Management Practices. Signs have been installed adjacent to Camden Central Pond and Heritage Park. These signs educate the public on the purpose of stormwater ponds, the benefits of shoreland plantings and native plants. Additional signs will be added to highlight unique projects throughout the city.

Camden Central Pond Educational Signage

Heritage Park Educational Signage

Metro Blooms Programs

Ongoing Rain Garden Workshop Program

In 2015, the City and others again sponsored a multi-part stormwater education workshop program conducted by Metro Blooms, a non-profit organization that grew out of the City's Committee on the Urban Environment (CUE). The goals of the workshop program are to reduce stormwater runoff, prevent stormwater pollution that damages our water bodies and improve the environmental and visual quality of the urban landscape. The workshops serve to inform, coach and offer consultation to Minneapolis residents protecting the upper Mississippi River watershed by installing properly designed bio-infiltration areas (rain gardens), redirecting downspouts and using native plants. One of the means of publicizing the workshops is a utility bill insert that reaches most of the approximately 100,000 households in Minneapolis. In 2015, 6 workshops were held within Minneapolis.

Lake Nokomis Neighbors for Clean Water

In 2015, Metro Blooms continued to lead the Lake Nokomis for Clean Water program. The City of Minneapolis was awarded a Clean Water Fund Grant by the Minnesota Board of Water & Soil Resources Competitive Grants Program for this project in 2014, in the amount of $400,000. The Minnehaha Creek Watershed District (MCWD) and Hennepin County are additional project partners, providing funding of $100,000 and $50,000, respectively.

Public Education and Outreach

Metro Blooms is managing the three-year project, which is a major expansion of a 2013 pilot program to engage residents in an initiative to reduce pollutants in stormwater runoff entering Lake Nokomis, one of the most visited lakes in Minnesota, and determined by the State to be impaired due to excessive nutrients. Building on the success of its Powderhorn Neighborhood of Rain Gardens initiative, Metro Blooms conducted an analysis of the sub-watershed to identify priority areas for BMP installations based on drainage pattern, land uses and presence of previously constructed BMPs, and is focusing on reducing runoff and pollutants from residential backyards, rooftops and driveways. WinSLAMM modeling of potential projects demonstrates 90-92% reduction in stormwater volume, TP and TSS from drainage areas. Installations will be paired with education and outreach to property owners focused on long-term benefits of sustainable source control.

Storm Drain Inlet Stenciling

Stenciling of storm drain inlets, also called catch basins, educates the people painting stormwater messages on the storm drains, and also 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, rivers and streams in Minneapolis.

In 2015, the City continued the program by providing self-contained stenciling kits. Each kit contains everything needed to stencil storm drains inlets: stencils, a map with storm drain inlet (catch basin) locations, stenciling paint, traffic cones, facemasks, a broom for prepping the site, latex gloves and trash bags, safety vests and glasses, and door hangers to explain the stenciling to area residents. By providing educational stormwater door hangers to distribute to residents, dialogue is encouraged between the stencilers and people who live nearby.

The stencils are specific to the type of receiving waterbody, thus referring to “Mississippi River”, “lake”, or “creek” as the case may be. The City has three versions of the “Mississippi River” stencils: in English, Spanish and Somali languages. The “lake” and “creek” stencils in were only available in English, but Spanish and Somali versions may be added.

Safety of the volunteers is very important, so we encourage groups to stencil on low volume streets, and we provide traffic cones and safety vests. If children are part of the group, we request that an adult be present at all times to supervise. The trash bags and gloves are used by the volunteers to pick up trash in the areas around the storm drain inlets, especially on the uphill side. Efforts of the organizations doing the stenciling are tracked, including maps of the target areas, the locations and numbers of the stenciled catch basins, the number of volunteers, and the number of door hangers distributed.

Public Education and Outreach

2015 Activities:

- Participants: 564
- Catch basins painted: 1,371
- Bags of trash and debris collected: 52
- Door hangers distributed 2,586

Volunteers can visit the following web site:

http://www.minneapolismn.gov/publicworks/stormwater/stenciling

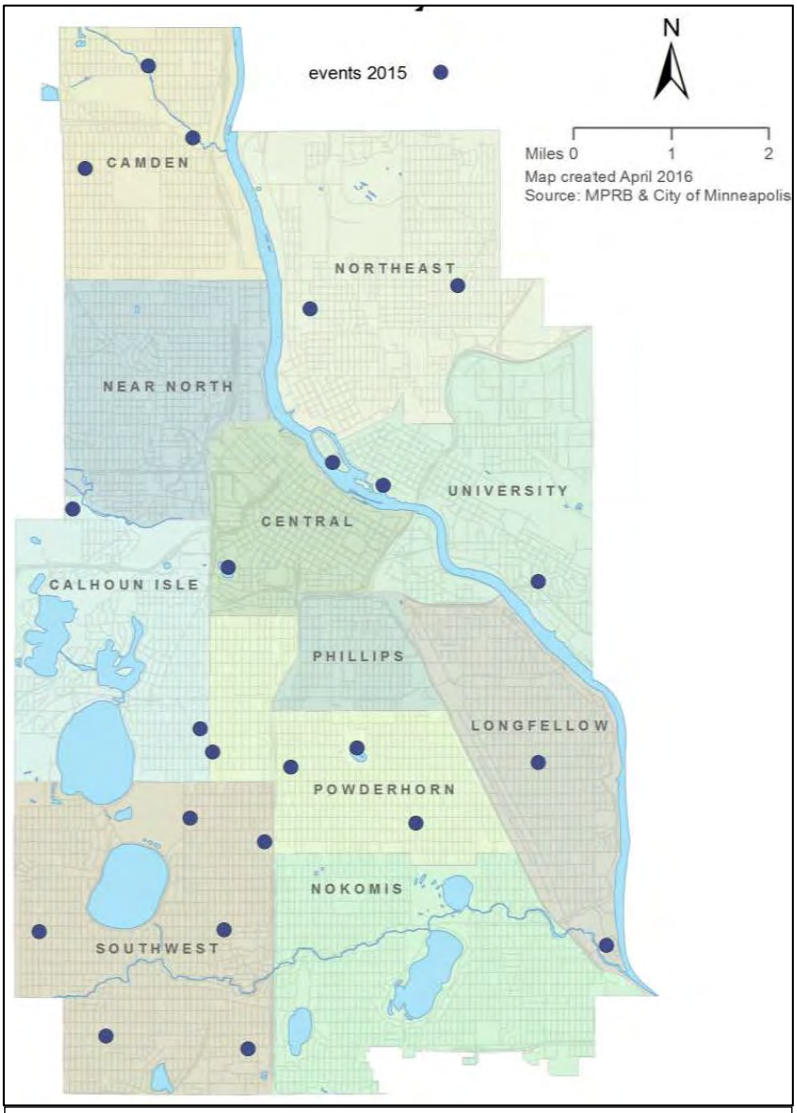
Public Education and Outreach

Minneapolis Park & Recreation Board Education Activities and Events

In 2015, Minneapolis Park & Recreation Board (MPRB) staff provided water quality education programs throughout the City. Environmental Management naturalist staff participated in 58 Minneapolis community festivals, neighborhood events, as well as concerts and movies (locations are listed 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, an aerial photo floor graphic of the city and its watersheds, and other hands learning activities.

2015 list of parks that had water-quality education program events. Several sites hosted multiple events.

- Armatage Park
- Bottineau Park
- Bryant Square Park
- Central Park Gym
- Creekview Park
- Father Hennepin Bluffs Park
- Fuller Park
- Longfellow Park
- Loring Park
- Luxton Park
- Lyndale Park
- Minnehaha Falls Park
- Martin Luther King Park
- Nicollet Island Park
- Painter Park
- Pershing Park
- Powderhorn Park
- Sibley Park
- Theodore Wirth Park
- Webber Park
- Windom NE Park
- Windom S Park
- Victory Memorial Park



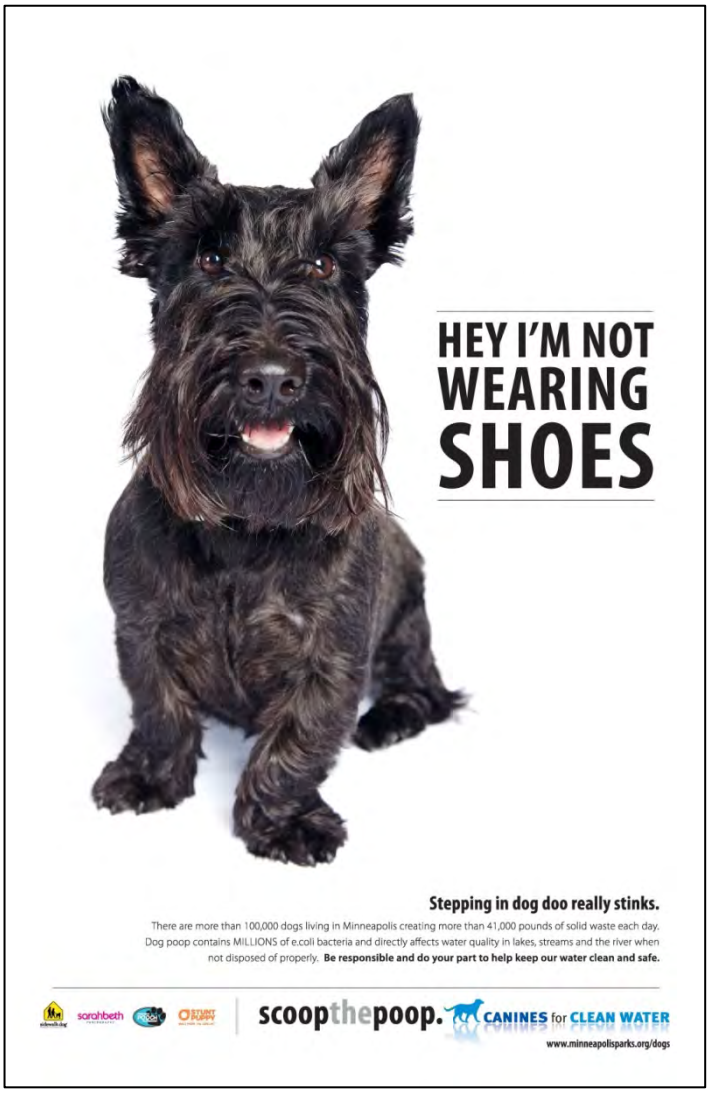
Water Quality Education Sites (many of these sites represent multiple events)

Public Education and Outreach

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 2015 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. However, detailed information about chlorides, their impacts, best practices for distribution was found on the Minneapolis Park & Recreation Board website www.minneapolisparks.org/dogs The same was true for information about the impact of dog poop on water quality.



Public Education and Outreach

Lake Calhoun

A new moveable water quality education exhibit was deployed at Lake Calhoun near Tin Fish, a very popular lakeside restaurant. The spinning cubes (see image) provides 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 interacted with the cubes.

Greening Teen Teamworks

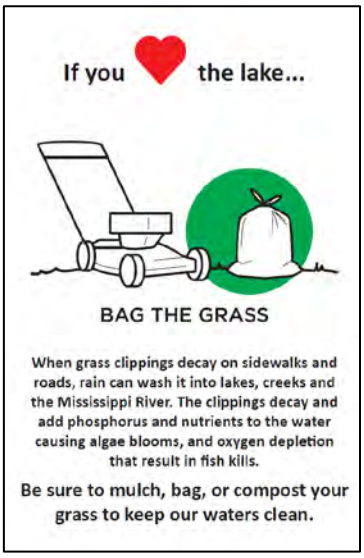
Teen Teamworks is a summer youth employment program managed by the Minneapolis Park & Recreation Board for 30+ years. Teen Teamworks hires and trains 250 to 300 youth each summer to assist in park maintenance work for 8 to 10 weeks depending on available funding. Two MPRB education staff are assigned to work with the site supervisors and teen crews to provide weekly instruction about storm water runoff, water quality, and actions that should be taken to help keep our lakes, creeks, and river healthy. These site-based crews are charged with keeping the park's storm drains clear and curblines picked up, and at parks with waterbodies, the crews remove debris from outlets and tidy up shorelines. Crews are required to create a project that demonstrates what they've learned about water quality; these projects have included posters, small exhibits, photo collages, short videos, and even a song. As part of the program participants must complete a pre and post knowledge test. Results show that teens and supervisors increase their knowledge and understanding of water quality, watersheds, runoff, and positive actions that benefit our lakes, creeks, and river. The program is funded by the Mississippi Watershed Management Organization.

Ongoing Education Efforts

During 2015 water quality education staff met with managers of local hardware stores to determine their interest and willingness to participate in a winter education campaign focused on reducing chloride use. Based on their input, MPRB will be designing and fabricating floor graphics that show a typical sidewalk panel and the correct amount of salt/de-icer to apply. The floor graphic will be placed in the hardware store aisle that features de-icer and chlorides. Some store managers also agreed that they could direct check-out staff to place an educational sticker onto each bag of chlorides sold. These items will be fabricated in the summer of 2016 for distribution in October.

The MPRB is currently engaged in an extensive Aquatic Invasives Species (AIS) Inspection Program at the public boat launches located at Lakes Calhoun, Harriet, and 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 also serves as an information source for the park visitors. During 2015 small sandwich boards were placed adjacent to the AIS booth. The boards had hand written information about the lake and how to be a good water steward. Based on the positive feedback from park visitors, including a lot of "I didn't know that", a set of changeable signs have been created with stewardship messages for use in 2016. 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.

Public Education and Outreach



Training

Two MPRB full time staff completed the introductory and advanced courses for Fostering Sustainable Behavior Community-Based Social Marketing (CBSM) led by Douglas McKenzie-Mohr. To quote from McKenzie-Mohr's website, "**CBSM is an approach to achieving broad sustainable behavior in our communities. It combines the knowledge from psychology and social marketing to leverage community members' action to change behavior. CBSM is more than education; it is spurring action *by* a community and *for* a community".** Community-based social marketing is composed of four steps: uncovering barriers to behaviors and then, based upon this information, selecting which behavior to promote; designing a program to overcome the barriers to the selected behavior; piloting the program; and then evaluating it once it is broadly implemented (McKenzie-Mohr & Smith, 1999). The MPRB's goal is to utilize CBSM in future water quality education efforts.

Earth Day Watershed Clean-Up Event

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.

Earth Day at Lake Calhoun

Public Education and Outreach

The annual Minneapolis Earth Day Clean-Up is held at several sites throughout the City of Minneapolis. It is a collaborative effort between the Minneapolis Park & Recreation Board (MPRB) and City of Minneapolis Solid Waste and Recycling. The 2015 event featured 38 sites across Minneapolis with more than 1800 volunteers helping to pick up and beautify the park system. Volunteers collected an impressive 8,480 pounds of trash, 620 pounds of recycling and 1,460 pounds of metal. In addition Earth Day participants received education in properly sorting recyclables, trash and organics as well as the opportunity to participate in naturalist led programs or to build their own bird house.

SITE	ADDRESS
Bassett Creek	SE Corner of Penn Ave. N. and 1 1/2 Ave. N
Bluff Street	20 20th Avenue South
Bryant Square Park	3101 Bryant Ave S
Cedar Lake	Cedar Lake Pkwy & 25th St. W
Columbia Park	Columbia Pkwy & 35th Ave NE
Creekview Park	5001 Humboldt Ave. N
Dairy Queen	4719 Lyndale N
East River Pky	E River Pkwy & Franklin Ave.
Farview Park	621 29th Ave. N
Father Hennepin Bluffs	100 6th Ave. SE
Gluek Park	1926 Marshall St. NE
Heritage Park	10th Ave. N and Van White Memorial Parkway
Kenny Park	1328 58th St. W
Kenwood Park	2101 Franklin Ave. W
Lake Calhoun East	Corner of W Lake St. & E. Calhoun Parkway
Lake Calhoun West	W 32nd St. and Calhoun Parkway
Lake Harriet	4135 Lake Harriet Parkway, Band Shell parking lot
Lake of the Isles East	W 27th St and E Lake of the Isles Parkway
Loring Park	1382 Willow Street
Lynnhurst Park	1345 W Minnehaha Parkway
Martin Luther King Jr. Park	4055 Nicollet Ave. S
McRae Park	906 47th St. E
Lake Nokomis	2401 E Minnehaha Parkway
Pearl Park	414 Diamond Lake Rd. E
Pershing Park	3523 48th St. W
Powderhorn Park	3400 15th Ave. S
Riverside Park	2700 8th St S
Sibley Park	1900 40th St. E
Stewart Park	2700- 12th Ave. S.

Todd Park	5600 Chicago Ave S
Theodore Wirth Park	3200 Glenwood Ave., Wirth Beach parking lot
W River Pkwy at 17th	W River Parkway & 17th Ave
W River Pkwy at 24th	W River Parkway & 24th St.
W River Pkwy at 36th	W River Parkway & 36th
W River Pky 44th	W River Parkway & 44th
Waite Park	1810 34th Ave. NE
Mill Ruins Park	420 1st Street South
Whittier Park	425 W. 26th St.

Earth Day volunteer sign-in at Lake Calhoun

Earth Day volunteers at Shingle Creek

Public Education and Outreach

Web sites

STORM & SURFACE WATER MANAGEMENT – The City provides the following primary web site for information about Storm and Surface Water Management:

http://www.minneapolismn.gov/publicworks/stormwater/index.htm

ENVIRONMENTAL SERVICES – The City's Environmental Services section maintains the following web site for additional information about its initiatives and programs:

http://www.minneapolismn.gov/environment/index.htm

STORMWATER MANAGEMENT PROGRAM and ANNUAL MS4 REPORT – The City and MPRB work with local watershed organizations and other partners to fulfill the requirements of the City's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit. The Stormwater Management Program and current and prior annual reports can be reviewed at the following web site to provide education to interested parties:

http://www.minneapolismn.gov/publicworks/stormwater/stormwater_npdesannualreportdocuments

LOCAL SURFACE WATER MANAGEMENT PLAN – This document is a key component of the City's comprehensive plan, The Minneapolis Plan For Sustainable Growth:

http://www.minneapolismn.gov/publicworks/stormwater/stormwater_local-surface

REGULATORY CONTROLS OF SURFACE WATER MANAGEMENT – The City of Minneapolis provides information regarding pesticides, fertilizers, illicit discharges, improper disposal and other water quality issues via the following City web site:

http://www.minneapolismn.gov/publicworks/stormwater/stormwater_regulatory-controls

FLOOD MITIGATION INFORMATION – The City web site provides educational information regarding flood mitigation. For information on flooding and safety precautions, the following web site can be viewed by interested parties:

http://www.minneapolismn.gov/publicworks/stormwater/flood/index.htm

COMBINED SEWER OVERFLOW – (CSO) PROGRAM – The City maintains a web site to educate Minneapolis residents and property owners about the City's CSO program to eliminate Combined Sewer Overflows:

http://www.minneapolismn.gov/publicworks/stormwater/cso/

MINNEAPOLIS STORMWATER UTILITY FEE and BEST MANAGEMENT PRACTICES (BMPs) – As a component of the City's Stormwater Utility Fee, the City web site encourages the implementation of various Best Management Practices (BMPs) such as rain gardens, rain swales and pervious pavement that would reduce the overall amount of impervious surface area throughout the City. These practices would also filter and cleanse stormwater.

http://www.minneapolismn.gov/publicworks/stormwater/fee/stormwater_fee_stormwater_faq

The City also maintains a link to the following MPCA web site where numerous BMP suggestions are available for implementation at various scales:

Minnesota Stormwater Manual: http://stormwater.pca.state.mn.us/index.php/Main_Page

PUBLIC EDUCATION & OUTREACH – Additional information about how the City and MPRB advance stormwater education activities can be found at the following web sites:

City of Minneapolis – http://www.minneapolismn.gov/publicworks/stormwater/stormwater_outreach

Minneapolis Park & Recreation Board - https://www.minneapolisparks.org/

EROSION and SEDIMENT CONTROL EDUCATION for CONTRACTORS and DEVELOPERS

During Minneapolis Development Review and the Site Plan Review processes, and during on-site inspections, Public Works and Environmental Services personnel provide Erosion and Sediment Control (ESC) guidance to contractors and developers. This guidance includes information regarding the City's ordinances, and local, state and federal regulations.

http://www.minneapolismn.gov/publicworks/stormwater/erosion/index.htm

XII. Public Participation Process

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 MPCA re-issued Municipal Separate Storm Sewer System (MS4) NPDES Permit No. MN0061018 to the City of Minneapolis and the MPRB as co-permittees in January 2011.

The Permit requires the implementation of approved stormwater management activities, referred to as Best Management Practices (BMPs). A new Stormwater Management Program (SWMP), documenting the structural and non-structural Best Management Practices used by the City and the MPRB was submitted to the MPCA for public comment and approval in September, 2011 and revised and finalized in May 2013. Additional revisions were made in July 2015. The SWMP is at the following web site:

http://www.ci.minneapolis.mn.us/www/groups/public/@publicworks/documents/webcontent/wcms1p-144838.pdf

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 7, 2016 at 9:30 AM in Council Chambers, Room 317 City Hall, 350 S 5th Street, Minneapolis, MN. The slide presentation is available at the following web site:

http://www.minneapolismn.gov/www/groups/public/@clerk/documents/agenda/wcmsp-181126.pdf

A notice of the 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 10, 2016. A list of the notice recipients is below.

The notice explained that emails or faxes 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 at http://www.minneapolismn.gov/publicworks/stormwater/stormwater_npdesannualreportdocuments.

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 being submitted along with the Annual Report. The revisions are primarily responsive to a 3-day field inspection in August 2013 by an EPA Inspection Team. The inspection, or audit, helped to identify opportunities for improvement regarding comprehensive training, written procedures and documentation, and availability of staff resources.

Performance Measures

Number of interested parties that were directly notified of public hearing, Stormwater Management Program (SWMP) availability, and proposed SWMP changes: 98 (includes 81 neighborhood organizations) (list follows)

Public Participation Process

ORGANIZATION	EMAIL ADDRESS	CONTACT PERSON
Bassett Creek Watershed Management Commission	Laura.jester@keystonewaters.com	Laura Jester
Blue Water Association	sheila62sdmn@yahoo.com	Sheila Cracraft-Fehler
Citizens Environmental Advisory Committee	jen.wendland.kader@gmail.com	Jen Kader
Clean Water Action	Gayle.prest@minneapolismn.gov mzellar@cleanwater.org	Gayle Prest Marie Zellar
Friends of the Mississippi River	wclark@fmr.org	Whitney Clark
Hennepin County Environmental Dept	randy.anhorn@hennepin.us	Randy Anhorn
Metropolitan Council Environmental Services	judy.sventek@metc.state.mn.us	Judy Sventek
(all) Minneapolis Neighborhood Organizations	Bob.Cooper@ci.minneapolis.mn.us	c/o Bob Cooper, CPED
Minnehaha Creek Watershed District	lerdahl@minnehahacreek.org	Lars Erdahl
MN Center for Environmental Advocacy	ksigford@mncenter.org	Kris Sigford
MN Dept of Agriculture, Pesticide Mgmt	ron.struss@state.mn.us	Ron Struss
MN Dept of Natural Resources, Ecological and Water Resources Division	steve.hirsch@.state.mn.us Kate.drewry@state.mn.us	Steve Hirsch Kate Drewry
MN Dept of Transportation, Water Resources	beth.neuendorf@state.mn.us	Beth Neuendorf
MN Environmental Partnership	stevemorse@mepartnership.org	Steve Morse
Mississippi River Revival	solomonsimon@hotmail.com	Sol Simon
Mississippi Watershed Management Organization	dsnyder@mwmo.org	Doug Snyder
St. Paul, City of	anne.weber@ci.stpaul.mn.us	Anne Weber, Sewer Utility
Shingle Creek Watershed Mgmt. Commission	judie@jass.biz	Judie Anderson

XIII. Coordination with Other Governmental 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: Bassett Creek Water Management Commission, Mississippi Watershed Management Organization, Minnehaha Creek Watershed District, and Shingle Creek Watershed Management Commission. Coordination activities and partnerships with other governmental entities also include MnDOT, Hennepin County, MPCA, 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 Third Generation Plan in 2006. In 2015 the watershed began planning its next generation plan. Minneapolis and other district cities' staff have been 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 Other Governmental Entities

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 2012-2015 creek restoration project was primarily funded by the Bassett Creek Watershed Management Commission, and was implemented by the City and the MPRB.
    - 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 and the BCWMC.
- The MPRB coordinates with the watershed organizations and the Metropolitan Council on watershed outlet monitoring.

Coordination with Other Governmental Entities

- 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: https://www.pca.state.mn.us/water/minnesotas-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.
- In 2015 Minneapolis partnered with the Minnehaha Creek Watershed District to publish a planning guide for cities, based on the Weather – Extreme Trends: A Stormwater Adaptation Study. The city participated in the 2013-2014 study, for which a team of academic principal investigators used downscaled global circulation models to quantify the impacts of projected precipitation trends and land cover changes on stormwater infrastructure, and explore community climate change adaptation strategies, using a fully developed portion of Minneapolis and the developing city of Victoria MN as case studies. The project was funded by the National Oceanic and Atmospheric Agency (NOAA).
    - Weather Extreme Trends Study:
        - http://www.minnehahacreek.org/project/weather-extreme-trends
    - Planning Guide:
        - http://minnehahacreek.org/sites/minnehahacreek.org/files/Community%20Adaptation%20Planning%20for%20Changing%20Landscapes%20and%20Climate_digital.pdf

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.

XIV. Stormwater Monitoring Results and Data Analysis

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.

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, *E. coli* monitoring following the MPCA's inland lakes standard is carried out at the MPRB's 12 official beaches located on six lakes, 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). *Escherichia coli* commonly referred to as *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.

2015 Water Resources Report

The Minneapolis Park & Recreation Board's annual ***2015 Water Resources Report*** is a comprehensive technical reference of water quality information for the citizens of Minneapolis. Due to the its length, only the NPDES stormwater runoff monitoring and BMP monitoring sections are included in this NPDES MS4 Annual Report, later in this Section. (In prior years, they have appeared as Appendices A4 and A5 of the Annual Report). The *2015 Water Resources Report* will be available electronically mid-2016 on the MPRB web page at www.minneapolisparks.org. The whole report can be found in the "Park Care – Water Resources" section of the website. Reports are also available from the Minneapolis public libraries archive department.

Minneapolis Lake Trends

In 2015, MPRB scientists monitored 13 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. Changes in lake water quality can be tracked by looking for trends in TSI scores over time. 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.

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

Lakes with Increasing Water Quality Indicators	Lakes with Stable Trends	Lakes with Decreasing Water Quality Indicators
Lake Calhoun	Brownie Lake	
Lake Nokomis	Cedar Lake	
Wirth Lake	Grass Lake	
	Lake Harriet	
	Lake Hiawatha	
	Lake of the Isles	
	Loring Pond	
	Powderhorn Lake	
	Spring Lake	

Lakes Calhoun, Nokomis, and Wirth have all seen a significant improvement in water quality indicators since the early 1990s (linear regression, $p < 0.1$). Although Calhoun's water quality is improved from the early 1990s, TSI scores have stabilized in the last 10 years. Lake Nokomis has seen a large improvement in water quality in the past few years following a biomanipulation project. 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.

Most of the Minneapolis lakes have no directional trend in water quality indicators since the early 1990s. The water quality in Cedar Lake showed improvement following restoration efforts through the late 1990s but has shown a slow decline since; however, current TSI scores are still below levels in the early 1990s. Lake Harriet experienced a few years with lower TSI scores following a littoral alum treatment in the mid-2000s, but has returned to values similar to the 1990s and remains stable. Lake Hiawatha is heavily influenced by the inflow from Minnehaha Creek. The TSI scores in Lake Hiawatha have remained stable over the past 24 years, but the lake has poorer water quality during drought years. The water quality in Lake of the Isles varies from year to year, 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. There is a recent trend towards worse water quality in the past six years. The water quality in Spring Lake is variable, but there is no significant trend in any direction since 1994.

Diamond Lake and Grass Lake are not included in this analysis, since TSI scores are only appropriate for deeper lake systems and there are no water clarity measurements available in these lakes. There are no lakes in Minneapolis with significant decreases in water quality indicators since the early 1990s (linear regression, $p < 0.1$).

NPDES Land Use Sites Monitoring Results (Stormwater Runoff Monitoring)

In 2015, stormwater runoff monitoring was carried out at four management 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.)

Stormwater Monitoring Results and Data Analysis

A. Background

The Minneapolis Park and Recreation Board (MPRB) and the City of Minneapolis are co-signatories on the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit. The MPRB has performed the NPDES MS4 stormwater monitoring since 2000. The purpose of the stormwater monitoring is to characterize the quantity and pollutant load of runoff from small areas representing various types of land use under a "no BMP" scenario. In reality, the results do not represent actual conditions for either runoff quantity or quality because there are numerous BMPs – Best Management Practices and other structural controls and management practices that reduce pollutants in stormwater runoff and/or temper stormwater runoff quantity in the 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. 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.

In 2015, the same four sites, representing the major land uses in Minneapolis -- residential, commercial/industrial, mixed use, and parkland -- were monitored for stormwater runoff quantity and quality. Representative sampling is mathematically extrapolated to calculate potential contaminant loading on a citywide scale, under the "no BMP" scenario. While the results do not represent actual impacts of stormwater discharge to receiving waters because they do not reflect the effects of structural controls and management practices, they nevertheless are useful to compare land uses and to posit baseline conditions for water quality modeling exercises.

B. 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 with low profile area/velocity pressure transducer probe, 2105 interface module, 2105ci or 2103ci cell phone modem, and a 3700 sampler. The 3700 sampler collected stormwater through 3/8" ID vinyl intake tubing complete with 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 network server database Monday through Friday. Each site could also be communicated with remotely by Flowlink Pro software in order to adjust pacing, enable or disable samplers, and see if a site had triggered.

Equipment installation began when freezing spring temperatures were no longer a concern in order to prevent area velocity transducer damage. See **Figure 14-1** for a map of site locations. Site 6 (22nd/Aldrich) was installed on 4/27/15. Site 7 (14th/Park), was installed on 4/21/15. Site 8a (Pershing Park) was installed on 4/23/15. Site 9 (61st/Lyndale) was installed on 4/22/15. See **Table 14-1** for site characteristics.

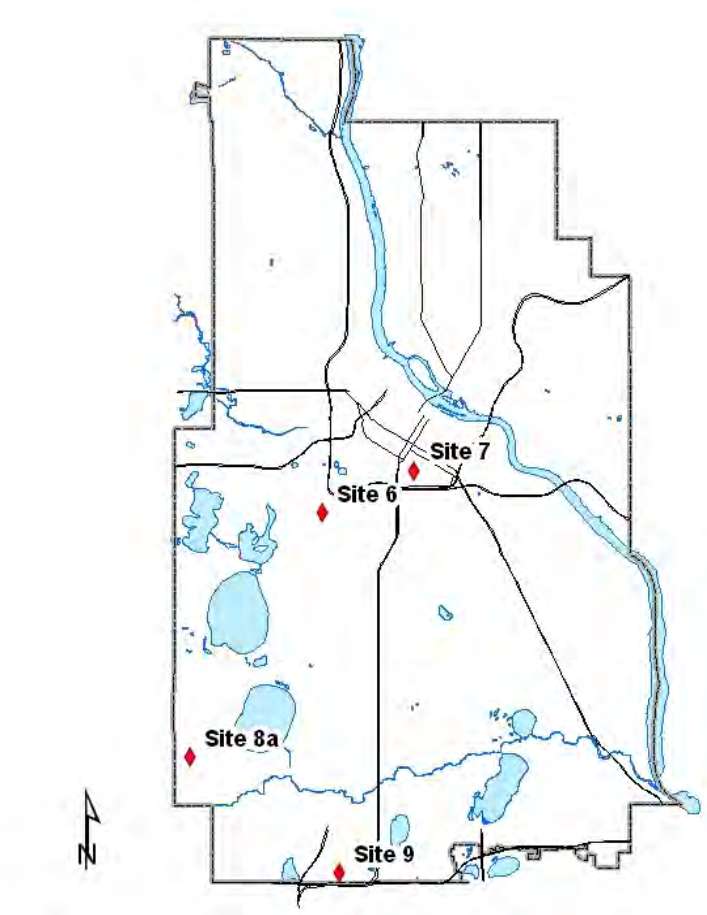


Figure 14-1 Map of the 2015 NPDES Sites Located within Minneapolis

Table 14-1. 2015 NPDES stormwater monitoring sites for Minneapolis.

Site ID	Site 6	Site 7	Site 8a	Site 9
Location	22nd St & Aldrich Ave S	E 14th St & Park Ave S	Pershing Field east of 49th St & Chowen Ave	335 ft. east of 61st St & Harriet Ave S
Land Use	Multi–Family Residential	Commercial/Industrial/ High Rise Residential	Recreational/Parkland	Commercial/Industrial
Area (acres)	8.9	13.1	2.5	34.9
Pipe Diameter (inches)	18	42	12	36
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 is 15 samples per site, per year. If a sample was missed during one month due to lack of precipitation events, then two or more were taken the next month. In 2015, flow-paced storm event samples were collected from May through early November.

The total volume sampled for each site and total recorded volumes in 2015 are given in **Table 14-2** along with the seasonal aggregate percentage sampled. Detailed information on sampling events is shown in **Table 14-3**.

Table 14-2. NPDES site volume totals for the sampling period 5/7/15 – 10/31/15.

	Site 6	Site 7	Site 8a	Site 9
Total volume recorded (with Flowlink) for 2015 (cf)	200,637	880,892	72,779	1,550,345
Total volume of sampled events (cf)	130,921	350,914	42,833	790,220
% sampled ANNUAL	65%	40%	59%	51%
% sampled SPRING (May- June)	30%	48%	7%	41%
% sampled SUMMER (July- September)	40%	34%	90%	44%
% sampled FALL (October- November)	29%	18%	3%	14%

Table 14-3. 2015 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.

Event	Start Date/Time		End Date/Time		Precip (inches)	Duration (hours)	Intensity (in/hr)	Time since last Precip. (hours)	Sample Type	2015 NPDES Events Collected			
										Site 6 22nd/Aldrich	Site 7 14th/Park	Site 8a Pershing	Site 9 61st/Lyndale
+1	1/26/2015	14:00	n/a	n/a	n/a	n/a	n/a	n/a	grab	X(w/Ecoli)	X(w/Ecoli)		X(w/Ecoli)
+2	2/24/2015	13:30	n/a	n/a	n/a	n/a	n/a	n/a	grab	X(w/Ecoli)	X(w/Ecoli)		X(w/Ecoli)
+3	3/9/2015	13:45	n/a	n/a	n/a	n/a	n/a	n/a	grab			X(w/Ecoli)	
4	5/7/2015	6:00	5/8/2015	2:45	0.10	20.75	0.005	26	composite				X
5	5/10/2015	12:30	5/11/2015	1:15	0.70	12.75	0.05	58	composite	X			X
6	5/14/2015	7:45	5/14/2015	23:00	0.33	15.25	0.02	78	composite	X(lmtd)	X		X
7	5/24/2015	2:45	5/25/2015	9:15	0.72	30.5	0.02	150	composite	X(lmtd)	X(lmtd)	X(lmtd)	X(lmtd)
8	5/26/2015	10:15	5/27/2015	12:30	1.19	26.25	0.05	25	composite	X(w/Ecoli)	X(w/Ecoli)	X	X(w/Ecoli)
9	5/29/2015	3:15	5/29/2015	4:30	0.29	1.25	0.23	39	composite	X(lmtd)	X	X(lmtd)	X
10	5/29/2015	14:30	5/29/2015	21:30	0.28	7	0.04	10	composite	X(lmtd)	X(lmtd)	X(lmtd)	X(lmtd)
11	6/3/2015	8:15	6/3/2015	20:15	0.72	12	0.06	107	composite	X	X	X	X
12	6/6/2015	23:30	6/7/2015	0:00	0.32	0.5	0.64	75	composite	X(lmtd)	X(lmtd)	X(lmtd)	X(lmtd)
13	6/11/2015	4:45	6/11/2015	15:45	0.31	11	0.03	101	composite	X	X		
14	6/17/2015	13:45	6/17/2015	14:15	0.16	0.5	0.32	142	composite			X(lmtd)	
15	6/20/2015	5:45	6/20/2015	8:15	0.39	2.5	0.16	64	composite	X(lmtd)	X(lmtd)		
16	6/22/2015	7:00	6/22/2015	16:15	1.52	9.25	0.16	47	composite	X	X		
17	7/12/2015	23:30	7/13/2015	10:00	1.65	10.5	0.16	155	composite	X		X	
18	7/15/2015	7:00	7/15/2015	17:00	0.13	10	0.01	45	composite			X	
19	7/17/2015*	0:00	7/18/2015	3:00	0.87	4	0.22	28	composite	X(lmtd)	X(lmtd)	X(lmtd)	X(lmtd)
20	7/24/2015	3:15	7/24/2015	6:45	0.47	3.5	0.13	202	composite			X(lmtd)	
21	7/28/2015	6:15	7/28/2015	12:15	1.49	6	0.25	95	composite	X(Ecoli only)		X	X(w/Ecoli)
22	8/16/2015	17:30	8/17/2015	4:00	0.62	10.5	0.06	229	composite	X	X	X	X
23	8/18/2015	10:15	8/19/2015	12:30	0.87	26.25	0.03	15	grab		X(Ecoli only)		
24	8/22/2015	18:00	8/22/2015	21:00	0.29	3	0.10	77	grab	X(lmtd)	X(lmtd)	X(lmtd)	X(lmtd)
25	9/16/2015	19:45	9/17/2015	17:30	0.88	21.75	0.04	153	composite	X(Ecoli only)	X(Ecoli only)		X(Ecoli only)
26	9/18/2015	16:30	9/18/2015	22:15	0.27	5.75	0.05	23	comp/grab			X(lmtd)	
27	10/8/2015	3:45	10/8/2015	8:15	0.29	4.5	0.06	320	composite	X	X	X	X
28	10/23/2015	5:00	10/24/2015	2:30	1.63	21.5	0.08	357	composite		X(lmtd)	X(lmtd)	X(lmtd)
29	10/27/2015	18:30	10/31/2015	10:30	1.19	88	0.01	88	composite	X(lmtd)	X		X
			Totals		**17.68**					**21**	**20**	**18**	**19**

+ snowmelt event

n/a = not applicable

X = event sampled with full parameters

X(lmtd) = event sampled with limited parameters generally due to holding times e.g.BOD, Ortho P, and TDP

X(w/Ecoli) = event sampled with *E. coli*

X(Ecoli only) = only *E. coli* sampled

*NWS data collected at MSP airport

Table 14-4 shows the parameters tested as part of the MS4 permit for each sample collected. **Table 14-5** gives the approved methods used for analysis, reporting limit, and holding time for each parameter as reported by the contract laboratory Instrumental Research, Inc. (IRI). Legend Technical Services Laboratory analyzed all metals samples.

Limited parameter sample designation is when the sample is analyzed after some of the parameters (e.g. BOD, TDP) holding times have expired and those parameters are not analyzed. In 2015, limited parameters were collected nineteen times. These samples were recovered after more than 24 hours and parameters with short holding times were not analyzed (e.g. cBOD, TDP) or there was limited composite volume.

As required by the MS4 permit, *Escherichia Coli* (*E. coli*) grab and pH samples were collected by quarterly sampling. *E.coli* was collected annually at all sites except at Site 8a (Pershing). Site 8a was inaccessible for grab sampling after snowmelt and equipment installation. When flow and time were sufficient, *E. coli* grab samples were collected. A total of sixteen *E. coli* grabs were collected in 2015. Site 6 (22nd/Aldrich), Site 7 (14th and Park), and Site 9 (61st and Lyndale) were each collected five times. Site 8a (Pershing) was collected once. If the pH was measured in the field it was using an Oakton Waterproof pHTestr 2™ or it was performed at the IRI laboratory. If the Oakton field meter was used, the pH meter was calibrated with 2-point calibration prior to each sampling trip.

With the exception of Site 8 (Pershing) all required *E. coli* grab and pH sampling was successfully accomplished in 2015.

Table 14-4. The list of monitored chemical parameters for the NPDES permit.

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 14-5. Analysis method, reporting limit, and holding times for parameters used by Instrumental Research, Inc.

Parameter	Method	Reporting Limit	Holding Times
cBOD, carbonaceous, 5 Day (20°C)	SM 5210 B	1.0 mg/L	24 hours
Chloride, Total	SM 4500-Cl^- B	2.0 mg/L	28 days
Specific Conductivity	SM 2510 B	10 µmhos/cm	28 days
E. coli (*Escherichia Coli*)	SM 9223B	1 MPN per 100mL	< 24hrs
Hardness	SM 2340 C	2.0 mg/L	6 months
Copper, Total	EPA 200.9	1.4 µg/L	6 months
Lead, Total	SM 3500-Pb B	3 µg/L	6 months
Zinc, Total	SM 3500-Zn B	2 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	SM 4500-NH_3 F	0.500 mg/L	7 days
Kjeldahl Nitrogen, Total	SM 4500-Norg B	0.500 mg/L	7 days
pH	SM 4500 H^+ B	0.01 units	15 minutes
Phosphorus, Ortho-P	SM 4500-P A, B, G	0.010 mg/L	48 hours
Phosphorus, Total Dissolved	SM 4500-P A, B, G	0.010 mg/L	48 hours
Phosphorus, Total	SM 4500-P A, B, E	0.010 mg/L	48 hours
Solids, Total Dissolved	SM 2540 C	10.0 mg/L	7 days
Solids, Total Suspended	SM 2540 D	1.0 mg/L	7 days
Solids, Volatile Suspended	SM 2540 E	2.0 mg/L	7 days
Sulfate*	ASTM D516-90	15 mg/L	28 days

Sulfate* samples were spiked (with 10 mg/L) and the spike was later subtracted to lower the 2015 detection limit to 5 mg/L.

C. Field Quality Assurance Samples

Ten percent of samples were laboratory quality assurance samples (e.g. duplicates, spikes). Field blanks consisted of deionized water which accompanied samples from the field sites to the analytical laboratory. A field blank was generated for each sampling trip and was analyzed for all NPDES parameters. All field blank parameters were below the minimum detection limits in 2015. 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.

If the Oakton field pH meter was used, the meter was calibrated with a 2-point calibration prior to each sampling trip.

An equipment blank (~ 2 L sample) was collected at Site 8a (Pershing) 11/05/15. This site has a standard NPDES stormwater monitoring 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 presample flush. After the flush was pumped to waste, a sample of deionized water was collected. The sample taken was of sufficient volume to allow analysis of all parameters. All analytes came back from the laboratory below the minimum detection limits.

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 31 of the MPRB Water Resources Report**, Quality Assurance Assessment Report for details.

Field measurements were recorded on a Field Measurement Form in the 2015 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.

A Chain of Custody form accompanied each set of sample bottles delivered to the lab. Each sampler tray or container was iced and labeled indicating the date and time of collection, the site location, and the field personnel initials. The recorded collection date and time assigned to the 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). All 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. P8 was used to estimate daily 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 (for snowmelt water equivalent) was used and is located at the Minneapolis/St. Paul International Airport.

According to a description 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 P8 estimated daily average cfs snowmelt data, with the ISCO Flowlink measured daily average cfs runoff data, the grab and composite water chemistry data were put into Flux32 (v3.10) and used to calculate flow-weighted mean concentrations.

In Flux32, all the chemical parameters were run unstratified, and if possible, stratified by flow and month. A minimum of three data points are required to "cut the data" in any stratification. Flux32 methods 2 and 6 were recorded for each parameter run. The modeled concentration value with the lowest coefficient of variation was chosen and used for load calculations.

The description of Flux32 based on the product help menu (US Army Corps, 2009) is that 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.

D. Results & Discussion

Seasonal statistics (snowmelt, spring, summer, and fall) of the data for the combination of all sites were calculated and are listed in **Table 14-6**. Seasonal patterns are evident.

Snowmelt had the highest geometric mean concentrations for all of the parameters, except *E. coli*. The snowmelt *E. coli* concentrations were the lowest measured. Bacteria are temperature dependent and do not grow well in the cold.

Spring stormwater had the lowest geometric mean concentrations for TDP and Pb.

Summer had the lowest geometric mean concentrations of TP, Ortho-P, TKN, NH_3, Cl, Hardness, TSS, TDS, cBOD, Sulfate, Cu and Zn.

Fall had the highest geometric mean concentrations for *E. coli*. Fall had lowest geometric mean concentration for the parameters: NO_2NO_3 and VSS.

Table 14-6. 2015 statistical summary of concentrations by season from all sites (6 –9).

2015 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	pH std units	*E. coli* MPN/100mL	Cu ug/L	Pb ug/L	Zn ug/L
SNOWMELT (January-March)	**MEAN (geometric)**	0.477	0.196	0.226	5.36	1.79	0.502	1847	215	124	50	2393	39	42	7.6	610	29	10	115
	MEAN (arithmetic)	0.598	0.348	0.348	5.67	2.49	1.56	4767	290	174	71	4502	55	62	7.7	3024	43	18	218
	MAX	1.68	1.12	1.15	8.26	5.39	6.06	12513	570	385	165	14457	117	145	11.6	12033	92	41	520
	MIN	0.249	0.054	0.093	2.79	0.587	0.045	37	64	25	14	214	14	12	6.5	29	3	2	10
	MEDIAN	0.459	0.147	0.158	6.16	1.58	0.781	3525	216	102	52	1726	32	50	6.8	345	29	14	160
	STDEV	0.506	0.390	0.389	1.93	2.033	2.29	4727	216	140	59	4958	46	52	2.0	5127	32	15	201
	NUMBER	7	7	7	7	7	6	7	7	7	7	7	7	7	7	5	7	7	7
	COV	0.847	1.12	1.12	0.340	0.816	1.47	0.992	0.745	0.805	0.841	1.10	0.823	0.836	0.256	1.70	0.758	0.827	0.921
SPRING (April-May)	**MEAN (geometric)**	0.245	0.065	0.101	1.96	0.446	0.270	30	32	68	29	67	6	5	7.0	7270	4	4	47
	MEAN (arithmetic)	0.297	0.075	0.126	2.29	0.531	0.297	42	37	102	37	83	8	6	7.1	7270	9	8	71
	MAX	0.754	0.147	0.378	6.56	1.69	0.654	247	110	396	125	299	22	16	8.6	7270	73	35	400
	MIN	0.059	0.032	0.029	0.66	0.237	0.106	9	16	5	3	30	1	3	6.5	7270	3	2	10
	MEDIAN	0.266	0.052	0.093	2.00	0.381	0.266	27	28	78	34	74	7	5	6.9	7270	3	4	46
	STDEV	0.190	0.042	0.095	1.44	0.411	0.132	51	22	101	26	72	6	4	0.5		17	11	86
	NUMBER	22	12	12	19	11	20	20	20	20	20	12	11	12	19	1	19	19	19
	COV	0.640	0.559	0.758	0.630	0.774	0.444	1.22	0.606	0.986	0.708	0.866	0.703	0.705	0.069		1.82	1.36	1.21
SUMMER (June-August)	**MEAN (geometric)**	0.215	0.072	0.079	1.45	0.345	0.265	3	21	55	22	40	5	3	6.6	10478	4	6	45
	MEAN (arithmetic)	0.242	0.087	0.090	1.79	0.392	0.301	6	23	75	27	50	5	3	6.7	10502	8	12	74
	MAX	0.701	0.270	0.236	5.87	0.773	1.02	40	50	252	82	158	14	6	7.7	11199	77	70	640
	MIN	0.083	0.017	0.023	0.250	0.250	0.090	1	10	12	4	13	3	3	6.1	9804	3	2	10
	MEDIAN	0.195	0.073	0.076	1.52	0.250	0.282	1	21	60	23	38	5	3	6.6	10502	3	6	53
	STDEV	0.133	0.058	0.048	1.16	0.221	0.173	9	10	58	17	37	3	1	0.4	986	15	16	113
	NUMBER	33	16	17	33	16	31	31	32	32	32	20	14	16	16	2	30	30	30
	COV	0.550	0.672	0.537	0.649	0.565	0.574	1.44	0.448	0.770	0.636	0.739	0.557	0.420	0.060	0.094	1.94	1.34	1.52
FALL (Sept-Nov)	**MEAN (geometric)**	0.417	0.172	0.207	1.48	0.493	0.254	5	31	56	18	98	16	12	6.4	11140	6	6	74
	MEAN (arithmetic)	1.34	0.197	0.236	2.15	0.65	0.419	10	37	87	34	143	22	22	6.4	11734	10	12	94
	MAX	12.6	0.324	0.387	5.47	1.44	1.43	38	120	233	91	600	59	110	6.7	17329	31	79	220
	MIN	0.074	0.067	0.068	0.250	0.190	0.033	1	14	3	1	45	7	6	6.1	8664	3	2	10
	MEDIAN	0.435	0.201	0.251	1.48	0.456	0.286	5	30	70	23	80	11	9	6.4	9208	3	5	75
	STDEV	3.39	0.100	0.111	1.67	0.487	0.420	12	28	69	30	186	20	36	0.2	4853	11	22	59
	NUMBER	13	8	7	13	8	13	13	12	13	13	8	7	8	7	3	12	12	12
	COV	2.53	0.508	0.470	0.776	0.751	1.00	1.25	0.761	0.788	0.859	1.30	0.912	1.66	0.027	0.414	1.03	1.78	0.624

-highest concentration

-lowest concentration

STDEV= standard deviation, COV= coefficient of variation, Blue highlighted cells have the highest seasonal geometric mean, Orange have the lowest seasonal geometric mean.

Table 14-7 shows the 2015 sampled storm event raw data concentrations. These data generally show peaks during snowmelt and early spring for many parameters, but at some sites there are additional peaks that occurred in late fall. Stormwater concentrations can be extremely variable because the concentrations can be due to precipitation, the intensity of precipitation, BMP activity and maintenance, etc.

Table 14-7. 2015 NDPES sampled event data by site.

Date Sampled	Time	Site Location	Sample Type	TP mg/L	TDP mg/L	OPO4 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. uhmos	pH std units	E. Coli MPN	Cu ug/L	Pb ug/L	Zn ug/L
1/26/2015	14:45	Site 6, 22nd & Aldrich	Grab	0.737	0.561	0.549	6.16	3.10	1.60	983	108	102	52	1726	17	18	3650	6.7	12033	29	28	160
2/24/15	13:30	Site 6, 22nd & Aldrich	Grab	0.459	0.087	0.093	8.26	5.01	0.045	8768	424	385	165	6022	117	100	29900	6.5	345	82	41	460
5/11/2015	0:51	Site 6, 22nd & Aldrich	Composite	0.312	0.104	0.078	2.70	0.593	0.168	71	16	138	64	47	9	<5.0	64	6.8		22	34	99
5/14/2015	20:08	Site 6, 22nd & Aldrich	Composite	0.478	0.140	0.186	2.86		0.417	50	24	63	39	64		5	88					
5/25/2015	3:30	Site 6, 22nd & Aldrich	Composite	0.318			2.97		0.106	22	26	39	26				66	6.6		<5.00	7	46
5/26/2015	19:40	Site 6, 22nd & Aldrich	Composite	0.240	0.047	0.073	2.17	0.359	0.254	20	22	80	30	35	3	<5.0	43	7.1		<5.00	5	22
5/28/2015	14:30	Site 6, 22nd & Aldrich	Grab																>2420			
5/29/2015	4:01	Site 6, 22nd & Aldrich	Composite	0.754													151					
5/29/2015	18:57	Site 6, 22nd & Aldrich	Composite	0.267			2.50		0.209	9	28	89	40				66	6.8		<5.00	29	77
6/3/2015	19:03	Site 6, 22nd & Aldrich	Composite	0.580	0.115	0.038	5.87	0.768	0.108	9	30	252	82	62	14	6	106	6.3		77	13	640
6/7/2015	0:28	Site 6, 22nd & Aldrich	Composite	0.226			2.58		0.262	<2.0	18	140	41				61			<5.00	70	110
6/11/2015	8:04	Site 6, 22nd & Aldrich	Composite	0.333	0.110	0.147	2.31		0.341	<2.0	22	81	48	37		<5.00	85	6.8				
6/20/2015	6:20	Site 6, 22nd & Aldrich	Composite	0.334			2.98		0.302	<2.0	28	44	20				79			20	24	75
6/22/2015	8:22	Site 6, 22nd & Aldrich	Composite	0.141	0.124	0.067	0.522	<0.500	0.224	<2.0	12	24	12	13	5	<5.00	34	6.6		<5.00	8	33
7/13/2015	0:30	Site 6, 22nd & Aldrich	Composite	0.172	0.017	0.023	1.48	<0.500	0.213	<2.0	10	47	24	16	3	<5.0	39	6.4		<5.00	17	40
7/18/2015	2:50	Site 6, 22nd & Aldrich	Composite	0.108			0.945		0.309	<2.0	16	40	16	43						<5.00	19	50
7/28/2015	8:50	Site 6, 22nd & Aldrich	Grab																>24200			
8/16/2015	19:54	Site 6, 22nd & Aldrich	Composite	0.349	0.108	0.093	2.66	0.773	0.497	<2.0	36	80	30	30	8	<5.0	68	6.5		21	45	110
8/22/2015	20:52	Site 6, 22nd & Aldrich	Composite	0.281			2.32		0.275	<2.0	16	108	38				66			20	47	89
9/17/2015	13:50	Site 6, 22nd & Aldrich	Composite																8664			
10/8/2015	5:16	Site 6, 22nd & Aldrich	Composite	0.639	0.202	0.387	3.95	0.633	0.065	5	30	131	91	76	59	8	112	6.1		15	10	60
10/28/2015	0:02	Site 6, 22nd & Aldrich	Composite	0.339			2.07		0.033	3	26	70	48				82			<5.00	19	65
1/26/2015	14:30	Site 7, 14th & Park	Grab	0.473	0.409	0.250	2.79	0.587	0.499	783	64	81	37	1346	14	15	2870	6.8	2420	28	14	130
2/24/15	13:45	Site 7, 14th & Park	Grab	0.249	0.064	0.095	6.98	5.390	0.069	12513	540	343	141	14457	81	145	43000	6.8	<1	92	31	520
5/14/2015	21:07	Site 7, 14th & Park	Composite	0.186	0.043	0.108	1.29	<0.500	0.654	45	30	28	19	84	10	9	125	7.5		<5.00	4	68
5/25/2015	2:51	Site 7, 14th & Park	Composite	0.109			0.655		0.331	20	20	51	47				65	6.8		<5.00	<3.00	29
5/26/2015	11:30	Site 7, 14th & Park	Grab																7270			
5/26/2015	18:59	Site 7, 14th & Park	Composite	0.609	0.032	0.062	1.11	0.314	0.186	25	20	45	20	30	<1.00	<5.0	57	7.3		<5.00	<3.00	25
5/29/2015	4:20	Site 7, 14th & Park	Composite	0.240	0.048	0.124	2.00	0.381	0.435	45	26	105	45	40	12	6	72	6.5		<5.00	<3.00	23
5/30/2015	19:06	Site 7, 14th & Park	Composite	0.086			0.909		0.127	10	28	34	14				86	6.7		<5.00	4	45
6/3/2015	19:50	Site 7, 14th & Park	Composite	0.286	0.035	0.063	2.75	<0.500	0.364	24	20	150	44	69	6	<5.00	129	6.6		<5.00	7	50
6/7/2015	1:09	Site 7, 14th & Park	Composite	0.153			2.07		0.281	2	22	68	22				83			<5.00	14	88
6/11/2015	8:43	Site 7, 14th & Park	Composite	0.151	0.049	0.082	0.944	0.580	0.494	2	20	17	11	76		5	89	6.6				
6/20/2015	8:33	Site 7, 14th & Park	Composite	0.132			1.20		0.439	4	22	46	22				74			<5.00	7	73
6/22/2015	8:15	Site 7, 14th & Park	Composite	0.135	0.054	0.074	0.92	<0.500	0.14	<2.0	14	47	20	18	7	<5.00	43	6.3		<5.00	11	55
7/18/2015	2:47	Site 7, 14th & Park	Composite	0.083			<0.500		0.351	<2.0	12	12	4	44						<5.00	3	25
8/16/2015	19:44	Site 7, 14th & Park	Composite	0.257		0.076	2.31	0.642			36											
8/18/2015	15:50	Site 7, 14th & Park	Grab																9804			
8/22/2015	21:22	Site 7, 14th & Park	Composite	0.178			1.52		0.253	3	16	96	30				68			<5.00	9	73
9/17/2015	13:40	Site 7, 14th & Park	Grab																17329			
10/8/2015	5:03	Site 7, 14th & Park	Composite	0.513	0.067	0.271	3.51	1.02	0.933	6	36	119	51	84	39	10	125	6.4		19	7	110
10/24/2015	13:57	Site 7, 14th & Park	Composite	0.159			1.48		0.184	4	30	62	23				100			<5.00	4	58
10/28/2015	9:02	Site 7, 14th & Park	Composite	0.074	0.103	0.068	<0.500	<0.500	0.366	1	18	3	<2.0	45	11	7	50	6.3		<5.00	<3.00	220
10/28/2015	23:46	Site 7, 14th & Park	Composite	0.222	0.103	0.122	0.980	0.190	0.076	5	32	34	16	76	11	8	102	6.4		<5.00	6	82

Table 14-7. 2015 NDPES sampled event data by site. (Continued)

Date Sampled	Time	Site Location	Sample Type	TP mg/L	TDP mg/L	OPO4 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. uhmos	pH std units	E. Coli MPN	Cu ug/L	Pb ug/L	Zn ug/L
3/9/15	13:45	Site 8, Pershing	Grab	1.68	1.12	1.15	4.65	1.05	<0.030	37	110	25	20	214	32	12	330	6.5	291	<5.00	<3.00	<20.0
5/25/2015	2:10	Site 8, Pershing	Composite	0.059					0.168	30	20	5	3				22	6.7		<5.00	<3.00	<20.0
5/26/2015	17:26	Site 8, Pershing	Composite	0.267	0.055	0.063	2.11	0.480	0.266	20	26	76	36	41	5	<5.0	61	6.8		<5.00	<3.00	<20.0
5/29/2015	4:06	Site 8, Pershing	Composite	0.424													150					
5/29/2015	18:41	Site 8, Pershing	Composite	0.140			1.12		0.243	9	28	30	14				34	6.6		<5.00	<3.00	23
6/3/2015	18:48	Site 8, Pershing	Composite	0.214	0.097	0.073	1.61	<0.500	0.282	9	30	42	30	39	5	<5.00	56	6.9		<5.00	<3.00	25
6/7/2015	0:17	Site 8, Pershing	Composite	0.127			1.18		0.166	4	12	14	7				29			<5.00	<3.00	<20.0
6/17/2015	14:07	Site 8, Pershing	Composite	0.432			3.92		0.160	3	34	119	56				95			29	13	130
7/13/2015	0:58	Site 8, Pershing	Composite	0.256	0.040	0.059	1.68	<0.500	0.102	<2.0	30	56	47	14	4	<5.0	66	6.6		<5.00	<3.00	<20.0
7/15/2015	17:08	Site 8, Pershing	Composite	0.142	0.074	0.062	1.19	<0.500	0.303	<2.0	18	16	8	32	3	<5.0	47	6.5		<5.00	<3.00	<20.0
7/18/2015	2:34	Site 8, Pershing	Composite	0.701			2.92		0.494	<2.0	50	64	26	158						<5.00	5	25
7/24/2015	5:43	Site 8, Pershing	Composite	0.265			1.03					44	15				62			<5.00	<3.00	30
7/28/2015	7:54	Site 8, Pershing	Composite	0.151	0.104	0.104	<0.500	<0.500	0.090	<2.0	10	23	9	37	3	3	22	6.1		<5.00	<3.00	<20.0
8/16/2015	2:26	Site 8, Pershing	Composite	0.363	0.270	0.236	1.63	0.751	1.02	1	16	13	10	33	7	<5.0	<10.0	6.5		<5.00	<3.00	<20.0
8/22/2015	21:08	Site 8, Pershing	Composite	0.190			1.26		0.335	<2.0	12	13	6				34			<5.00	<3.00	<20.0
9/24/2015	7:01	Site 8, Pershing	Composite	0.176			1.23		0.336	<2.0	18	46	18				42			<5.00	<3.00	32
10/8/2015	5:11	Site 8, Pershing	Composite	0.719	0.200	0.328	3.89	1.13	0.904	4	38	117	42	88		6	113	6.5		28	79	140
10/24/2015	1:34	Site 8, Pershing	Composite	0.112			0.780		0.128	<2.0	14	13	7				39			<5.00	<3.00	<20.0
1/26/2015	14:05	Site 9, 61st & Lyndale	Grab	0.321	0.147	0.158	3.99	0.721	1.06	3525	216	201	65	6022	18	50	12915	9.3	29	41	12	220
2/24/15	14:15	Site 9, 61st & Lyndale	Grab	0.263	0.054	0.136	6.88	1.58	6.065	6759	570	83	14	1726	109	93	33400	11.6	<1	25	<3.00	25
5/7/2015	18:35	Site 9, 61st & Lyndale	Composite	0.701	0.147	0.029	6.56	1.69	0.242	247	110	396	125	299	22	16	449	7.4		73	35	400
5/11/2015	8:42	Site 9, 61st & Lyndale	Composite	0.136	0.086	0.056	1.92	0.527	0.354	52	40	118	35	92	8	7	179	7.5		24	9	120
5/14/2015	22:08	Site 9, 61st & Lyndale	Composite	0.294	0.116	0.183	1.66	0.692	0.447	50	60	79	28	96	6	<5.00	172	7.5		<5.00	5	91
5/25/2015	13:22	Site 9, 61st & Lyndale	Composite	0.265			5.17		0.265	44	52	29	15				268	7.1		<5.00	<3.00	52
5/26/2015	11:05	Site 9, 61st & Lyndale	Grab																>24200			
5/26/2015	15:24	Site 9, 61st & Lyndale	Composite	0.133	0.045	0.378	2.39	0.314	0.357	20	64	341	66	89	4	5	127	8.6		<5.00	4	66
5/29/2015	7:13	Site 9, 61st & Lyndale	Composite	0.301	0.036	0.171	1.74	0.237	0.397	40	44	164	42	83	7	7	123	6.9		<5.00	<3.00	42
5/30/2015	4:44	Site 9, 61st & Lyndale	Composite	0.221			1.60		0.313	14	52	132	33				124	7.2		23	9	100
6/3/2015	19:20	Site 9, 61st & Lyndale	Composite	0.303	0.071	0.110	3.13	<0.500	0.189	14	44	136	39	80	5	6		7.2		<5.00	<3.00	56
6/7/2015	3:47	Site 9, 61st & Lyndale	Composite	0.253			1.90		0.311	17	36	162	34				152			<5.00	7	110
7/18/2015	3:53	Site 9, 61st & Lyndale	Composite	0.149			0.982		0.303	14	26	88	24	125						<5.00	6	66
7/28/2015	7:44	Site 9, 61st & Lyndale	Composite	0.188	0.052	0.117	0.616	<0.500	0.212	15	38	184	40	43	3	5	139	7.7		<5.00	6	98
7/28/2015	8:05	Site 9, 61st & Lyndale	Grab																11199			
8/16/2015	23:10	Site 9, 61st & Lyndale	Composite	0.172	0.072	0.098	0.927	<0.500	0.309	11	24	76	21	33	3	<5.0	97	7.1		<5.00	6	67
8/22/2015	22:04	Site 9, 61st & Lyndale	Composite	0.195			1.07		0.193	40	18	101	19				191			<5.00	5	48
9/17/2015	13:20	Site 9, 61st & Lyndale	Grab																9208			
10/8/2015	5:29	Site 9, 61st & Lyndale	Composite	0.808	0.255	0.251	3.20	1.44	1.43	15	48	186	59	108	20	14	195	6.7		15	5	130
10/24/2015	12:29	Site 9, 61st & Lyndale	Composite	0.625			5.47		0.238	35	120	233	78				359			31	9	150
10/27/2015	18:34	Site 9, 61st & Lyndale	Composite	12.6	0.324		<0.500	<0.500	0.471	38		89	<2.0	600	7	110						
10/29/2015	5:11	Site 9, 61st & Lyndale	Composite	0.435	0.324	0.226	0.936	0.279	0.286	10	30	28	12	67	7	9	125	6.2		<5.00	3	68

Median Comparison

Table 14-8 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 2015 and 2001-2014 data for comparison.

In 2015, all three MPRB land use categories saw a significant decrease or similar value in the median concentrations of all parameters when compared to the NURP data, with the exception of TKN. It is unknown why all MPRB TKN data are higher than the NURP TKN data. A possible explanation is there is more decaying vegetative material 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 1920's to 1990's) and banned after 1996. The lead reduction in the environment is clearly seen in the MPRB data sets.

It is important to note that the MPRB sites monitored in 2001-2004 are located in different watersheds and have similar but not identical land uses to those monitored in 2005-2015.

Table 14-8. Typical Median stormwater sampled concentrations.

Land Use	Residential			Mixed			Composite of all categories		
Location	MPRB[1]	MPRB[2]	NURP	MPRB[3]	MPRB[4]	NURP	MPRB[5]	MPRB[6]	NURP
Year(s)	2015	2001–2014		2015	2001–2014		2015	2001–2014	
TP (mg/L)	0.333	0.412	0.383	0.178	0.234	0.263	0.257	0.345	0.330
TKN (mg/L)	2.62	2.43	1.9	1.29	1.57	1.29	1.91	2.05	1.5
NO_3NO_2 (mg/L)	0.633	0.352	0.736	0.348	0.423	0.558	0.431	0.423	0.68
cBOD (mg/L)	9	11	10	11	8	8	7	10	9
TSS (mg/L)	80	84	101	49	60	67	76	83	100
Cu (µg/L)	9	18	33	3	18	27	3	18	30
Pb (µg/L)	22	31	144	6	12	114	6	14	140
Zn (µg/L)	76	78	135	68	82	154	63	81	160

[1] Site 6 data.
[2] Sites 1 and 2 data, (Site 6, 2005-2014).
[3] Site 7 data.
[4] Sites 5 and 5a data, (Site 7, 2005-2014).
[5] Sites 6 – 9 data.
[6] Sites 1 – 5a data, (Site 6 – 9, 2005-2014).

NURP = median event mean concentrations as reported by the Nationwide Urban Runoff Program (USEPA, 1996).
MPRB = median values calculated by the MPRB for the identified year(s).

Geometric Mean Comparison

Table 14-9 lists the statistical calculations for all measured parameters for each site. Most of the geometric mean maximums occurred at Site 9 (61st and Lyndale) the industrial site. The lowest geometric mean values generally occur at Site 8 (Pershing) and Site 7 (14th & Park). This is as expected since Site 8 (Pershing) is parkland and Site 7 (14th & Park) is a mixed use watershed with little vegetation.

Table 14-9. 2015 event concentration statistics.

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	pH std units	E. coli MPN/100mL	Cu ug/L	Pb ug/L	Zn ug/L
6, 22nd Aldrich	MEAN (geometric)	0.328	0.106	0.105	2.57	0.203	0.753	8	27	84	39	78	12	5	6.6	3301	9	20	85
6, 22nd Aldrich	MEAN (arithmetic)	0.372	0.147	0.158	3.07	0.301	1.30	553	50	106	48	681	26	14	6.6	7014	19	26	134
6, 22nd Aldrich	MAX	0.754	0.561	0.549	8.26	1.60	5.01	8768	424	385	165	6022	117	100	7.1	12033	82	70	640
6, 22nd Aldrich	MIN	0.108	0.017	0.023	0.52	0.033	0.250	1	10	24	12	13	3	3	6.1	345	3	5	22
6, 22nd Aldrich	MEDIAN	0.333	0.110	0.093	2.62	0.239	0.633	4	25	80	39	45	9	3	6.6	8664	9	22	76
6, 22nd Aldrich	STDEV	0.189	0.145	0.164	1.92	0.347	1.644	2063	96	88	36	1750	38	29	0.3	6016	25	18	169
6, 22nd Aldrich	NUMBER	19	11	11	18	18	9	18	18	18	18	12	9	11	12	3	16	16	16
6, 22nd Aldrich	COV	0.509	0.990	1.04	0.624	1.15	1.26	3.73	1.93	0.824	0.748	2.57	1.47	2.08	0.040	0.858	1.33	0.689	1.27
7, 14th Park	MEAN (geometric)	0.189	0.067	0.102	1.33	0.278	0.467	12	28	48	21	107	10	8	6.7	7394	4	5	68
7, 14th Park	MEAN (arithmetic)	0.226	0.092	0.116	1.78	0.343	0.842	750	53	74	32	1364	19	19	6.7	9206	10	7	98
7, 14th Park	MAX	0.609	0.409	0.271	6.98	0.933	5.39	12513	540	343	141	14457	81	145	7.5	17329	92	31	520
7, 14th Park	MIN	0.074	0.032	0.062	0.250	0.069	0.190	1	12	3	1	18	1	3	6.3	2420	3	2	23
7, 14th Park	MEDIAN	0.178	0.054	0.089	1.29	0.341	0.348	6	22	49	22	72	11	7	6.6	8537	3	6	68
7, 14th Park	STDEV	0.151	0.108	0.071	1.53	0.218	1.45	2941	119	77	31	4140	24	42	0.4	6222	22	7	119
7, 14th Park	NUMBER	19	11	12	19	18	12	18	19	18	18	12	10	11	13	4	17	17	17
7, 14th Park	COV	0.67	1.18	0.609	0.860	0.634	1.73	3.92	2.24	1.04	0.984	3.04	1.26	2.18	0.055	0.676	2.17	0.980	1.21
8, Pershing	MEAN (geometric)	0.253	0.133	0.141	1.53	0.258	0.450	3	24	30	15	52	5	3	6.6	291	3	2	18
8, Pershing	MEAN (arithmetic)	0.357	0.244	0.260	1.90	0.333	0.551	8	29	42	21	73	8	4	6.6	291	6	7	30
8, Pershing	MAX	1.68	1.12	1.15	4.65	1.02	1.13	37	110	119	56	214	32	12	6.9	291	29	79	140
8, Pershing	MIN	0.059	0.040	0.059	0.250	0.090	0.250	1	10	5	3	14	3	3	6.1	291	3	2	10
8, Pershing	MEDIAN	0.235	0.101	0.089	1.44	0.266	0.365	2	23	30	15	39	5	3	6.5	291	3	2	10
8, Pershing	STDEV	0.380	0.360	0.374	1.27	0.278	0.376	11	24	35	16	68	11	3	0.2		9	19	40
8, Pershing	NUMBER	18	8	8	16	15	8	16	16	17	17	9	7	8	10	1	17	17	17
8, Pershing	COV	1.07	1.47	1.44	0.666	0.834	0.683	1.44	0.830	0.831	0.770	0.939	1.27	0.834	0.030		1.55	2.70	1.36
9, 61st Lyndale	MEAN (geometric)	0.338	0.102	0.133	1.94	0.402	0.485	46	56	121	28	166	9	11	7.6	1441	7	5	85
9, 61st Lyndale	MEAN (arithmetic)	0.966	0.133	0.159	2.65	0.708	0.652	577	88	149	39	676	17	25	7.7	6812	14	7	106
9, 61st Lyndale	MAX	12.6	0.324	0.378	6.88	6.06	1.69	6759	570	396	125	6022	109	110	11.6	11199	73	35	400
9, 61st Lyndale	MIN	0.133	0.036	0.029	0.250	0.189	0.237	10	18	28	1	33	3	3	6.2	29	3	2	25
9, 61st Lyndale	MEDIAN	0.265	0.086	0.147	1.90	0.311	0.314	35	46	132	34	94	7	7	7.3	9208	3	5	80
9, 61st Lyndale	STDEV	2.82	0.103	0.094	2.04	1.33	0.552	1697	129	96	29	1602	28	36	1.4	5958	19	8	87
9, 61st Lyndale	NUMBER	19	13	12	19	19	13	19	18	19	19	14	13	13	14	3	18	18	18
9, 61st Lyndale	COV	2.92	0.777	0.591	0.770	1.89	0.846	2.94	1.46	0.644	0.737	2.37	1.70	1.44	0.177	0.875	1.33	1.08	0.818
All	MEAN (geometric)	0.270	0.097	0.117	1.79	0.279	0.520	12	32	63	25	98	9	7	6.9	2831	5	6	55
All	MEAN (arithmetic)	0.482	0.147	0.166	2.36	0.429	0.827	486	56	94	35	737	18	17	6.9	7145	12	12	92
All	MAX	12.6	1.12	1.15	8.26	6.06	5.39	12513	570	396	165	14457	117	145	11.6	17329	92	79	640
All	MIN	0.059	0.017	0.023	0.250	0.033	0.190	1	10	3	1	13	1	3	6.1	29	3	2	10
All	MEDIAN	0.257	0.097	0.104	1.91	0.284	0.431	10	28	76	29	69	7	6	6.7	8664	3	6	63
All	STDEV	1.44	0.188	0.189	1.78	0.742	1.13	1987	102	86	30	2397	27	32	0.9	5691	20	16	116
All	NUMBER	75	43	43	72	70	42	71	71	72	72	47	39	43	49	11	68	68	68
All	COV	2.99	1.28	1.14	0.753	1.73	1.37	4.09	1.84	0.915	0.858	3.25	1.52	1.92	0.130	0.797	1.63	1.36	1.27
	-Highest value																		
	-Lowest value																		

All = all 4 sites, STDEV = standard deviation, COV = coefficient of variation.

Site 6 (22nd & Aldrich) is an older residential watershed. It had the highest geometric means for TKN, NO_2NO_3, VSS, cBOD, Cu, and Pb. The cause of the higher TKN, and NO_2NO_3 values may be pet waste or the dense leaf canopy in the watershed adding to the organic nitrogen load. The higher VSS is likely due to the dense leaf canopy adding a higher VSS to the solids load. The higher Cu and Pb are likely the result of vehicular wear inputs (e.g. brake dust, tire weights). The geometric mean concentration of Pb has been persistently high at this site, and is possibly a remnant of lead based paints shedding from the older houses and soils. The low NH_3 is due to the oxidation of ammonia and ammonium to NO_2NO_3.

Site 7 (14th & Park) is a dense mixed use watershed. It had the highest geometric mean concentrations for *E coli*. This is likely due to pet and wildlife waste in the watershed. Site 7 also had the lowest geometric mean for all phosphorus and the TKN value. This is likely the result of the hard surface landscape, with minimal vegetation, in this mixed use watershed.

Site 8 (Pershing) is a park. It had the highest geometric mean TDP and Ortho-P values likely due to decaying organic material in the parkland watershed or turf maintenance. Site 8 also had the lowest geometric mean NO_2NO_3, Cl, Hardness, TSS, VSS, cBOD, Sulfate, and all metals. This is also likely due to the park's vegetated watershed. The low *E. coli* was not used for analysis since it was a single sample collected during snowmelt.

Site 9 (61st and Lyndale) is a Commercial/Industrial watershed. It had the highest geometric mean for TP, NH_3, Cl, Hardness, TSS, TDS, Sulfate, and Zn. Site 9 had the lowest geometric mean values for *E. coli*, where multiple samples were collected. 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.

Mean Comparison

Mean data were comparable to typical urban stormwater data from the Nationwide Urban Runoff Program (NURP), Center for Watershed Protection (CWP), and Bannerman *et al.* (1993) are in **Table 14-10**.

Data from MPRB Sites 1–5a (2001–2004) and 6–9 (2005–2014) were partially similar to Sites 6–9 in 2015. NO_3NO_2, Cl, and TDS were higher in 2015. NH_3, TSS and the metals Cu, Pb, and Zn were lower in 2015. The 2015 mean increase in Cl and TDS are likely related to a harsher winter climate and more salt use. The mean decrease in NH_3, TSS and all the metals Cu, Pb, and Zn are welcome, but the root cause is unknown.

Table 14-10. Typical Mean urban stormwater concentrations. " -- " = not reported.

Parameter	NURP[1]	CWP[2]	Bannerman *et al.*[3]	Mpls PW[4]	St. Paul[5]	MWMO[6] 2015	MPRB[7] 2001–2014	MPRB[8] 2015
TP (mg/L)	0.5	0.3	0.66	0.417	0.484	0.337	0.460	0.482
TDP (mg/L)	--	--	0.27	0.251	--	0.087	0.146	0.147
TKN (mg/L)	2.3	--	--	--	2.46	1.85	2.78	2.36
NO_3NO_2 (mg/L)	0.86	--	--	--	0.362	0.492	0.568	0.827
NH_3 (mg/L)	--	--	--	0.234	--	0.168	1.02	0.423
Cl (mg/L)	--	230 (winter)	--	--	--	121	280	548
BOD (mg/L)	12	--	--	14.9	25	14	16	18
TDS (mg/L)	--	--	--	73.3	78	290	552	737
TSS (mg/L)	239	80	262	77.6	129	115	124	94
Cu (µg/L)	50	10	16	26.7	30	20.0	24.7	12.3
Pb (µg/L)	240	18	32	75.5	233	14.0	24.3	11.6
Zn (µg/L)	350	140	204	148	194	121	119	92

[1] USEPA (1996)
[2] Center for Watershed Protection (2000)
[3] Monroe study area of Bannerman *et al.* (1993)
[4] City of Minneapolis Public Works Department (1992) – average from a combination of land uses
[5] City of St. Paul 1994 stormwater data – average from a combination of land uses
[6] Mississippi Watershed Management Organization 2015 data, average of snowmelt and storms from all sites
[7] MPRB arithmetic mean data calculated from NPDES Sites 1 – 5a (2001 – 2004), 6 – 9 (2005 – 2014)
[8] MPRB arithmetic mean data calculated from NPDES Sites 6 – 9 (2015)

Flow-Weighted Mean Comparison

The flow-weighted mean concentrations presented in **Table 14-11** were calculated using FLUX32. Sample chemistry concentrations and associated daily average flows were used as input for these calculations. The data were run unstratified and often stratified by flow or season to achieve the most accurate and precise results. The method (2 or 6) and event mean concentration with the lowest coefficient of variation was generally chosen as the final concentration value. The "rule of sensibility" was used if the value with the lowest coefficient of variation was an extreme outlier, then the next value was chosen.

Table 14-11. Flow–weighted mean concentrations and related statistics for NPDES parameters in 2015.

Site	TP (mg/L)	TDP (mg/L)	Ortho-P (mg/L)	TKN (mg/L)	NO_3NO_2 (mg/L)	NH_3 (mg/L)	Cl* (mg/L)	Hardness (mg/L)	TSS (mg/L)	VSS (mg/L)	TDS* (mg/L)	cBOD (mg/L)	Sulfate (mg/L)	Cu (µg/L)	Pb (µg/L)	Zn (µg/L)
6, 22nd Aldrich	0.267	0.089	0.085	2.10	0.217	0.531	8	20	78	34	38	12	3.0	0.011	0.018	0.089
7, 14th Park	0.241	0.051	0.085	1.35	0.285	0.344	877	23	56	24	49	9	5.0	0.003	0.006	0.052
8a, Pershing	0.225	0.109	0.092	1.39	0.213	0.272	3	24	54	27	39	4	3.0	0.003	0.004	0.021
9, 61st Lyndale	0.614	0.107	0.174	1.86	0.334	0.438	28	51	160	39	108	7	12.0	0.016	0.005	0.086
MEAN	**0.337**	**0.089**	**0.109**	**1.68**	**0.262**	**0.396**	**229**	**30**	**87**	**31**	**59**	**8**	**5.8**	**0.008**	**0.008**	**0.062**
MEDIAN	**0.254**	**0.098**	**0.089**	**1.63**	**0.251**	**0.391**	**18**	**24**	**67**	**31**	**44**	**8**	**4.0**	**0.007**	**0.006**	**0.069**
STANDEV	**0.186**	**0.027**	**0.043**	**0.366**	**0.058**	**0.113**	**432**	**14**	**50**	**7**	**33**	**3**	**4.3**	**0.006**	**0.007**	**0.032**

-Highest value

-Lowest value

* 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.

Site 6 (22nd & Aldrich) is a multi-family residential watershed. Site 6 had the highest modeled concentrations of TKN, NH_3, Pb, and Zn. It is believed 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. Site 6 had the lowest modeled concentrations of Ortho-P, Hardness, and TDS.

Site 7 (14th & Park) is a densely developed mixed-use watershed. Site 7 had the highest Cl modeled parameter. Site 7 had the lowest modeled TDP, TKN, and VSS. These are all likely due to the dense, highly developed, and low vegetation nature of the watershed.

Site 8a (Pershing) is a parkland watershed. Site 8a had none of the highest modeled event mean concentrations. Site 8a had the lowest modeled TP, NO2NO3, NH3, Cl, TSS, cBOD, Sulfate, Cu, Pb, and Zn. This is likely due to the more natural vegetative state of the watershed and an absence of road runoff.

Site 9 (61st and Lyndale) is a commercial/industrial watershed. Site 9 had the highest modeled concentration of TP, Ortho-P, NO_3NO_2, Hardness, TSS, VSS, TDS, Sulfate, and Cu. Site 9 had none of the lowest modeled event mean concentrations. 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. In 2008, the baseflow was significantly diminished when the cement aggregate mixing facility improved its on-site runoff and ponding.

Table 14-12 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 & Aldrich) is more closely related to the Yates residential watershed land-use characteristics. Site 7 (14th & Park) and Site 9 (61st and Lyndale) are more comparable to the Sandberg light industrial watershed land-use characteristics.

Table 14-12. 2015 Flow-weighted mean stormwater pollutant concentrations (mg/L) and ranges as reported by the USGS (as cited in MPCA, 2000).

Pollutant	Monitoring Site					
	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 (Mean Range)	133 (2 – 758)	78 (24 – 385)	740 (17- 26,610)	337 (7 – 4,388)	56 (3 – 343)	160 (28 – 396)
Pb (Mean Range)	0.23 (0.015 –1.8)	0.018 (0.005 -0.070)	0.02 (0.008-0.31)	0.19 (0.003 –1.5)	0.006 (0.002 – 0.031)	0.005 (0.002 – 0.035)
Zn (Mean Range)	0.198 (0.02 – 2.2)	0.089 (0.022 -0.640)	0.235 (0.028-0.53)	0.185 (0.02 –0.81)	0.052 (0.023 – 0.520)	0.086 (0.025 – 0.400)
TKN (Mean Range)	3.6 (0.6 – 28.6)	2.10 (0.52 – 8.26)	1.2 (1.0 – 29.2)	2.5 (0.4 – 16.0)	1.35 (0.250 – 6.98)	1.86 (0.250 – 6.88)
TP (Mean Range)	0.63 (0.10 –3.85)	0.267 (0.108 – 0.754)	0.62 (0.2 – 13.1)	0.63 (0.07 – 4.3)	0.241 (0.074 – 0.609)	0.614 (0.133 – 12.6)

When comparing the USGS flow-weighted mean concentrations to the MPRB sites in **Table 14-12**, Site 6 was 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 14-12**. Site 7 had significantly lower values than Sandberg for all parameters. Site 9 had roughly half of the Sandberg values with the notable exception of TP. The Site 9 TKN was slightly higher than Sandberg's TKN but was comparable.

The overall mean comparison of **Table 14-12** to MPRB water quality values at sites 6, 7, 8a, and 9 shows 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 14-13 shows the flow-weighted mean concentrations in 2015 compared to previous years. Flow-weighted mean concentrations for Cl and TDS were difficult to estimate using FLUX32 due to large outliers from the snowmelt samples. These estimates should be used with caution. When samples were below the RL (reporting limit), half of the RL was used for calculations.

Table 14-13. MPRB Flow–weighted mean concentration compared to previous years. Each year is the average flow–weighted mean concentration of all sites monitored that year.

	Flow-weighted mean concentrations														
	Sites 1-5a				Site 6-9										
Parameter	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
TP (mg/L)	0.470	0.337	0.474	0.332	0.354	0.548	0.472	0.486	0.583	0.341	0.355	0.368	0.369	0.313	0.337
TDP (mg/L)	0.112	0.095	0.114	0.121	0.123	0.135	0.108	0.139	0.249	0.063	0.126	0.123	0.157	0.121	0.089
Ortho-P (mg/L)	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	0.179	0.097	0.194	0.129	0.109
TKN (mg/L)	2.21	1.60	2.10	1.94	3.48	3.54	4.43	3.22	3.61	1.53	1.74	2.00	2.34	2.40	1.68
NO_3NO_2 (mg/L)	0.398	0.423	0.496	0.382	0.448	0.638	0.496	0.582	0.755	0.414	0.498	0.397	0.402	0.937	0.262
NH_3(mg/L)	0.494	0.722	0.346	0.918	1.74	1.64	0.970	0.966	1.64	0.666	0.922	0.719	0.747	1.00	0.396
Cl (mg/L)	37	11	587	40	18	91	412	139	803	60	213	14	72	205	229
Hardness (mg/L)	nc	na	nc	nc	na	nc	nc	nc	nc	na	48.0	37	41	41	30
TSS (mg/L)	116	83	116	70	108	156	180	148	121	107	104	101	95	123	87
VSS (mg/L)	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	30.2	31	29	34	31
TDS (mg/L)	306	85	725	130	252	183	737	507	3323	124	693	97	301	359	59
cBOD (mg/L)	12	8	16	20	9	9	17	25	53	7	11	13	13	10	8
Sulfate (mg/L)	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc	15.4	18.4	8.1	6.8	5.8
Cd (µg/L)	0.532	0.518	2.11	2.80	2.50	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Cu (µg/L)	15	31	23	15	19	29	36	16	40	23	25	16	19	13	8
Pb (µg/L)	23	17	22	14	41	31	34	28	23	24	18	15	22	16	8
Zn (µg/L)	180	76	107	76	86	94	133	132	204	100	103	90	79	68	62

nc = data not collected.
na= data not analyzed for.
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, street sweeping type and frequency, BMP maintenance schedule frequency, etc. can cause fluctuations in chemical concentrations. **Table 14-13** illustrates the variability of stormwater from year to year.

The variability from year to year is due to three likely causes. First, the watersheds monitored have occasionally changed. Second, the timing between street sweeping frequency, BMP maintenance frequency, and sampling probably affect variability within the monitoring year and between years. Third, precipitation frequency, intensity, and duration affect results.

Surcharge Events

Surcharge events happen during high precipitation totals 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 surcharge water inundates the auto-sampler tray the samples are considered contaminated and dumped.

Table 14-14 show the 2015 NPDES surcharge dates. With the exception of Site 8a, most of the surcharging events were storms greater than 1 inch.

Table 14-14. Surcharge events in 2015 at associated NPDES sites.

Site	Surcharge Dates
Site 6 (22nd and Aldrich) 18" pipe	7/13,7/28
Site 7 (Park and 14th) 42" pipe	None
Site 8a (Pershing) 12" pipe	5/26, 5/29, 6/3, 6/7, 6/17, 6/22, 6/28, 7/6, 7/13, 7/15, 7/18, 7/28, 8/7, 8/18, 8/22, 9/6, 9/9, 9/17, 10/8
Site 9 (61st and Lyndale) 42" pipe	7/13, 8/7

Site 8a (Pershing) is of special concern as it had nineteen surcharges in 2015. At this site, storms as small as 0.33 inches or as large as 3.00 inches caused 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 8 watershed/area of Minneapolis is lower in elevation than the surrounding areas, causing a regular back up of many storm sewers in the system. Minneapolis Public Works is aware of this problem. The surcharges at this site do not appear to have caused any flooding problems. Site 8a samples appear to not be significantly affected by surcharging because the sampler is secured in an above ground enclosure.

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 2015, baseline monitoring was continued with multiple BMP projects. These included:

1) A test and control of a St. Anthony Falls Laboratory (SAFL) baffle installed in a catch basin sump in non standard orientation.
2) Iron Enhanced Sand Filters (IESF) at both a street and alley runoff site.
3) A flood relief vault and downstream pipe.
4) Webber Stormwater Pond, treating water and stormwater discharged from a Natural Swimming Pool and surrounding area.
5) Lyndale Dog Park *E. coli* bacteria sampling.

E. 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).

37th Avenue North Greenway, Parallel SAFL Baffle

BACKGROUND

The 37th Avenue N Greenway project was a flood control project that incorporated innovative stormwater BMPs. The project, in North Minneapolis, consisted of several blocks of 37th Avenue N being closed off and turned into a bike and

pedestrian path over underground flood storage chambers. The water quality project components included large underground vaults used for floodwater retention, iron enhanced sand filters used to treat both street and alley runoff, and St. Anthony Falls Laboratory (SAFL) baffles used to prevent resuspension of captured materials in catch basin sumps.

SAFL baffles were developed at the University of Minnesota's Saint Anthony Falls Laboratory. The baffle is a large flat stainless steel plate with large 4"-6" holes in the plate to dissipate the energy of the oncoming stormwater and prevent cavitation in the sump below, **Figure 14-2**. Normally, SAFL baffles are placed perpendicular, in the sump, to the incoming stormwater. At the 37th greenway catch basins (CB), the SAFL baffles were placed parallel in the sump to the incoming stormwater. This project was undertaken to see if SAFL baffles prevent sediment resuspension when placed parallel to flow in a CB sump rather than when placed perpendicular to flow in a typical installation.

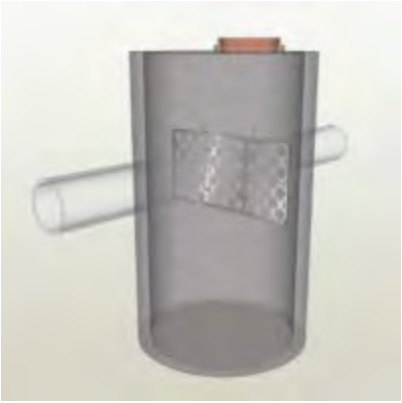


Figure 14-2. Drawing of a SAFL baffle in a sump. Baffle in the diagram is perpendicular to flow, unlike the baffles in the study site.

F. Methods

Site Installation and Tools

Four catch basins (CB) were chosen for study. Two had SAFL baffles in them (test) and two did not (control). They were located at 37th and Morgan Avenue North (control) and 37th and Newton Avenue North (test) in North Minneapolis. The catch basins were located on each side of the street, directly across from each other.

The 37th & Morgan West CB drainage area was 1.2 acres and the East CB drainage area was 0.8 acres. The 37th & Newton West and East CB drainage areas were each 1 acre. For both sites, the land use was residential with approximately 50% impervious cover and a dense tree canopy. The catch basin sumps were vacuumed clean by the City Public Works November 3rd, 2014 prior to the start of the study. Orange tape down marks were painted on each side of all the catch basins on November 17th, 2014, **Figure 14-3**. The watersheds of the test and control sites were comparable because they are similar in size and land use, and they were one block apart so they experience similar environmental conditions.

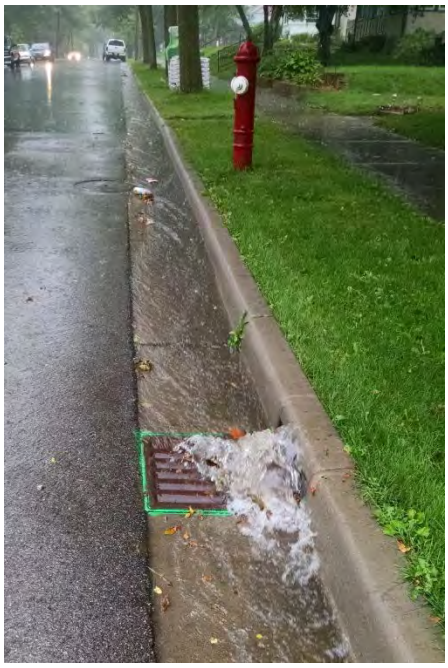


Figure 14-3 Stormwater flowing into a control catch basin at 37th & Morgan.

A tape down was made with a fiberglass measuring tape and a lightly weighted Plexiglas foot (or plate) attached to the end of it, **Figure 14-4**. The Plexiglas foot was designed so it would lightly rest on top of the sump precipitate and not compress or plunge into it. A "zero' tape down reading was taken and recorded from both sides of each clean catch basin on December 7th, 2014. Tapedown readings were taken on each side and averaged into one reading, **Figure 14-5**. If sediment was uneven in the sump, the average reading should account for uneven loading. As sediment accumulated, the tape down length would become shorter.

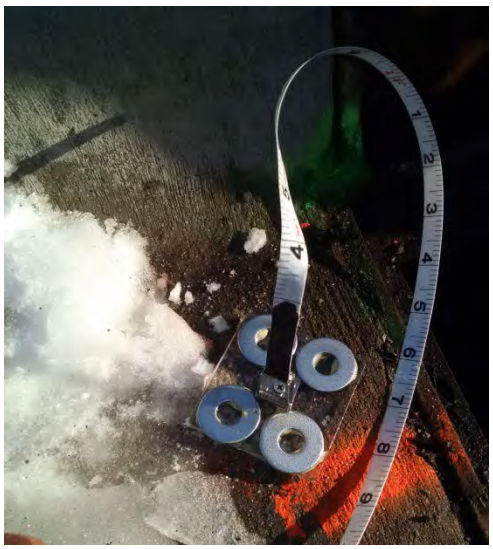


Figure 14-4. Showing tapedown foot construction.

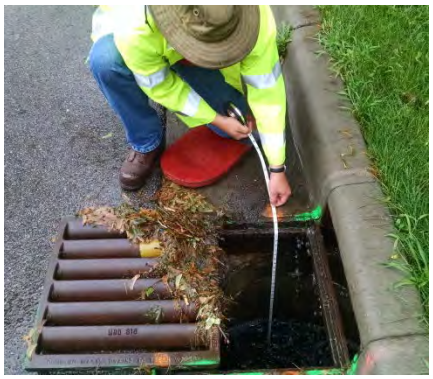


Figure 14-5. Measuring a tapedown from a fixed point to the catch basin.

Data Collection

During ice free conditions, tapedown measurements were made every two weeks on both sides from April 1, 2015 to October 28th, 2015. The catch basin grates were removed and the top edge of the catch basin casting, at the painted marks, were used as the fixed measuring points for the tapedowns. The tapedown measurement was when the tape was lowered from the measuring point straight down until the foot rested on the material in the sump. These measurements were recorded on field sheets and later transferred into Excel for analysis and graphing.

RESULTS & DISCUSSION

Initially, it was unknown if placing SAFL baffles parallel to the flow in a CB sump would prevent resuspension of previously captured sediment. **Table 14-14** and **Figure 14-6** show the data collected in 2015.

In **Table 14-14**, the catch basins at Newton Avenue are the test catch basins with the SAFL baffles, and Morgan Avenue are the control without SAFL baffles. The two readings taken at each catch basin are averaged in the colored columns. The green columns are the Morgan average and the red columns are the Newton average. The final column shows the average difference in sediment accumulation between the test and control catch basins.

Table 14-14. Tapedown depths and average tapedown depths (in feet) to a fixed point at each catch basin. *Newton sites were the test catch basins with SAFL baffles. NA=data not available.

Date	Intls	Morgan NW	Morgan SW	Morgan W Mean	Morgan NE	Morgan SE	Morgan E Mean	Newton NW	Newton SW	Newton* W Mean	Newton NE	Newton SE	Newton* E Mean	Mean Difference Between Test/Control (feet)
12/1/2014	MP, RB	6.18	6.18	**6.18**	6.16	6.21	**6.19**	6.08	6.13	**6.11**	6.13	6.18	**6.16**	0.05
4/1/2015	MP, RB	5.96	5.90	**5.93**	5.89	5.88	**5.89**	5.69	5.65	**5.67**	5.88	5.91	**5.90**	0.13
4/14/2015	MP, RB	5.61	5.65	**5.63**	5.45	5.01	**5.23**	5.22	5.35	**5.29**	5.56	5.64	**5.60**	-0.01
4/30/2015	MP	5.61	5.65	**5.63**	5.49	5.61	**5.55**	NA	NA	**NA**	NA	NA	**NA**	NA
5/11/2015	MP, QS	5.55	5.57	**5.56**	5.55	5.40	**5.48**	5.15	5.19	**5.17**	5.49	5.51	**5.50**	0.18
5/27/2015	MP AT	5.39	5.50	**5.45**	5.26	5.39	**5.33**	4.84	4.87	**4.86**	5.39	5.20	**5.30**	0.31
6/12/2015	MP AT	5.07	5.25	**5.16**	5.09	5.54	**5.32**	4.57	4.35	**4.46**	5.23	5.01	**5.12**	0.45
6/24/2015	MP QS	4.82	5.04	**4.93**	4.38	5.09	**4.74**	4.43	5.10	**4.77**	5.01	4.65	**4.83**	0.04
7/8/2015	MP QS	5.12	5.19	**5.16**	4.54	5.11	**4.83**	4.64	4.59	**4.62**	4.88	4.85	**4.87**	0.25
7/23/2015	MP RB	5.18	5.13	**5.16**	4.94	5.28	**5.11**	4.67	4.89	**4.78**	4.91	5.04	**4.98**	0.26
8/4/2015	MP AT	5.19	5.15	**5.17**	5.09	5.21	**5.15**	4.76	4.79	**4.78**	4.83	5.04	**4.94**	0.31
8/19/2015	MP AT	5.16	5.18	**5.17**	5.01	5.10	**5.06**	4.61	4.62	**4.62**	4.60	4.59	**4.60**	0.51
9/2/2015	RB AT	5.10	5.06	**5.08**	5.00	5.11	**5.06**	4.58	4.70	**4.64**	4.48	4.59	**4.54**	0.48
9/16/2015	MP AT	4.92	5.09	**5.01**	4.96	5.10	**5.03**	4.43	4.30	**4.37**	4.31	4.43	**4.37**	0.65
9/30/2015	MP AT	5.15	5.10	**5.13**	4.95	5.10	**5.03**	4.36	4.51	**4.44**	4.34	4.70	**4.52**	0.60
10/15/2015	MP AT	5.18	5.06	**5.12**	4.93	5.06	**5.00**	4.31	4.24	**4.28**	4.60	4.49	**4.55**	0.65
10/28/2015	MP AT	4.94	4.87	**4.91**	4.62	4.76	**4.69**	3.71	3.67	**3.69**	4.22	4.04	**4.13**	0.89

In **Figure 14-6** initially there did not appear to be a difference between the test (Newton) and control (Morgan) catch basins. Then mid-summer (~August 1) the catch basins at Newton, with the SAFL baffles, began to show a difference and were accumulating more sediment, presumably by preventing resuspension. At the conclusion of this study the average SAFL baffle catch basin accumulated 10.6 inches (0.89 feet) more sediment than catch basins without SAFL baffles. Although there was some mid-summer resuspension at both sites overall the SAFL baffles appear to prevent resuspension in catch basins even when placed parallel to flow above the sumps.

Anecdotally, the Newton sites were also more odiferous than the Morgan sites. Odor was likely caused by more accumulated organic material in the Newton sump being digested.

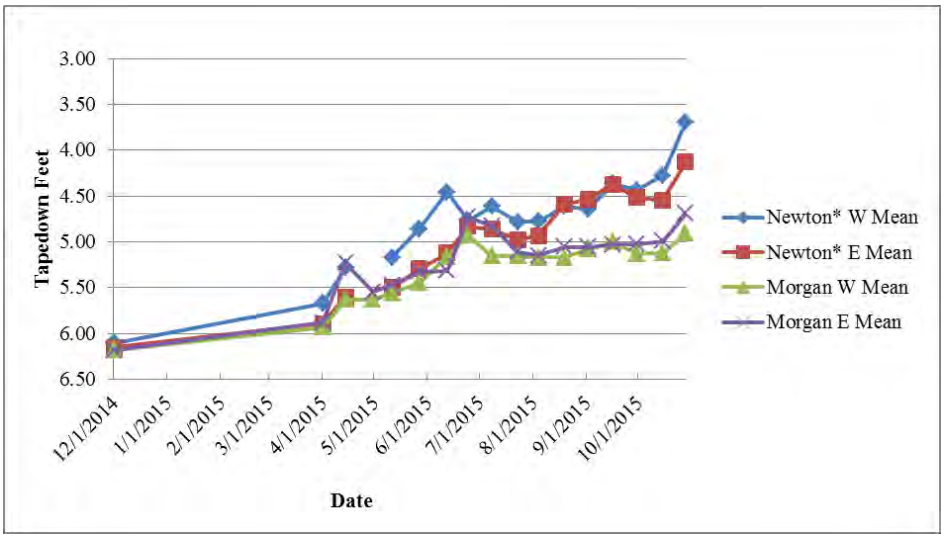


Figure 14-6. Average tapedown depths to a fixed point at each catch basin. *Newton sites were the test catch basins with SAFL baffles.

37th Avenue N Greenway, Iron Enhanced Sand Filters

BACKGROUND

The 37th Avenue N Greenway project is a flood control project that has incorporated innovative stormwater Best Management Practices (BMPs). The project, in North Minneapolis, consisted of several blocks of 37th Avenue N being closed off and turned into a bike and pedestrian path over underground flood storage chambers. BMP components of the project consist of: large underground vaults for floodwater retention, iron enhanced sand filters (IESF) to treat both street and alley runoff, and St. Anthony Falls Laboratory (SAFL) baffles to prevent resuspension in catch basin sumps.

Carlos Herrera, of Herrera Environmental Consultants, in Seattle, Washington invented the first iron sand filters used for treating dissolved phosphorus in stormwater. He conducted pilot scale testing using full depth filter columns in the late 1980s. The Lakemont Washington Filtration Facility was constructed in phases between 1990 and 1994 when the sand filter, enhanced with a mixture of 95% sand and 5% iron (chopped steel wool), was the first installed in the nation. They were originally called amended sand filters.

The first iron enhanced sand filter (iron filings) built in Minnesota was designed by Barr Engineering and the Ramsey Washington Metro Watershed District and installed in Maplewood Minnesota. The University of Minnesota's Saint Anthony Falls Laboratory has done further research on these filters and helped to greatly expand their use.

This project consisted of auto-monitoring two IESFs, one draining a street and one draining an alley. The Street Site was located on North Morgan Avenue, and the Alley Site was between North Newton Avenue and Oliver Avenue North, **Figure 14-7**. The IESFs were constructed as a 3 foot wide trench approximately 30 feet long. A drain tile, acting as an underdrain, is buried the length of the basin. The subsoil was amended with compost on the sides of the basin and it sits over a deeper subsoil of clay. The land use is 50% impervious residential with a dense tree canopy. The drainage area of the 37th & Morgan site is 1.2 acres and the 37th Alley site is 2.3 acres. Note the large shade tree in **Figure 14-7** at the 37th and Morgan site.

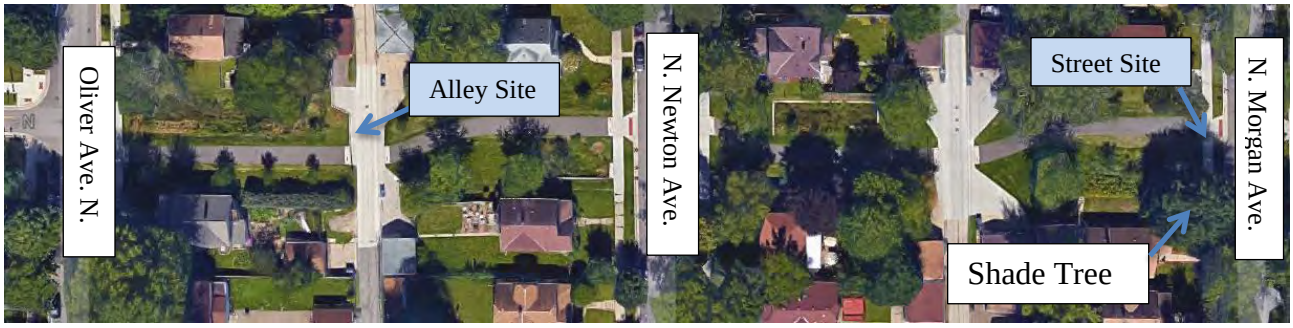


Figure 14-7. Map of the 37th Greenway iron enhanced sand filter monitoring sites.

When constructed, the sand filter was amended with 5% iron filings to absorb dissolved phosphorus. When stormwater passes through these filters, iron in the filter should bind with dissolved phosphorus in stormwater, limiting excess nutrients from going downstream. Typically, about 25% to 50% of the phosphorus found in stormwater is dissolved (MPRB/Mpls. NPDES event mean concentrations 2001-2015); therefore, an overall decrease in the amount of phosphorus reaching Crystal Lake downstream should be expected.

The inlet to the iron enhanced filter begins at a 12 inch flared end pipe which discharges into a small cement splash block vault (to capture solids) at one end of the filter, **Figure 14-8**. The outlet to the filter is a four inch PVC pipe with a threaded cap with a restrictor hole drilled in it intended to slow the drainage and increase the contact time with the iron filings, **Figure 14-9**.

Figure 14-8: Flared End section and splash block inlet structure to the IESF.

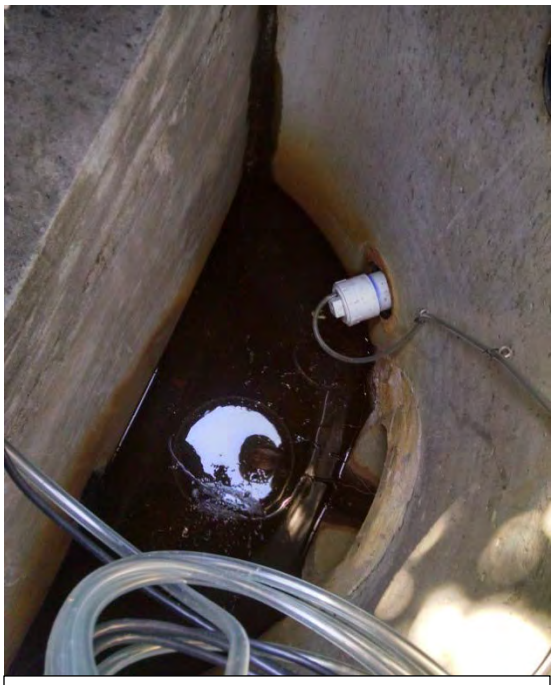


Figure 14-9: Photograph of the 4-inch (white) PVC outlet structure from the IESF.

Both the inlet and outlets were auto sampled and composited the majority of the time. The City, MPCA, and MPRB partnered to do a detailed chemical analysis of select individual storms, where individual bottles were analyzed separately. Single bottle analysis was expected to allow for a better understanding of how these iron enhanced sand filters work throughout the entire event hydrograph.

G. Methods

Site Installation

Extensive skilled labor including cement masons, plumbers, carpenters, painters, and welders were needed to install monitoring equipment at the 37th Ave Greenway IESF sites. The cement masons were critical due to the extensive concrete hole drilling and anchor placement needed **Figure 14-10 and Figure 14-11**.

Figure 14-10. The cement shop drilling access holes and anchors.

Figure 14-11. Mounting sub-surface custom anchor brackets for the sampler enclosure structures.

To monitor the inlet and outlet sites, the inlets were each equipped with one ISCO 2150 datalogger, 2105 interface module, and 2013ci cell phone modem along with a low-profile A/V (area velocity) level probe being placed at the inlet. The 2105 interface module was equipped with a splitter in order to trigger both inlet and outlet samplers simultaneously. Both the inlet and outlet were equipped with ISCO 3700 samplers. The datalogger used the cell phone modem to remotely upload data to the server Monday through Friday. The datalogger could also be remotely called up and programmed to change the pacing or triggers.

Figure 14-12. The 37th Alley Site fully installed. The enclosure structure contains the above ground samplers.

A tipping bucket rain gauge was installed nearby (within 1/4 mile) on a secure rooftop at Folwell Recreation Center. Data was periodically collected throughout the summer from the Hobo datalogger attached to the rain gauge. When precipitation data were missing, it was supplemented with data from the 38th and Bryant Ave S. MPRB South Side Service Center. Precipitation can vary widely over short distances; therefore, having local rain data allowed for more accurate storm event precipitation totals.

Sample Collection

At both the Street runoff site (Morgan Avenue) and Alley runoff site (between Newton and Oliver), the inlet and outlet samplers were each an ISCO 3700 autosampler equipped with 24 one liter bottles, 3/8" inner diameter vinyl tubing, and an intake strainer. The inlet low profile A/V probe and intake strainer were placed just upstream from the flared end outlet with a spring ring. The inlet strainer was placed pointing upstream and offset behind the A/V probe as to not interfere with it. The inlet sampler was triggered at ¾ inches of flow. Both sites used a splitter to trigger inlet and outlet samplers. The datalogger was programmed so once triggered, the inlet sampler would sample only through the storm, but the outlet sampler would continue to run, even if the inlet dropped below the trigger.

At the Street runoff site, the inlet was programmed to flow-pace every 112 cubic feet, taking one flow-paced sample per bottle during the storm. The outlet sampler was programmed to be time-paced, and one sample per bottle every 60 minutes was collected during the storm.

At the Alley runoff site (between Newton and Oliver), the inlet was programmed to flow-pace every 254 cubic feet, taking one flow-paced sample per bottle during the storm. The outlet sampler was programmed to time-pace and one sample per bottle every 22 minutes was collected during the storm. The goal was to collect 15 storms including five storms where individual bottles could be collected and analyzed separately. Due to the amount of custom work and the amount of problem solving this unique sampling set up required, 15 storms were not collected at all IESF sites in 2015.

RESULTS & DISCUSSION

Sample Collection

Table 14-15 shows the events collected and the precipitation, duration, time since last precipitation and intensity of each storm. In 2015, the 37th & Morgan In/Out site collected thirteen paired storm samples. The 37th Alley In/Out collected eight paired storm samples. Most of the storms were composited but a few of the storms had the individual bottles analyzed separately. The 37th & Morgan In/Out site collected five individual bottle storms and at the 37th Alley In/Out site two individual bottle storms were collected. It was planned that individual bottle analysis would allow a better understanding of what was chemically occurring (with phosphorus, solids, and iron) through time during a storm.

Five precipitation events required the South Side Service Center rain gauge, at 38th and Bryant Ave S, to be used to supplement missing precipitation data from the Folwell rain gauge.

Table 14-15. The 2015 precipitation events captured at the 37th & Morgan and 37th Alley IESF sites. A precipitation event was defined as a storm greater than 0.10 inches, separated by eight hours or more from other precipitation.

Start Date/Time	End Date/Time	Precip (inches)	Duration (hours)	Time since last Precip. (hours)	Intensity inch/hr	37th & Morgan In	37th & Morgan Out	37th Alley In	37th Alley Out
06/11/2015 4:45	6/11/2015 15:45	**0.31***	**11**	**101**	**0.03**	Composite	Composite		
06/20/2015 5:45	6/20/2015 8:15	**0.39***	**2.5**	**64**	**0.16**	Composite	Composite	Composite	Composite
06/22/2015 7:00	6/22/2015 16:15	**1.52***	**9.25**	**47**	**0.16**			Composite	Composite
06/26/2015 17:45	6/26/2015 17:45	**0.17***	**0.25**	**98**	**0.68**	Composite	Composite		
7/6/2015 0:52	7/6/2015 13:11	**0.34**	**12**	**683**	**0.03**			Composite	Composite
07/12/2015 23:30	7/13/2015 10:00	**1.65***	**10.5**	**155**	**0.16**	Ind Btl.	Ind Btl.	Ind Btl.	Ind Btl.
7/18/2015 0:53	7/18/2015 10:53	**0.11**	**10**	**276**	**0.01**	Composite	Composite		
7/28/2015 6:18	7/28/2015 11:05	**0.21**	**5**	**92**	**0.04**	Ind Btl.	Ind Btl.	Ind Btl.	Ind Btl.
8/6/2015 9:48	8/7/2015 9:20	**0.23**	**24**	**215**	**0.01**	Composite	Composite	Composite	Composite
	8/9/2015 0:00	Non Precip Event				Composite	Composite	Composite	Composite
8/18/2015 11:10	8/19/2015 10:12	**0.35**	**23**	**266**	**0.02**	Composite	Composite	Composite	Composite
9/9/2015 12:16	9/10/2015 6:39	**0.13**	**18**	**68**	**0.01**	Composite	Composite		
9/17/2015 4:59	9/17/2015 22:17	**0.21**	**17**	**166**	**0.01**	Ind Btl.	Ind Btl.		
9/23/2015 18:10	9/24/2015 15:10	**0.10**	**21**	**115**	**0.005**	Ind Btl.	Ind Btl.		
10/27/2015 18:45	10/29/2015 6:13	**0.57**	**35**	**81**	**0.02**	Ind Btl.	Ind Btl.		
* SSSC precip data									

The event of 8/9/15 appeared to be a non-precipitation event. No record of precipitation at Folwell, the NWS MSP airport, or the MPRB South Side Service Center was found.

Event Data

Table 14-16 shows the 2015 37th & Morgan and 37th Alley IESF chemistry data. Data that are underlined failed that parameter during the blind monthly QAQC standards from internal MPRB testing. The sample type column indicates if the sample was a composite or an individual bottle event (Indv Btl). Individual bottle events were when each bottle was analyzed separately. In **Table 14-16,** the shaded rows separate storm events. The parameters collected were: TP, TDP, Ortho-P, TSS, and Fe. There was a limited amount of TP and TSS water chemistry collected. The additional data proved useful in answering IESF functionality questions.

Table 14-16. The 2015 37th & Morgan Inlet Iron Enhanced Sand Filter data.

Date Sampled	Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P 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. uhmos	pH std units	Cu ug/L	Pb ug/L	Zn ug/L	Fe ug/L
6/11/2015	8:24	37th & Morgan In	Composite	0.956	0.575	0.553						13										1000
6/20/2015	7:04	37th & Morgan In	Composite	0.872	0.273	0.341						130										2300
6/22/2015	9:04	37th & Morgan In	Composite	0.415	0.129	0.142						62										1000
6/26/2015	17:45	37th & Morgan In	Composite	0.965	0.186	0.542						119										4800
6/28/2015	1:15	37th & Morgan In #1	Indv Btl.	0.680	0.089	0.171						75										2600
6/28/2015	17:05	37th & Morgan In #2	Indv Btl.	0.387	0.070	0.134						77										1300
7/12/2015	23:14	37th & Morgan In #1	Indv Btl.	2.16	0.701	0.692						367										9500
7/13/2015	0:22	37th & Morgan In #2	Indv Btl.	0.367	0.032	0.079						116										2300
7/13/2015	0:25	37th & Morgan In #3	Indv Btl.	0.865	0.062	0.182						367										9300
7/13/2015	0:27	37th & Morgan In #4	Indv Btl.	0.278	0.011	0.035						67										1100
7/13/2015	0:44	37th & Morgan In #5	Indv Btl.	0.211	0.014	0.037						25										400
7/13/2015	1:02	37th & Morgan In #6	Indv Btl.	0.266	0.021	0.038						22										370
7/13/2015	1:20	37th & Morgan In #7	Indv Btl.	0.211	0.017	0.036						16										300
7/13/2015	1:40	37th & Morgan In #8	Indv Btl.	0.167	0.017	0.034						18										190
7/13/2015	2:12	37th & Morgan In #9	Indv Btl.	0.187	0.012	0.031						24										140
7/18/2015	4:49	37th & Morgan In	Composite	0.199	0.107	0.106						15										230
7/28/2015	6:38	37th & Morgan In #2	Indv Btl.	0.342	0.153	0.193						35										600
7/28/2015	6:42	37th & Morgan In #4	Indv Btl.	0.293	0.132	0.172						53										640
7/28/2015	6:47	37th & Morgan In #6	Indv Btl.	0.887	0.336	0.214						26										1600
7/28/2015	7:04	37th & Morgan In #8	Indv Btl.	0.229	0.109	0.137						32										570
7/28/2015	7:28	37th & Morgan In #10	Indv Btl.	0.134	0.087	0.084						22										440
7/28/2015	7:53	37th & Morgan In #12	Indv Btl.	0.109	0.066	0.07						7										110
7/28/2015	8:17	37th & Morgan In #14	Indv Btl.	0.133	0.059	0.07						7										180
7/28/2015	8:42	37th & Morgan In #16	Indv Btl.	0.144	0.077	0.072						7										210
7/28/2015	9:19	37th & Morgan In #18	Indv Btl.	0.149	0.063	0.072						4										160
7/28/2015	10:05	37th & Morgan In #20	Indv Btl.	0.229	0.127	0.127						9										170
8/7/2015	1:16	37th & Morgan In	Composite	0.433	0.077	0.119						55						6.5				490
8/9/2015	14:42	37th & Morgan In	Composite	0.425	0.187	0.187						17										530
8/18/2015	21:34	37th & Morgan In	Composite	0.132	0.061	0.068						9										140
9/10/2015	5:29	37th & Morgan In	Composite	0.12	0.098	0.07	1.39	0.816	0.231	<2.0	30.0	11	5	10	6	<5.0	46	7.3	<5.00	<3.00	20	200
9/17/2015	6:41	37th & Morgan In #1	Indv Btl.	0.314	0.134	0.153						81										400
9/17/2015	6:52	37th & Morgan In #2	Indv Btl.	0.204	0.143	0.119						32										170
9/17/2015	7:12	37th & Morgan In #3	Indv Btl.	0.200	0.130	0.107						22										200
9/24/2015	4:27	37th &Morgan In #1	Indv Btl.	0.317	0.252	0.143						10										500
9/24/2015	6:46	37th & Morgan In #2	Indv Btl.	0.261	0.183	0.119						19										290
9/24/2015	7:09	37th & Morgan In #3	Indv Btl.	0.209	0.157	0.105						10										210
10/27/2015	19:00	37th & Morgan In #1	Indv Btl.	2.62	2.29	2.68						25										620
10/27/2015	21:20	37th & Morgan In #2	Indv Btl.	2.37	1.99	2.10						53										210
10/27/2015	21:42	37th & Morgan In #3	Indv Btl.	2.11	1.91	1.84						30										25
10/27/2015	22:03	37th & Morgan In #4	Indv Btl.	2.00	1.79	1.69						26										25
10/27/2015	22:25	37th & Morgan In #5	Indv Btl.	1.91	1.37	1.43						25										25
10/27/2015	22:46	37th & Morgan In #6	Indv Btl.	1.46	1.35	1.27						20										25
10/27/2015	23:08	37th & Morgan In #7	Indv Btl.	1.39	1.25	1.20						18										25
10/27/2015	23:31	37th & Morgan In #8	Indv Btl.	1.26	1.07	0.963						13										25
10/27/2015	23:54	37th & Morgan In #9	Indv Btl.	1.17	1.00	0.901						19										25
10/28/2015	0:18	37th & Morgan In #10	Indv Btl.	1.07	0.902	0.811						17										25
10/28/2015	0:40	37th & Morgan In #11	Indv Btl.	0.989	0.819	0.731						13										25
10/28/2015	1:01	37th & Morgan In #12	Indv Btl.	0.905	0.762	0.676						15										25
10/28/2015	1:24	37th & Morgan In #13	Indv Btl.	0.872	0.735	0.625						3										25
10/28/2015	1:52	37th & Morgan In #14	Indv Btl.	0.771	0.706	0.583						9										25
10/28/2015	2:20	37th & Morgan In #15	Indv Btl.	0.838	0.649	0.539						11										25
10/28/2015	2:49	37th & Morgan In #16	Indv Btl.	0.704	0.691	0.516						4										25
10/28/2015	3:23	37th & Morgan In #17	Indv Btl.	0.721	0.632	0.500						10										25
10/28/2015	4:11	37th & Morgan In #18	Indv Btl.	0.771	0.642	0.493						7										25
10/28/2015	4:56	37th & Morgan In #19	Indv Btl.	0.805	0.644	0.484						5										25
10/28/2015	5:10	37th & Morgan In #20	Indv Btl.	0.704	0.602	0.465						8										25
10/28/2015	5:30	37th & Morgan In #21	Indv Btl.	0.704	0.564	0.448						16										25

Table 14-16 (cont.). The 2015 37th & Morgan Outlet Iron Enhanced Sand Filter data.

Date Sampled	Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P 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. uhmos	pH std units	Cu ug/L	Pb ug/L	Zn ug/L	Fe ug/L
6/11/2015	13:36	37th & Morgan Out	Composite	0.364	0.222	0.243						52										3700
6/20/2015	13:27	37th & Morgan Out	Composite	0.262	0.121	0.118						8										2300
6/26/2015	23:15	37th & Morgan Out	Composite	0.286	0.044	0.115						18										8300
7/12/2015	18:29	37th & Morgan Out #2	Indv Btl.	0.254	0.192	0.218						1										490
7/12/2015	23:14	37th & Morgan Out #3	Indv Btl.	0.251	0.205	0.234						5										430
7/13/2015	0:12	37th & Morgan Out #4	Indv Btl.	0.257	0.194	0.222						0										340
7/13/2015	1:12	37th & Morgan Out #5	Indv Btl.	0.255	0.182	0.248						5										1500
7/13/2015	2:12	37th & Morgan Out #6	Indv Btl.	0.218	0.16	0.212						3										2000
7/13/2015	3:12	37th & Morgan Out #7	Indv Btl.	0.210	0.149	0.198						0										2600
7/13/2015	4:12	37th & Morgan Out #8	Indv Btl.	0.195	0.16	0.188						4										3300
7/13/2015	5:12	37th & Morgan Out #9	Indv Btl.	0.194	0.128	0.178						1										3800
7/13/2015	6:12	37th & Morgan Out #10	Indv Btl.	0.191	0.117	0.185						2										4200
7/13/2015		37th & Morgan Out	Composite	0.236	0.167	0.194						2										580
7/18/2015	2:52	37th & Morgan Out	Composite	0.322	0.146	0.244						11										4600
7/28/2015	6:56	37th & Morgan Out #2	Indv Btl.	0.273	0.244	0.255						2										580
7/28/2015	7:56	37th & Morgan Out #3	Indv Btl.	0.272	0.253	0.264						2										470
7/28/2015	8:56	37th & Morgan Out #4	Indv Btl.	0.294	0.245	0.260						2										420
7/28/2015	9:56	37th & Morgan Out #5	Indv Btl.	0.371	0.267	0.278						2										520
7/28/2015	10:56	37th & Morgan Out #6	Indv Btl.	0.281	0.209	0.246						4										2500
7/28/2015		37th & Morgan Out	Composite	0.248	0.173	0.210						2										900
8/7/2015	9:21	37th Morgan - Out	Composite	0.269	0.127	0.175						9						7.3				2500
8/10/2015	8:36	37th Morgan Out	Composite	0.395	0.248	0.285						11										4900
8/19/2015	4:30	37th Morgan Out	Composite	0.203	0.147	0.169						2										980
9/10/2015	8:22	37th Morgan Out	Composite	0.209	0.140	0.189	1.01	<0.500	0.107	<2.0	100	5	3	140	4	8	225	6.9	<5.00	<3.00	<20.0	2000
9/17/2015	6:02	37th Morgan Out #2	Indv Btl.	0.293	0.168	0.205						5										2300
9/17/2015	7:02	37th Morgan Out #3	Indv Btl.	0.187	0.142	0.148						1										300
9/17/2015	8:02	37th Morgan Out #4	Indv Btl.	0.231	0.163	0.191						1										1400
9/17/2015	9:02	37th Morgan Out #5	Indv Btl.	0.219	0.169	0.197						1										2200
9/17/2015	10:02	37th Morgan Out #6	Indv Btl.	0.227	0.132	0.200						3										2800
9/24/2015	3:23	37th Morgan Out #2	Indv Btl.	0.285	0.183	0.168						8										2000
9/24/2015	4:23	37th Morgan Out #3	Indv Btl.	0.267	0.210	0.205						6										1200
9/24/2015	5:23	37th Morgan Out #4	Indv Btl.	0.241	0.188	0.184						4										790
9/24/2015	6:23	37th Morgan Out #5	Indv Btl.	0.259	0.199	0.213						4										1300
9/24/2015	7:23	37th Morgan Out #6	Indv Btl.	0.190	0.158	0.148						3										400
9/24/2015	8:23	37th Morgan Out #7	Indv Btl.	0.206	0.172	0.181						3										1100
9/24/2015		37th Morgan Out	Composite	0.224	0.024	0.192						14										5100
10/27/2015	18:55	37th Morgan Out #1	Indv Btl.	1.54	1.33	1.40						15										1700
10/27/2015	19:55	37th Morgan Out #2	Indv Btl.	1.86	1.72	1.95						18										1300
10/27/2015	20:55	37th Morgan Out #3	Indv Btl.	1.76	1.72	1.70						13										1000
10/27/2015	21:55	37th Morgan Out #4	Indv Btl.	1.48	1.40	1.35						9										850
10/27/2015	22:55	37th Morgan Out #5	Indv Btl.	1.20	1.20	1.11						4										830
10/27/2015	23:55	37th Morgan Out #6	Indv Btl.	0.990	1.03	0.903						6										710
10/28/2015	0:55	37th Morgan Out #7	Indv Btl.	0.869	0.886	0.773						2										700
10/28/2015	1:55	37th Morgan Out #8	Indv Btl.	0.855	0.772	0.711						3										750
10/28/2015	2:55	37th Morgan Out #9	Indv Btl.	0.721	0.731	0.642						2										800
10/28/2015	3:55	37th Morgan Out #10	Indv Btl.	0.708	0.637	0.688						6										800
10/28/2015	4:55	37th Morgan Out #11	Indv Btl.	0.772	0.657	0.596						8										650
10/28/2015	5:55	37th Morgan Out #12	Indv Btl.	0.721	0.684	0.574						2										690
10/28/2015	6:55	37th Morgan Out #13	Indv Btl.	0.725	0.557	0.541						6										790
10/28/2015	7:55	37th Morgan Out #14	Indv Btl.	0.704	0.537	0.502						6										820
10/28/2015	8:55	37th Morgan Out #15	Indv Btl.	0.564	0.520	0.521						9										970
10/28/2015	9:55	37th Morgan Out #16	Indv Btl.	0.607	0.473	0.505						9										1100
10/28/2015	10:55	37th Morgan Out #17	Indv Btl.	0.537	0.507	0.574						8										1200

Table 14-16 (cont). The 2015 37th Alley Inlet/Outlet Iron Enhanced Sand Filter data.

Date Sampled	Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P 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. uhmos	pH std units	Cu ug/L	Pb ug/L	Zn ug/L	Fe ug/L
6/20/2015	6:00	37th Alley In	Composite	1.40	0.500	0.536						162										3100
6/22/2015	8:41	37th Alley In	Composite	0.396	0.113	0.153						45										1100
7/6/2015	0:41	37th Alley In	Composite	0.387	0.139	0.226						230										430
7/12/2015	23:18	37th Alley In #1	Indv Btl.	0.775	0.098	0.310						625										6700
7/12/2015	23:21	37th Alley In #2	Indv Btl.	0.580	0.113	0.201						306										4100
7/12/2015	23:25	37th Alley In #3	Indv Btl.	0.513	0.147	0.236						234										2900
7/12/2015	23:29	37th Alley In #4	Indv Btl.	0.415	0.130	0.197						155										2100
7/12/2015	23:33	37th Alley In #5	Indv Btl.	0.322	0.106	0.171						114										1700
7/12/2015	23:45	37th Alley In #6	Indv Btl.	0.259	0.089	0.147						70										1100
7/13/2015	0:20	37th Alley In #7	Indv Btl.	0.166	0.071	0.113						25										430
7/28/2015	6:30	37th Alley In #1	Indv Btl.	0.714	0.261	0.380						201										2700
7/28/2015	6:40	37th Alley In #2	Indv Btl.	0.443	0.215	0.277						149										1800
7/28/2015	6:45	37th Alley In #3	Indv Btl.	0.391	0.179	0.229						280										2900
7/28/2015	6:50	37th Alley In #4	Indv Btl.	0.353	0.144	0.191						175										1400
7/28/2015	6:56	37th Alley In #5	Indv Btl.	0.381	0.164	0.225						106										1500
7/28/2015	7:00	37th Alley In #6	Indv Btl.	0.320	0.177	0.219						59										970
8/6/2015	15:12	37th Alley In	Composite	0.672	0.212	0.283						118						6.7				2000
8/9/2015	14:21	37th Alley In	Composite	0.335	0.144	0.163						26										570
8/18/2015	14:35	37th Alley In	Composite	0.203	0.113	0.127						19										370
6/20/2015	7:27	37th Alley Out	Composite	0.332	0.277	0.269						2										160
6/22/2015	10:01	37th Alley Out	Composite	0.341	0.309	0.278						7										98
7/6/2015	9:22	37th Alley Out	Composite	0.214	0.160	0.154						10										250
7/12/2015	23:21	37th Alley Out #1	Indv Btl.	0.180	0.063	0.061						5										230
7/12/2015	23:43	37th Alley Out #2	Indv Btl.	0.111	0.067	0.079						1										320
7/13/2015	0:05	37th Alley Out #3	Indv Btl.	0.137	0.107	0.113						4										270
7/13/2015	0:27	37th Alley Out #4	Indv Btl.	0.136	0.123	0.129						6										270
7/13/2015	0:49	37th Alley Out #5	Indv Btl.	0.150	0.128	0.146						2										260
7/13/2015	1:11	37th Alley Out #6	Indv Btl.	0.165	0.151	0.148						1										250
7/28/2015	7:16	37th Alley Out #1	Indv Btl.	0.176	0.094	0.131						5										250
7/28/2015	8:00	37th Alley Out #3	Indv Btl.	0.184	0.149	0.160						4										280
7/28/2015	8:44	37th Alley Out #5	Indv Btl.	0.276	0.169	0.192						11										320
7/28/2015	9:28	37th Alley Out #7	Indv Btl.	0.498	0.420	0.368						5										320
7/28/2015	10:12	37th Alley Out #9	Indv Btl.	0.498	0.420	0.379						8										300
7/28/2015	10:56	37th Alley Out #11	Indv Btl.	0.480	0.402	0.373						5										260
7/28/2015	11:40	37th Alley Out #13	Indv Btl.	0.479	0.455	0.368						4										270
8/6/2015	16:12	37th Alley Out	Composite	0.388	0.278	0.272						7						7.2				190
8/9/2015	15:03	37th Alley Out	Composite	0.404	0.323	0.312						6										120
8/18/2015	19:51	37th Alley Out	Composite	0.340	0.293	0.283						2										140

Table 14-17 shows the 2015 Inlet/Outlet paired storms for both 37th & Morgan and 37th Alley sites. The phosphorus, TDP, Ortho P, TSS, and Fe results can be compared. The geometric mean and median were calculated for the storms with individual bottles collected so one value can be used for comparison with the composite samples. The geometric mean was calculated because it is believed to be the best statistical tool for comparison purposes of stormwater data. Individual storms are separated by shading of the rows.

Table 14-17. 37th & Morgan Inlet/Outlet paired storm comparison of composites and individual bottles during storm.

Date Sampled/Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P mg/L	TSS mg/L	Fe ug/L
06/11/15 08:24	37th & Morgan In	Composite	0.956	0.575	0.553	13	1000
06/11/15 13:36	37th & Morgan Out	Composite	0.364	0.222	0.243	52	3700
06/20/15 07:04	37th & Morgan In	Composite	0.872	0.273	0.341	130	2300
06/20/15 13:27	37th & Morgan Out	Composite	0.262	0.121	0.118	8	2300
06/26/15 17:45	37th & Morgan In	Composite	0.965	0.186	0.542	119	4800
06/26/15 23:15	37th & Morgan Out	Composite	0.286	0.044	0.115	18	8300
07/12/15 23:14	37th & Morgan In #1	Indv Btl.	2.16	0.701	0.692	367	9500
07/13/15 00:22	37th & Morgan In #2	Indv Btl.	0.367	0.032	0.079	116	2300
07/13/15 00:25	37th & Morgan In #3	Indv Btl.	0.865	0.062	0.182	367	9300
07/13/15 00:27	37th & Morgan In #4	Indv Btl.	0.278	0.011	0.035	67	1100
07/13/15 00:44	37th & Morgan In #5	Indv Btl.	0.211	0.014	0.037	25	400
07/13/15 01:02	37th & Morgan In #6	Indv Btl.	0.266	0.021	0.038	22	370
07/13/15 01:20	37th & Morgan In #7	Indv Btl.	0.211	0.017	0.036	16	300
07/13/15 01:40	37th & Morgan In #8	Indv Btl.	0.167	0.017	0.034	18	190
07/13/15 02:12	37th & Morgan In #9	Indv Btl.	0.187	0.012	0.031	24	140
	37th & Morgan In GEO MEAN		**0.346**	**0.029**	**0.064**	**54**	**862**
	37th & Morgan In MEDIAN		**0.266**	**0.017**	**0.037**	**25**	**400**
07/12/15 18:29	37th & Morgan Out #2	Indv Btl.	0.254	0.192	0.218	1	490
07/12/15 23:14	37th & Morgan Out #3	Indv Btl.	0.251	0.205	0.234	5	430
07/13/15 00:12	37th & Morgan Out #4	Indv Btl.	0.257	0.194	0.222	0	340
07/13/15 01:12	37th & Morgan Out #5	Indv Btl.	0.255	0.182	0.248	5	1500
07/13/15 02:12	37th & Morgan Out #6	Indv Btl.	0.218	0.16	0.212	3	2000
07/13/15 03:12	37th & Morgan Out #7	Indv Btl.	0.210	0.149	0.198	0	2600
07/13/15 04:12	37th & Morgan Out #8	Indv Btl.	0.195	0.160	0.188	4	3300
07/13/15 05:12	37th & Morgan Out #9	Indv Btl.	0.194	0.128	0.178	1	3800
07/13/15 06:12	37th & Morgan Out #10	Indv Btl.	0.191	0.117	0.185	2	4200
	37th & Morgan Out GEO MEAN		**0.223**	**0.163**	**0.208**	**2**	**1456**
	37th & Morgan Out MEDIAN		**0.218**	**0.160**	**0.212**	**2**	**2000**
07/18/15 04:49	37th & Morgan In	Composite	0.199	0.107	0.106	15	230
07/18/15 02:52	37th & Morgan Out	Composite	0.322	0.146	0.244	11	4600
07/28/15 06:38	37th & Morgan In #2	Indv Btl.	0.342	0.153	0.193	35	600
07/28/15 06:42	37th & Morgan In #4	Indv Btl.	0.293	0.132	0.172	53	640
07/28/15 06:47	37th & Morgan In #6	Indv Btl.	0.887	0.336	0.214	26	1600
07/28/15 07:04	37th & Morgan In #8	Indv Btl.	0.229	0.109	0.137	32	570
07/28/15 07:28	37th & Morgan In #10	Indv Btl.	0.134	0.087	0.084	22	440
07/28/15 07:53	37th & Morgan In #12	Indv Btl.	0.109	0.066	0.070	7	110
07/28/15 08:17	37th & Morgan In #14	Indv Btl.	0.133	0.059	0.070	7	180
07/28/15 08:42	37th & Morgan In #16	Indv Btl.	0.144	0.077	0.072	7	210
07/28/15 09:19	37th & Morgan In #18	Indv Btl.	0.149	0.063	0.072	4	160
07/28/15 10:05	37th & Morgan In #20	Indv Btl.	0.229	0.127	0.127	9	170
	37th & Morgan In GEO MEAN		**0.213**	**0.104**	**0.110**	**15**	**334**
	37th & Morgan In MEDIAN		**0.189**	**0.098**	**0.106**	**15**	**325**
07/28/15 06:56	37th & Morgan Out #2	Indv Btl.	0.273	0.244	0.255	2	580
07/28/15 07:56	37th & Morgan Out #3	Indv Btl.	0.272	0.253	0.264	2	470
07/28/15 08:56	37th & Morgan Out #4	Indv Btl.	0.294	0.245	0.260	2	420
07/28/15 09:56	37th & Morgan Out #5	Indv Btl.	0.371	0.267	0.278	2	520
07/28/15 10:56	37th & Morgan Out #6	Indv Btl.	0.281	0.209	0.246	4	2500
	37th & Morgan Out GEO MEAN		**0.296**	**0.243**	**0.260**	**2**	
	37th & Morgan Out MEDIAN		**0.281**	**0.245**	**0.260**	**2**	
08/07/15 01:16	37th & Morgan In	Composite	0.433	0.077	0.119	55	490
08/07/15 09:21	37th Morgan Out	Composite	0.269	0.127	0.175	9	2500
	Non-precipitation event						
08/09/15 14:42	37th & Morgan In	Composite	0.425	0.187	0.187	17	530
08/10/15 08:36	37th Morgan Out	Composite	0.395	0.248	0.285	11	4900
08/18/15 21:34	37th & Morgan In	Composite	0.132	0.061	0.068	9	140
08/19/15 04:30	37th Morgan Out	Composite	0.203	0.147	0.169	2	980
09/10/15 05:29	37th & Morgan In	Composite	0.120	0.098	0.070	11	200
09/10/15 08:22	37th Morgan Out	Composite	0.209	0.140	0.189	5	2000

Date Sampled/Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P mg/L	TSS mg/L	Fe ug/L
09/17/15 06:41	37th & Morgan In #1	Indv Btl.	0.314	0.134	0.153	81	400
09/17/15 06:52	37th & Morgan In #2	Indv Btl.	0.204	0.143	0.119	32	170
09/17/15 07:12	37th & Morgan In #3	Indv Btl.	0.200	0.130	0.107	22	200
	37th & Morgan In GEO MEAN		**0.234**	**0.136**	**0.125**	**39**	**239**
	37th & Morgan In MEDIAN		**0.204**	**0.134**	**0.119**	**32**	**200**
09/17/15 06:02	37th Morgan Out #2	Indv Btl.	0.293	0.168	0.205	5	2300
09/17/15 07:02	37th Morgan Out #3	Indv Btl.	0.187	0.142	0.148	1	300
09/17/15 08:02	37th Morgan Out #4	Indv Btl.	0.231	0.163	0.191	1	1400
09/17/15 09:02	37th Morgan Out #5	Indv Btl.	0.219	0.169	0.197	1	2200
09/17/15 10:02	37th Morgan Out #6	Indv Btl.	0.227	0.132	0.200	3	2800
	37th & Morgan Out GEO MEAN		**0.229**	**0.154**	**0.187**	**2**	**1429**
	37th & Morgan Out MEDIAN		**0.227**	**0.163**	**0.197**	**1**	**2200**
09/24/15 04:27	37th &Morgan In #1	Indv Btl.	0.317	0.252	0.143	10	500
09/24/15 06:46	37th & Morgan In #2	Indv Btl.	0.261	0.183	0.119	19	290
09/24/15 07:09	37th & Morgan In #3	Indv Btl.	0.209	0.157	0.105	10	210
	37th & Morgan In GEO MEAN		**0.259**	**0.193**	**0.121**	**12**	**312**
	37th & Morgan In MEDIAN		**0.261**	**0.183**	**0.119**	**10**	**290**
09/24/15 03:23	37th Morgan Out #2	Indv Btl.	0.285	0.183	0.168	8	2000
09/24/15 04:23	37th Morgan Out #3	Indv Btl.	0.267	0.210	0.205	6	1200
09/24/15 05:23	37th Morgan Out #4	Indv Btl.	0.241	0.188	0.184	4	790
09/24/15 06:23	37th Morgan Out #5	Indv Btl.	0.259	0.199	0.213	4	1300
09/24/15 07:23	37th Morgan Out #6	Indv Btl.	0.190	0.158	0.148	3	400
09/24/15 08:23	37th Morgan Out #7	Indv Btl.	0.206	0.172	0.181	3	1100
	37th & Morgan Out GEO MEAN		**0.239**	**0.184**	**0.182**	**4**	**1014**
	37th & Morgan Out MEDIAN		**0.250**	**0.186**	**0.183**	**4**	**1150**
10/27/15 19:00	37th & Morgan In #1	Indv Btl.	2.62	2.29	2.68	25	620
10/27/15 21:20	37th & Morgan In #2	Indv Btl.	2.37	1.99	2.10	53	210
10/27/15 21:42	37th & Morgan In #3	Indv Btl.	2.11	1.91	1.84	30	25
10/27/15 22:03	37th & Morgan In #4	Indv Btl.	2.00	1.79	1.69	26	25
10/27/15 22:25	37th & Morgan In #5	Indv Btl.	1.91	1.37	1.43	25	25
10/27/15 22:46	37th & Morgan In #6	Indv Btl.	1.46	1.35	1.27	20	25
10/27/15 23:08	37th & Morgan In #7	Indv Btl.	1.39	1.25	1.20	18	25
10/27/15 23:31	37th & Morgan In #8	Indv Btl.	1.26	1.07	0.963	13	25
10/27/15 23:54	37th & Morgan In #9	Indv Btl.	1.17	1.00	0.901	19	25
10/28/15 00:18	37th & Morgan In #10	Indv Btl.	1.07	0.902	0.811	17	25
10/28/15 00:40	37th & Morgan In #11	Indv Btl.	0.989	0.819	0.731	13	25
10/28/15 01:01	37th & Morgan In #12	Indv Btl.	0.905	0.762	0.676	15	25
10/28/15 01:24	37th & Morgan In #13	Indv Btl.	0.872	0.735	0.625	3	25
10/28/15 01:52	37th & Morgan In #14	Indv Btl.	0.771	0.706	0.583	9	25
10/28/15 02:20	37th & Morgan In #15	Indv Btl.	0.838	0.649	0.539	11	25
10/28/15 02:49	37th & Morgan In #16	Indv Btl.	0.704	0.691	0.516	4	25
10/28/15 03:23	37th & Morgan In #17	Indv Btl.	0.721	0.632	0.500	10	25
10/28/15 04:11	37th & Morgan In #18	Indv Btl.	0.771	0.642	0.493	7	25
10/28/15 04:56	37th & Morgan In #19	Indv Btl.	0.805	0.644	0.484	5	25
10/28/15 05:10	37th & Morgan In #20	Indv Btl.	0.704	0.602	0.465	8	25
10/28/15 05:30	37th & Morgan In #21	Indv Btl.	0.704	0.564	0.448	16	25
	37th & Morgan In GEO MEAN		**1.13**	**0.962**	**0.850**	**13**	**32**
	37th & Morgan In MEDIAN		**0.989**	**0.819**	**0.731**	**15**	**25**
10/27/15 18:55	37th Morgan Out #1	Indv Btl.	1.54	1.33	1.40	15	1700
10/27/15 19:55	37th Morgan Out #2	Indv Btl.	1.86	1.72	1.95	18	1300
10/27/15 20:55	37th Morgan Out #3	Indv Btl.	1.76	1.72	1.70	13	1000
10/27/15 21:55	37th Morgan Out #4	Indv Btl.	1.48	1.40	1.35	9	850
10/27/15 22:55	37th Morgan Out #5	Indv Btl.	1.20	1.20	1.11	4	830
10/27/15 23:55	37th Morgan Out #6	Indv Btl.	0.990	1.03	0.903	6	710
10/28/15 00:55	37th Morgan Out #7	Indv Btl.	0.869	0.886	0.773	2	700
10/28/15 01:55	37th Morgan Out #8	Indv Btl.	0.855	0.772	0.711	3	750
10/28/15 02:55	37th Morgan Out #9	Indv Btl.	0.721	0.731	0.642	2	800
10/28/15 03:55	37th Morgan Out #10	Indv Btl.	0.708	0.637	0.688	6	800
10/28/15 04:55	37th Morgan Out #11	Indv Btl.	0.772	0.657	0.596	8	650
10/28/15 05:55	37th Morgan Out #12	Indv Btl.	0.721	0.684	0.574	2	690
10/28/15 06:55	37th Morgan Out #13	Indv Btl.	0.725	0.557	0.541	6	790
10/28/15 07:55	37th Morgan Out #14	Indv Btl.	0.704	0.537	0.502	6	820
10/28/15 08:55	37th Morgan Out #15	Indv Btl.	0.564	0.520	0.521	9	970
10/28/15 09:55	37th Morgan Out #16	Indv Btl.	0.607	0.473	0.505	9	1100
10/28/15 10:55	37th Morgan Out #17	Indv Btl.	0.537	0.507	0.574	8	1200
	37th & Morgan Out GEO MEAN		**0.903**	**0.823**	**0.797**	**6**	**890**
	37th & Morgan Out MEDIAN		**0.772**	**0.731**	**0.688**	**6**	**820**

Table 14-17 (cont).

Table 14-17 (cont.). 37th Alley In/Out paired storm comparison of composites and individual bottles during storm.

Date Sampled/Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P mg/L	TSS mg/L	Fe ug/L
06/20/15 06:00	37th Alley In	Composite	1.40	0.500	0.536	162	3100
06/20/15 07:27	37th Alley Out	Composite	0.332	0.277	0.269	2	160
06/22/15 08:41	37th Alley In	Composite	0.396	0.113	0.153	45	1100
06/22/15 10:01	37th Alley Out	Composite	0.341	0.309	0.278	7	98
07/06/15 00:41	37th Alley In	Composite	0.387	0.139	0.226	230	430
07/06/15 09:22	37th Alley Out	Composite	0.214	0.160	0.154	10	250
07/12/15 23:18	37th Alley In #1	Indv Btl.	0.775	0.098	0.310	625	6700
07/12/15 23:21	37th Alley In #2	Indv Btl.	0.580	0.113	0.201	306	4100
07/12/15 23:25	37th Alley In #3	Indv Btl.	0.513	0.147	0.236	234	2900
07/12/15 23:29	37th Alley In #4	Indv Btl.	0.415	0.130	0.197	155	2100
07/12/15 23:33	37th Alley In #5	Indv Btl.	0.322	0.106	0.171	114	1700
07/12/15 23:45	37th Alley In #6	Indv Btl.	0.259	0.089	0.147	70	1100
07/13/15 00:20	37th Alley In #7	Indv Btl.	0.166	0.071	0.113	25	430
	37th & Alley In GEO MEAN		**0.388**	**0.105**	**0.188**	**145**	**2014**
	37th & Alley In MEDIAN		**0.415**	**0.106**	**0.197**	**155**	**2100**
07/12/15 23:21	37th Alley Out #1	Indv Btl.	0.180	0.063	0.061	5	230
07/12/15 23:43	37th Alley Out #2	Indv Btl.	0.111	0.067	0.079	1	320
07/13/15 00:05	37th Alley Out #3	Indv Btl.	0.137	0.107	0.113	4	270
07/13/15 00:27	37th Alley Out #4	Indv Btl.	0.136	0.123	0.129	6	270
07/13/15 00:49	37th Alley Out #5	Indv Btl.	0.150	0.128	0.146	2	260
07/13/15 01:11	37th Alley Out #6	Indv Btl.	0.165	0.151	0.148	1	250
	37th & Alley Out GEO MEAN		**0.145**	**0.101**	**0.107**	**3**	**265**
	37th & Alley Out MEDIAN		**0.144**	**0.115**	**0.121**	**3**	**265**
07/28/15 06:30	37th Alley In #1	Indv Btl.	0.714	0.261	0.380	201	2700
07/28/15 06:40	37th Alley In #2	Indv Btl.	0.443	0.215	0.277	149	1800
07/28/15 06:45	37th Alley In #3	Indv Btl.	0.391	0.179	0.229	280	2900
07/28/15 06:50	37th Alley In #4	Indv Btl.	0.353	0.144	0.191	175	1400
07/28/15 06:56	37th Alley In #5	Indv Btl.	0.381	0.164	0.225	106	1500
07/28/15 07:00	37th Alley In #6	Indv Btl.	0.320	0.177	0.219	59	970
	37th & Alley In GEO MEAN		**0.418**	**0.186**	**0.247**	**145**	**1750**
	37th & Alley In MEDIAN		**0.386**	**0.178**	**0.227**	**162**	**1650**
07/28/15 07:16	37th Alley Out #1	Indv Btl.	0.176	0.094	0.131	5	250
07/28/15 08:00	37th Alley Out #3	Indv Btl.	0.184	0.149	0.160	4	280
07/28/15 08:44	37th Alley Out #5	Indv Btl.	0.276	0.169	0.192	11	320
07/28/15 09:28	37th Alley Out #7	Indv Btl.	0.498	0.420	0.368	5	320
07/28/15 10:12	37th Alley Out #9	Indv Btl.	0.498	0.420	0.379	8	300
07/28/15 10:56	37th Alley Out #11	Indv Btl.	0.480	0.402	0.373	5	260
07/28/15 11:40	37th Alley Out #13	Indv Btl.	0.479	0.455	0.368	4	270
	37th & Alley Out GEO MEAN		**0.339**	**0.258**	**0.258**	**6**	**285**
	37th & Alley Out MEDIAN		**0.479**	**0.402**	**0.368**	**5**	**280**
08/06/15 15:12	37th Alley In	Composite	0.672	0.212	0.283	118	2000
08/06/15 16:12	37th Alley Out	Composite	0.388	0.278	0.272	7	190
	Non-precipitation event						
08/09/15 14:21	37th Alley In	Composite	0.335	0.144	0.163	26	570
08/09/15 15:03	37th Alley Out	Composite	0.404	0.323	0.312	6	120
08/18/15 14:35	37th Alley In	Composite	0.203	0.113	0.127	19	370
08/18/15 19:51	37th Alley Out	Composite	0.340	0.293	0.283	2	140

Initially, the 37th & Morgan iron enhanced sand filter appeared to be removing TP, TSS, and dissolved phosphorus (TDP and Ortho-P) during the first three storms collected in June. However, after July 12th the IESF exported TDP and Ortho-P. This suggests that the dissolved phosphorus export is possibly soil temperature dependent and may be biologically

driven, **Figure 14-13**. Also, 37th and Morgan site continually exported Fe throughout the study period. This site has a large deciduous shade tree on the southeast corner of the IESF that shades the IESF much of the day (**Figure 14-7**). Shading may prevent the 37th and Morgan IESF from drying out completely, creating wet anaerobic conditions, which may contribute to the export of Fe via iron reducing bacteria.

Similar to the 37th and Morgan site, the 37th Alley site appears to remove TP and TSS early in the season, but after June 20th it also exported TDP and Ortho-P. While only one 37th Alley early season storm was collected, this site appears to follow same pattern as the 37th and Morgan IESF of late season dissolved phosphorus export. Nutrient export at this site may be soil temperature dependent and biologically driven. However, this site did not export Fe. The 37th Alley site is not shaded and has full sun most of the day (**Figure 14-7**). Drier conditions that do not favor the presence of iron reducing bacteria may explain why this IESF does not export Fe.

Since the IESFs are exporting dissolved phosphorus after mid-summer, the nutrient export phenomenon is possibly tied to temperature and/or a biological process that transforms TP into dissolved phosphorus within the IESFs. Both IESFs removed TP from stormwater. This TP could then be digested by biological soil organisms, transforming the TP into TDP and Ortho-P. The nutrient export finding could also be due to the biological transformation of TP within the compost, placed during construction, in the iron enhanced sand filters **Figure 14-13**.

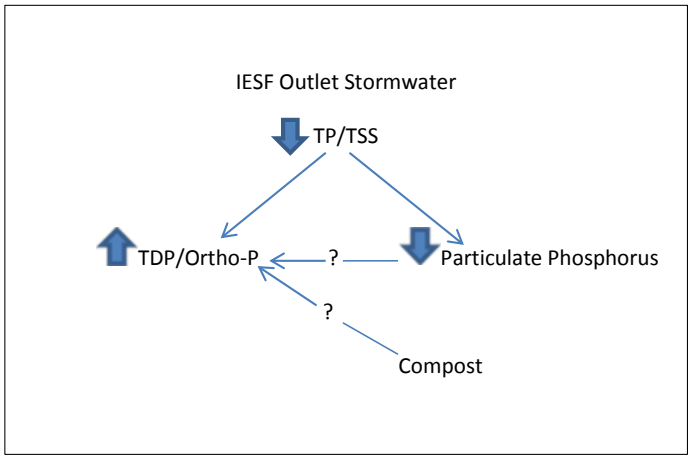


Figure 14-13. Diagram of IESF increasing and decreasing concentrations and possible paths for them. Question marks represent transformation of TP via biological activity. The blue arrows represent an increase or decrease in phosphorus.

Figure 14-14 shows the orange color of the 37th & Morgan outlet sample bottles. The orange staining is from iron leaving the filter. From the top of the picture moving counterclockwise, the bottles get progressively darker as the filter exports iron through the storm.

Figure 14-14. The 37th and Morgan outlet samples. Starting at 1 o'clock and moving counter clockwise samples progress through the storm.

Figures 14-15 through 14-19 show the events with individual inlet and outlet bottles sampled throughout the storm at 37th & Morgan. The graphs show the Ortho-P In/Out and the Fe In/Out, on the same time scale. This site received street runoff which was very high in organics from its residential watershed.

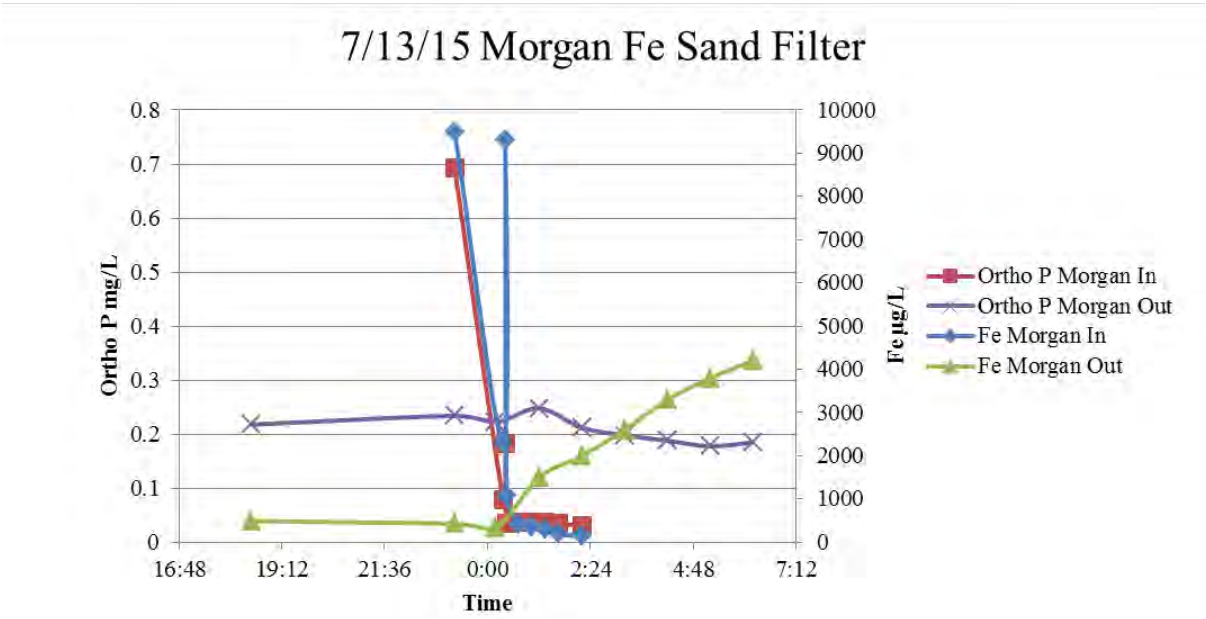


Figure 14-15. The 37th & Morgan IESF In/Out concentration of individual bottles during the 7/13/15 storm of 1.65".

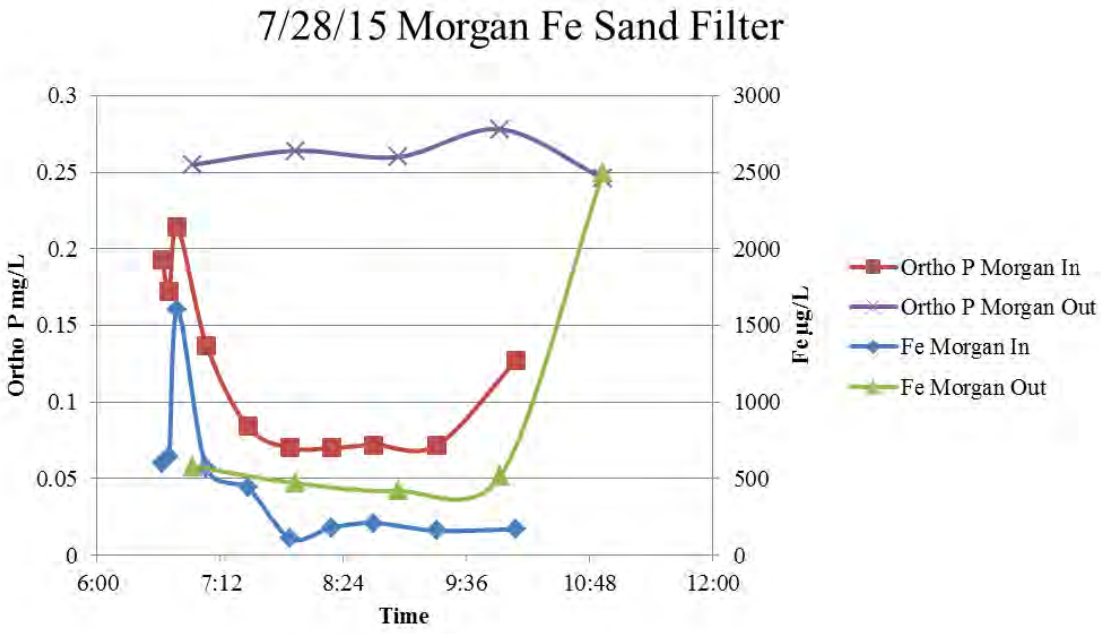


Figure 14-16. The 37th & Morgan IESF In/Out concentration of individual bottles during the 7/28/15 storm of 0.21".

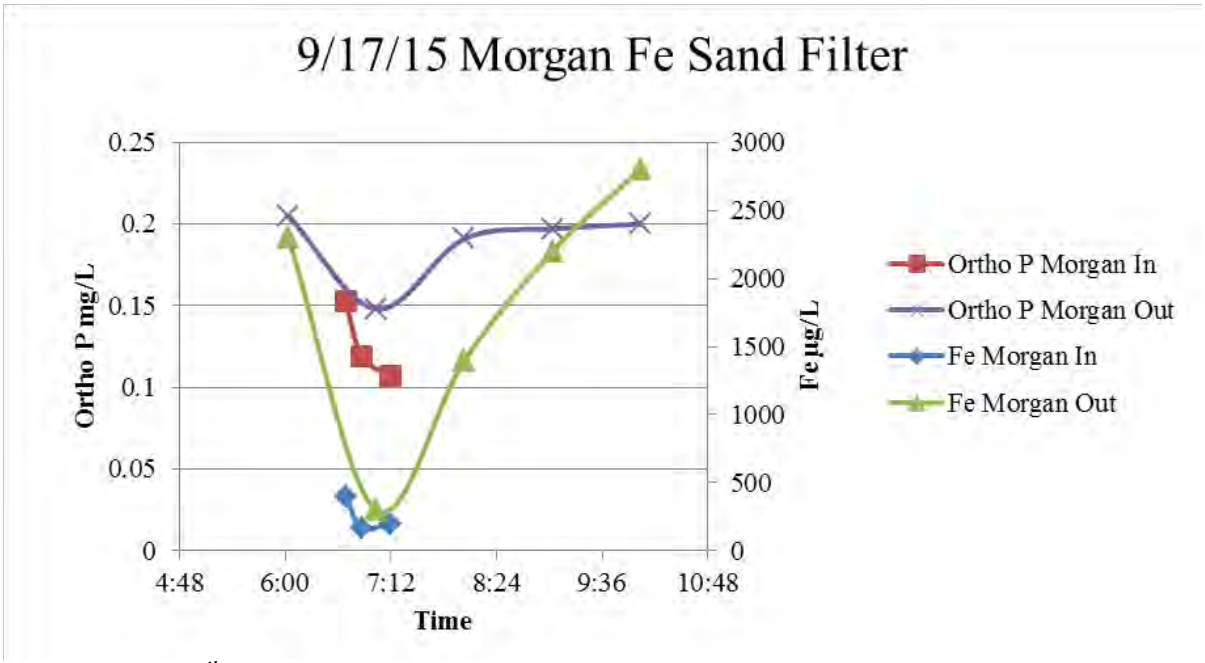


Figure 14-17. The 37th & Morgan IESF In/Out concentration of individual bottles during the 9/17/15 storm of 0.21".

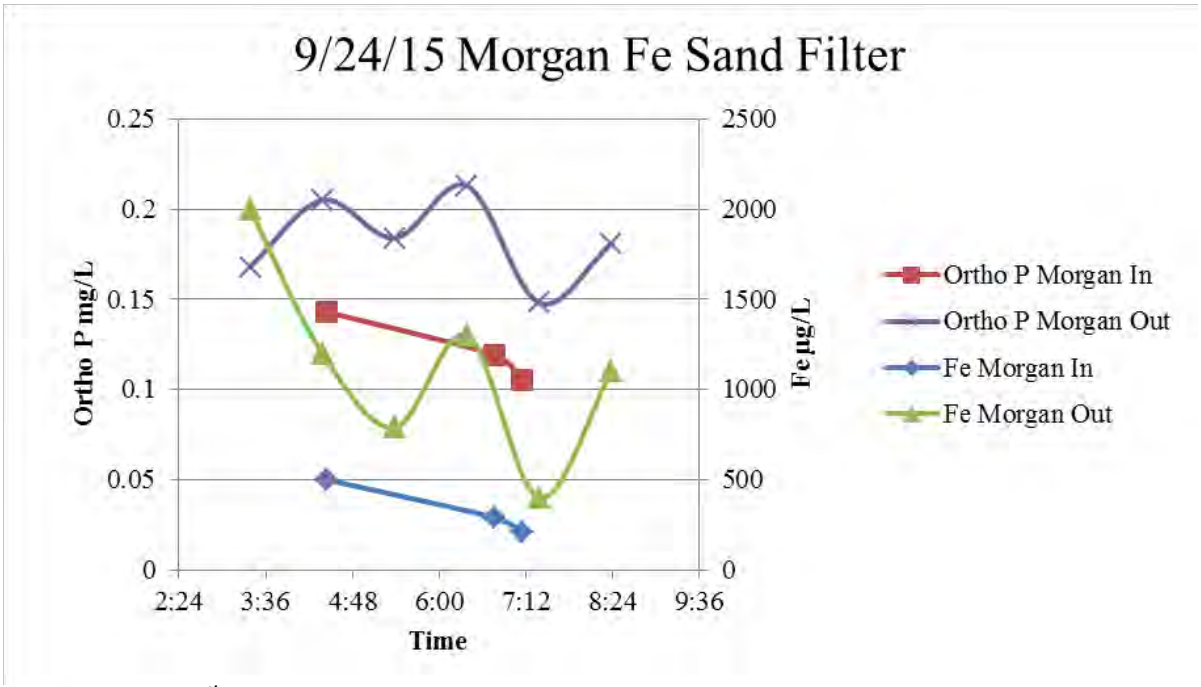


Figure 14-18. The 37th & Morgan IESF In/Out concentration of individual bottles during the 9/24/15 storm of 0.10".

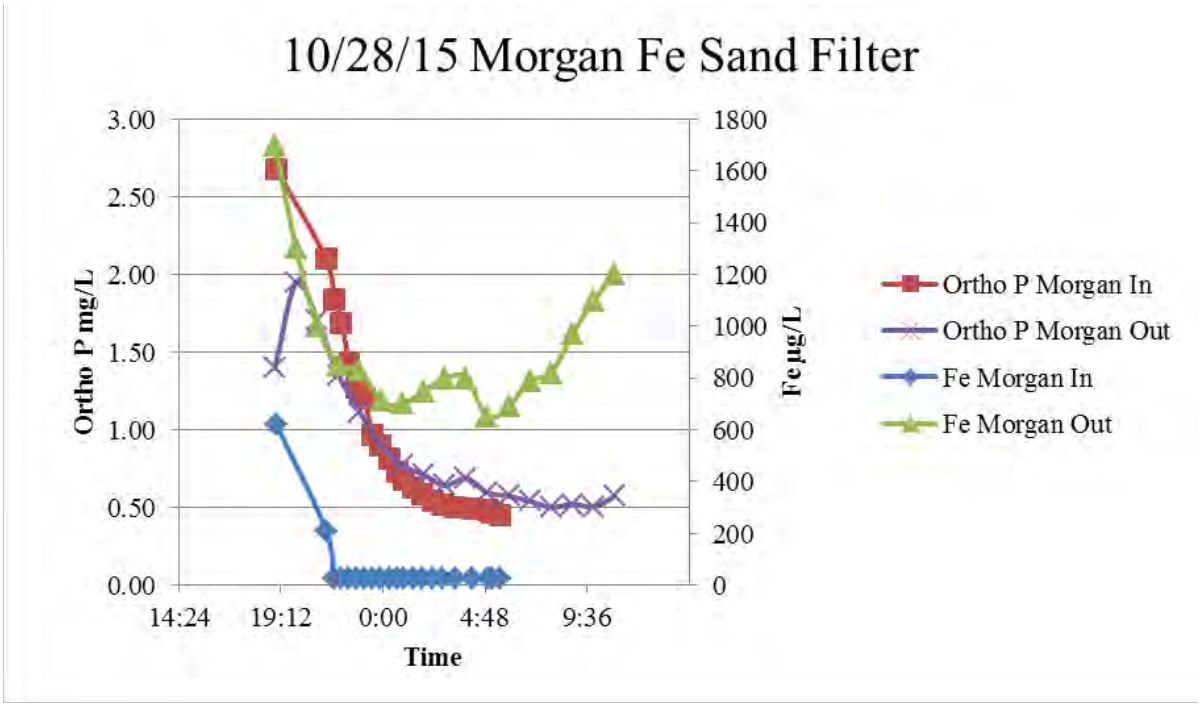


Figure 14-19. The 37th & Morgan IESF In/Out concentration of individual bottles during the 10/28/15 storm of 0.57".

The 37th & Morgan site is exporting iron and dissolved phosphorus much of the time. Dissolved phosphorus export may be a product of two things. First, the TSS (organic solids load) coming from the street may be decomposing, becoming anaerobic and causing particulate total phosphorus to be converted into dissolved phosphorus, leading to the increase in dissolved phosphorus leaving the filter. Second, it is also possible that there is an unknown interaction with compost that was added to the sand filter that is releasing phosphorus that exists within the filter due to its construction. It should be noted that phosphorus remains iron bound only during aerobic conditions. If iron bound phosphorus becomes anaerobic, the bond releases and phosphorus becomes mobile.

Iron is also being exported from the IESF at 37th and Morgan. pH data (in **Table 14-16)** show that the mobility of iron does not appear to be driven by low pH. Finally, the filter at 37th and Morgan is shaded and may not be drying out completely between storms. If it is remaining saturated, anaerobic condition may be leading to iron mobilization. Under anaerobic conditions, iron reducing bacteria could convert solid Fe^{+3} to the more soluble Fe^{+2} state. The exact cause of iron release is unknown and was not able to be determined by this study.

Figures 14-20 and 14-21 show the 37th Alley Ortho-P In/Out and the Fe In/Out. This site received alley runoff.

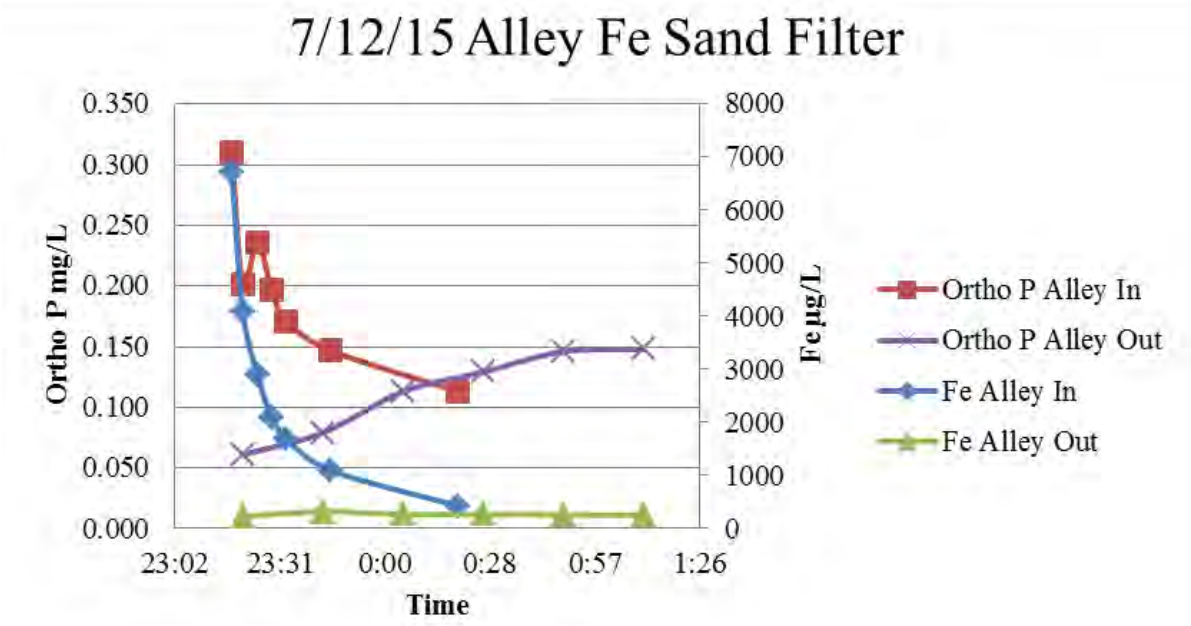


Figure 14-20. The 37th Alley IESF In/Out concentration of individual bottles during the 7/12/15 storm of 1.65".

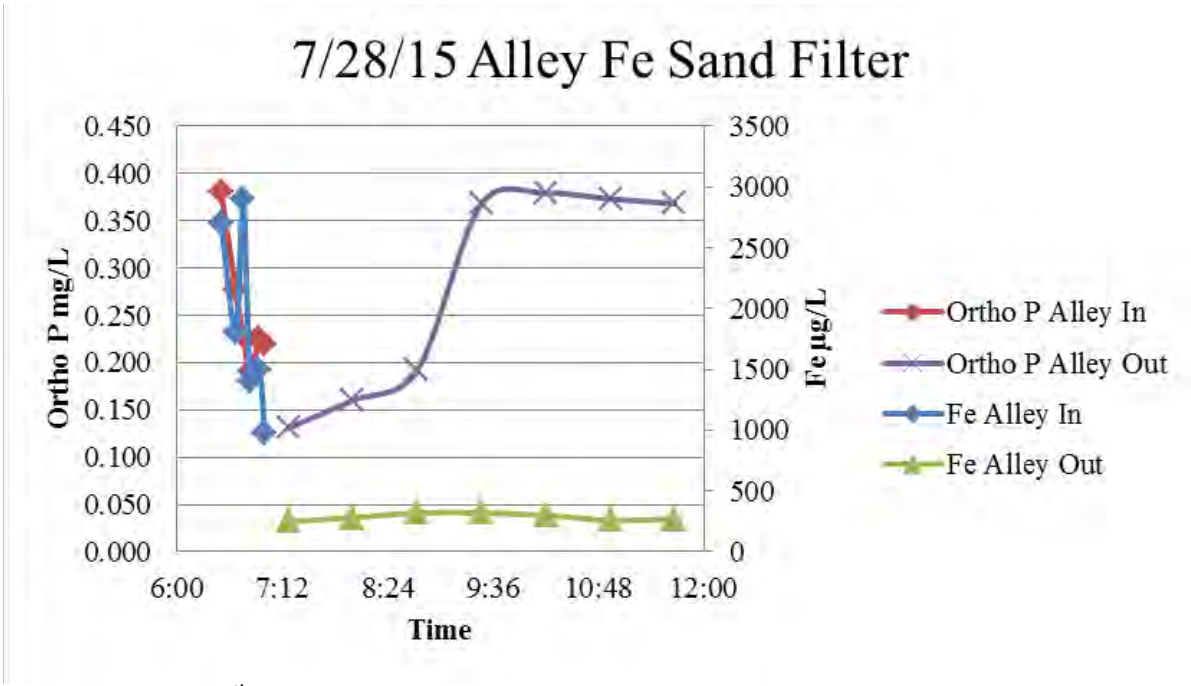


Figure 14-21. The 37th Alley IESF In/Out concentration of individual bottles during the 7/28/15 storm of 0.21".

The 37th Alley site appears to be removing TP, TSS, and Fe, but exporting dissolved phosphorus. The dissolved phosphorus export has two possible explanations. First, particulate phosphorus like organic solids could be breaking down, and transforming into dissolved phosphorus. Second, phosphorus export could be due to dissolved phosphorus leaching out of the IESF itself from phosphorus laden material within the BMP, like compost.

Storm Event Statistics

Tables 14-18 and 14-19 show a statistical comparison of the inlet and outlet data for 37th & Morgan and 37th Alley sites.

Table 14-18. 37th & Morgan In/Out statistical comparison. The bold values, from the Indv Btl. Storm events, are the geometric mean of all of the bottles collected for that storm.

Date Sampled/Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P mg/L	TSS mg/L	Fe ug/L
06/11/15 08:24	37th & Morgan In	Composite	0.956	0.575	0.553	13	1000
06/20/15 07:04	37th & Morgan In	Composite	0.872	0.273	0.341	130	2300
06/26/15 17:45	37th & Morgan In	Composite	0.965	0.186	0.542	119	4800
07/13/15 02:12	37th & Morgan In	Indv Btl.	**0.346**	**0.029**	**0.064**	**54**	**862**
07/18/15 04:49	37th & Morgan In	Composite	0.199	0.107	0.106	15	230
07/28/15 10:05	37th & Morgan In	Indv Btl.	**0.213**	**0.104**	**0.110**	**15**	**334**
08/07/15 01:16	37th & Morgan In	Composite	0.433	0.077	0.119	55	490
08/09/15 14:42	37th & Morgan In	Composite	0.425	0.187	0.187	17	530
08/18/15 21:34	37th & Morgan In	Composite	0.132	0.061	0.068	9	140
09/10/15 05:29	37th & Morgan In	Composite	0.120	0.098	0.070	11	200
09/17/15 07:12	37th & Morgan In	Indv Btl.	**0.234**	**0.136**	**0.125**	**39**	**239**
09/24/15 07:09	37th & Morgan In	Indv Btl.	**0.259**	**0.193**	**0.121**	**12**	**312**
10/28/15 05:30	37th & Morgan In	Indv Btl.	**1.13**	**0.962**	**0.850**	**13**	**32**
	MEAN (geometric)		**0.369**	**0.151**	**0.171**	**25**	**420**
	MEAN (artithmatic)		**0.483**	**0.230**	**0.251**	**39**	**882**
	MAX		**1.13**	**0.962**	**0.850**	**130**	**4800**
	MIN		**0.120**	**0.029**	**0.064**	**9**	**32**
	MEDIAN		**0.346**	**0.136**	**0.121**	**15**	**334**
	STDEV		**0.347**	**0.250**	**0.239**	**40**	**1267**
	NUMBER		**13**	**13**	**13**	**13**	**13**
	COV		**0.719**	**1.09**	**0.952**	**1**	**1**

Date Sampled/Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P mg/L	TSS mg/L	Fe ug/L
06/11/15 13:36	37th & Morgan Out	Composite	0.364	0.222	0.243	52	3700
06/20/15 13:27	37th & Morgan Out	Composite	0.262	0.121	0.118	8	2300
06/26/15 23:15	37th & Morgan Out	Composite	0.286	0.044	0.115	18	8300
07/13/15 06:12	37th & Morgan Out	Indv Btl.	**0.223**	**0.163**	**0.208**	**2**	**1456**
07/18/15 02:52	37th & Morgan Out	Composite	0.322	0.146	0.244	11	4600
07/28/15 10:56	37th & Morgan Out	Indv Btl.	**0.296**	**0.243**	**0.260**	**2**	**683**
08/07/15 09:21	37th & Morgan Out	Composite	0.269	0.127	0.175	9	2500
08/10/15 08:36	37th & Morgan Out	Composite	0.395	0.248	0.285	11	4900
08/19/15 04:30	37th & Morgan Out	Composite	0.203	0.147	0.169	2	980
09/10/15 08:22	37th & Morgan Out	Indv Btl.	0.209	0.140	0.189	5	2000
09/17/15 10:02	37th & Morgan Out	Indv Btl.	**0.229**	**0.154**	**0.187**	**2**	**1429**
09/24/15 08:23	37th & Morgan Out	Indv Btl.	**0.239**	**0.184**	**0.182**	**4**	**1014**
10/28/15 10:55	37th & Morgan Out	Indv Btl.	**0.903**	**0.823**	**0.797**	**6**	**890**
	MEAN (geometric)		**0.295**	**0.171**	**0.213**	**6**	**2031**
	MEAN (artithmatic)		**0.323**	**0.212**	**0.244**	**10**	**2673**
	MAX		**0.903**	**0.823**	**0.797**	**52**	**8300**
	MIN		**0.203**	**0.044**	**0.115**	**2**	**683**
	MEDIAN		**0.269**	**0.154**	**0.189**	**6**	**2000**
	STDEV		**0.177**	**0.184**	**0.167**	**13**	**2109**
	NUMBER		**13**	**13**	**13**	**13**	**13**
	COV		**0.546**	**0.865**	**0.684**	**1**	**1**

When comparing the 37th and Morgan geometric mean inlet and outlet concentrations of all of the storms combined (**Table 14-18**), these data show the IESF filter is capturing a small amount of TP and TSS but is exporting dissolved phosphorus and iron. For example, the geometric mean TP was reduced from an inlet concentration of 0.369 mg/L to an outlet concentration of 0.295 mg/L. The 37th and Morgan IESF reduced TSS inlet geometric mean from an inlet concentration of 25 mg/L to an outlet concentration of 6 mg/L.

The 37th and Morgan IESF filter also exported dissolved phosphorus. For example the TDP geometric mean concentrations rose from an inlet value of 0.151 mg/L to an outlet value of 0.171 mg/L, and a geometric mean inlet Ortho-P concentration of 0.171 mg/L to an outlet concentration of 0.213 mg/L.

The Morgan IESF filter also saw a significant amount of iron being exported, going from an inlet geometric mean concentration of 0.420 mg/L to an outlet concentration of 2.031 mg/L.

Table 14-19. 37th Alley In/Out statistical comparison. The bold values, from the Individual Bottle Storm events, are the geometric mean of all of the bottles collected for that storm.

Date Sampled/Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P mg/L	TSS mg/L	Fe ug/L
06/20/15 06:00	37th Alley In	Composite	1.40	0.500	0.536	162	3100
06/22/15 08:41	37th Alley In	Composite	0.396	0.113	0.153	45	1100
07/06/15 00:41	37th Alley In	Composite	0.387	0.139	0.226	230	430
07/13/15 00:20	37th Alley In	Indv Btl.	**0.388**	**0.105**	**0.188**	**145**	**2014**
07/28/15 07:00	37th Alley In	Indv Btl.	**0.418**	**0.186**	**0.247**	**145**	**1750**
08/06/15 15:12	37th Alley In	Composite	0.672	0.212	0.283	118	2000
08/09/15 14:21	37th Alley In	Composite	0.335	0.144	0.163	26	570
08/18/15 14:35	37th Alley In	Composite	0.203	0.113	0.127	19	370
	MEAN (geometric)		**0.447**	**0.164**	**0.218**	**82**	**1102**
	MEAN (artithmatic)		**0.524**	**0.189**	**0.240**	**111**	**1417**
	MAX		**1.40**	**0.500**	**0.536**	**230**	**3100**
	MIN		**0.203**	**0.105**	**0.127**	**19**	**370**
	MEDIAN		**0.392**	**0.142**	**0.207**	**131**	**1425**
	STDEV		**0.351**	**0.123**	**0.122**	**70**	**903**
	NUMBER		**8**	**8**	**8**	**8**	**8**
	COV		**0.670**	**0.649**	**0.507**	**0.629**	**0.638**

Date Sampled/Time	Site Location	Sample Type	TP mg/L	TDP mg/L	Ortho-P mg/L	TSS mg/L	Fe ug/L
06/20/15 07:27	37th Alley Out	Composite	0.332	0.277	0.269	2	160
06/22/15 10:01	37th Alley Out	Composite	0.341	0.309	0.278	7	98
07/06/15 09:22	37th Alley Out	Composite	0.214	0.160	0.154	10	250
07/13/15 01:11	37th Alley Out	Indv Btl.	**0.145**	**0.101**	**0.107**	**3**	**265**
07/28/15 11:40	37th Alley Out	Indv Btl.	**0.339**	**0.258**	**0.258**	**6**	**285**
08/06/15 16:12	37th Alley Out	Composite	0.388	0.278	0.272	7	190
08/09/15 15:03	37th Alley Out	Composite	0.404	0.323	0.312	6	120
08/18/15 19:51	37th Alley Out	Composite	0.340	0.293	0.283	2	140
	MEAN (geometric)		**0.299**	**0.235**	**0.229**	**5**	**177**
	MEAN (artithmatic)		**0.313**	**0.250**	**0.242**	**5**	**188**
	MAX		**0.404**	**0.323**	**0.312**	**10**	**285**
	MIN		**0.145**	**0.101**	**0.107**	**2**	**98**
	MEDIAN		**0.339**	**0.278**	**0.271**	**6**	**175**
	STDEV		**0.083**	**0.073**	**0.067**	**3**	**66**
	NUMBER		**8**	**8**	**8**	**8**	**8**
	COV		**0.264**	**0.292**	**0.276**	**0.493**	**0.351**

When comparing the 37th Alley geometric mean inlet and outlet concentrations (**Table 14-19**), these data show the Alley IESF filter is capturing a small amount of TP and also capturing TSS. The TP went from an inlet geometric mean concentration of 0.447 mg/L to an outlet geometric mean concentration of 0.299 mg/L. The 37th Alley TSS went from an inlet geometric mean of 82 mg/L to an outlet geometric mean of 5 mg/L. The 37th Alley site captured iron with an inlet geometric mean of 1102 µg/L and an outlet geometric mean of 5 µg/L.

In conclusion, both the street and alley runoff IESFs are exporting more dissolved phosphorus than they are receiving. The dissolved phosphorus is either being biologically transformed from the inlet TP organic load into dissolved phosphorus or the compost added to the IESF during construction could be an internal source of phosphorus.

The 37th and Morgan IESF is exporting iron. The exact mechanism is unknown but it is proposed that tree shading at this site is preventing the IESF from drying out and causing anaerobic saturated soil conditions leading to the possible mobilization of iron by iron reducing bacteria. Future pH, alkalinity and hardness data should be collected to determine if the iron loss is due to pH or a lack of buffering capacity in the IESF, which also could mobilize iron.

The landscape woodchips which are used to retain moisture for the plants in the IESF may be retaining moisture and preventing IESFs from drying out. Prolonged wet conditions within the IESFs could lead to conditions favoring phosphorus and iron export, either though chemical or biological transformation. It is recommended that woodchips covering the 37th St Greenway basins be removed in order to begin to test the hypothesis that prolonged wet conditions could be favoring TDP and Fe export from the site.

Barr Engineering, the project designer, will be consulted for any future experimental design changes to help better understand why both IESF's are exporting dissolved phosphorus and the 37th and Morgan IESF is exporting iron.

Areas of possible future study for the 37th Avenue Greenway IESFs are:

- Remove wood chips to determine if this organic layer prevents drying.
- Consider removing compost to test if this material is a phosphorus source.
- Use soil moisture sensor to determine how long it takes for the IESF to dry out.

When siting additional IESFs it is recommended that:

- Future IESFs be constructed in sunny areas to facilitate return to dry, aerobic conditions
- Pretreatment at future IESFs removes sediment and organic matter, as excess sediment and organic matter could lead to anaerobic conditions in the IESF.
- Carefully consider whether compost is needed, as it may be a phosphorus source.

37th & Oliver Flood Relief Vault

BACKGROUND

The 37th Avenue N Greenway underground vault project was built for flood relief in 2011, **Figure 14-22**. An underground flood retention vault at 37th and Oliver Avenue North was monitored in 2015 to determine if the vault provided any reduction in water depth (stage) in the downstream 24" reinforced concrete pipe (RCP). This is one of the flood vaults

installed in the 37th Avenue N Greenway project. The vault was built to attenuate peak flow in the downstream 24" RCP pipe.

The project drainage area is 5.5 acres, 50% impervious, and residential with a dense tree canopy.

Installation of monitoring equipment for this project occurred on 4/28/15. On 5/13/15, to better achieve laminar flow in the 24" outlet pipe, the area velocity (AV) probe was moved further downstream in the pipe.

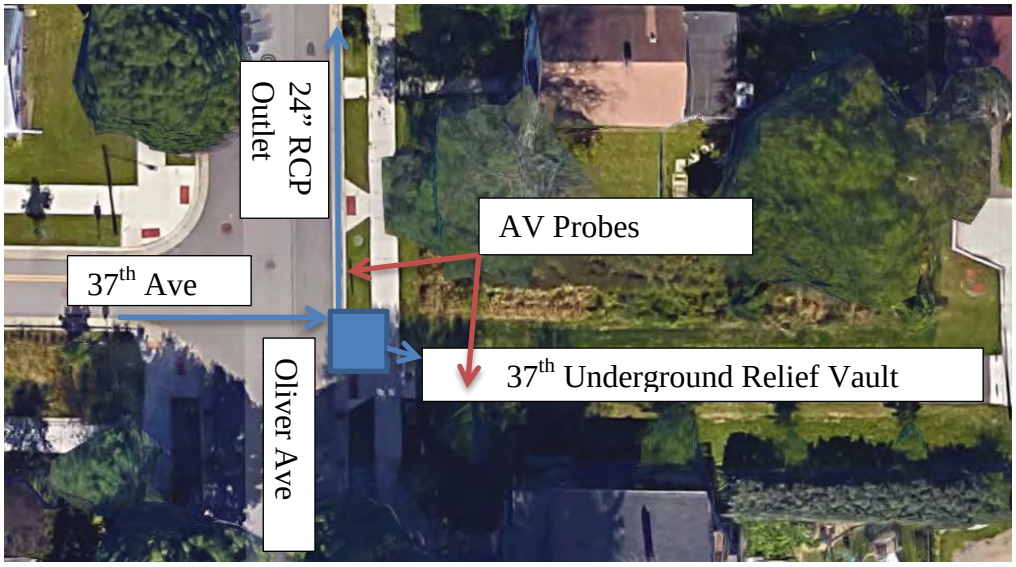


Figure 14-22. Map of 37th and Oliver storm sewer pipe structure and storage vault.

H. Methods

Equipment Used and Installation

The monitoring equipment installed at the 37th and Oliver vault was a 2105ci cell phone modem, two 2150 dataloggers, two battery modules, and two area velocity probes. An extra-long AV probe cable was needed for the 24" downstream pipe and a standard AV probe was used to measure the level in the vault. The equipment was hung from a side-iron in the manhole.

Help from cement masons was critical to the project due to the large number of eye-bolts and anchors that were needed for both AV probes and associated cables. **Figure 14-23** shows the level probe being anchored to the vault floor. **Figure 14-24** shows the outlet to the vault leading to the 24" downstream pipe. The 24" downstream pipe required a spring ring, because it was installed 4-5 feet into the downstream pipe where it is not possible to use power tools. **Figures 14-25** and **14-26** show the 24" downstream pipe installation and final spring ring configuration. A cell phone antenna was buried in the sidewalk for better reception.

Both dataloggers at the site were programed to push up data to a server database via the cell phone modem, Monday through Friday.

Figure 14-23. AV Anchor plate being installed in the vault floor.

Figure 14-24. Photograph showing the vault entrance/exit pipe (right) and 24” downstream storm sewer outlet (left).

Figure 14-25. Installation of the spring ring in the 24” downstream outlet pipe.

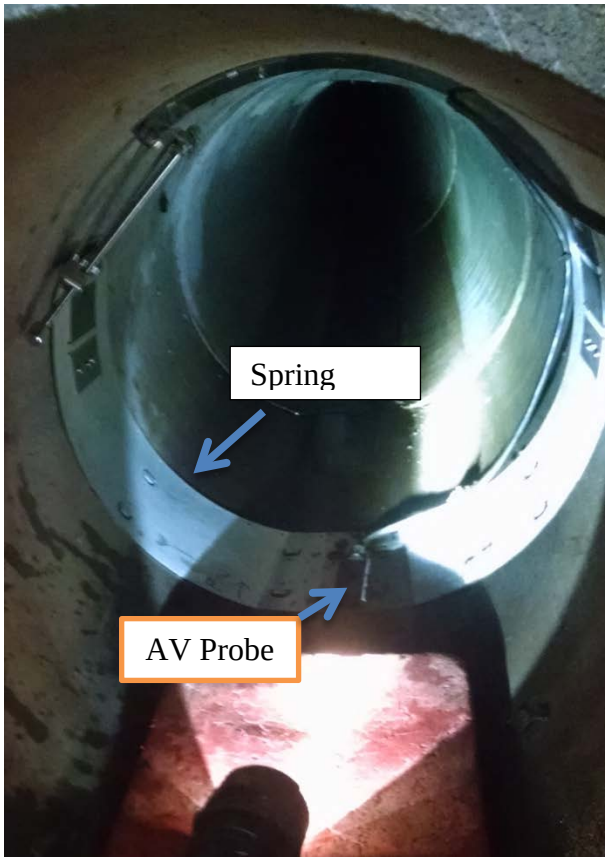


Figure 14-26. The spring ring and AV probe installed in the 24" downstream pipe.

RESULTS & DISCUSSION

Level and Stage Data

Figure 14-27 shows the stage in both the vault and the 24" RCP storm sewer pipe from May through November 2015.

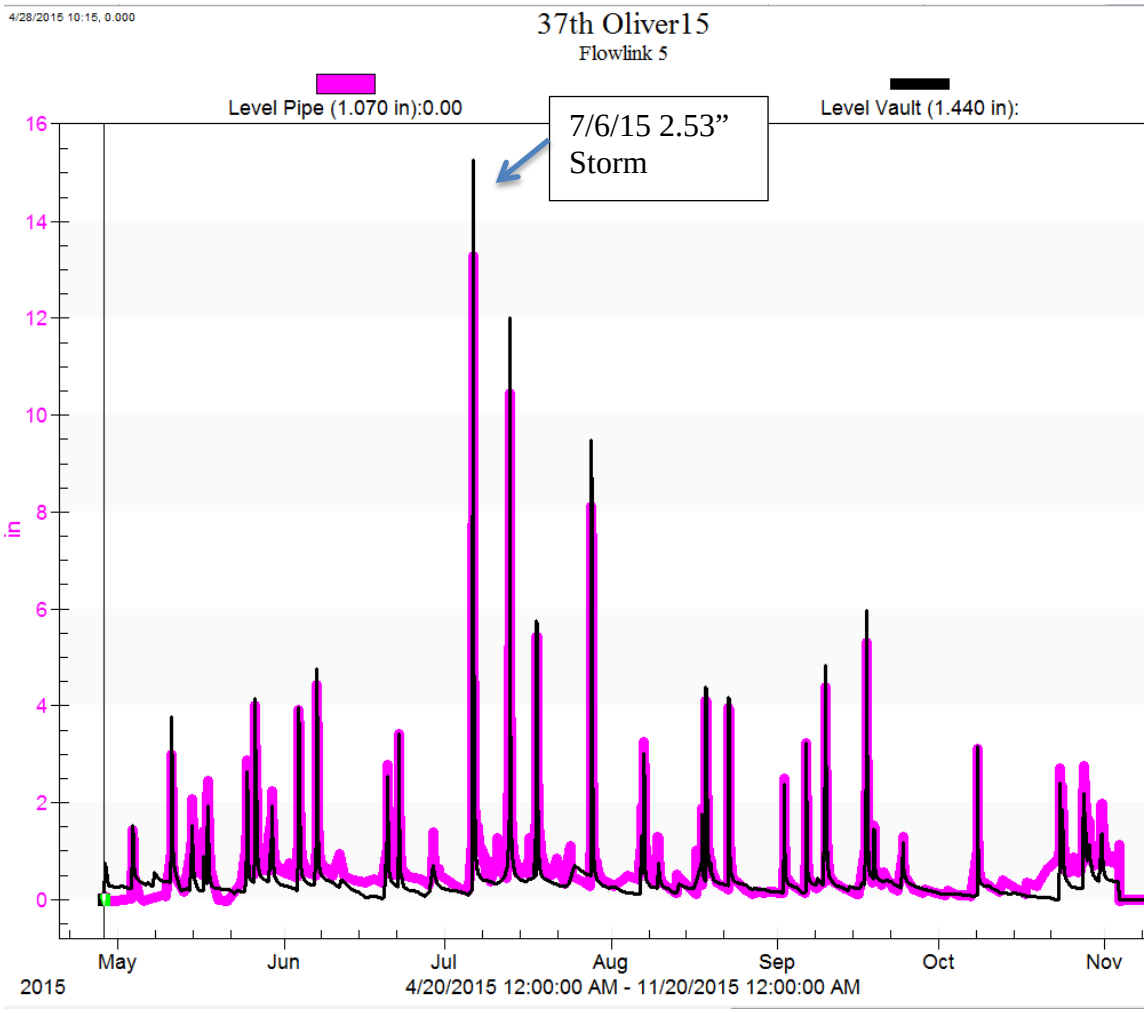


Figure 14-27. Graph of the stage in both the pipe and vault. The pipe level is pink and the vault level is black.

Figure 14-27 shows the effects of the level in the pipe in pink, and the level of the vault in black. The vault appeared to provide a maximum amount of approximately two inches of stage reduction in the downstream pipe compared to the level in the vault during the largest storm of 2015. The flood relief in the pipe appears minimal but may have a significant effect on larger storms or storms not experienced in 2015.

In conclusion, the vault appears to be working to attenuate the peak discharge in the downstream 24" RCP. The stage in the underground vault varied when compared to the 24" downstream pipe but the vault relieved a maximum of approximately two inches of stage in the downstream pipe, as shown in **Figure 14-27**. The stage in the vault never exceeded 15.24 inches during the largest storm on 7/6/15 of 2.53". The 24" RCP downstream pipe did not surcharge in 2015.

Webber Stormwater Pond (WSP)

BACKGROUND

The Webber Stormwater Pond (WSP) construction began in 2013 and finished in 2015. The purpose of this study is to determine how well the WSP treats runoff from the adjacent Webber Natural Swimming Pool (WNSP) and surrounding area. The stormwater pond is the only remaining remnant of the old Webber Pond (former public water 27111800). It has two inlets and one outlet, **Figure 14-28 and 14-29**. The North Inlet is a 12 inch reinforced concrete pipe (RCP) and takes drainage from the WNSP overflow and immediate pool area. The South Inlet is a 24 inch RCP and takes drainage from the WNSP wash basin and a few catch basins surrounding the WNSP, **Figure 14-30**. An underdrain, beneath the WNSP, is another potential water source to the pond, and may be a source of groundwater to the WSP.

The WSP outlet is a vault with an orifice and a weir. The orifice is a 4 inch hole about a 1 foot below the top of the weir. Most of the drainage flows through the orifice into a 12 inch pipe, but during large storms water overtops the weir. The Webber Stormwater Pond (WSP) discharges to Shingle Creek, **Figure 14-31**.

***Figure 14-28. Aerial photo of Webber stormwater pond during construction*.**

Figure 14-29. Photo of Webber stormwater pond following construction.

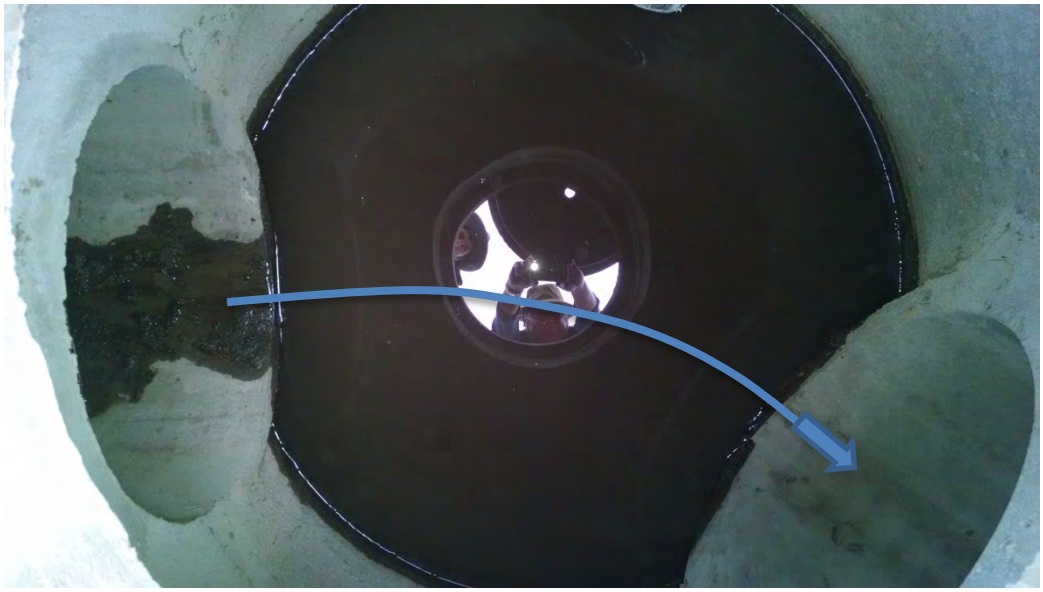


Figure 14-30. Webber South inlet 24 inch RCP pipe. Arrow shows direction of flow.

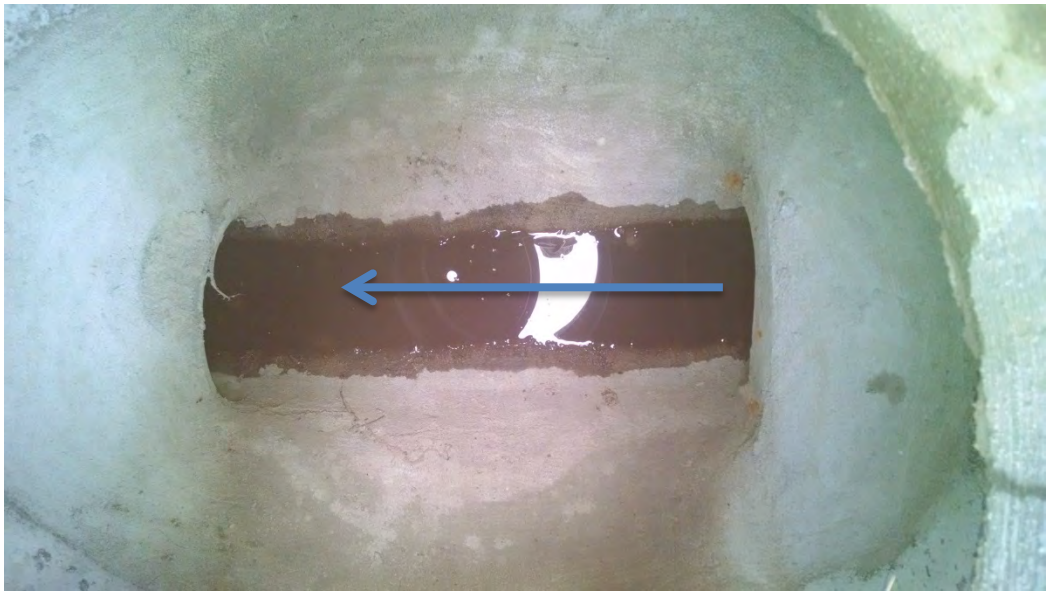


Figure 14-31. Webber outlet 12 inch RCP pipe. Arrow shows direction of flow towards Shingle Creek.

The drainage area of the South Inlet (24" RCP) is 85,000 square feet and the North Inlet (12" RCP) drainage area is 43,000 square feet. The land use is the pool patio and grassed area around the WNSP as well as pool water discharged to the North Inlet from the WNSP.

I. Methods

Site Installation

Due to its proximity and secure location, a tipping bucket rain gauge was installed on the roof of Folwell Recreation Center where precipitation data was also collected for an iron enhanced sand filter BMP project. Folwell Park is three quarters of a mile from Webber Pond. Data were periodically collected throughout the summer from a Hobo datalogger attached to the rain gauge. When precipitation data were missing, data were supplemented with information from the 38th and Bryant Ave S. MPRB South Side Service Center.

In 2015, there were delays in installation due delays in construction at the NSP and stormwater pond. The South Inlet monitoring equipment was installed on 7/10/15, the North Inlet monitoring equipment was installed on 7/9/15, and the Outlet monitoring equipment was installed on 6/24/15. Monitoring equipment at each of the sites included an ISCO 2150 datalogger, 2105 interface module, 2013ci cell phone modem, a low-profile A/V (area velocity) level probe, and a 3700 ISCO sampler. The inlets were too shallow to hang equipment and required above ground doghouse monitoring boxes. The datalogger used the cell phone modem to remotely upload data to a server daily Monday through Friday. The datalogger could also be remotely called up and programmed to change the 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

The South Inlet was set to trigger at 0.75 inches of flow to avoid the non-precipitation events and paced at 65 cubic feet. The North Inlet was initially set to trigger at 0.75 inches of flow but later adjusted up to 1.25 inches to avoid the non-precipitation events and paced at 50 cubic feet. Non-precipitation events produced enough flow to trigger the inlets but not the pond outlet. The outlet appeared to have an almost continuous baseflow of less than 1 inch for much of the summer. The outlet trigger was set for 1 inch.

RESULTS & DISCUSSION

Sample Collection

In 2015, six Webber North Inlet and nine Webber South Inlet storms were collected. At the Webber Outlet, ten storms were collected (**Table 14-20**).

The South Inlet had a significant number of non-precipitation events due to a wash pad located in its watershed being used one to three times a day to clean filter bags. The filter bag washings became less frequent at the end of summer with the purchase of a new robot to clean the WNSP. The non-precipitation events experienced at the North Inlet occurred due to irrigation water overspray and pool discharge. It was a significant challenge to collect stormwater events and separate out non-stormwater events created from daily maintenance and irrigation discharge.

Verizon cell phone service is very weak in this area of Minneapolis. All of the dataloggers suffered weak signals and communication issues. The North inlet datalogger had several modem communication and internal software problems that required substantial time to solve with the manufacturer. These issues did not lead to loss of data.

Table 14-20. The 2015 precipitation events captured near Webber Stormwater Pond. The rain gauge was on the roof of the Folwell Recreation Center. A precipitation event was defined as a storm greater than 0.10 inches, separated by eight hours or more from other precipitation.

Start Date/Time	End Date/Time	Precip (inches)	Duration (hours)	Time since last Precip. (hours)	Intensity inch/hr	Webber Inlet North	Webber Inlet South	Webber Outlet
7/6/2015 0:52	7/6/2015 13:11	**0.34**	**12**	**683**	**0.03**			X(bact. only)
07/12/2015 23:30	7/13/2015 10:00	**1.65***	**10.5**	**155**	**0.16**		X	X
07/15/2015 7:00	7/15/2015 17:00	**0.13***	**10**	**45**	**0.01**		X	X
7/18/2015 0:53	7/18/2015 10:53	**0.11**	**10**	**276**	**0.01**	X(lmtd)	X(lmtd)	X
7/28/2015 6:18	7/28/2015 11:05	**0.21**	**5**	**92**	**0.04**	X	X	X
8/6/2015 9:48	8/7/2015 9:20	**0.23**	**24**	**215**	**0.01**	X(lmtd)	X	X
8/18/2015 11:10	8/19/2015 10:12	**0.35**	**23**	**266**	**0.02**	X(lmtd)	X	
Non Precip Event	8/27/2015 0:00						X(bact. only)	X(bact. only)
Non Precip Event	9/8/2015 0:00							X(bact. only)
9/9/2015 12:16	9/10/2015 6:39	**0.13**	**18**	**68**	**0.007**	X	X	X(lmtd)
9/17/2015 4:59	9/17/2015 22:17	**0.21**	**17**	**166**	**0.01**	X(W/bact.)	X(W/bact.)	X(W/bact.)

*SSSC precip data

X = event sampled with full parameters

X(lmtd) = event sampled with limited parameters generally due to holding times e.g.BOD, Ortho P, and TDP

X(w/bact.) = event sampled for bacteria

X(bact. only) = only bacteria sampled

Figures 14-32 through 14-34 show the stage discharge of the two Webber inlets (North and South) and the outlet for 2015. During the period of record, the South Inlet had 59,828 cf measured, the North Inlet had 87,602 cf measured, and the Outlet had 260,280 cf measured. These figures are not the same time period, but the period of record that each was monitored.

The additional outlet volume, in the mass balance, was caused by a number of contributing factors. First, the two inlets were very shallow so the temperature was not stable and caused drift in both inlet probes which slightly affected the amount of discharge calculated by the probes. Second, an underdrain beneath the WNSP may carry groundwater to the pond that is not measured by the inlets. Although the WSP is lined, the outlet had a consistent baseflow which supports the hypothesis that groundwater is discharging into the WSP. Finally, when comparing the period of record, the sites were installed at slightly different times. The Outlet site was installed two weeks prior to the Inlet installation and so consequently the outlet probe measured more water.

Figures 14-32 and 14-33 (Inlets) show the level and discharge for the period of record. Diurnal swings in temperature, automatic irrigation overspray (at 1am and 4am), and WNSP discharge at the north inlet created “noise” in the charts. The Outlet site presented in **Figure 14-34** shows the level and discharge for the period of record. A 1.65 inch storm on July 13 was the only storm that caused the outlet weir to be overtopped.

Loads were calculated using the same time periods, 7/25/15 through 11/5/15, and can be seen in **Table 14-23**. The mass balance of inlets vs outlet during the same time period (7/25/15 – 11/5/15) shows that the outlet is measuring ~38%

more water than the inlets. This discrepancy may be due to groundwater discharging from the underdrain tile or a breach in the pond liner allowing in groundwater.

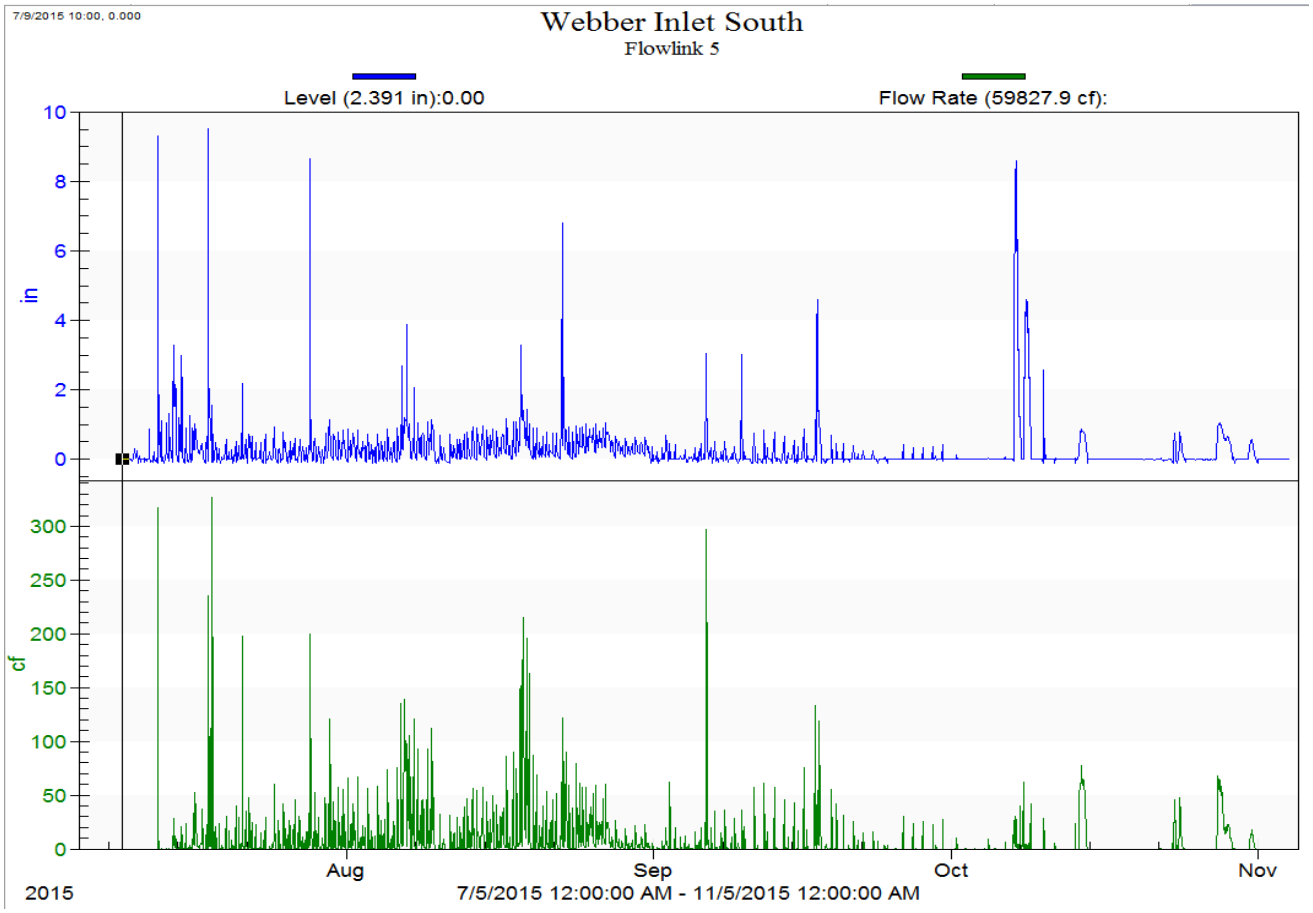


Figure 14-32. Webber Inlet South stage and discharge for the period of record.

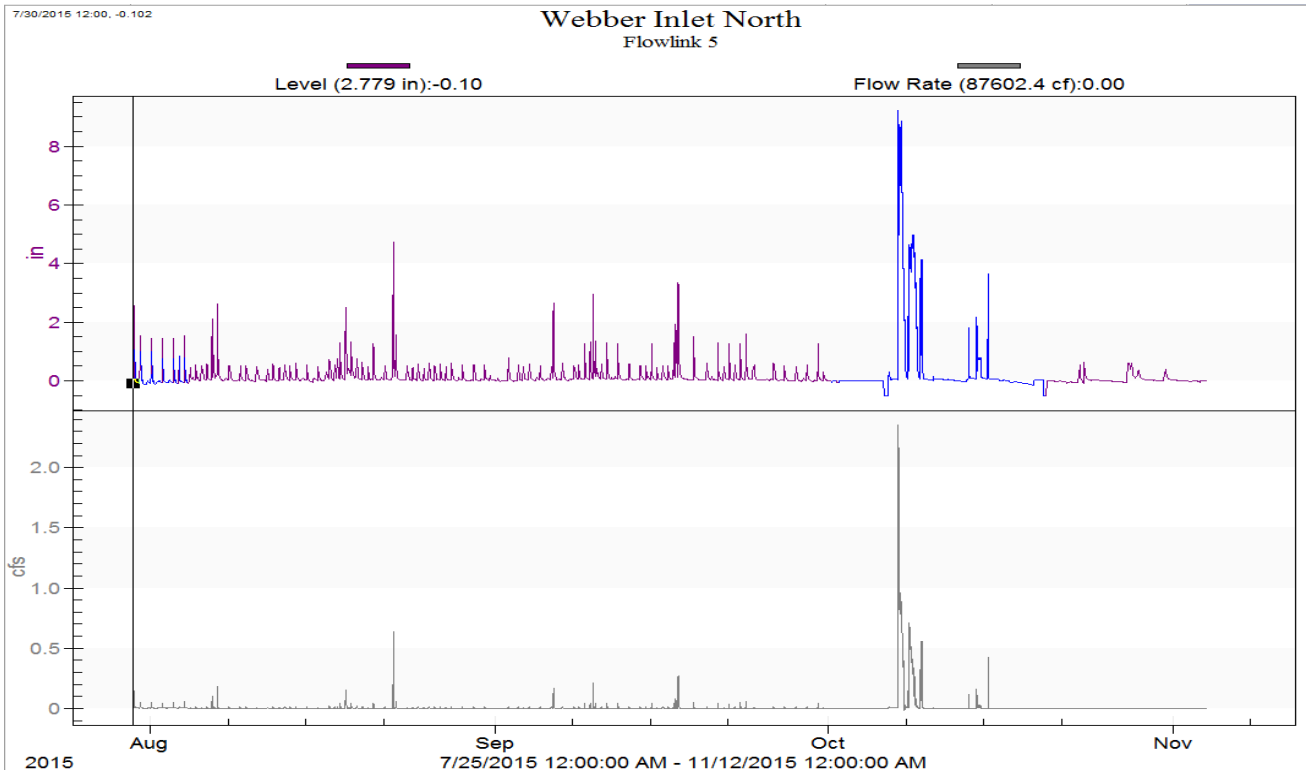


Figure 14-33. Webber Inlet North stage and discharge for the period of record.

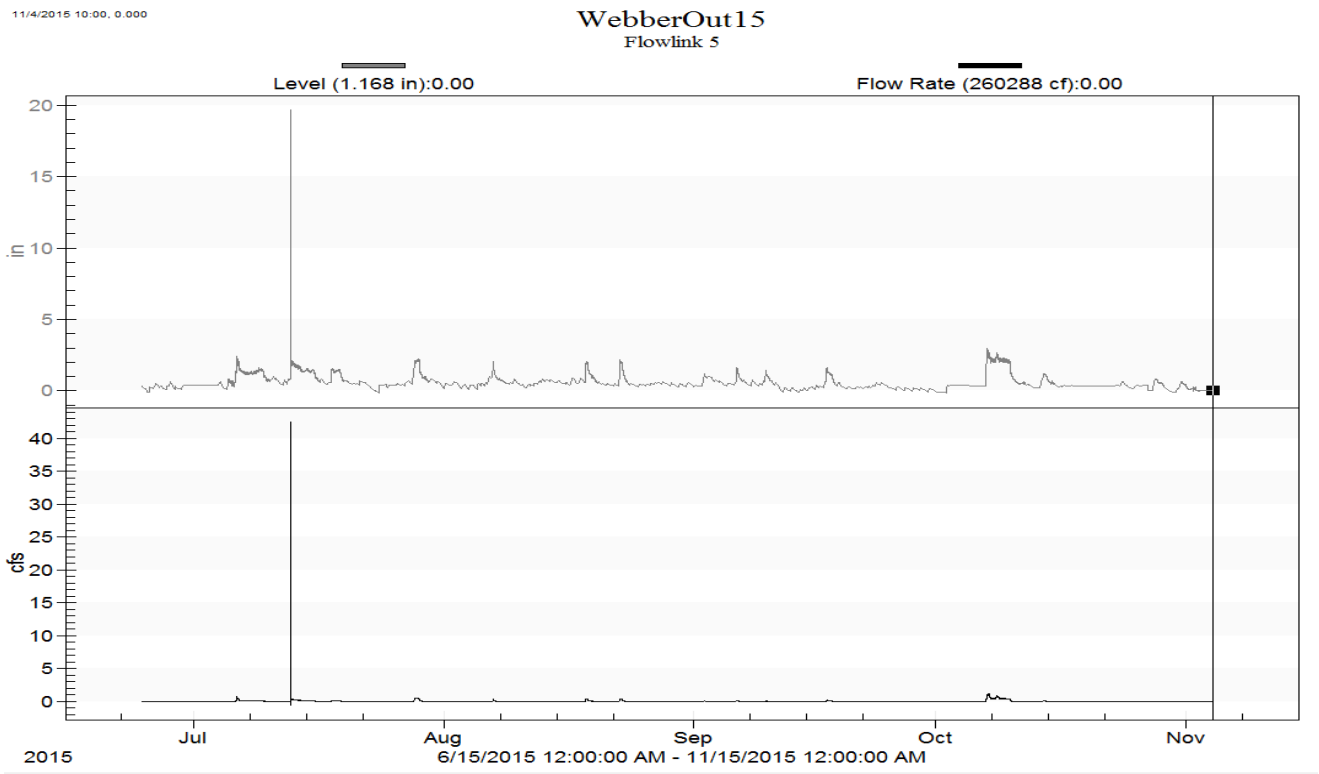


Figure 14-34. Webber Outlet stage and discharge for the period of record.

Storm Event Data and Statistics

Table 14-21 shows the 2015 Webber Stormwater Pond water chemistry data. Due to site construction, installation was delayed until mid-summer. Some of the events collected were analyzed for limited parameters because of low volume or expired holding times. The pond appears to reduce many chemical parameters (TP, TDP, Ortho-P, TKN, NH_3, NO_3NO_2, TSS, VSS, cBOD, and all metals) as they settled out or were degraded. The bacterial data are limited and vary widely. From the outlet data, it appears that the pond does settle out or degrade bacteria.

Data that are underlined in **Table 14-21** failed the blind monthly MPRB internal QAQC performance standard for that parameter for that month. It was deemed the data can be used, with the caution, noting that performance standards were outside the 80% to 120% recovery standards.

Table 14-21. **Webber Stormwater Pond water chemistry events data.** Cells with "less than" values indicate that the concentration of that parameter was below detection limit. NA = data not available due to expired holding time or low volume. Data that are underlined 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	Ortho-P 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. uhmos	pH std units	E. Coli MPN	Enterococci MPN	Pseduomonas MPN	Cu ug/L	Pb ug/L	Zn ug/L
7/13/2015	0:29	Webber In South	composite	0.524	0.084	0.108	2.75	<0.500	<0.030	14	58	36	28	120	5	<5.0	230	7.1				<5.00	7	34
7/15/2015	7:03	Webber In South	composite	0.170	0.025	0.046	1.64	<0.500	0.592	25	80	54	18	191	<1.00	19.4	358	7.2				<5.00	6	<20.0
7/18/2015	4:13	Webber In South	composite	0.370	NA	NA	1.22	NA	0.365	14	44	92	27	229	NA	NA	NA	NA				<5.00	10	27
7/28/2015	7:03	Webber In South	composite	1.46	0.173	0.227	9.38	<0.500	0.203	7	30	547	204	88	32	8.3	235	6.8				44	27	160
8/7/2015	2:48	Webber In South	composite	0.803	0.061	0.252	7.24	2.85	0.712	13	76	174	37	136	21	23.5	328	7.5				49	11	94
8/19/2015	17:27	Webber In South	composite	0.418	0.078	0.080	3.48	1.37	0.401	17	76	111	53	144	8	22.3	264	7.2				<5.00	4.6	47
8/27/2015	10:05	Webber In South	grab																12033	185				
9/9/2015	21:11	Webber In South	composite	1.10	0.339	0.258	13.9	4.45	0.120	3	104	655	244	113	NA	5.82	305	NA				NA	NA	NA
9/17/2015	14:52	Webber In South	composite	0.314	0.192	0.208	2.25	0.853	0.375	15	76	82	24	144	6	19.5	259	7.3				31	4	41
9/17/2015	11:16	Webber In South	grab																10460	104620				
7/18/2015	2:37	Webber In North	composite	0.293	NA	NA	1.12	NA	0.176	<2.0	56	77	21	105	NA	NA	NA	NA				<5.00	9	28
7/28/2015	7:14	Webber In North	composite	0.570	0.253	0.265	2.11	<0.500	0.078	3	20	155	40	66	7	10.3	111	6.8				<5.00	19	49
8/7/2015	1:09	Webber In North	composite	0.722	0.107	0.226	2.58	<0.500	0.225	8	72	122	40	119	NA	NA	194	NA				NA	NA	NA
8/19/2015	1:49	Webber In North	composite	0.180	NA	0.092	1.28	<0.500	<0.030	16	72	NA	NA	NA	NA	NA	NA	NA				NA	NA	NA
9/10/2015	1:47	Webber In North	composite	0.197	0.082	0.106	1.49	0.686	9.04	26	100	55	19	145	NA	26.2	279	NA				NA	NA	NA
9/17/2015	12:22	Webber In North	composite	0.904	0.143	0.271	7.38	1.00	0.092	13	96	669	174	186	NA	17.5	253	7.1				<5.00	4	<20.0
9/17/2015	11:15	Webber In North	grab																>242000	120330				
7/6/2015	14:30	Webber Outlet	grab																1300					
7/14/2015	9:39	Webber Outlet	composite	0.097	0.038	0.029	1.09	<0.500	0.344	15	112	13	2	191	<1.00	52.0	339	7.5				<5.00	<3.00	<20.0
7/15/2015	8:30	Webber Outlet	composite	0.068	0.042	0.024	1.05	<0.500	0.031	14	110	6	<2.0	155	<1.00	51.7	329	7.6				<5.00	<3.00	<20.0
7/19/2015	2:08	Webber Outlet	composite	0.076	NA	NA	0.537	NA	0.029	15	100	12	6	314	NA	NA	NA	NA				<5.00	<3.00	<20.0
7/29/2015	2:08	Webber Outlet	composite	0.107	0.076	0.057	0.831	<0.500	<0.030	15	38	6	5	131	3	32.3	235	7.9				<5.00	<3.00	<20.0
8/7/2015	4:57	Webber Outlet	composite	0.102	0.097	0.072	0.766	<0.500	<0.030	17	76	3	<2.0	147		29.7	254	9.1				<5.00	<3.00	<20.0
8/19/2015	1:19	Webber Outlet	composite	0.077	0.060	0.047	0.788	<0.500	<0.030	18	76	2	<2.0	157	4	26.4	231	8.6				<5.00	3	<20.0
8/27/2015	9:50	Webber Outlet	grab																84	411				
9/8/2015	10:15	Webber Outlet	grab																77		15			
9/9/2015	22:25	Webber Outlet	composite	0.106	NA	0.069	1.04	0.621	NA	18	80	NA	NA	NA	NA	NA	NA	NA						
9/17/2015	11:20	Webber Outlet	grab																>242000	>242000				
9/18/2015	2:14	Webber Outlet	composite	0.129	0.089	0.075	0.989	0.664	0.083	17	80	8	4	186	6	23.1	262	7.1				41	<3.00	<20.0
9/16/2015	14:15	Webber Outlet - non event	grab																>2420	1553				

Table 14-22 shows statistics from the Webber Pond 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 less than values were present, half of the less than value was used in the calculations.

In comparing the geometric means of inlets vs outlet, it appears that the stormwater pond is removing much of the (TP, TDP, Ortho-P, TKN, NH_3, NO_3NO_2, TSS, VSS, cBOD, and all metals) either by settling or degradation. The Outlet samples had higher concentrations of Cl, Hardness, TDS, and Sulfate, when compared to the Inlets. The increase in concentration of these chemical parameters at the outlet may be due to soil erosion in the pond basin, nutrient contributions from waterfowl, or a connection with groundwater.

Site ID	Statistical Function	TP mg/L	TDP mg/L	Ortho-P 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	Cu ug/L	Pb ug/L	Zn ug/L
Webber Inlet South	MEAN (geometric)	0.523	0.102	0.143	3.77	0.811	0.343	12	64	133	49	140	6	11	8.25	7.74	42.9
Webber Inlet South	MEAN (arithmetic)	0.645	0.136	0.168	5.23	1.47	0.395	14	68	219	79	146	12	14	19.1	9.69	59.0
Webber Inlet South	MAX	1.46	0.339	0.258	13.9	4.45	0.712	25	104	655	244	229	32	23	49.0	27.0	160
Webber Inlet South	MIN	0.170	0.025	0.046	1.22	0.250	0.120	3	30	36	18	88	1	3	2.50	3.50	10.0
Webber Inlet South	MEDIAN	0.471	0.084	0.208	3.12	0.853	0.375	14	76	102	32	140	7	19	2.50	6.60	41.0
Webber Inlet South	STDEV	0.443	0.108	0.088	4.53	1.61	0.205	7	23	241	90	45	12	9	21.4	8.09	51.5
Webber Inlet South	NUMBER	8	7	7	8	7	7	8	8	8	8	8	6	7	7	7	7
Webber Inlet South	COV	0.687	0.793	0.522	0.865	1.10	0.519	0.480	0.340	1.10	1.14	0.309	1.00	0.597	1.12	0.835	0.874
Webber Inlet North	MEAN (geometric)	0.396	0.133	0.174	2.10	0.404	0.303	7	62	140	41	117	NA	17	2.50	8.49	23.9
Webber Inlet North	MEAN (arithmetic)	0.478	0.146	0.192	2.66	0.487	1.92	11	69	216	59	124	NA	18	2.50	10.5	29.0
Webber Inlet North	MAX	0.904	0.253	0.271	7.38	1.00	9.04	26	100	669	174	186	NA	26	2.50	19.0	49.0
Webber Inlet North	MIN	0.180	0.082	0.092	1.12	0.250	0.078	1	20	55	19	66	NA	10	2.50	3.70	10.0
Webber Inlet North	MEDIAN	0.432	0.125	0.226	1.80	0.250	0.176	10	72	122	40	119	NA	18	2.50	8.70	28.0
Webber Inlet North	STDEV	0.300	0.075	0.087	2.38	0.343	3.98	9	29	256	65	45	NA	8	0.00	7.80	19.5
Webber Inlet North	NUMBER	6	4	5	6	5	5	6	6	5	5	5	1	3	3	3	3
Webber Inlet North	COV	0.629	0.516	0.452	0.894	0.705	2.07	0.836	0.422	1.19	1.11	0.360	NA	0.442	0	0.745	0.673
Webber Outlet	MEAN (geometric)	0.093	0.063	0.049	0.865	0.327	0.037	16	80	6	2	176	2	34	3.73	1.66	10.0
Webber Outlet	MEAN (arithmetic)	0.095	0.067	0.053	0.885	0.362	0.076	16	84	7	3	183	3	36	8.00	1.71	10.0
Webber Outlet	MAX	0.129	0.097	0.075	1.09	0.664	0.344	18	112	13	6	314	6	52	41.0	3.00	10.0
Webber Outlet	MIN	0.068	0.038	0.024	0.537	0.250	0.015	14	38	2	1	131	1	23	2.50	1.50	10.0
Webber Outlet	MEDIAN	0.100	0.068	0.057	0.910	0.250	0.029	16	80	6	2	157	3	31	2.50	1.50	10.0
Webber Outlet	STDEV	0.020	0.024	0.021	0.188	0.192	0.121	2	24	4	2	62	2	13	14.6	0.567	0
Webber Outlet	NUMBER	8	6	7	8	7	7	8	8	7	7	7	5	6	7	7	7
Webber Outlet	COV	0.213	0.364	0.388	0.213	0.530	1.59	0.110	0.284	0.588	0.742	0.336	0.830	0.356	1.82	0.331	0

NA = data not available

Table 14-22. Webber Stormwater Pond 2015 data showing statistics of the inlets and outlet. All "less than data" were transformed into half the reporting limit for statistical calculations (e.g. Pb <3 becomes 1.5). NA = data not available due to limited samples.

Table 14-23 shows the load calculations (for the same period of time 7/25/15 through 11/5/15), when all of the equipment was installed and functional. The geometric mean of all of the data for a specific parameter was used for the load concentration calculation. Webber Stormwater Pond appears to be exporting more water, Chloride, Hardness, Total Dissolved Solids, and Sulfate than it received. The Pond is capturing Total Phosphorus, Nitrogen, Total Suspended Solids, Volatile Suspended Solids, and metals. The North Inlet cBOD could not be calculated due to the limited number of events.

Table 14-23. Load calculations comparing inlets and outlet, in pounds, to the Webber Stormwater Pond for the period 7/25/15 through 11/5/15. Yellow highlighted areas are where the parameter is exporting.

LOADS	Water	TP	TDP	Ortho-P	TKN	NH3	NO3NO2	Cl	Hardness	TSS	VSS	TDS	cBOD	Sulfate	Cu	Pb	Zn
Dates 7/25 - 11/5	cubic ft	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs	Lbs
Webber Inlet South	40,669	1.33	0.26	0.36	9.6	2.06	0.87	30	162	339	124	355	16	29	0.02	0.02	0.11
Webber Inlet North	87,602	2.17	0.73	0.95	11.5	2.21	1.66	38	338	765	223	642	NA	92	0.01	0.02	0.06
Webber Outlet	177,365	1.03	0.70	0.54	9.6	3.62	0.40	178	889	67	25	1949	20	378	0.01	0.004	0.03
Lbs Removed (Added)	(49,094)	2.46	0.29	0.77	11.5	0.64	2.13	(111)	(389)	1036	321	(951)	NA	(257)	0.02	0.04	0.14
% Reduction/Added	-38%	70%	29%	59%	54%	15%	84%	-166%	-78%	94%	93%	-95%	NA	-213%	65%	90%	85%

The hydrological mass balance showing more water leaving the stormwater pond than entering was surprising. This finding is likely due to groundwater entering the pond from either the WNSP underdrain or a breach in the liner. The impact of the WNSP underdrain drain will need to be assessed to see what impact it could be having on the WSP.

The outlet does an excellent job of retaining stormwater and attenuates peak storm events. The pond and its outlet structure (weir with 4" orifice) make even small storm drainage last for days. However, this retention feature can be challenging when trying to cleanly separate (inlet outlet) paired storms when they comingle due to the long drawdown time of the pond.

The North Inlet is a 12 inch pipe and had more recorded flow than the South Inlet 24 inch pipe. A significant amount of irrigation overspray affected that site. The irrigation sprinklers were programed to automatically irrigate at 1am and 4am. MPRB staff will need to be notified of this overspray, its effects, and to try and mitigate this. The WNSP also drained through the North 12" Inlet which accounts for a significant amount of water discharged through this pipe.

Daily filter bag washing events affected the South 24" inlet pipe. Sampler triggers had to be set very high on the inlets which caused some low intensity storms to be missed. A new pool cleaning robot was purchased late summer 2015 which reduced the number of bag washings to once a day. Some of the non-precipitation inlet events were collected and analyzed but they do not produce enough flow to trigger the outlet sampler as currently programmed. In 2016 more of these non-precipitation events will be collected to better characterize them and to compare the non-precipitation events that the pond captures to stormwater.

In conclusion, the Webber Stormwater Pond reduces bacteria and most pollutants from the adjacent Natural Swimming Pool, but a few parameters saw an increase rather than a reduction in discharge. It is unknown where these pollutants are coming from, or if the pond needs a "break in" period where it will come to equilibrium.

Lyndale Farmstead Dog Park

BACKGROUND

The Lyndale Farmstead Dog Park was built in 2012, **Figure 14-35**. It was a former parking lot used for equipment storage and overflow parking at the adjacent Minneapolis Park Board Service Center. It is approximately 0.56 acres in area and its surface is entirely crushed gravel that is sloped to the southwest side where an underdrain carries runoff to the adjacent stormwater pond. The dog park is located next to a stormwater pond that handles drainage from the adjacent residential watershed.

Following construction, fine particles washed off the gravel and plugged the subsurface BMP drainage filter causing ponding. Ponding in the dog park caused muddy and unpleasant conditions for park patrons. In 2013, above ground surface drains were retrofitted directly to the subsurface underdrain. This retrofit prevented ponding, but circumvented filtration.

The Lyndale Dog Park drains directly to the adjacent stormwater pond where it is pumped to the Mississippi via a stormwater lift station. The adjacent stormwater pond floods a few times a year which, depending on the amount of precipitation and storm intensity, sometimes results in flooding half or more of the dog park.

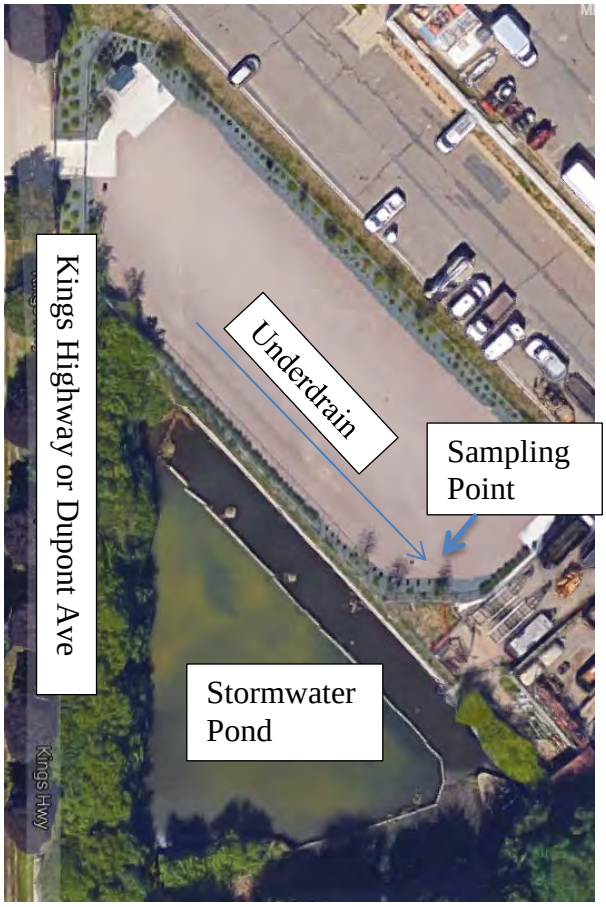


Figure 14-35. Map of Lyndale Farmstead Dog Park and adjacent stormwater pond.

Methods

Sample Collection

Bacteria grab samples were collected during precipitation events. Samples were obtained with a modified dip pole, **Figure 14-36**. The time, date and depth of flow in the pipe was recorded when the grab sample was collected.

***Figure 14-36. Collecting bacteria grab sample at Lyndale Farmstead Dog Park*.**

It took several storms to determine which pipe was the dog park underdrain. Initially the visible 12" RCP pipe was incorrectly sampled. Later, the smaller PVC pipe (above the 12" RCP) was determined to be the correct underdrain pipe, and was sampled, **Figure 14-37**.

All precipitation events were measured via a tipping bucket rain gauge at the adjacent South Side Service Center, approximately 100 yards away.

Figure 14-37. View inside the vault of Lyndale Farmstead Dog Park. The small PVC pipe at the top is the underdrain to the dog park.

RESULTS & DISCUSSION

Sample Collection

Due to the large surface area of the gravel bed, it appears that at least ¼ inch of rain is needed to overcome depressional storage and produce runoff. If there is more than approximately 1 ½ inches of rain, and a sample is not collected immediately, the stormwater pond can surcharge the pipe, making sampling impossible.

Table 14-24 shows the precipitation events sampled in 2015.

Table 14-24. The 2015 precipitation events captured at the Lyndale Dog Park. A precipitation event was defined as being separated by eight hours or more from other precipitation.

Start Date/Time		End Date/Time		Precip (inches)	Duration (hours)	Intensity (in/hr)	Time since last Precip. (hours)	Lyndale Dog Park
5/26/2015	10:15	5/27/2015	12:30	**1.19**	**26.25**	**0.05**	**25**	**X(w/bact.)**
6/3/2015	8:15	6/3/2015	20:15	**0.72**	**12.00**	**0.06**	**107**	**X(w/bact.)**
6/22/2015	7:00	6/22/2015	16:15	**1.52**	**9.25**	**0.16**	**47**	**X(bact./chem)**
7/6/2015	0:30	7/6/2015	12:15	**2.52**	**11.75**	**0.21**	**176**	**X(bact./chem)**
8/18/2015	10:15	8/19/2015	12:30	**0.87**	**26.25**	**0.03**	**15**	**X(w/bact.)**
10/23/2015	5:00	10/24/2015	2:30	**1.63**	**21.50**	**0.08**	**357**	**X(w/bact.)**
11/16/2015	7:30	11/19/2015	12:15	**1.66**	**79.25**	**0.02**	**98**	**X(w/bact.)**

X(w/bact.) = event sampled for bacteria

X(bact./chem) = bacteria sampled with TP and TSS

Event Data

Table 14-25 shows the 2015 chemistry and bacteria data collected at the Lyndale Dog Park. The dog park *E. coli* bacteria samples ranged from 3,076 MPN to greater than 24,200 MPN.

Table 14-25. The 2015 chemistry and bacteria data collected at the Lyndale Dog Park.

Date Sampled	Time	Site Location	Sample Type	TP mg/L	TSS mg/L	*E. coli* MPN
5/26/2015	10:45	Dog Park Underdrain	grab			19,863
6/3/2015	13:30	Dog Park Underdrain	grab			12,033
6/22/2015	8:30	Dog Park Underdrain	grab	0.518	216	>2,420
7/6/2015	8:10	Dog Park Underdrain	grab	0.209	208	3,076
8/18/2015	14:10	Dog Park Underdrain	grab			>24,200
10/23/2015	12:30	Dog Park Underdrain	grab			11,531
11/17/2015	8:00	Dog Park Underdrain	grab			5,650

The limited TP and TSS samples indicate moderate TP and relatively high TSS. In the field, grab samples appeared tan and cloudy. It is likely that fine particulates washing off the crushed gravel caused the high TSS values. The TP values are similar to other values found in stormwater. For comparison, the event mean concentration from the MPRB NPDES data from 2001 through 20015 TP ranged from a low of 0.313 mg/L to a high of 0.583 mg/L, similar to the two dog park samples, and TSS ranged from a low of 70 mg/L to a high of 180 mg/L., lower than the dog park samples.

Table 14-26 shows the 2015 NPDES site *E. coli* geometric mean data for comparison with the Lyndale Dog Park samples. The NPDES sites, *E. coli* data, were all lower than the Lyndale Dog Park but the 14th and Park site (a mixed use site) was close to the level of bacteria in the Lyndale Dog Park. The two Lyndale Dog Park samples with "greater than" data were used as those values, with the greater than symbol removed.

Table 14-26. The 2015 NPDES *E. coli* comparison to the Lyndale Dog Park. Bacteria are sampled quarterly at the other NPDES representative land use sites.

Site	Land Use	2015 *E. coli* Geometric Mean
22nd Aldrich	Residential	3,301
14th Park	Mixed Use	7,394
61st Lyndale	Industrial	1,441
Lyndale Dog Park	Dog Park	8,339

In order to better characterize the Lyndale Dog Park *E. coli* in stormwater runoff, more bacteria grab samples will need to be collected and analyzed in 2016. Additional, due to the limited number of TP and TSS samples additional samples will also be collected to better understand and characterize them in 2016.

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	01/01/15 – 03/31/15	1.36 inches (0.035 m)
Spring	04/01/15 – 05/31/15	5.97 inches (0.152 m)
Summer	06/01/15 – 08/31/15	14.71 inches (0.374 m)
Fall	09/01/15 – 12/31/15	14.10 inches (0.358 m)
Total	01/01/15 – 12/31/15	36.14 inches (0.918 m)

Flow-weighted mean concentrations and related statistics for NPDES parameters in 2015.

Site	TP (mg/L)	TDP (mg/L)	Ortho-P (mg/L)	TKN (mg/L)	NO_3NO_2 (mg/L)	NH_3 (mg/L)	Cl* (mg/L)	Hardness (mg/L)	TSS (mg/L)	VSS (mg/L)	TDS* (mg/L)	cBOD (mg/L)	Sulfate (mg/L)	Cu (µg/L)	Pb (µg/L)	Zn (µg/L)
6, 22nd Aldrich	0.267	0.089	0.085	2.10	0.217	0.531	8	20	78	34	38	12	3.0	0.011	0.018	0.089
7, 14th Park	0.241	0.051	0.085	1.35	0.285	0.344	877	23	56	24	49	9	5.0	0.003	0.006	0.052
8a, Pershing	0.225	0.109	0.092	1.39	0.213	0.272	3	24	54	27	39	4	3.0	0.003	0.004	0.021
9, 61st Lyndale	0.614	0.107	0.174	1.86	0.334	0.438	28	51	160	39	108	7	12.0	0.016	0.005	0.086
MEAN	**0.337**	**0.089**	**0.109**	**1.68**	**0.262**	**0.396**	**229**	**30**	**87**	**31**	**59**	**8**	**5.8**	**0.008**	**0.008**	**0.062**
MEDIAN	**0.254**	**0.098**	**0.089**	**1.63**	**0.251**	**0.391**	**18**	**24**	**67**	**31**	**44**	**8**	**4.0**	**0.007**	**0.006**	**0.069**
STANDEV	**0.186**	**0.027**	**0.043**	**0.366**	**0.058**	**0.113**	**432**	**14**	**50**	**7**	**33**	**3**	**4.3**	**0.006**	**0.007**	**0.032**

-Highest value

-Lowest value

* 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.

Statistical summary for event mean concentrations by season in 2015. Statistics were calculated from all sites (6-9). STDEV= standard deviation,

2015 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	pH std units	*E. coli* MPN/100mL	Cu ug/L	Pb ug/L	Zn ug/L
SNOWMELT (January-March)	**MEAN (geometric)**	0.477	0.196	0.226	5.36	1.79	0.502	1847	215	124	50	2393	39	42	7.6	610	29	10	115
	MEAN (arithmetic)	0.598	0.348	0.348	5.67	2.49	1.56	4767	290	174	71	4502	55	62	7.7	3024	43	18	218
	MAX	1.68	1.12	1.15	8.26	5.39	6.06	12513	570	385	165	14457	117	145	11.6	12033	92	41	520
	MIN	0.249	0.054	0.093	2.79	0.587	0.045	37	64	25	14	214	14	12	6.5	29	3	2	10
	MEDIAN	0.459	0.147	0.158	6.16	1.58	0.781	3525	216	102	52	1726	32	50	6.8	345	29	14	160
	STDEV	0.506	0.390	0.389	1.93	2.033	2.29	4727	216	140	59	4958	46	52	2.0	5127	32	15	201
	NUMBER	7	7	7	7	7	6	7	7	7	7	7	7	7	7	5	7	7	7
	COV	0.847	1.12	1.12	0.340	0.816	1.47	0.992	0.745	0.805	0.841	1.10	0.823	0.836	0.256	1.70	0.758	0.827	0.921
SPRING (April-May)	**MEAN (geometric)**	0.245	0.065	0.101	1.96	0.446	0.270	30	32	68	29	67	6	5	7.0	7270	4	4	47
	MEAN (arithmetic)	0.297	0.075	0.126	2.29	0.531	0.297	42	37	102	37	83	8	6	7.1	7270	9	8	71
	MAX	0.754	0.147	0.378	6.56	1.69	0.654	247	110	396	125	299	22	16	8.6	7270	73	35	400
	MIN	0.059	0.032	0.029	0.66	0.237	0.106	9	16	5	3	30	1	3	6.5	7270	3	2	10
	MEDIAN	0.266	0.052	0.093	2.00	0.381	0.266	27	28	78	34	74	7	5	6.9	7270	3	4	46
	STDEV	0.190	0.042	0.095	1.44	0.411	0.132	51	22	101	26	72	6	4	0.5		17	11	86
	NUMBER	22	12	12	19	11	20	20	20	20	20	12	11	12	19	1	19	19	19
	COV	0.640	0.559	0.758	0.630	0.774	0.444	1.22	0.606	0.986	0.708	0.866	0.703	0.705	0.069		1.82	1.36	1.21
SUMMER (June-August)	**MEAN (geometric)**	0.215	0.072	0.079	1.45	0.345	0.265	3	21	55	22	40	5	3	6.6	10478	4	6	45
	MEAN (arithmetic)	0.242	0.087	0.090	1.79	0.392	0.301	6	23	75	27	50	5	3	6.7	10502	8	12	74
	MAX	0.701	0.270	0.236	5.87	0.773	1.02	40	50	252	82	158	14	6	7.7	11199	77	70	640
	MIN	0.083	0.017	0.023	0.250	0.250	0.090	1	10	12	4	13	3	3	6.1	9804	3	2	10
	MEDIAN	0.195	0.073	0.076	1.52	0.250	0.282	1	21	60	23	38	5	3	6.6	10502	3	6	53
	STDEV	0.133	0.058	0.048	1.16	0.221	0.173	9	10	58	17	37	3	1	0.4	986	15	16	113
	NUMBER	33	16	17	33	16	31	31	32	32	32	20	14	16	16	2	30	30	30
	COV	0.550	0.672	0.537	0.649	0.565	0.574	1.44	0.448	0.770	0.636	0.739	0.557	0.420	0.060	0.094	1.94	1.34	1.52
FALL (Sept-Nov)	**MEAN (geometric)**	0.417	0.172	0.207	1.48	0.493	0.254	5	31	56	18	98	16	12	6.4	11140	6	6	74
	MEAN (arithmetic)	1.34	0.197	0.236	2.15	0.65	0.419	10	37	87	34	143	22	22	6.4	11734	10	12	94
	MAX	12.6	0.324	0.387	5.47	1.44	1.43	38	120	233	91	600	59	110	6.7	17329	31	79	220
	MIN	0.074	0.067	0.068	0.250	0.190	0.033	1	14	3	1	45	7	6	6.1	8664	3	2	10
	MEDIAN	0.435	0.201	0.251	1.48	0.456	0.286	5	30	70	23	80	11	9	6.4	9208	3	5	75
	STDEV	3.39	0.100	0.111	1.67	0.487	0.420	12	28	69	30	186	20	36	0.2	4853	11	22	59
	NUMBER	13	8	7	13	8	13	13	12	13	13	8	7	8	7	3	12	12	12
	COV	2.53	0.508	0.470	0.776	0.751	1.00	1.25	0.761	0.788	0.859	1.30	0.912	1.66	0.027	0.414	1.03	1.78	0.624

-highest concentration

-lowest concentration

COV= coefficient of variance.

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 A

STORM DRAINAGE AREAS BY RECEIVING WATER BODY

Surface Water	Outfall	Total (acres)	Res. %	Comm. %	Ind. %	Public %	Open %	Rail %	Runoff Coeff.	Pop.
Mississippi River (Minneapolis)	10-xxx	18,077	0.53	0.16	0.16	0.04	0.07	0.04	0.46	263,400
Mississippi River (Columbia Heights)	10-100	348	0.48	0.11	0.33	0.00	0.08	0.00	0.37	2,765
Mississippi River (UofM)	15-xxx	100	0.00	0.00	0.00	1.00	0.00	0.00	0.55	0
Shingle Creek	20-xxx	1,365	0.62	0.17	0.06	0.03	0.04	0.07	0.44	11,493
Ryan Lake (Minneapolis)	21-xxx	49	1.00	0.00	0.00	0.00	0.05	0.00	0.45	388
Bassett Creek	40-xxx	2,293	0.58	0.12	0.13	0.03	0.08	0.05	0.44	26,756
New Bassett Creek Tunnel	41-xxx	219	0.22	0.26	0.26	0.04	0.10	0.11	0.45	669
Brownie Lake (Minneapolis)	51-xxx	34	0.99	0.00	0.01	0.00	0.00	0.00	0.45	193
Cedar Lake (Minneapolis)	52-xxx	224	0.79	0.01	0.00	0.00	0.17	0.03	0.38	1,674
Lake of the Isles	53-xxx	760	0.76	0.07	0.02	0.01	0.12	0.01	0.42	13,644
Lake Calhoun (Minneapolis)	54-xxx	1,249	0.69	0.11	0.03	0.10	0.07	0.00	0.46	13,640
Cemetary Lake	55-xxx	205	0.00	0.99	0.00	0.00	0.01	0.00	0.60	41
Sanctuary Pond	56-xxx	68	0.00	1.00	0.00	0.00	0.00	0.00	0.60	0
Lake Harriet	57-xxx	863	0.83	0.09	0.01	0.04	0.02	0.00	0.46	12,249
Hart Lake (Minneapolis)	61-xxx	3	0.32	0.68	0.00	0.00	0.00	0.00	0.55	0
Silver Lake (Minneapolis)	62-xxx	28	0.94	0.03	0.00	0.00	0.03	0.00	0.44	245
Crystal Lake (Minneapolis)	63-xxx	469	0.92	0.04	0.00	0.02	0.03	0.00	0.45	5,985
Legion Lake (Minneapolis)	64-xxx	49	1.00	0.00	0.00	0.00	0.00	0.00	0.45	332
Legion Lake (Richfield)	64-xxx	1,700	0.96	0.00	0.01	0.00	0.03	0.00	0.30	9,781
Richfield Lake (Minneapolis)	65-xxx	715	0.88	0.06	0.02	0.00	0.04	0.00	0.32	4,388
Richfield Lake (Richfield)	65-xxx	58	0.58	0.37	0.05	0.00	0.01	0.00	0.51	442
Wood Lake (Richfield)	66-xxx	627	0.75	0.05	0.02	0.00	0.18	0.00	0.29	7,316
Minnehaha Creek	70-xxx	3,213	0.85	0.07	0.01	0.04	0.03	0.00	0.44	38,399
Diamond Lake	71-xxx	685	0.72	0.11	0.09	0.03	0.05	0.00	0.47	6,456
Lake Nokomis	72-xxx	620	0.78	0.03	0.00	0.03	0.16	0.00	0.40	7,120
Taft Lake	73-xxx	100	0.76	0.00	0.00	0.00	0.24	0.00	0.37	675
Mother Lake (Minneapolis)	74-xxx	49	0.83	0.19	0.00	0.00	0.00	0.00	0.48	111
Mother Lake (Richfield)	74-xxx	245	0.71	0.09	0.00	0.00	0.20	0.00	0.30	2,025
Unnamed Wetland W of Mother Lake	75-xxx	41	0.91	0.00	0.00	0.00	0.00	0.09	0.41	344
Lake Hiawatha	76-xxx	1,008	0.87	0.07	0.02	0.03	0.02	0.00	0.46	14,707
Birch Pond	81-xxx	31	0.00	0.00	0.00	0.00	1.00	0.00	0.10	0
Powderhorn Lake	82-xxx	286	0.88	0.05	0.02	0.04	0.01	0.00	0.46	5,621
Grass Lake	83-xxx	386	0.90	0.04	0.00	0.05	0.02	0.00	0.46	4,128
Unnamed Wetland on Hwy 62	84-xxx	17	0.86	0.00	0.14	0.00	0.00	0.00	0.47	0
Unnamed Wetland on Ewing Ave S	85-xxx	22	0.86	0.00	0.14	0.00	0.00	0.00	0.47	0
GRAND TOTAL		**36,205**	**0.58**	**0.13**	**0.10**	**0.04**	**0.06**	**0.03**	**0.42**	**454,987**

Appendix A1 - Storm Drainage Areas by Receiving Water Body
Source: Minneapolis Public Works - Surface Water & Sewers

Appendix A-3: Sources of Pollutants in Stormwater Runoff[1]

	Coal Plants / Incinerators	Gasoline / Diesel Fuel Combustion	Metal Corrosion / Metal Protection	Road Salts	Deterioration of Brake Pads / Tires	Asphalt	Fertilizers / Pesticides / Soil Treatments	Wood Preservatives	Paints and Stains	Plastics	Soil Erosion	Sanitary Waste	Manufacturing	Animal Waste	Atmospheric Deposition	Grass Clippings, Leaves and other Plant Materials	Coal Tar Based Sealants for Parking Lots, Driveways
METALS																	
Copper [a, b]	X		X		X		X	X	X	X		X	X	X			
Lead [a]		X	X	X	X		X		X	X			X		X		
Zinc [a]			X	X	X		X		X	X			X	X			
OTHER POLLUTANTS																	
Arsenic [b]	X						X	X			X		X	X	X		
Bacteria: E. Coli [a]											X	X		X			
Cyanide		X	X	X					X	X		X					
Chloride, Total [a]	X	X		X						X		X		X			
Oil and Grease [a]		X			X	X							X				
Polycyclic Aromatic Hydrocarbons (PAH) [b]	X	X				X	X					X	X				X
Sulfate [a]	X	X				X			X	X		X		X	X		X
Volatile Organic Compounds (VOC)	X	X		X		X	X		X	X		X	X	X	X		
SEDIMENT AND OTHER SOLIDS																	
Total Dissolved Solids (TDS) [a]	X			X		X	X					X		X	X	X	
Total Suspended Solids (TSS) [a]	X		X	X	X	X	X			X	X	X	X	X	X	X	
NUTRIENTS																	
Nitrate / Nitrite [a]		X					X				X	X	X	X	X	X	
Nitrogen, Ammonia Un-Ionized [a]	X	X	X				X					X		X	X	X	
Nitrogen, Total Kjeldahl (TKN) [a]							X				X	X		X	X	X	
Phosphorus, Total [a]	X	X			X	X	X				X	X	X	X	X	X	
Phosphorus, Total Dissolved [a]	X	X					X				X	X		X	X	X	
LABORATORY ANALYSIS PARAMETERS																	
Biochemical Oxygen Demand (BOD_5) [a]							X				X	X		X	X	X	
pH [a]	X		X	X													

[a] MS4 Monitored Parameter
[b] Stormwater Pond Dredging Parameter

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[1] Sources:

Massachusetts Department of Environmental Protection, Source Water Assessment Program, DRAFT Land Use/Associated Contaminants Matrix, 1999

Mississippi Watershed Management Organization, 2006 Annual Report, Appendix C, Table 4

MPCA, Managing Dredged Materials in the State of Minnesota, Figure 2, 2009

Texas Commission on Environmental Quality (TCEQ) Source Water Assessment and Protection (SWAP) Program's List of Potential Source of Contamination Types and Subtypes Detailed Listing, Descriptions, and Applied Contaminants, 2009

CITY OF MINNEAPOLIS
STORMWATER MANAGEMENT ORDINANCE SUMMARY

Ordinance: On November 24, 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, entitled "*Stormwater Management*". The Chapter 54 ordinance establishes requirements for projects with land disturbing activities on sites greater than one (1) acre, including phased or connected actions, and for existing stormwater devices.

Goals: The purpose of this ordinance is to minimize negative impacts of stormwater runoff rates, volumes and quality on Minneapolis lakes, streams, wetlands, and the Mississippi River by guiding future significant development and redevelopment activity, and by assuring long-term effectiveness of existing and future stormwater management constructed facilities. The Chapter 54 Ordinance specifies that stormwater management standards be set according to the receiving water body, and the table below lists discharge requirements by receiving water. The standards include but are not limited to:

- Reductions of suspended solids for Mississippi River discharges
- Controlled rate of runoff for discharges to streams, areas prone to flooding and areas with infrastructure limitations
- A reduction in nutrients for stormwater discharging to Minneapolis lakes and wetlands

Minneapolis Development Review: Stormwater Management Plans are required for all construction projects greater than 1 acre in size. These plans are reviewed through the "Minneapolis Development Review" process. Responsibility for ongoing operation and maintenance is one component of the Stormwater Management Plan.

Registration: Stormwater devices shall be registered with the City of Minneapolis Department of Regulatory Services, with an annual permit being required for each registered stormwater device.

Stormwater 'Buyout' for off-site management, in lieu of on-site treatment:
This option is reserved for only those sites that demonstrate that performance of on-site stormwater management is not feasible. With approval of the City Engineer, the Chapter 54 Ordinance allows developers to contribute to the construction of a regional stormwater facility in lieu of on-site treatment/management. Final plan approval is conditional on payment received.

For the complete text of the *Chapter 54 Ordinance* requirements, see the Minneapolis Storm and Surface Water Management web site:
http://www.ci.minneapolis.mn.us/stormwater/stormwater-management-for-projects/CHAPTER54Ordinance.pdf

Receiving Waters	Total Discharge Requirements
All receiving waters	70% removal of total suspended solids
Brownie Lake	10% phosphorus load reduction
Cedar Lake	40% phosphorus load reduction
Lake of the Isles	20% phosphorus load reduction
Lake Calhoun	30% phosphorus load reduction
Lake Harriet	20% phosphorus load reduction
Powderhorn Lake	30% phosphorus load reduction
Lake Hiawatha	42% phosphorus load reduction
Lake Nokomis	25% phosphorus load reduction
Loring Park Pond	0% phosphorus load increase
Webber Pond	0% phosphorus load increase
Wirth Lake[1]	30% phosphorus load reduction
Spring Lake	30% phosphorus load reduction
Crystal Lake[2]	30% phosphorus load reduction
Diamond Lake	30% phosphorus load reduction
Grass Lake	30% phosphorus load reduction
Birch Pond	0% phosphorus load increase
Ryan Lake	30% phosphorus load reduction
Other wetlands	30% phosphorus load reduction
Mississippi River	70% removal of total suspended solids
Minneapolis streams	No increase in rate of runoff from site

[1] Wirth Lake is not within the limits of the City of Minneapolis
[2] Crystal Lake in located in Robbinsdale, but receives run-off from Minneapolis

PW-SWS Stormwater Treatment Facilities

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
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
Description	**Materials (*before sales tax*)**	**Hourly Servicing Fee**	**Flat Rate**
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 January 1, 2016.

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 **three dollars and thirty-nice cents ($3.39)** 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 Size	Fixed 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 thrity-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.

- **CHAPTER 510. - STORMWATER MANAGEMENT SYSTEM AND OPERATION OF A STORMWATER UTILITY**

- **510.10. - Definitions.**

In addition to the words, terms and phrases elsewhere defined in this chapter, the following words, terms and phrases as used in this chapter shall have the following meanings:

Bonds means revenue or general obligation bonds, notes, loans or other debt obligations heretofore or hereafter issued to finance the costs of improvements and/or operations and maintenance.

Building permit means a permit issued by the director of inspections that permits construction of a structure.

City means City of Minneapolis, Minnesota.

City council means governing body of the city.

Costs of capital improvements means costs incurred in providing capital improvements to the stormwater management system or any portion thereof including, without limitation, the cost of alteration, enlargement, extension, improvement, construction, reconstruction, testing and development of the stormwater management system; insurance premiums for insurance taken out and maintained during construction, professional services and studies connected thereto; principal and interest on bonds heretofore or hereafter issued, acquisition of real and personal property by purchase, lease, donation, condemnation or otherwise for the stormwater management system or for its protection; and costs associated with purchasing equipment, computers, furniture, etc., that are necessary for the operation of the system or the utility.

Debt service means an amount equal to the sum of (i) all interest payable on bonds during a fiscal year, plus (ii) any principal installments payable on the bonds during that fiscal year.

Developed property means real property, other than undisturbed property; provided that, property used for agricultural uses, upon which no dwelling unit is located, shall not constitute developed property for purposes of this chapter.

Director means the city engineer/director of the public works department for the City of Minneapolis or the director's designee.

Dwelling unit means one (1) or more rooms, designed, occupied or intended for occupancy as a separate living quarter, with a single complete kitchen facility, sleeping area and bathroom provided within the unit for the exclusive use of a single household.

Equivalent stormwater unit (ESU) means a unit of measure that is equal to the average impervious area of single-family residential developed property that falls within the medium class, with a single-family detached dwelling unit located thereon and within the city's limits, as established by city council resolution or ordinance, as provided for herein.

Equivalent stormwater unit rate or *ESU rate* means the storm sewer charge imposed on single-family residential developed property within the medium class, as established by city council resolution or ordinance, as provided herein.

Exempt property means public rights-of-way, public trails, public streets, public alleys, public sidewalks, railroad tracks that are not in railroad yards, and also means public lands and/or easements upon which the stormwater management system is constructed and/or located.

Fiscal year means a twelve-month period commencing on the first day of January of any year or such other twelve-month period adopted as the fiscal year of the city.

Impervious area means the number of square feet of hard surface areas that either prevent or retard the entry of water into the soil matrix, as it entered under natural conditions as undisturbed property, and/or cause water to run off the surface in greater quantities or at an increased rate of flow from that present under natural conditions as undisturbed property, including, but not limited to, roofs, roof extensions, driveways, pavement and athletic courts.

Other residential developed property means developed property upon which two (2) or more family and/or multi-family dwellings are located.

Non-residential developed property means developed property other than single residential developed property and other residential developed property.

Operating budget means the annual stormwater utility operating budget adopted by the city for the succeeding fiscal year.

Operations and maintenance means, without limitation, the current expenses, paid or secured, of operation, maintenance, repair and minor replacement of the system, as calculated in accordance with generally accepted accounting practice. This shall include, without limiting the generality of the foregoing, cost of studies related to the operation of the system; costs of the study performed heretofore in relation to establishing storm sewer charges for the stormwater utility and other start up costs of the stormwater utility; costs related to the national pollutant discharge elimination system permit study, application, negotiation and implementation, including public education and outreach, as mandated by federal and state laws and regulations and the costs of obtaining and complying with all other permits required by law, insurance premiums, administrative expenses, equipment costs, including professional services, labor costs and the cost of materials and supplies used for current operations.

Revenues means all rates, fees, assessments, rentals or other charges or other income received by the stormwater utility in connection with the management and operation of the system, including amounts received from the investment or deposit of monies in any fund or account, as calculated in accordance with generally accepted accounting practices.

Runoff coefficients means those numbers approved by the city council that are used to estimate the impervious area for each non-single family classified property. A list of the coefficients used for the city is found in Table 1 that is incorporated herein.

Single-family residential developed property means developed property upon which single-family detached dwellings are located.

Stormwater charge means a charge authorized by this chapter, Minnesota Statutes 2004, Section 444.075, and other applicable law, and further as set forth in resolution or ordinance heretofore or hereafter adopted or hereafter amended by the city council, which is established to pay operation and maintenance, costs of capital improvements, debt service associated with the stormwater management system and other costs included in the operating budget.

Stormwater management system, *sewer system* or *system* means storm sewers that exist at the time the ordinance codified in this chapter is adopted or that are hereafter established and all appurtenances necessary

in the maintaining and operating of the same, including, but not limited to pumping stations; enclosed storm sewers; outfall sewers; surface drains; street, curb and alley improvements associated with storm or surface water improvements; natural and manmade wetlands; channels; ditches; rivers; streams; wet and dry bottom basins; pocket ponds; multiple pond systems; settling basins; infiltration trenches or basins; filter systems; bioretention areas; dry or wet swales; grass channels; roof top detention; skimming devices; grit chambers and other flood control facilities; and works for the collection, transportation, conveyance, pumping, treatment, controlling, storing, managing, and disposing storm or surface water or pollutants originating from or carried by storm or surface water.

Stormwater utility or *utility* means the utility created by this chapter to operate, maintain and improve the stormwater management system and for all other purposes set forth in this chapter.

Undisturbed property means real property that has not been altered from its natural condition in a manner that disturbed or altered the topography or soils on the property to the degree that the entrance of water into the soil matrix is prevented or retarded.

Vacant land means real property upon which there is no structure, as shown in the records of the city assessor's office, which is not designed for or regularly used for commercial residential purposes, and which is not used in connection with another piece of property. Vacant land includes undisturbed property and land with no building used as a community garden. (2004-Or-132, § 1, 11-5-04)

- **510.20. - Creation of stormwater utility.**

Pursuant to the provisions of Minnesota Statutes 2004, Section 444.075, the city's general home rule powers, its nuisance powers, police powers and all other authorized powers, the city council does establish a stormwater utility and stormwater management system and declares its intention to operate, construct, maintain, repair and replace the stormwater management system and operate the stormwater utility. (2004-Or-132, § 1, 11-5-04)

- **510.30. - Findings and determinations.**

The city finds that the elements of the stormwater management system that provides for the collection, conveyance, detention/retention, treatment and release of stormwater, the reduction of hazard to property and life resulting from stormwater runoff, improvement in general health and welfare through reduction of undesirable stormwater conditions and improvement to the water quality in the storm and surface water system and its receiving waters are of benefit and provide services to all property within the city. It is further found, determined and declared that this chapter is in furtherance of and implements the goals and strategies of the local surface water management plan, the annual Combined Sewer Overflow (CSO) report and the city's National Pollutant Discharge Elimination System (NPDES) permit. (2004-Or-132, § 1, 11-5-04)

- **510.40. - Administration.**

The stormwater utility, under the supervision of the director, shall have the power to:

(1) Administer the acquisition, design, construction, maintenance, operation, extension and replacement of the stormwater management system, including real and personal property that is or will become a part of or protect the system.

(2)

Prepare regulations, as needed, to implement this chapter, and forward those regulations to the city council for consideration and adoption, and adopt those procedures, as are desirable, to implement adopted regulations or to carry out other responsibilities of the utility.

(3)

Administer and enforce this chapter and all regulations, guidelines and procedures adopted relating to the design, construction, maintenance, operation and alteration of the stormwater management system, including, but not limited to, the flow rate, volume, quality and/or velocity of the stormwater conveyed thereby.

a.

Advise the city council on matters relating to the stormwater management system.

b.

Develop and review plans concerning creation, design, construction, extension and replacement of the system and make recommendations to the city council related thereto.

c.

Inspect private systems, as necessary, to determine the compliance of those systems with this chapter and any regulations adopted pursuant hereto.

d.

Make recommendations to the city council concerning the adoption of ordinances, resolutions, guidelines and regulations to protect and maintain water quality within the stormwater management system in compliance with water quality standards established by state, county, regional and/or federal agencies, as now adopted or hereafter adopted or amended.

e.

Analyze the cost of services and benefits provided by the stormwater management system and the structure of fees, service charges, fines and other revenues of the stormwater utility at least once each year.

f.

Make recommendations to the city council concerning the cost of service and benefits provided by the stormwater management system and structure of fees, service charges, fines and other revenues of the stormwater utility.

g.

Analyze the appropriateness of providing credits against the stormwater charge for owners of property who employ structural or non-structural best management practices or other stormwater management practices on-site that significantly reduce the quantity or improve the quality of stormwater run-off from their property that enters the system and make recommendations to the city council regarding the provision of these credits.

h.

Administer programs established pursuant hereto or pursuant to ordinances, resolutions, regulations or guidelines hereafter adopted by the city council that provide for credits and/or incentives that reduce stormwater charges imposed against properties. (2004-Or-132, § 1, 11-5-04)

- **510.50. - Operating budget.**

The city shall, as part of its annual budget process, adopt an operating budget for the stormwater utility for the next following fiscal year. The operating budget shall be prepared in conformance with the state budget law, city policy and generally accepted accounting practices. The initial operating budget commences January 1, 2005, and ends December 31, 2005. (2004-Or-132, § 1, 11-5-04)

- **510.60. - Stormwater charge.**

(a) *Stormwater charge established*. Subject to the provisions of this chapter, there is imposed on each and every single-family residential developed property, other residential developed property and non-residential developed property, and vacant property, other than exempt property, and the owner and non-owner users thereof, a stormwater charge. In the event the owner and non-owner user of a particular developed property are not the same, the liability for the owner and non-owner user for the stormwater charge attributable to the developed property shall be joint and several liability. This stormwater charge shall be determined and set by the provisions of this chapter in accordance with the ESU and ESU rate, which is established by ordinance or resolution of the city council and which may be amended from time to time by the city council.

(1)

Stormwater charge for single-family residential developed property. Three (3) classes of single-family residential developed property are established to account for the wide range of the amount of impervious area that exists on individual single-family residential developed properties in the city. The three (3) single-family customer classes are based on statistical sampling of estimated impervious area as developed from the city assessor's single-family residential developed real estate property records which includes: foundation square footage, garage stalls, estimation of driveway square footage and foundation square footage of any outbuildings/other improvements. Classification of the single-family residential developed customer class properties into the three (3) customer classes is made based on estimated impervious area. Single-family residential developed properties will be assigned to one (1) of three (3) single-family residential customer classes. The three (3) single-family residential customer classes are as follows:

a.

Single-family residential developed property/high — greater than one thousand five hundred seventy-eight (1,578) square feet of estimated impervious area.

b.

Single-family residential developed property/medium — equal to or greater than one thousand four hundred eighty-five (1,485) square feet and less than or equal to one thousand five hundred seventy-eight (1,578) square feet of estimated impervious area.

c.

Single-family residential developed property/low — less than one thousand four hundred eighty-five (1,485) square feet of estimated impervious area.

The stormwater charge for each of these classes shall be as follows:

High	1.25 % of an ESU
Medium	1 ESU
Low	.75 % of an ESU

In the event of a newly constructed dwelling unit, the charge for the stormwater charge attributable to that dwelling unit shall commence upon the issuance of the building permit for that dwelling unit.

(2)

Stormwater charge for other residential developed property. The stormwater charge for other residential developed property shall be the ESU rate multiplied by the numerical factor obtained by multiplying the gross area of a property by the runoff coefficient for the other residential developed property, as set forth in Table 1 (the actual coefficient will be defined at the time of the annual rate adoption) and then dividing the above product by the ESU, as this ESU is established by City Council resolution or ordinance ((gross square footage X runoff coefficient)/ESU = ## ESU). In the event of a newly constructed dwelling unit, the stormwater charge attributable to that dwelling unit shall commence upon the issuance of the building permit for that dwelling unit.

(3)

Stormwater charge for non-residential developed property. The stormwater charge for non-residential developed property shall be the ESU rate multiplied by the number of ESU's for each individual non-residential developed property. The number of ESU's for each individual non-residential developed property shall be obtained by multiplying the gross area of each individual property by the runoff coefficient for the customer class that is the most similar to the use to which that individual non-residential developed property is currently being put, as set forth in Table 1 (the actual coefficient will be defined at the time of the annual rate adoption) and then dividing the above product by the ESU, as this ESU is established by city council resolution or ordinance ((gross square footage X runoff coefficient)/ESU = ## ESU)). The minimum stormwater charge for any non-residential developed property shall be in an amount equal to that of one (1) ESU. In the event of newly developed non-residential developed property, the stormwater charge attributable to that development shall commence upon the issuance of the building permit. In the event of additional development to property that is already developed property, the charge for the stormwater charge attributable to that additional development shall commence upon the issuance of the building permit.

(4)

Stormwater charge for vacant property. The stormwater charge for vacant property shall be the ESU rate multiplied by the number of ESU's for each individual vacant property. The number of ESU's for each individual vacant property shall be obtained by multiplying the gross area of each individual property by the runoff coefficient for the vacant property class, as set forth in Table 1 (the actual coefficient will be defined at the time of the annual rate adoption) and then dividing the above product by the ESU, as this ESU is established by city council resolution or ordinance ((gross square footage X runoff coefficient)/ESU = ## ESU)). There is no minimum stormwater charge for vacant property.

(b)

Stormwater charge calculation. The director shall initially, and from time to time, determine the class of residential developed property into which each individual residential developed property falls to establish the stormwater charge, based on the impervious area of the parcel as shown in the single-family records maintained by the city assessor's office. The stormwater charge for other residential developed property, for non-residential developed property, and for vacant property in the city shall be calculated as provided for subsection (a)(2), (3) & (4). The director shall make the initial calculation with respect to existing other residential developed property, non-residential developed property, and vacant property and may from time to time change this calculation from the information and data deemed pertinent by the director. With respect to property proposed to be non-residential developed property, the applicant for development approval shall submit square footage impervious area calculations, in accordance with the submission requirements for the application being submitted, as set forth in the applicable section of Title 20 of this Code.

(c)

Stormwater charge credit. A system of credits, which may reduce the stormwater charge that is imposed, as provided for above, is hereby established. A credit shall be granted for developed or undeveloped property pursuant to the rules provided for herein. The director shall, pursuant to the rules provided for herein, grant a credit to those owners or non-owner users of properties, against which stormwater charges are imposed, who employ structural or non-structural best management practices or other stormwater management practices on-site that significantly reduce the quantity or significantly improve the quality of stormwater run-off from their property that enters the system. The director shall propose rules providing guidelines for the awarding of credits. The council shall approve, or approve as modified, these rules for the awarding of credits. The rules shall be consistent with this section. A credit also shall be granted in a percentage amount set by said city council pursuant to the rules for properties with respect to which a final plan or final plat has been approved or other final development approval has been granted by the city, on or before the effective date of this ordinance, which requires the construction of an on-site structural or non-structural best management practices or other stormwater management practices that

significantly reduce the quantity or improve the quality of stormwater run-off from their property that enters the system, provided that, the practices are constructed and/or operational within one (1) year from the date of the applicable final approval. The credit shall begin in the fiscal year that the practice becomes operational. The credit for the first year, however, shall be prorated to reflect the number of months of the first fiscal year that the practices are operational, where appropriate. (2004-Or-132, § 1, 11-5-04)

- **510.70. - Appeal procedure.**

(a) Owners of residential developed property, non-residential developed property or vacant property, with respect to which a stormwater charge has been imposed, that disagree:

(1)
With the class into which their single-family residential developed property is placed;

(2)
With the calculation of the stormwater charge;

(3)
With whether their property is benefited by the stormwater utility; or

(4)
With whether their property is entitled to a credit or the continuation of a credit or on the amount of a credit;

may appeal the calculation or finding to a designee of the director by giving written notice of the appeal to the director at the director's customary offices within the (10) days of notice of that determination.

The director's designee assigned to hear such appeal shall not be a person that is regularly assigned to utility billing or the stormwater utility. Appeals from the calculation or finding to the designee of the director, as delineated herein above are separate and distinct from the billing complaint procedures established by Sections 509.920 and 509.930 of this Code.

(b)
The director's designee shall give written notice of the time and place for the review requested, pursuant to subsection (a) hereof, to the appealing owner or non-owner user. The review shall be held within fifteen (15) days of receipt by the director of the written appeal. In addition to any oral presentation, appellant shall state all grounds supporting the appeal in writing, attaching any exhibits, such as photographs, drawings or maps and affidavits that support the claim. In addition, the appellant shall submit a land survey prepared by a registered surveyor showing dwelling units, total property area, type of surface material and impervious area, as appropriate, and any other information that the director shall designate in writing to the appellant. The director may waive the submission of a land survey, if director determines that the survey is not necessary to make a determination on the appeal.

(c)
The burden of proof shall be on the appellant to demonstrate, by clear and convincing evidence, that the determination of the director, from which the appeal is being taken, is erroneous.

(d)
The filing of a notice of appeal shall not stay the imposition, calculation or duty to pay the stormwater charge. The appellant shall pay the stormwater charge, as stated in the billing.

(e)
Within fifteen (15) days of the review, the director's designee shall send a written copy of the designee's decision to the appellant with a copy to the director.

(f)

If the appellant believes this decision is in error, the appellant may file a written request for a review by the city council based on the written record by filing a request with the city clerk with a copy to the director. The request for review shall be reviewed based on the written record by a committee or subcommittee of the city council, or by a person appointed by the city council, or any designated combination thereof, within thirty (30) days of the filing of the request. The report of the committee, subcommittee and/or other reviewer shall be referred to the full council and be acted upon by the full council within thirty (30) days of the review. The decision of the city council on appeal is subject to judicial review, as provided by the laws of the state.

(g)

If the director's designee's determines, upon appeal, that appellant should not pay a charge, pay a charge amount less than the amount appealed from, receive a credit or receive a greater credit than the credit appealed from or the city council, upon appeal, so determines, the city shall issue a check to the appellant in the appropriate amount within ten (10) days of the date of the applicable decision, provided the charge has, as required herein, been paid by the appellant. (2004-Or-132, § 1, 11-5-04)

- **510.80. - Stormwater charge collection.**

(a) The stormwater charge shall be billed and collected by the city. The stormwater charge shall be shown as a separate item on the billing from the sewer utility charge levied and assessed pursuant to Section 511.290. In the event the owner and non-owner of a particular developed property are not the same, the liability for the owner and non-owner user for the stormwater charge attributable to the developed property shall be joint and severable. The same administrative procedures for special assessments shall be applied to the stormwater charge, as are applied for water use under Chapter 509 of this Code.

(b)

Pursuant to Minnesota Laws 1973, Chapter 320, whenever payment remains in default for a stormwater charge, the city council may annually levy an assessment equal to the unpaid costs, including penalty and interest against each developed property that is not exempt property and upon which the stormwater charge is unpaid. (2004-Or-132, § 1, 11-5-04)

- **510.90. - Stormwater fund.**

Stormwater charges collected by the city shall be paid into a fund that is hereby created and shall be known as the "Stormwater Fund." This fund shall be used for the purpose of paying costs of capital improvements, administration of the stormwater utility, operation and maintenance and debt service of the stormwater management system and to carry out all other purposes of the utility. (2004-Or-132, § 1, 11-5-04)

- **510.100. - Equivalent stormwater unit (ESU) rate.**

The ESU and the ESU rate that is used to determine the charge for each class of residential developed property, other residential developed property, non-residential developed property, and vacant property shall be as established in an ordinance or a resolution heretofore adopted or hereafter adopted by the city council, and as thereafter amended. (2004-Or-132, § 1, 11-5-04)

- **510.110. - Severability.**

In the event that any portion or section of this chapter is determined to be invalid, illegal or unconstitutional by a court of competent jurisdiction, the decision shall in no manner affect the remaining portions or sections of this chapter, which shall remain in full force and effect.

Table 1 - Ordinance

Bar- Rest.- Entertainment	.60—.75
Car Sales Lot	.60—.95
Cemetery w/Monuments	.10—.25
Central Business District	.85—1.00
Common Area	.10—.25
Garage or Misc. Res.	.30—.55
Group Residence	.60—.75
Ind. Warehouse- Factory	.50—.90
Industrial Railway	.50—.90
Institution- Sch.- Church	.60—.95
Misc. Commercial	.60—.95
Mixed Comm.- Res - Apt.	.60—.75
Multi-Family Apartment	.60—.75
Multi-Family Residential	.35—.50
Office	.60—.95
Parks & Playgrounds	.10—.25
Public Accommodations	.60—.95
Retail	.60—.95
Single Family Attached	.60—.75
Single Family Detached	ESU
Sport or Rec. Facility	.60—.95
Utility	.50—.90
Vacant Land Use	.10—.25
Vehicle Related Use	.60—.90
LAND USE	**RANGE**

(2004-Or-132, § 1, 11-5-04; 2005-Or-102, § 1, 11-4-05)

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	$14.93
Medium	1.00 ESU	$11.94
Low	.75 ESU	$8.96

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 City of Minneapolis Stormwater Fee website . If you need additional information, please contact (612) 673-2965.

Last updated Mar 3, 2015

City of Minneapolis

Fire Inspection Services

Spill Response Protocol

1) Report to the State Duty Officer/911 Emergency Communications.

2) Assessment of the site/incident, determination of Incident Action Plan (IAP).

3) Secure appropriate City/ State/ Federal resources, as well as private contractors, for implementation of IAP.

4) Oversight of site incident remediation and recovery activities.

5) Investigation/determination of causation, potential penalties, and future prevention measures.

CITY OF MINNEAPOLIS
PUBLIC WORKS DEPARTMENT
Street Maintenance Division
Standard Operating Procedure for Vehicle Related Spills (VRS)
May, 2014

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

DEFINITION of TERMS

FIS: Fire Inspection Services (also historically known as Minneapolis Environmental Management or Minneapolis Pollution Control)

MPCA: Minnesota Pollution Control Agency

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 FIS 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 FIS, the MPCA will notify FIS and provide them with the details relating to the spill incident. The FIS 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 FIS as soon as possible. A final report on the action(s) taken will be sent to the MPCA from FIS.

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 FIS 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).

- Less than 5 gallons: If the spill quantity is judged to be less than 5 gallons, no contact with FIS 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, but is not to be sent to FIS.

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

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 911 before taking any action to clean up a spill of unknown composition. FIS will manage these spills through their contracts with private entities specializing in these activities, or manage and coordinate the cleanup with the MSMD. If FIS 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 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
   - **Fire Inspection Services (FIS)**
     Steve Kennedy: 612-685-8528 (work)
     Tom Frame: 612-673-8501 (work)
     Emergency after-hours contacts:
     Steve Kennedy 612-685-8528
   - **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 cleanup/disposal of a spill event. The MSMD, FIS 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.

CITY OF MINNEAPOLIS - STREET DEPARTMENT

OIL AND HAZARDOUS MATERIAL SPILL DATA

DATE OF REPORT	TIME OF REPORT	NAME & ADDRESS OF RESPONSIBLE PARTY
DATE OF INCIDENT	TIME OF INCIDENT	
TYPE OF POLLUTANT	QUANTITY	CAUSE OF SPILL
PRECISE LOCATION		PERSON MAKING REPORT/PHONE NUMBER
AREAS AFFECTED		PARTY REPORTING SPILL TO STREET DEPT.
PROBABLE FLOW DIRECTION	SOIL TYPE	OTHERS CONTACTED: FIS_____ MPCA_____ FIREDEPT_____ POLICE_____ OTHER
WATERS POTENTIALLY AFFECTED		
EFFECTS OF SPILL/ IMMEDIATE DANGER TO HUMAN LIFE, PROPERTY		PROXIMITY OF WELLS, SEWER, BASEMENTS
ACTION TAKEN TO DATE		IS THIS FIRST NOTICE REGARDING SPILL?
CONTAINMENT OF SPILL		WHO SHOULD BE CONTACTED FOR FURTHER INFORMATION? PHONE NO.
CLEAN-UP TO DATE: MATERIAL USED_____ LOADER USED_____ TRUCKS USED_____ PICK-UP TRUCK USED_____ MACHINE SWEEPER USED_____ LABOR: FOREMAN HOURS_____ MAINT CREW LEADER _____ CONST LABORER_____ OTHER_____		COMMENTS?

ORIGINAL: When job completed, send immediately to Street Accounting.
COPY 1 : Send to Street Accounting with daily time when labor/eq. first used.
COPY 2 : PCA NOTIFICATION COPY - send immediately(first available interoffice mailing) to Steve Kennedy, FIS - Environmental Management, PSC, Room 401

STREET JOB#_____

LABOR COST $_____
EQUIP COST $_____
MAT'L COST $_____
TOTAL COST$_____

June, 2004

SPECIFICATION FOR DISPOSAL OF SPILL DEBRIS FROM VEHICLE RELATED SPILLS

City of Minneapolis
Department of Public Works

DEFINITIONS:

VRM: Vehicle Related Material: Petroleum products and 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.

SPILL DEBRIS: Sand that has been placed to absorb VRM and subsequently recovered for disposal.

CONTRACT PERIOD: The contract period shall be from July 1, 2004 to June 30, 2007.

SCOPE:

These specifications cover the loading, transportation and disposal of spill debris from a central site located within the City of Minneapolis. The "Contractor" for the purposes of this specification, refers to a permitted landfill facility that has been approved by the appropriate regulatory agencies.

GENERAL:

The City of Minneapolis expects to generate an estimated 500 cubic yards of spill debris during the contract period. This quantity is only an estimate of the City's requirement for said contract period, and may be increased or reduced in any amount without any adjustment in unit price. The primary source of this material is from the results of clean-up operations following vehicular collisions or accidental discharge from vehicles.

The spill debris will consist primarily of sand used to absorb VRM from City streets, as well as plastic sheeting used during the storage process. The Contractor will be required to transport and dispose of all such materials that have been stored at the City facility. The only acceptable disposal method for the spill debris shall be placement into or used as daily cover at a certified and fully permitted landfill facility.

SCOPE OF SERVICES:

The Contractor shall:

Provide two (2) 20 cubic-yard leak-proof roll-off containers with a counter-balanced lockable lid for the duration of the contract period at the City of Minneapolis Linden Yard Site, or any other designated site within the City of Minneapolis. The City of Minneapolis will provide Contractor access to this container throughout the contract period.

When a container is filled with spill debris, the City of Minneapolis will mechanically blend the material in the container and perform sampling and laboratory analysis in accordance with Minnesota Pollution Control Agency Guidance Documents. Any additional analyses required by the Contractor shall be stated in the proposal.

The City of Minneapolis will forward all pertinent analytical laboratory results to the Contractor.

The Contractor shall state in the proposal, the length of time needed, following receipt of the laboratory test results, before the full container is transported to the Contractors facility.

The City of Minneapolis will contact the Contractor, once a roll-off container is full and sampling/ analyses has begun. It shall be the responsibility of the Contractor to provide a replacement container for subsequent and interim spill debris storage. There must be, at all times, adequate space in a container available for the storage of spill debris at the City of Minneapolis facility.

The Contractor shall obtain all proper permits and manifests for the loading, transporting, and disposal of the spill debris. The contractor shall load and haul all such material to an approved disposal site. The

disposal method shall be approved by the appropriate regulatory agency(s). The Contractor shall provide documentation of all required approvals to the City of Minneapolis prior to acceptance of the material. The Contractor shall also provide the City with any and all documentation required by regulatory agencies, following the disposal of the spill debris.

CONTENT OF PROPOSALS:

The following required information shall accompany each bid:

Location of landfill site.
Cost per ton of material for disposal, utilizing the aforementioned 20 cubic-yard roll-off containers.
Cost per ton of material for disposal when the material is stockpiled without the use of a roll-off container. (Minimum stockpile being 10 tons)
The cost per ton for Superfund/CERCLA indemnification (include limits).
Cost per day for two (2) 20 cubic-yard leak-proof roll-off containers with a counter-balanced lockable lid at the Minneapolis site.
Cost for the option, at the sole discretion of the city, of extending this agreement for each of two additional years.
List of subcontractors and functions.
Qualification and experience of Contractor and all subcontractors

The bid will be based on a per ton (2000 pound) basis, which will include all transportation, permitting and regulatory cost. All loads shall be weighed on scales certified by the State of Minnesota

GENERAL TERMS AND CONDITIONS:

The following are the general terms and conditions, supplemental to those contained elsewhere in these specifications, which responding Contractors must comply with in order to be consistent with the requirements for the specification. Any deviation from these or any other stated requirements must be listed as exceptions on the bid sheet.

Once the bid forms are submitted in response to these specifications, they become the property of the City of Minneapolis, whether or not the bid is accepted. The City shall have the right to use any ideas presented in any bid submitted.

Representatives of the City of Minneapolis will review all bids received. An interview may be part of the evaluation process. Factors, upon which the proposal will be judged include, but are not limited to, the following:

Residual risk to the City of Minneapolis following disposal.
Expressed understanding of the project objective.
Cost of disposal.
Project work plan, including level of detail.
Qualification of both the Contractors assigned personnel, and subcontractors.

CITY'S RIGHTS:

The City reserves the right to reject any or all proposals or parts of proposals, to accept part or all of proposal on the basis considerations other than lowest cost, and to create a project of lesser or based on the component prices submitted. The City also reserves the right to cancel the Agreement without penalty, if circumstances arise which prevent the City from completing the project. In addition, the City reserves the right to re-bid for any phase of this work.

HOLD HARMLESS:

The Contractor agrees to defend, indemnify and hold harmless the City, its officer and employees, from any liabilities, claims, damages, costs, judgments, and expenses, including attorney's fees, resulting directly or indirectly from an act or omission of the contractor, it's employees, agents or employees of subcontractors, in the performance of this contract or by reason of the failure of the contractor to fully perform, in any

respect, all of its obligation under this contract.

The City agrees to defend and hold harmless insofar as the law allows the Contractor, its officers and employees, from any liabilities, claims, damages, cost, judgements, and expenses, including attorney's fees, resulting directly or indirectly from an act or omission of the City or its employees in the performance under this contract or by reason of the failure of the city to fully perform its obligations under this contract.

INTEREST OF MEMBERS OF CITY:

The Contractor represents and agrees that no member of the governing body, officer, employee or agency of the City has any interest, financial or otherwise, direct or indirect, in the Agreement.

EQUAL OPPORTUNITY STATEMENT:

Contractor agrees to comply with the provisions of all applicable federal, state and City of Minneapolis statutes, ordinances and regulations pertaining to civil rights and nondiscrimination including without limitation Minnesota Statute, Section 181.59 and Chapter 363 and Minneapolis code of Ordinances, Chapter 139, incorporated herein by reference.

AFFIRMATIVE ACTION:

Persons who are authorized to enter into contractual relationships with the City are encouraged to review the City's policies on Affirmative Action.

NON-DISCRIMINATION:

The Contractor will not discriminate against any employee or applicant for employment because of race, color, creed, religion, ancestry, sex, national origin, affectional preference, disability, age, marital status or status regard to public assistance or as a disabled veteran or veteran of the Vietnam era. Such prohibition against discrimination shall include, but no limited to, the following: employment, upgrading, demotion or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation and section for training, including apprenticeship.

The Contractor shall agree to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the City, setting forth this nondiscrimination clause. In addition, the Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment with regard to race, creed, religion, ancestry, sex, national origin, affectional preference, disability, age, marital status or status wit regard to public assistance or status as a disabled veteran or veteran of the Vietnam era, and comply in all other aspects with the requirements of the Minneapolis Code, Chapter 139.

CONTRACT INCORPORATION OF PROPOSAL CONTENTS:

The contents of the proposal and any clarifications or modification to the contract thereof submitted by the successful proposer may, at the City's option, become part of the Agreement obligation and be incorporated by reference into the ensuing contract.

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INSURANCE:

This agreement shall be effective only upon the approval by the City of acceptable evidence of the insurance detailed below. Such insurance secured by the Contractor shall be issued by insurance companies acceptable to the City and admitted in Minnesota. The insurance specified may be in a policy or policies of insurance, primary or excess. Such insurance shall be in force on the date of the execution of the agreement and shall remain continuously in force for the duration of the contract period.

The Contractor and its subcontractors shall secure and maintain the following insurance:

a) Worker's Compensation insurance that meets the statutory obligations with Coverage B – Employer's Liability limits of at least $100,000 each accident, $500,000 disease – policy limit

and $100,000 disease each employee.

b) Commercial General Liability insurance with limits of at least $500,000 general aggregate, $500,000 products – completed operations $500,000 personal and advertising injury, $500,000 each occurrence $50,000 fire damage, and $5,000 medical expense any one person. The policy shall be on an "occurrence" basis, shall include contractual liability coverage and the City shall be named an additional insured.

c) Commercial Automobile Liability insurance covering all owned, non-owned and hired automobiles with limits of at least $500,000 per accident.

Acceptance of the insurance by the City shall not relieve, limit or decrease the liability of the Contractor. Any policy deductible or retention shall be the responsibility of the Contractor. The Contractor shall control any special unusual hazards and be responsible for any damages that result from those hazards. The City does not represent that the insurance requirements are sufficient to protect the Contractor's interest or provide adequate coverage.

Evidence of coverage is to be provided on a City provided Certificate or Insurance. A thirty- (30) day written notice is required if the policy is canceled, not renewed or materially changed.

The Contractor shall require all of its subcontractors to comply with this provision.

The Contractor shall not assign any interest in the Agreement, and shall not transfer any interest in the same (whether by assignment or novation) without the prior written approval of the City, provided, however, that claims for money due or to become due to the contractor may be assigned to a bank, trust company or other financial institution, or to a Trustee in Bankruptcy without such approval. Notice to any such assignment or transfer shall be furnished promptly to the City.

COMPLIANCE REQUIREMENTS

All Contractors hired by the City of Minneapolis are required to abide by the regulations of the Americans with Disabilities Act of 1990 (ADA) which prohibits discrimination against individuals with disabilities. The Contractor will not discriminate against any employee or applicant for employment because their disability and will take affirmative action to insure that all employment practices are free from such discrimination. Such employment practices include but are not limited to the following: Hiring, promotion, demotion, transfer, recruitment, or recruitment advertising, layoff, discharge, compensation and fringe benefits, classification referral and training. The ADA also requires contractor associated with the City of Minneapolis to provide qualified applicants and employees with disabilities with reasonable accommodations that do not impose undue hardship. Contractors also agree to post in conspicuous areas accessible to employees and applicants, notices of their policy on nondiscrimination.

In the event the Contractor's noncompliance with the nondiscrimination clauses of this agreement, this agreement may be cancelled, terminated, or suspended, in whole or part, and the Contractor may be declared ineligible by the Minneapolis City Council from any further

Grit ID	Location	Date Inspected	Floatables Y/N	Volume Of Sediment Removed	Date Cleaned
1	UPTON AVE N & 53RD AVE N	4/1/15	N	1	4/1/31
2	UPTON AVE N & 53RD AVE N	4/3/15	N	1	4/3/15
3	SHERIDAN AVE N, N OF 52ND AVE N	7/27/15	N	2	7/27/15
4	RUSSELL AVE N NORTH OF 52ND AVE N	5/26/15	N		
5	PENN AVE N & 52ND AVE N	5/11/15	N	1	5/11/15
6	PENN AVE N & 52ND AVE N	5/20/15	N	1	5/20/15
7	OLIVER AVE N & 52ND AVE N	7/4/15	N	2.5	7/24/15
8	NEWTON AVE N & SHINGLE CREEK	8/28/15	N	0.25	8/28/15
9	OLIVER AVE N & 51ST AVE N	5/11/15	N	0.5	5/11/15
10	MORGAN AVE N & 51ST AVE N	4/30/15	N	0.25	4/30/15
11	KNOX AVE N & 51ST AVE N	4/28/15	Y	0.5	4/30/15
		9/29/15	Y	2	9/30/15
12	KNOX AVE N & 50TH AVE N	9/16/15	Y	4	9/16/15
13	IRVING AVE N & 50TH AVE N	9/17/15	Y	2.5	9/17/15
14	JAMES AVE N, NORTH OF 49TH AVE N	5/26/15	N	0.25	5/26/15
15	21ST AVE N & 1ST ST N	10/2/15	Y	28	10/3/15
16	XERXES AVE N & 14TH AVE N	10/21/15	N	1.5	10/21/15
		11/2/15	Y	40	11/4/15
17	XERXES AVE N & GLENWOOD AVE	7/1/15	N	3	7/1/15
18	MORGAN AVE N & CHESNUT AVE	7/27/15	N	4.5	7/27/15
19	GIRARD AVE NO & CURRIE AVE NO				
20	BRIDAL VEIL TUNNEL OUTLET				
21	LAKE OF THE ISLES PKWY & LOGAN AVE	9/14/15	Y	18	8/15/15
22	W 22ND ST & JAMES AVE S				
23	YARD SUMPS, 26TH & HIAWATHA				
24	DREW AVE S & W LAKE ST	8/5/15	N	5.3	8/5/15
25	EXCELSIOR BLVD & MARKET PL	9/15/15	Y	12	9/16/15
26	W LAKE ST & ALDRICH AVE S	8/6/15	N	1.5	8/6/15
27	W 32ND ST & BRYANT AVE S				

27	W 32ND ST & BRYANT AVE S				
28	W 33RD ST & HOLMES AVE S	11/28/15	Y	6	11/2/15
29	W 33RD ST & GIRARD AVE S	11/3/15	N	18	11/3/15
30	YORK AVE S & W LAKE CALHOUN PARKWAY				
31	CHOWEN AVE S & W 41ST ST				
32	E 42ND ST & BLOOMINGTON AVE S	8/11/15	N	2	8/11/15
		12/4/15	Y	1	12/4/15
33	E 43RD ST & PARK AVE S				
34	W 44TH ST & LAKE HARRIET PARKWAY				
35	E 44TH ST & OAKLAND AVE S	4/24/15	N		
36	E 46TH ST & 31ST AVE S	8/13/15	N	1	8/13/15
37	46TH AVE S & GODFREY RD				
38	W 47TH ST & YORK AVE S	4/23/15	N	0.25	4/23/15
39	W 47TH ST & WASHBURN AVE S	8/6/15	N		
40	W 47TH ST & LAKE HARRIET PARKWAY				
41	W 48TH ST & YORK AVE S	4/23/15	N	1	4/23/15
42	QUEEN AVE S & LAKE HARRIET PARKWAY	11/4/15	N	32	11/6/15
43	16TH AVE S & E MINNEHAHA PKWY				
44	SHERIDAN AVE S & W 50TH ST	8/3/15	Y	2	8/3/15
45	JAMES AVE S & MINNEHAHA CREEK				
46	MORGAN AVE S & W 53RD ST	10/29/15	N	28	10/30/15
47	E 55TH ST & PORTLAND AVE S	4/21/15	N	1	4/21/15
48	E 56TH ST & PORTLAND AVE S	4/21/15	N	2	4/21/15
49	E 57TH ST & PORTLAND AVE S	4/22/15	N	0.25	4/22/15
50	E 57TH ST & PORTLAND AVE S				
51	GIRARD AVE S BETWEEN W 59TH ST & W 60TH ST	4/20/15	N	2.5	4/20/15
52	E 59TH ST & 12TH AVE S	8/10/15	N	3	8/10/15
53	GIRARD AVE S & W 60TH ST	4/21/15	N		
54	GIRARD AVE S, W 60TH ST - DUPONT AVE S	10/21/15	Y	46	10/22/15
55	GRASS LAKE TERRACE, GIRARD TO JAMES AVE S	10/22/15	N	5	10/22/15
56	GRASS LAKE SERVICE ROAD BEHIND #6035 JAMES AVE S	4/20/15	N	0.5	4/20/15
57	GRASS LAKE SERVICE ROAD BEHIND #6077 JAMES AVE S	4/20/15	N	0	
58	GRASS LAKE SERVICE ROAD BEHIND #1416 W 61ST ST	4/20/15	N	0	
59	W 61ST ST & GRASS LAKE SERVICE ROAD				
60	IRVING AVE S & W 61ST ST				
61	E RIVER RD & CECIL ST	7/20/15	N	8	7/22/15
		10/16/15	Y	3	10/16/15
62	HIAWATHA PARK REFECTORY TURN-A-ROUND	8/11/15	N	1	8/11/15

62	HIAWATHA PARK REFLECTORY TURN-A-ROUND				
63	33RD AVE N & 1ST ST N/RAILROAD TRACKS	6/15/15	N	3	6/15/15
64	26TH AVE N & PACIFIC (N TRANSFER STATION)				
65	SOUTH TRANSFER STATION	8/13/15	N	2	8/13/15
66	MAPLE PLACE & EAST ISLAND AVE	7/23/15	N	1	7/23/15
67	DELASALLE DR & E ISLAND	7/23/15	N	1.5	7/23/15
68	W ISLAND - 300' S OF MAPLE PLACE	7/23/15	N	1.5	7/23/15
69	EASTMAN AVE & W ISLAND	7/23/15	N	2.5	7/23/15
70	ROYALSTON & 5TH AVE N				
71	THE MALL & E LAKE OF THE ISLES	10/14/15	Y	40	10/16/15
72	S OF 37TH AVE NE & ST ANTHONY PKWY	6/29/15	Y		
		10/1/15	Y	15	10/2/15
73	4552 KNOX AVE N (IN ALLEY BEHIND)				
74	STEVENS AVE S 300' S OF MINNEHAHA CREEK	10/26/15	N		
75	IRVING AVE N (IMPOUND LOT)				
76	MARKET PLAZA & EXCELSIOR BLVD				
77	ALLEY - 38TH TO 39TH ST & NICOLLET TO BLAISDELL AVE	4/20/15	N	0.5	4/20/15
78	SHINGLE CREEK WETLAND - W SIDE	8/4/15	Y	4	8/4/15
79	SHINGLE CREEK WETLAND - EAST SIDE	8/28/15	Y	11	8/31/15
80	WOODLAWN BLVD & E 50TH ST	8/10/15	Y	1.5	8/10/15
81	WOODLAWN BLVD & E 53RD ST				
82	12TH AVE S & POWDERHORN TERRACE	4/29/15	Y	0.25	4/29/15
83	13TH AVE S & POWDERHORN TERRACE	5/5/15	Y	0.25	5/5/15
84	3421 15TH AVE S (180' W OF CL)	4/27/15	Y	2.5	4/27/15
85	3329 14TH AVE S	4/28/15	N	0.5	4/28/15
86	13TH AVE S & E 35TH ST	4/28/15	Y	3	4/29/15
87	3318 10TH AVE S	4/30/15	Y	0.5	4/30/15
88	ACROSS THE STREET FROM 702, NO. BD. VAN WHITE BLVD.	6/16/15	Y	1	6/16/15
		8/27/15	Y	1	8/27/15
89	ACROSS THE STREET FROM 706, NO. BD. VAN WHITE BLVD.	6/16/15	Y	1	6/16/15
		8/27/15	Y	0	8/27/15
90	10TH AVE. NO. & ALDRICH AVE. NO. (S.W.C.)	7/1/15	Y	1.5	7/1/15
91	SO. BD. VAN WHITE BLVD., 200' SO. OF 8TH AVE. NO.	8/6/15	Y	0	8/6/15
92	ACROSS THE STREET FROM 701, SO. BD. VAN WHITE BLVD.	5/19/15	Y	2	5/19/15
		10/13/15	Y	1	10/13/15
93	SO. BD. VAN WHITE BLVD., 250' SO. OF 10TH AVE. NO	8/26/15	Y	3	8/26/15
94	10TH AVE. NO. & NO. BD. VAN WHITE BLVD. (S.W.C.)	12-/3	Y	1.5	12/3/15
95	WEST SIDE OF ALDRICH AVE. NO. & 9TH AVE. NO.	7/31/15	Y	2.5	7/31/15

96	8TH AVE. NO. & NO. BD. VAN WHITE BLVD. (N.E.C.)	6/16/15	Y	3	6/16/15
97	29TH AVE. & LOGAN AVE. - NO. STORM WATER DET. POND (E & W) #1	6/9/15	Y	5	6/9/15
97	29TH AVE. & LOGAN AVE. - NO. STORM WATER DET. POND (E & W) #2	6/9/15	Y	4	6/10/15
97	29TH AVE. & LOGAN AVE. - NO. STORM WATER DET. POND (E & W) #3	6/10/15	Y	4	6/10/15
		10/14/15	Y	8	10/16/15
98	MALMQUIST LN. & HUMBOLDT NO.	8/3/15	Y	3.5	8/4/15
99	SHINGLE CREEK DR. & HUMBOLDT NO.	5/11/15	N		
100	SO. OF 49TH AVE. NO. & HUMBOLDT NO.	9/29/15	Y	3.5	9/29/15
101	NO. OF 49TH AVE. NO. & HUMBOLDT NO.	7/31/15	Y		7/31/15
		9/30/15	Y	2	10/1/15
102	28TH ST. E. & HIAWATHA * MNDOT HIAWATHA				
103	E. LAKE ST. & HIAWATHA * MNDOT HIAWATHA				
104	NAWADAHA LN./SERVICE RD. & HIAWATHA * MNDOT HIAWATHA				
105	MINNEHAHA PARKWAY (NO. SIDE) S.B. LANE * MNDOT HIAWATHA				
106	E. 50TH ST. (SW COR) & HIAWATHA * MNDOT HIAWATHA				
107	E. 54TH ST. & RIVERVIEW RD. * MNDOT HIAWATHA RE-ROUTE				
108	ALLEY SUMP MH WEST OF COLUMBUS AVE S & E 37TH ST - no as-builts				
109	22ND AVE N AND W RIVER ROAD	8/5/15	Y	1	8/5/15
110	W. CALHOUND PARKWAY 100' NO. OF RICHFIELD RD.	8/14/15	Y	3	8/14/15
111	RICHFIELD RD. NEAR W. CORNER OF THE PARKING LOT	8/31/15	Y	0.25	8/31/15
112	W. 36TH ST. 30' W. OF CALHOUN PARKWAY	8/13/15	Y	4	8/13/15
113	20' EAST OF VAN WHITE MEM. BLVD (N.B.) AND 5TH AVE N (1016 - 5TH AVE N)	6/17/15	Y	2	6/17/15
114	DUPONT AVE. NO. & 4TH AVE. NO.	8/25/15	Y	2	8/25/15
115	VAN WHITE MEM. BLVD (S.B.) AND 4TH AVE N	8/26/15	Y	2	8/26/15
116	400' NORTH (60' INTO POND) VAN WHITE MEM. BLVD (S.B.) AND 4TH AVE N	6/16/15	N	0.25	6/16/15
117	300' NORTH (WEST SIDE) OF VAN WHITE MEM. BLVD (S.B.) AND 4TH AVE N	6/16/15	Y	2	6/16/15
118	200' NORTH (POND SIDE) OF VAN WHITE MEM. BLVD (S.B.) AND 10TH AVE N	8/24/15	Y	3	8/24/15
119	11TH AVE N AND VAN WHITE BLVD (N.B.)	8/24/15	Y	0.5	8/24/15
120	VAN WHITE MEM. BLVD (S.B.) (160' so. of fremont ave. no. on the e. side of the street)	8/20/15	Y	0.25	8/20/15
121	50' NORTH (EAST SIDE) OF VAN WHITE MEM. BLVD (S.B.) AND FREMONT AVE N	8/20/15	Y	0.5	8/20/15
122	MINNEHAHA PARKWAY @ 39TH AVE S N SIDE OF PKWY	9/4/15	N	3	9/4/15
123	COLUMBUS AVE S SOUTH OF E 37TH ST REROUTE - no as-builts	4/24/15	N	0.25	4/24/15
124	COLUMBUS AVE S - CHICAGO AVE S ALLEY - no as-builts	4/24/15	N	0.25	4/24/15
125	COLUMBUS AVE S ACROSS FROM #3644 - no as-builts	4/24/15	N	1	4/24/15
126	E 37TH ST AND COLUMBUS S # 3640 COLUMBUS - no as-builts	4/24/15	N	0.25	4/24/15
127	E 37TH ST AND COLUMBUS S # 3700 COLUMBUS - no as-builts	4/28/15	N	0.5	4/28/15

127	E 37TH ST AND COLUMBUS S # 3700 COLUMBUS - no as-builts				
128	W 27TH ST AND LAKE OF THE ISLES PKWY - no as-builts				
129	YARD SUMPS, 26TH AND HIAWATHA				
130	YARD SUMPS, 26TH AND HIAWATHA				
131	YARD SUMPS, 26TH AND HIAWATHA				
132	YARD SUMPS, 26TH AND HIAWATHA				
133	ALLEY DRY WELL, BETWEEN HUMBOLDT/IRVING AVE S AND W 25TH ST/26TH ST, no as-builts	4/23/15	N	1.5	4/23/15
134	W 22ND ST @ E LAKE OF THE ISLES BLVD, no as-builts				
135	CHICAGO AVE S BETWEEN WASHINGTON AVE S AND 2ND ST S - no as-builts				
136	111 22ND AVE N (ALLEY BETWEEN 1ST ST N AND 2ND ST N AT VACATED 21ST AVE N)				
137	W 44TH ST @ LAKE HARRIET PKWY EAST (Installed on existing 54" Concrete Pipe)	10/27/15	Y	5	10/27/15
138	EWING AVE S BETWEEN W. FRANKLIN AVE AND W 22ND ST - Pending as-built info	12/10/15	N	0.5	10/10/15
139	EWING AVE S @ W FRANKLIN AVE - Pending as-built info	10/20/15	N	0.25	10/20/15
140	E LAKE ST WEST OF 14TH AVE S (Hennepin County const. Lake St.)	8/12/15	N		
141	W LAKE ST EAST OF 14TH AVE S (Hennepin County const. Lake St.)	6/26/15	Y	4	6/26/15
		8/12/15	Y	0.25	8/12/15
142	18TH AVE S SOUTH OF E LAKE ST (Hennepin County const. Lake St.)	8/11/15	Y	0	8/11/15
143	LONGFELLOW AVE S SOUTH OF E LAKE ST (Hennepin County const. Lake St.)	8/11/15	Y	0	8/11/15
144	31ST AVE S NORTH OF E LAKE ST (Hennepin County const.. Lake St.)	9/2/15	Y	2	9/2/15
145	CEDAR AVE S AND E MINNEHAHA PARKWAY (20' S. of S. curb of Minnehaha & 5' W. of W. curb of Cedar)	9/1/15	N	6	9/1/15
146	E LAKE ST AND 46TH AVE S 12' W OF THE W CURB AND 9' SO OF THE N CURB ON LAKE ST (added 10/31/07) (service pending)				
147	E LAKE ST AND 47TH AVE S 6' S OF THE N CURB ON LAKE ST AND 1' W OF THE W CURB ON 47TH AVE EXTENDED (added 10/31/07) (service pending)				
148	E LAKE ST AT 42ND AVE S (8.4' W of the E curb on 42nd St and 38' N of the N curb on Lake St) (Hennepin Co. Construction) (added 11/1/07) (service pending)				
149	W 44TH ST AND ALDRICH AVE S SWC	12/10/15	Y	4	12/10/15
150	W RIVER ROAD AND 23RD AVE N				
151	DIAMOND LK RD & CLINTON AVE S				
152	3RD AVE. SO. & 2ND ST. S.				
153	PLEASANT AVE & W LAKE ST	11/8/15	Y	3.5	11/9/15
154	W LAKE ST AND DUPONT AVE S	7/27/15	Y	1	7/27/15
155	W LAKE ST AND BLAISDELL AVE S	8/3/15	Y		
156	W 43RD ST & E LAKE HARRIET PARKWAY	5/20/15	N	6	5/20/15
157	STEVENS AVE S & DIAMOND LK RD	9/29/15	N	1	9/29/15
158	E 61ST ST & COLUMBUS AVE S	9/29/15	N	4	9/29/15
159	2ND AVE N & 7TH ST N (Target Center)				
160	2ND AVE N & 6TH ST N	9/23/15	Y	0.5	9/23/15
161	3RD AVE N & WASHINGTON AVE N				

161	3RD AVE N & WASHINGTON AVE N				
162	DOWLING AVE N & OLIVER AVE N				
163	PLYMOUTH AVE N & WEST SIDE OF RIVER				
164	PLYMOUTH AVE N & EAST SIDE OF RIVER				
165	1409 Washington Ave N	10/19/15	N	2.5	10/19/15
166	Thomas Ave S & Dean Pkwy to Kenilworth Lagoon (Lake of the Isles) (Burka- plan sheet only)	10/2/15	N	4	10/2/15
167	E River Rd north of Washington Ave SE (CCLRT) no information on file per Lois E 11/15/2013				
168	Dowling Ave N Alley Drain between Morgan Ave N and Newton Ave N				
169	Dowling Ave N Alley Drain between Newton Ave N and Oliver Ave N				
170	Dowling Ave N at Oliver Ave N				
171	Newton Ave N at Dowling Ave N sump MH				
	New Van Whithe Blvd Bridge				

Body of Water	Outfall_ID	Location	Inspection Date	Structure Type	Outfall Pipe Size	Material Type
Shingle Creek	20-010	52nd Ave N and Sheridan Ave N (extended)	11-Aug-15	Concrete Apron	18	RCP
Shingle Creek	20-012	53rd Ave N and Russell Ave N (extended)	11-Aug-15	Concrete Apron	60	RCP
Shingle Creek	20-013	52nd Ave N and Russell Ave N (extended)	11-Aug-15	Concrete Apron	12	RCP
Shingle Creek	20-020	Penn Ave N and 52nd Ave N	11-Aug-15	Diffuser	0	RCP
Shingle Creek	20-030	52nd Ave N (Penn Av N)	11-Aug-15	Concrete Apron	18	RCP
Shingle Creek	20-040	52nd Ave N (Oliver Ave N)	11-Aug-15	CMP Apron	21	CMP
Shingle Creek	20-050	Newton Ave N	11-Aug-15	Concrete Apron	15	RCP
Shingle Creek	20-060	51st Ave N (Newton Av N)	11-Aug-15	Pipe	10	PVC
Shingle Creek	20-060A	51st ave n and morgan ave n	11-Aug-15	CMP Apron	12	CMP
Shingle Creek	20-070	Knox Ave N	11-Aug-15	CMP Apron	36	CMP
Shingle Creek	20-080	50th Ave N (Knox Ave N)	11-Aug-15	Concrete Apron	30	RCP
Shingle Creek	20-090	50th Ave N (James Ave N)	11-Aug-15	Pipe	21	CMP
Shingle Creek	20-100	49th Ave N (Ryan Creek)	11-Aug-15	Concrete Apron	12	RCP
Shingle Creek	20-110	49th Ave N (Ryan Creek)	11-Aug-15	Concrete Apron	36	RCP
Shingle Creek	20-120	49th Ave N (Humboldt Ave N)	12-Aug-15	Box Culvert	60	RCP
Shingle Creek	20-130A	47th Ave N (Humboldt Ave N) 200' S of 47th Ave N	12-Aug-15	Box Culvert	24	RCP
Shingle Creek	20-140	47th Ave N (Shingle Crk Pkwy)	12-Aug-15	Concrete Apron	27	RCP
Shingle Creek	20-140A	47th & Humboldt Bridge (westside)	12-Aug-15	Concrete Apron	24	RCP
Shingle Creek	20-150	47th Ave N (Girard Ave N)	12-Aug-15	CMP Apron	18	CMP
Shingle Creek	20-150A	47th Ave N (Girard Ave N) 50' North of 20-150	12-Aug-15		0	
Shingle Creek	20-160	Malmquist Lane	12-Aug-15	Concrete Apron	36	RCP
Shingle Creek	20-170	Fremont Ave N (Shingle Crk Pkwy)	12-Aug-15	Pipe	12	CMP
Shingle Creek	20-190	46th Ave N (Shingle Crk Pkwy)	12-Aug-15	CMP Apron	18	CMP
Shingle Creek	20-200A	Dupont Ave N (Shingle Crk Pkwy)	12-Aug-15	Pipe	12	CMP
Shingle Creek	20-200B	Dupont Ave N (Shingle Crk Pkwy)	12-Aug-15	Concrete Apron	60	RCP
Shingle Creek	20-210A	45th Ave N (Dupont Ave N)	12-Aug-15	Pipe	8	CMP
Shingle Creek	20-210B	44th Ave N (Soo Line RR)	12-Aug-15	Pipe	60	CMP
Shingle Creek	20-220	45th Ave N (Colfax Ave N)	12-Aug-15	Concrete Apron	24	RCP
Shingle Creek	20-230	Webber Pkwy and 43rd Ave N (goes through park to Shingle Creek)	12-Aug-15		0	
Shingle Creek	20-240	Weber Pkwy (Aldrich Ave N)	12-Aug-15	Diffuser	48	RCP
Shingle Creek	20-240B	Shingle Creek (N side of Crk @ rr bridge).	12-Aug-15	CMP Apron	24	CMP
Shingle Creek	20-250	Lyndale Ave N (S of Creek)	12-Aug-15	Pipe	12	
Shingle Creek	20-260	Lyndale Ave N (N of Creek)	12-Aug-15	Pipe	12	
Shingle Creek	20-270	I- 94 (S of Creek)	12-Aug-15	Pipe	24	
Shingle Creek	20-280	I-94 (E of I-94 at Creek)	12-Aug-15	Pipe	48	
Shingle Creek	20-290	I-94 (N of Creek)	12-Aug-15	Pipe	36	
Ryan Lake	21-010		27-Aug-15	Sluiceway	0	RCP
Bassett Creek	40-010	14th Ave N @ Xerxes Ave N	27-Aug-15	Box Culvert	72	RCP
Bassett Creek	40-015		27-Aug-15	Pipe	30	RCP

Bassett Creek	40-020	Xerxes Ave N (S of T.H. 55)	28-Aug-15	Box Culvert	20	RCP
Bassett Creek	40-030	Vincent Ave N (N of T.H. 55)	27-Aug-15	Concrete Apron	36	RCP
Bassett Creek	40-040	Upton Ave N (N of T.H. 55)	28-Aug-15	Concrete Apron	42	RCP
Bassett Creek	40-040	Upton Ave N (N of T.H. 55)	24-Aug-15	Concrete Apron	48	RCP
Bassett Creek	40-050		28-Aug-15	Pipe	24	HDPE
Bassett Creek	40-060	100' N of 5th Av N @ Thomas Av N	28-Aug-15	Pipe	18	RCP
Bassett Creek	40-070	S of Thomas Av N @ Inglewood St N	28-Aug-15	Concrete Apron	24	RCP
Basset Creek	40-080	Thomas Av N (N of Chestnut Av N)	03-Nov-15		0	
Basset Creek	40-090	Queen Av N (N of Chestnut Av N)	03-Nov-15	Pipe	48	RCP
Basset Creek	40-110	Oliver Av N - S of 2nd Av N	03-Nov-15	Pipe	24	RCP
Basset Creek	40-120	Newton Av N (S of Bassett Creek)	03-Nov-15	Pipe	0	HDPE
Basset Creek	40-120a	Newton Av N (S of Bassett Creek)	03-Nov-15	Pipe	24	RCP
Basset Creek	40-130	Morgan Av N (N of Bassett Creek)	03-Nov-15		44	RCP
Basset Creek	40-140	Morgan Av N extended (S of Bassett Creek)	03-Nov-15	Pipe	60	RCP
Basset Creek	40-150	Irving Av N	03-Nov-15	Concrete Apron	0	RCP
Basset Creek	40-160	Old Basset Creek Tunnel Entrance	04-Nov-15	Box Culvert	0	RCP
Bassett Creek	40-400	Bassett Creek outlet to Mississippi River	27-Aug-15	HDPE Apron	20	HDPE
Bassett Creek	50-025		28-Aug-15	CMP Apron	30	RCP
Brownie Lake	51-010	North edge of Brownie Lake	24-Aug-15	Box Culvert	36	RCP
Brownie Lake	51-020	Cedar Lake Road - 250' SW of Lake View	24-Aug-15	Pipe	18	PVC
Brownie lake	51-030	From St Louis Park--South edge of Brownie Lake	24-Aug-15	Pipe	60	RCP
Cedar Lake	52-010	W '21st St (extended)	24-Aug-15	CMP Apron	18	CMP
Cedar Lake	52-020	Burnham Road @ Kenilworth Lagoon	04-Nov-15	Pipe	12	CMP
Cedar Lake	52-020	Burnham Road @ Kenilworth Lagoon	24-Aug-15	Pipe	12	CMP
Cedar Lake	52-030	Park Lane - 500' North of Burnham Road	24-Aug-15		0	
Cedar Lake	52-040	Burnham Road - '100' North of Cedar Lake Pkwy	24-Aug-15		0	
Cedar Lake	52-050	Cedar Lake Pkwy @ Depot	24-Aug-15	Diffuser	12	RCP
Cedar Lake	52-070	Cedar Lake Pkwy @ Drew Ave S (extended)	24-Aug-15	Diffuser	36	RCP
Cedar Lake	52-080	Cedar Lake Pkwy @ Ewing Av S (extended	24-Aug-15		0	
Cedar Lake	52-100	Cedar Lake Pkwy @ West 24th St	24-Aug-15	Box Culvert	36	RCP
Cedar Lake	52-110	Cedar Lake Pkwy @ West 22nd St	24-Aug-15	Box Culvert	42	RCP
Cedar Lake	52-120	Cedar Lake Pkwy @ West Franklin Av	24-Aug-15	Box Culvert	0	RCP
Lake Hiawatha	76-010	27th Av S @ E44th St	16-Apr-15	CMP Apron	69	Brick
Lake Hiawatha	76-010a		16-Apr-15	Pipe	18	CMP
Lake Hiawatha	76-020a		16-Apr-15	Pipe	0	CMP
Lake Hiawatha	76-030	E 45th St @ 28th Av S	16-Apr-15		0	
Lake Hiawatha	76-040	E 45th St @ 28th Av S	15-Apr-15		0	
Lake Hiawatha	76-050	E 46th St @ 28th Av S	15-Apr-15	Pipe	12	RCP
Powderhorn Lake	82-010	Powderhorn Terrace @ 12th Av S	17-Apr-15	Concrete Apron	36	CMP
Powderhorn Lake	82-010A	100' E of 82-010	17-Apr-15	Concrete Apron	24	RCP
Powderhorn Lake	82-020	15th Av S 300' S of E 34th St	17-Apr-15	Concrete Apron	36	CMP
Powderhorn Lake	82-025	150' S of 82-020	17-Apr-15	Pipe	15	PVC
Powderhorn Lake	82-025A	West side of lake 200' s of 82-020	17-Apr-15	Pipe	12	HDPE

Powderhorn Lake	82-030	E 35th St @ 13th Av S	17-Apr-15		0	
Powderhorn Lake	82-040	10th Av S 200' S of E 33rd St	17-Apr-15	Concrete Apron	36	RCP
Powderhorn Lake	82-050		17-Apr-15	Head Wall	0	

April 2016 - Eberhart, PW-SWS

Introduction:
The federal Clean Water Act requires states to adopt water quality standards to protect waters from pollution. The goal is to protect high-quality waters and improve the quality of impaired waters, so that beneficial uses (such as fishing, swimming and protection of aquatic life) are maintained and restored, where these uses are attainable. *Adapted from MPCA 12/2011 Guidance Manual for Assessing the Quality of Minnesota Surface Waters.*

The process includes the following steps: 1) Assess waters, 2) Determine whether impaired, 3) Place water on the impaired list, 4) Monitor and study the water body, 5) Complete a pollutant load allocation formula (called a "Total Maximum Daily Load", or TMDL), 6) Develop a restoration strategy, 7) Implement the strategy, 8) Monitor changes in water quality, and then 9) De-list if standards are being achieved, or 10) Determine next steps. The list of impaired water bodies, or 303(d) List, is updated every two years.

City of Minneapolis TMDL Status

Name of Surface Water (includes lakes, creeks, wetlands and Mississippi River). Alphabetical order. * indicates waterbody is not in Minneapolis.	Receives Minneapolis municipal stormwater runoff?	State ID	Next-in-line Receiving Water	Status of Impairment and TMDL Study	Designated Use that is Affected by the Impairment
BASSETT CREEK	yes (and from upstream municipalities)	07010206-538	Mississippi River	1) FISHES BIOASSESSMENTS (listed 2004) - TMDL study not started yet, may be reassessed.	Aquatic Life
				2) BACTERIA (listed 2008) - TMDL approved Nov. 2014 (metro-wide).	Aquatic Recreation
				3) CHLORIDE (listed 2010) - TMDL study underway.	Aquatic Life
BASSETT'S POND * (Part of Bassett Creek. Located in City of Golden Valley, in Wirth Park owned and managed by Minneapolis Park & Recreation Board)	yes	27-0036	Bassett Creek	No impairments.	
BIRCH POND	yes (portion of southbound Wirth Parkway)	27-0653	Landlocked (historic pumping to Chain of Lakes)	No impairments.	
BROWNIE LAKE	yes (and from City of Saint Louis Park)	27-0038	Cedar Lake	1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL approved 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
				2) EXCESS NUTRIENTS (listed 2004) - **DE-LISTED** 2010 (could be listed again if TP rises again).	
				3) CHLORIDE (listed 2014) - TMDL study underway metro-wide.	Aquatic Life
CEDAR LAKE	yes (and from City of Saint Louis Park)	27-0039	Lake of the Isles	1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL approved 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
CEMETERY LAKE	no	27-0017	Lake Calhoun	No impairments.	
CRYSTAL LAKE * (Located in Robbinsdale)	yes (and from City of Robbinsdale)	27-0034	Shingle Creek	1) EXCESS NUTRIENTS (listed 2002) - TMDL Study approved 2009, in implementation stage.	Aquatic Recreation
DIAMOND LAKE	yes	27-0022	Minnehaha Creek	1) Was formerly listed for EXCESS NUTRIENTS, but removed from list in 2008 because it was determined to be a wetland (or game lake) that had been mischaracterized by DNR as a lake. There are no nutrient standards for wetlands at this time.	
				2) CHLORIDE (listed 2014) - TMDL study underway metro-wide.	Aquatic Life
FERDINAND POND (see Legion Lake)	yes (and MnDOT Crosstown)	--	Legion Lake	No impairments. Status as a "wetland" to be determined by DNR.	
GRASS LAKE (Officially a wetland. Was previously part of Richfield Lake, which was divided by construction of Highway 62)	yes	27-0681	Landlocked	1) EXCESS NUTRIENTS (listed in 2006) - TMDL study has not started, MPCA target start date is 2020.	Aquatic Recreation
LAKE CALHOUN	yes (and from upstream municipalities)	27-0031	Lake Harriet	1) MERCURY IN FISH TISSUE (listed 1998) - statewide TMDL completed 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
				2) PFOS IN FISH TISSUE (listed 2008) - regulatory action by MPCA in lieu of TMDL is underway (pollutant source in St. Louis Park), target completion 2022.	Aquatic Consumption
LAKE HARRIET	yes	27-0016	Minnehaha Creek	1) MERCURY IN FISH TISSUE (listed 1998) - statewide TMDL completed 2008, not stormwater-related, no MS4 responsibilities. Target completion 2025.	Aquatic Consumption
				2) PFOS IN FISH TISSUE (listed 2008) - regulatory action by MPCA in lieu of TMDL is underway (pollutant source in St. Louis Park), target completion 2022.	Aquatic Consumption
LAKE HIAWATHA (Part of Minnehaha Creek)	yes (and from upstream municipalities)	27-0018	Minnehaha Creek	1) EXCESS NUTRIENTS (listed 2002) - part of Minnehaha Creek *E. Coli* Bacteria/Lake Hiawatha Nutrients TMDL Study. TMDL approved 2014.	
LAKE NOKOMIS	yes (and from Richfield and a portion of MSP Airport)	27-0019	Minnehaha Creek	1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL approved 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
				2) PCB IN FISH TISSUE (listed 1998) - TMDL status unknown, target completion 2025.	Aquatic Consumption
				3) EXCESS NUTRIENTS (listed 2002) - TMDL study approved 2011, in implementation stage. (TMDL name: Minnehaha Creek Watershed Lakes)	Aquatic Recreation

Name of Surface Water (includes lakes, creeks, wetlands and Mississippi River). Alphabetical order. * indicates waterbody is not in Minneapolis.	Receives Minneapolis municipal stormwater runoff?	State ID	Next-in-line Receiving Water	Status of Impairment and TMDL Study	Designated Use that is Affected by the Impairment
LAKE OF THE ISLES	yes	27-0040	Lake Calhoun	1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL approved 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
				2) PFOS IN FISH TISSUE (listed 2008) - regulatory action underway by MPCA in lieu of TMDL (pollutant source in St. Louis Park), target completion 2022.	Aquatic Consumption
LEGION LAKE * (Located in Richfield; the former Legion Lake wetland area in Minneapolis is now Ferdinand Pond)	no (lake is in Richfield; a wetland area formerly considered part of Legion Lake is now Ferdinand Pond)	27-0024	Taft Lake	No impairments for Legion Lake, but Legion Lake is involved in the TMDL for Lake Nokomis.	
LORING LAKE (commonly called Loring Pond)	yes (little direct runoff BUT takes runoff on occasion from 35W Tunnel)	27-0655	Mississippi River	1) CHLORIDE (listed 2014) - TMDL study underway metro-wide.	Aquatic Life
MINNEHAHA CREEK	yes (and from upstream municipalities)	07010206-539	Mississippi River	1) FISHES BIOASSESSMENTS (listed 2004) - TMDL study not started, may reassess (baseflow not constant), appears to be on hold until 2020.	Aquatic Life
				2) CHLORIDE (listed 2008) - TMDL study underway metro-wide.	Aquatic Life
				3) BACTERIA (listed 2008) - part of Minnehaha Creek *E. Coli* Bacteria/Lake Hiawatha Nutrients TMDL study. TMDL approved 2014.	Aquatic Recreation
				4) DISSOLVED OXYGEN (listed 2010) - TMDL study not started, may reassess (baseflow not constant), appears to be on hold until 2020.	Aquatic Life
				5) AQUATIC MACROINVERTEBRATE BIOASSESSMENTS (listed 2014) - TMDL study not started.	Aquatic Life
MISSISSIPPI RIVER (the specific reach upstream of Upper Saint Anthony Falls, to Coon Creek)	yes (and from upstream municipalities)	07010206-509	n/a	1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL approved 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
				2) PCB IN FISH TISSUE (listed 1998) - targeted TMDL completion date is 2025.	Aquatic Consumption
				3) BACTERIA (listed 2002) TMDL approved Nov. 2014 (metro-wide), bacteria not an issue in this river segment this round, MPCA plans to look again in 2020.	Aquatic Recreation
MISSISSIPPI RIVER (the specific reach between Upper and Lower Saint Anthony Falls)	yes (and from upstream municipalities)	07010206-513	n/a	1) MERCURY IN FISH TISSUE (listed 1998) - not stormwater-related, statewide TMDL approved 2008.	Aquatic Consumption
				2) PCB IN FISH TISSUE (listed 1998) - targeted TMDL completion date is 2025.	Aquatic Consumption
				3) BACTERIA (not listed, but part of TMDL approved Nov. 2014 (metro-wide) - bacteria not an issue in this river segment this round, MPCA plans to look again in 2020.	Aquatic Recreation
MISSISSIPPI RIVER (the specific reach downstream of Lower Saint Anthony Falls, to Lock and Dam #1)	yes (and from upstream municipalities)	07010206-503	n/a	1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL finalized 2008, not stormwater-related, so no MS4 responsibilities.	Aquatic Consumption
				2) BACTERIA (listed 2002) TMDL approved Nov. 2014 (metro-wide), bacteria not an issue in this river segment this round, MPCA plans to look again in 2020.	Aquatic Recreation
MISSISSIPPI RIVER * (impaired downstream of confluence with Minnesota R., to Lake Pepin)	this impairment is downstream of the Minneapolis segments	07010206-xxx	n/a	1) TOTAL SUSPENDED SOLIDS (TSS) (listed 1998) (replaced turbidity standard with site-specific TSS standard) - South Metro Ms. R. TSS TMDL study near completion. **Zero reduction required for Minneapolis.**	
LAKE PEPIN * (widening of MISSISSIPPI RIVER) (as tributary to Lake Pepin nutrient/eutrophication biological indicators TMDL)	this impairment is downstream of the Minneapolis segments	25-0001	n/a	1) EXCESS NUTRIENTS (listed 2002) - Lake Pepin TMDL study in progress.	
MOTHER LAKE * (formerly in Minneapolis, now Airport)	yes	27-0023	Lake Nokomis	No excess nutrients impairment for Mother Lake, but Mother Lake is involved in the TMDL for Lake Nokomis.	
POWDERHORN LAKE	yes	27-0014	Landlocked (has been pumped to Mississippi River in the past)	1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL approved 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
				2) EXCESS NUTRIENTS (listed 2002) - **DE-LISTED** in 2012, due to improved water quality.	
				3) CHLORIDE (listed 2014) - TMDL study underway metro-wide.	Aquatic Life
RYAN CREEK (primarily conveyed by storm drain pipe, about two blocks exposed, on industrial property)	yes (and Ryan Lake)	don't know	Shingle Creek	No impairments.	

Name of Surface Water (includes lakes, creeks, wetlands and Mississippi River). Alphabetical order. * indicates waterbody is not in Minneapolis.	Receives Minneapolis municipal stormwater runoff?	State ID	Next-in-line Receiving Water	Status of Impairment and TMDL Study	Designated Use that is Affected by the Impairment
RYAN LAKE part * (located in Minneapolis and in Cities of Robbinsdale and Brooklyn Center)	yes (and from upstream municipalities)	27-0058	Ryan Creek	1) EXCESS NUTRIENTS (listed 2002) - TMDL Study approved 2007, **DE-LISTED** 2014 because of restoration activities under TMDL Implementation Plan.	
SANCTUARY MARSH	no	27-0665	Lake Harriet	No impairments.	
SHINGLE CREEK	yes (and from upstream municipalities)	07010206-506	Mississippi River	1) CHLORIDE (listed 1998) - TMDL approved 2007, now in implementation stage.	Aquatic Life
				2) DISSOLVED OXYGEN (listed 2004) - TMDL approved 2011, now in implementation stage.	Aquatic Life
				3) AQUATIC MACROINVERTEBRATE BIOASSESSMENTS (listed 2006) - TMDL approved 2011, now in implementation stage.	Aquatic Life
				4) BACTERIA (listed 2014) - TMDL approved Nov. 2014 (metro-wide).	Aquatic Recreation
SILVER LAKE * (located in Cities of New Brighton and Columbia Heights)	yes, from a very small corner of Minneapolis (and from New Brighton, Columbia Heights and St. Anthony Village)	62-0083	Ramsey County Ditch 3, then Rice Creek	1) EXCESS NUTRIENTS (listed 2002) - TMDL approved 2010, now in implementation stage.	Aquatic Recreation
				1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL approved 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
				3) CHLORIDE (listed 2014) - TMDL study underway metro-wide.	Aquatic Life
SPRING LAKE	yes (and from I-394)	27-0654	Landlocked? (possible occasional connection to tunnel to Mississippi River)	1) CHLORIDE (listed 2014) - TMDL study underway metro-wide.	Aquatic Life
TAFT LAKE * (formerly in Minneapolis, now Airport)	yes (formerly part of Minneapolis, now Airport)	27-0683	Lake Nokomis	1) No excess nutrients impairment for Taft Lake, but Taft Lake is involved in the TMDL for Lake Nokomis.	
WEBBER POND	no (reconstructed 2013-2015 with no stormwater outfalls to it)	27-1118	Shingle Creek	No impairments.	
WIRTH LAKE * (located in City of Golden Valley, in Wirth Park owned and managed by Minneapolis Park & Recreation Board)	no apparent Minneapolis municipal runoff (MPRB only; parkway runoff appears to be only in Golden Valley)	27-0037	Bassett Creek	1) MERCURY IN FISH TISSUE (listed 1998) - Statewide TMDL approved 2008, not stormwater-related, no MS4 responsibilities, target completion 2025.	Aquatic Consumption
				2) EXCESS NUTRIENTS (listed 2002) - TMDL approved 2010 (Wirth Lake Excess Nutrients TMDL Report). **DE-LISTED** 2014 because of activities carried out under TMDL Implementation Plan.	

Color Key:

Chloride.

Bacteria.

Excess nutrients.

related to Lake Nokomis Excess Nutrients TMDL.

Total Suspended Solids (TSS)

Dissolved oxygen, or bioassessments for fish or aquatic macroinvertebrates.

PFOS or PCB

Mercury - no MS4 responsibilities.

Notes:

MERCURY -- Presence of mercury is primarily airborne, not stormwater runoff. Statewide Mercury TMDL is being carried out by MPCA. No MS4 responsibilities.

PFOS -- Presence of perfluorooctane sulfonate (PFOS) is primarily related to industrial discharge. Regulatory action in lieu of TMDL is underway.

PCB -- Polychlorinated biphenyls.

* indicates waterbody is not in Minneapolis.

Message from Minnesota's Clean Water Council: We recognize that people are hungry for immediate results; however, managing water resources is an ongoing task, and some clean water outcomes may take several decades to achieve. Once a best management practice has been implemented, it often takes many years, or decades, before a positive environmental outcome is achieved in a highly degraded river, lake or groundwater source.

EROSION CONTROL

Goal: To set a consistent standard for erosion control inspections performed by City of Minneapolis Regulatory Services Inspectors that is transparent and accountable to the public.

All enforceable erosion control standards can be found in Minneapolis Code of Ordinances

- Title 3, Chapter 52 EROSION AND SEDIMENT CONTROL FOR LAND DISTURBANCE ACTIVITIES,

Best Management Practices (BMPs) used are adapted from Minnesota Department of Transportation erosion control measures.

I. Demolition and Construction >500 ft² and <5,000 ft²

A. APPLICABILITY

- This section pertains to construction and demolition activities with ground disturbance greater than 500 square feet or 5 cubic yards but less than 5,000 square feet.
- Construction or Demolition permit issued by the City of Minneapolis;

B. ADMINISTRATIVE ACTIVITIES:

- On a bi-weekly basis administrative staff reviews KIVA for erosion control permits
- Upon issuance of an erosion control permit for construction or demolition administrative staff will develop a request for services (RFS) in KIVA for EMBESE.

C. INSPECTOR ACTIVITIES:

- All inspectors must attend and pass an approved erosion control course and possess a current storm water erosion control license
- Upon receiving the EMBESE RFS through KIVA the inspector conducts an initial inspection.

- If a demolition project the inspector verifies that the demolition is complete and properly graded. If there are concerns they are addressed with the Problem Properties Unit or Code Construction Services.
- If the site does not have a construction permit the inspector verifies that the contractor graded the site and removed construction debris.
- The inspector checks the contractor's erosion control best management practices to ensure that the measures are adequate to prevent erosion of soil from the site.
- Inspect sidewalk, alley, and street for soil eroding from the site or tracking from demolition activities.
- Identify and inspect storm drains in vicinity to ensure that soil eroding from the site is not entering storm drains.
- If a significant amount of soil has escaped the site and entered the storm drain which cannot be recovered a citation may be issued without prior notice.
- If demolition and site grading are complete, BMPs are in place and adequate to control erosion, and no soil is noted in public thoroughfares enter notes into KIVA noting compliance.
- Schedule site visit in 5 weeks if conditions are compliant to check erosion control status at that time or to assess the establishment of vegetation. Enter as an EMS02 for single or multi-family residential or small commercial.
- Contact the contractor directly and establish a due date to correct site issues. Follow up by writing orders in KIVA to the contractor outlining deficiencies and due date for compliance. If a contractor is notified directly their due date may be as short as 24hrs depending on severity and no longer than 7 days. The due date within this time frame is the sole discretion of the trained inspector. Any due date shorter than 24 hours or longer than 7 days requires a supervisor's or manager's approval.
- Schedule re-inspection for due date.
- If site is not in compliance upon re-inspection issue a citation to the contractor through KIVA.
- When outstanding non-compliance is resolved schedule the next round of inspections or final inspection for determining vegetative cover.
- If vegetative cover is at least 70% close RFS and permit in KIVA.

D. **RECORD KEEPING**

- Digital photographs are to be downloaded into stellant under the appropriate EMBESE folder using the correct RFS number.
- If created, paper files are to be placed into the company file in the main filing cabinet.

III. Construction >5,000 ft²

E. **APPLICABILITY**

- This section pertains to construction and demolition activities with ground disturbance greater than 5000 square feet.
- Construction or demolition permit issued by the City of Minneapolis;

F. **ADMINISTRATIVE ACTIVITIES:**

- Administrative staff reviews KIVA for erosion control permits
- Upon issuance of an erosion control permit for construction of sites greater than 5000 square feet administrative staff develop a request for services (RFS) in KIVA for EMBESE.

G. **INSPECTOR ACTIVITIES:**

- All inspectors must attend and pass an approved erosion control course and possess a storm water erosion control
- Upon receiving the EMBESE RFS through KIVA on the Daily Inspection Report the inspector conducts an initial inspection.
- Upon entering the site all staff members MUST be wearing a hard hat, safety glasses and steel toed boots.
- Inspect Stormwater Pollution Prevention Plans at the job site trailer. Note inspection dates, occurrences and issues. Ensure the site was inspected on days with rains over 0.5 inches.
- If a demolition project the inspector verifies that the demolition is complete and properly graded. If there are concerns they are addressed with Code Construction Services.
- Any drainage concerns that may impact adjacent properties are noted.
- If the site does not have a construction permit the inspector verifies that the contractor graded the site and removed construction debris.
- The inspector checks the contractor's erosion control best management practices to ensure that the measures are adequate to prevent erosion of soil from the site.
- Inspect sidewalk, alley, and street for soil eroding from the site or tracking from demolition activities.
- Identify and inspect storm drains in vicinity to ensure that soil eroding from the site is not entering storm drains.
- If a significant amount of soil has escaped the site and entered the storm drain which cannot be recovered a citation may be issued without prior notice.

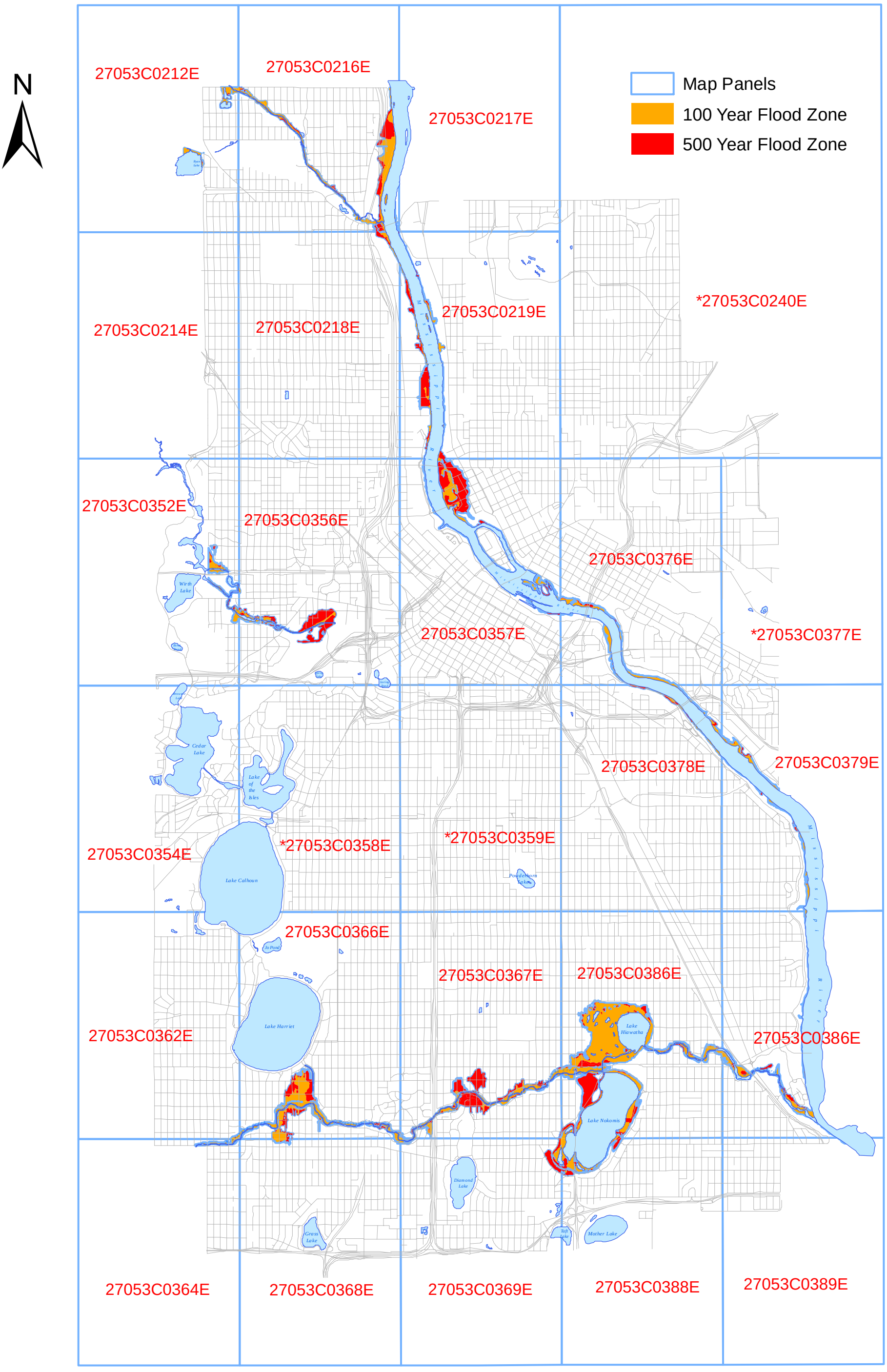
- If demolition and site grading are complete, BMPs are in place and adequate to control erosion, and no soil is noted in public thoroughfares enter notes into KIVA noting compliance.
- Schedule site visit in 7 weeks if conditions are compliant to check erosion control status at that time or to assess the establishment of vegetation.
- Following storm events greater than 0.5 inches of rain in 24hrs inspect records to ensure contractor conducted required additional inspections
- Contact the contractor directly and establish a due date to correct site issues. Follow up by writing orders in KIVA to the contractor outlining deficiencies and due date for compliance. If a contractor is notified directly their due date may be as short as 24hrs depending on severity and no longer than 7 days. The due date within this time frame is the sole discretion of the trained inspector. Any due date shorter than 24 hours or longer than 7 days requires a supervisor's or manager's approval.
- Schedule re-inspection for due date.
- If site is not in compliance upon re-inspection issue a citation to the contractor through KIVA.
- When outstanding non-compliance is resolved schedule the next round of inspections or final inspection for determining vegetative cover.
- If vegetative cover is at least 70% close RFS and permit in KIVA.

H. **RECORD KEEPING**

- Digital photographs and related documents are to be downloaded into Stellant.
- All notes of inspections must be entered in KIVA

Appendix B

F.E.M.A. DESIGNATED FLOOD ZONES



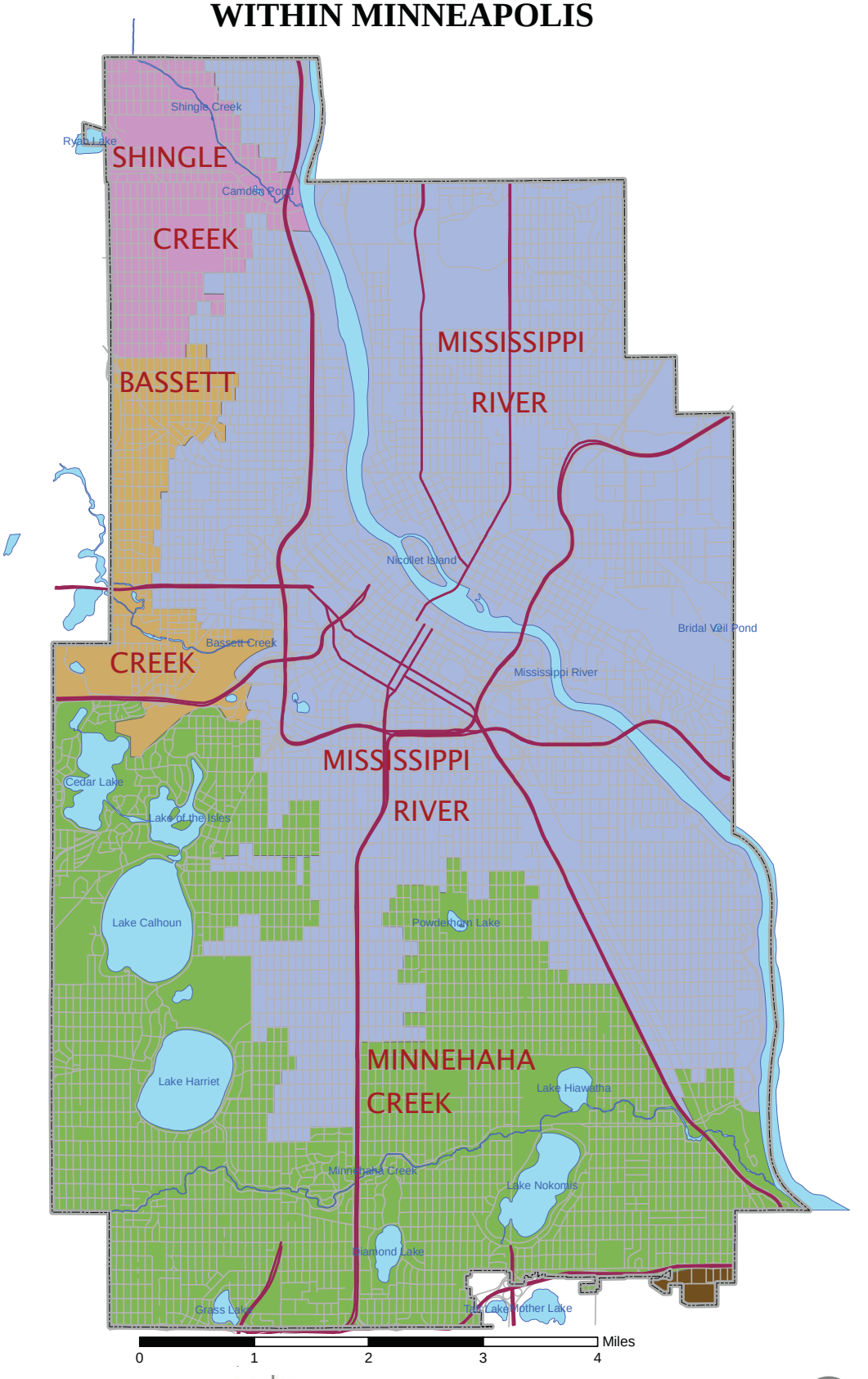
EFFECTIVE DATE FOR MAP PANELS IS SEPTEMBER 2, 2004

APPENDIX B-1

May, 2016

Minneapolis
City of Lakes

WATERSHED MANAGEMENT BOUNDARIES WITHIN MINNEAPOLIS

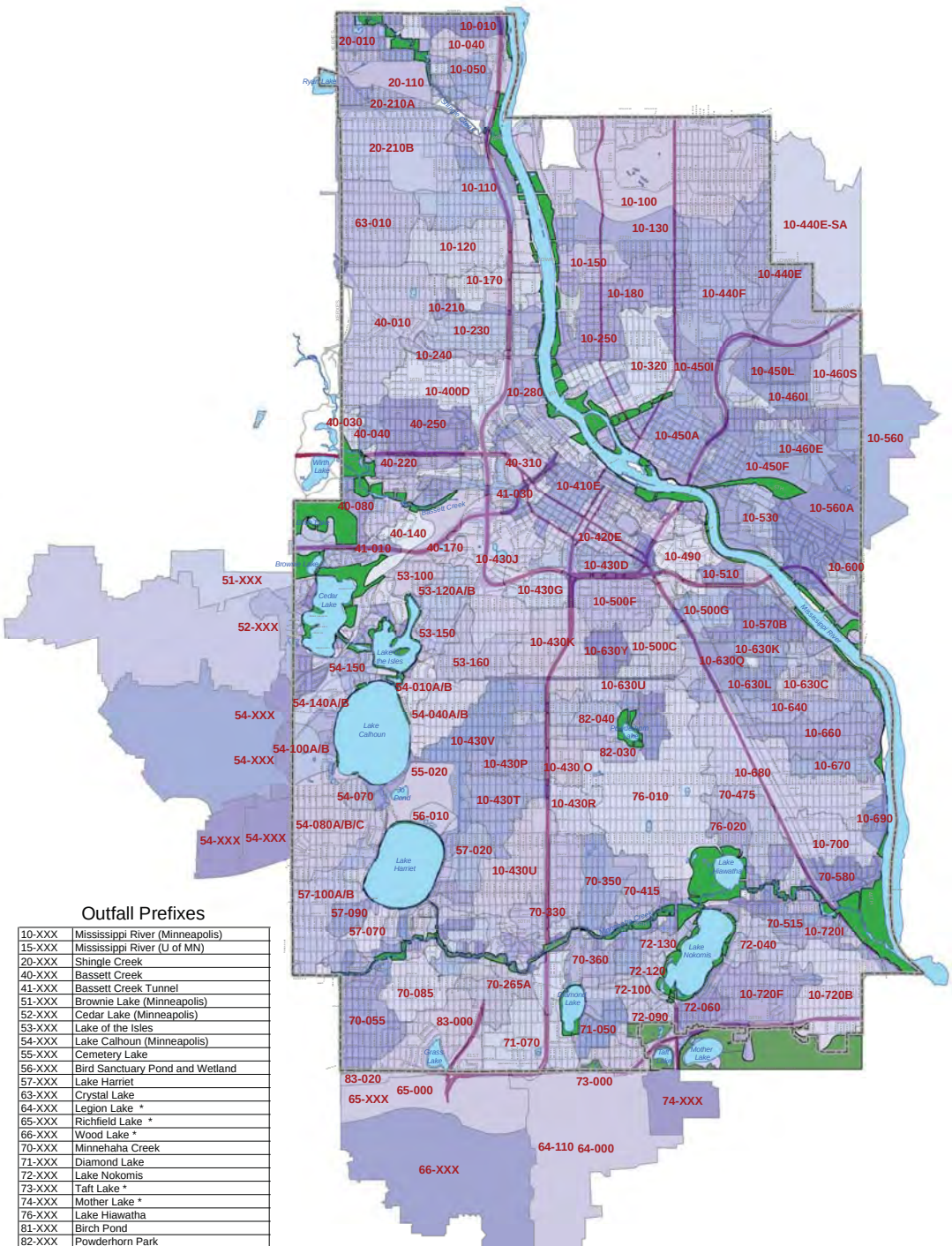


- Lakes & Streams
- Bassett Creek Water Management Commission
- Minneapolis/St. Paul International Airport
- Minnehaha Creek Watershed District
- Mississippi Watershed Management Organization
- Shingle Creek Watershed Management Commission

MINNEAPOLIS PUBLIC WORKS
SURFACE WATER & SEWERS DIVISION

March, 2008

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	

Miles
0 1 2 3 4

March, 2008

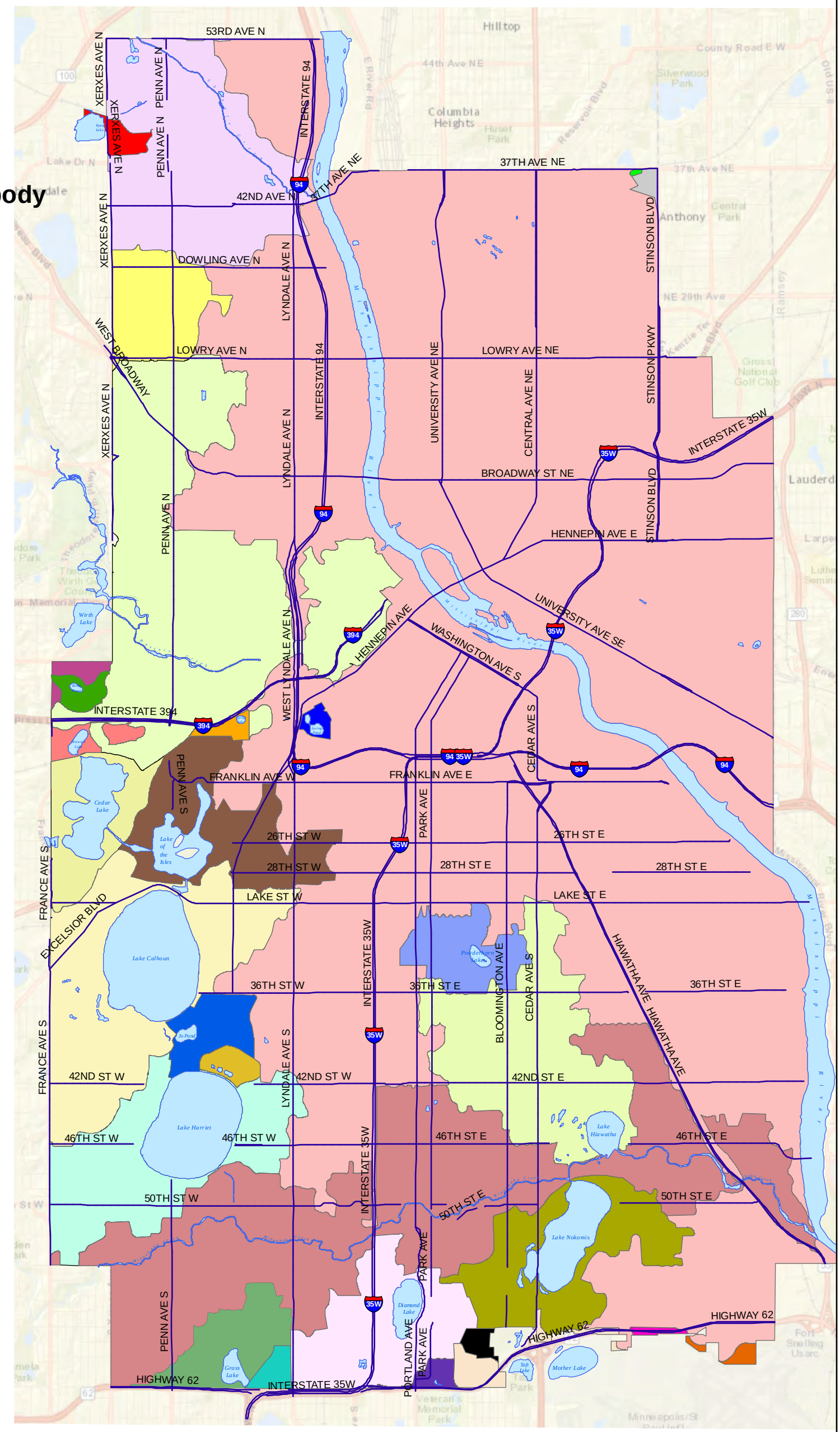
MINNEAPOLIS PUBLIC WORKS
SURFACE WATER & SEWERS DIVISION

MINNEAPOLIS DRAINAGE AREAS TO RECEIVING WATER BODIES

N

Watersheds by Waterbody

- Bassett Creek
- Birch Pond
- Brownie Lake
- Cedar Lake
- Cemetery Lake
- Crystal Lake
- Diamond Lake
- Grass Lake
- Hwy 62 Wetland
- Hart Lake
- Lake Calhoun
- Lake Harriet
- Lake Hiawatha
- Lake Nokomis
- Lake of the Isles
- Legion Lake
- Loring Pond
- Minnehaha Creek
- Mississippi River
- Mother Lake
- Powderhorn Lake
- Richfield Lake
- Ryan Lake
- Sanctuary Pond
- Shingle Creek
- Silver Lake
- Solomon Park Wetland
- Spring Lake
- Taft Lake
- Wirth Lake
- reportmask
- World Street Map



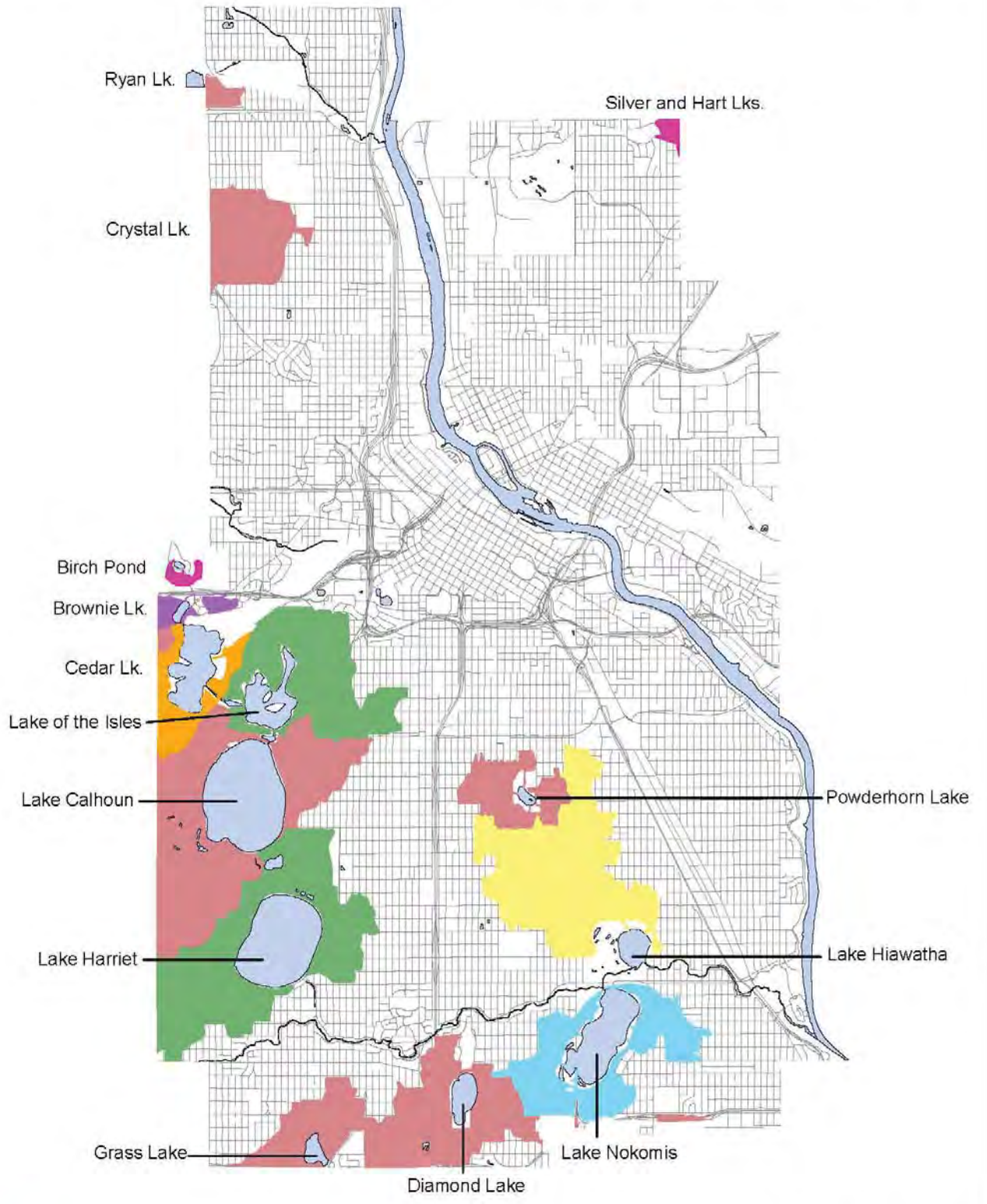
JUNE 2016

APPENDIX B-4

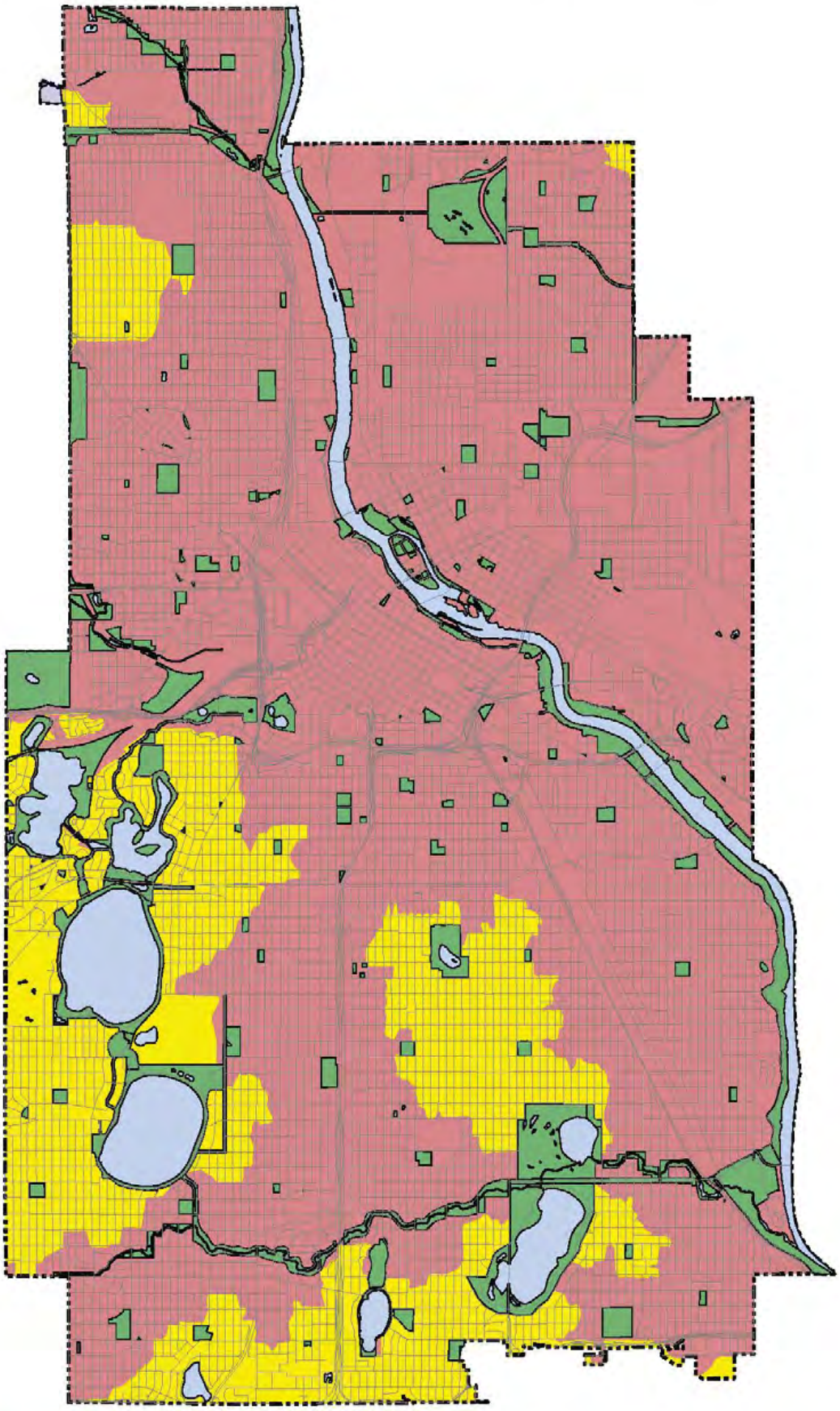
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P
China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStre
Community

Minneapolis
City of Lakes

Appendix B5: # Phosphorus Load Reductions for Lakes and Wetlands

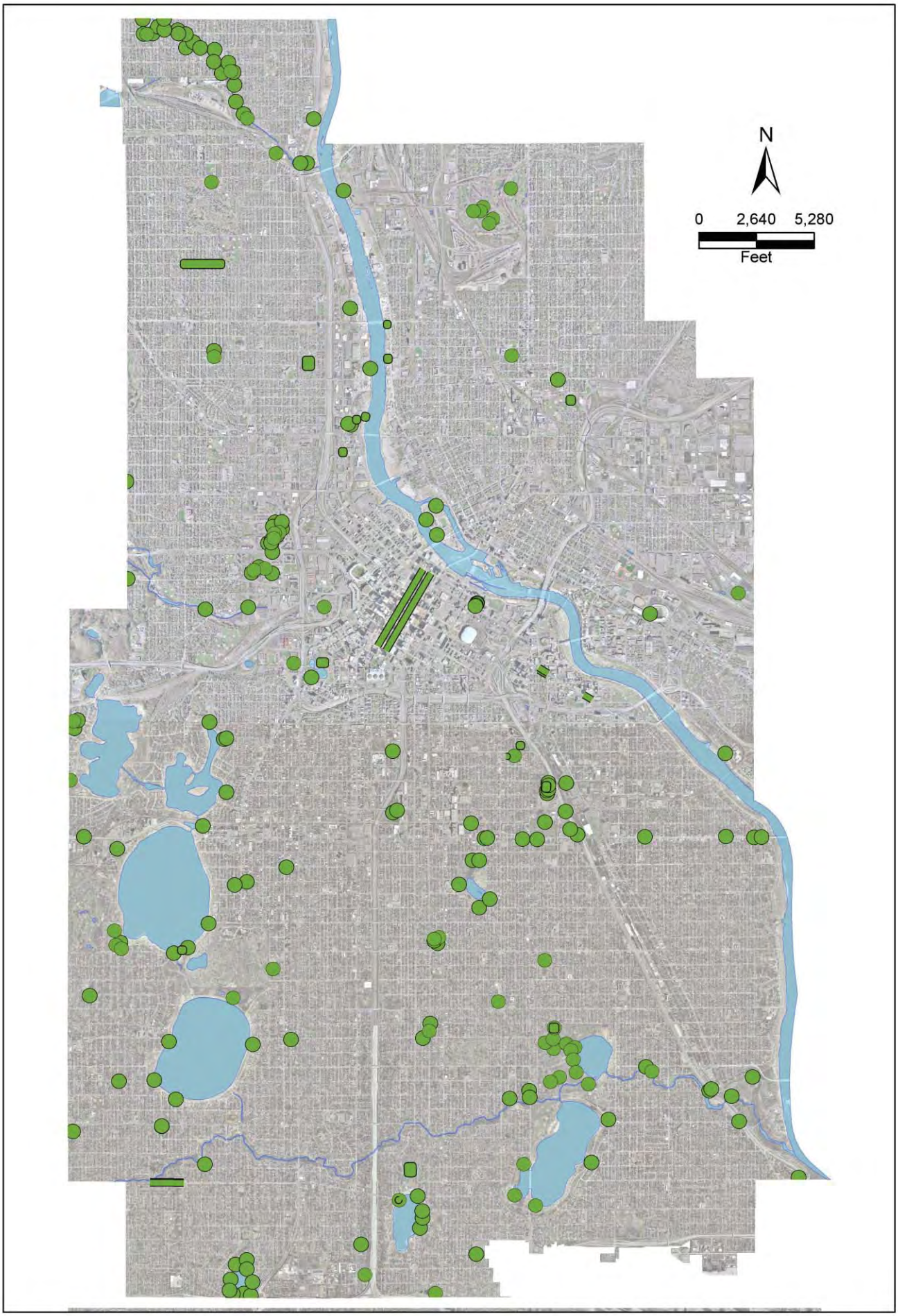


Appendix B6: Drainage Areas By River/Creeks OR Lakes/Wetlands



Areas drain to river or creeks
Areas drain to lakes or wetlands
Street centerlines
City boundary
Water features
Parks

July 23, 2013



Appendix B7: CITY OF MINNEAPOLIS
MUNICIPAL POST CONSTRUCTION BMPS
AUGUST 19 2013

Appendix C

Appendix C: Public Comment

History

The Minneapolis stormwater management program endeavors to improve the water quality of Minneapolis surface waters. These are the lakes, streams, wetlands, and the Mississippi River. The goals are preservation and enhancement of our natural and historic environment, and fulfilling regulatory requirements. The National Pollutant Discharge Elimination system (NPDES) is a program created in 1990 by the United States Environmental Protection Agency (EPA) to protect water quality through the regulation of discharges of pollutants to surface waters. The Minnesota Pollution Control Agency (MPCA) is the Minnesota authority that is responsible for administering this program. Under this program, co-permittees City of Minneapolis and Minneapolis Park and Recreation Board (MPRB) maintain Municipal Separate Storm Sewer System (MS4) Phase I Permit MN 0061018.

Requirements for Annual Reporting, Public Comment, and Council Action

The MPCA issued Permit MN0061018 to the City and the MPRB on December 1, 2000, and re-issued the permit on January 21, 2011. This Annual Report fulfills the requirement for documentation and analysis of the activities conducted in the previous year, 2015. It is a coordinated effort by various City departments as well as the MPRB. Re-issuance of the permit also required that the City and the MPRB develop a new Stormwater Management Program (SWMP). It was completed September 28, 2011, with revisions in May 2013, August 2014, and July 2015 and can be found at:
http://www.ci.minneapolis.mn.us/www/groups/public/@publicworks/documents/webcontent/wcms1p-144838.pdf

As part of the permit process to provide opportunities for public input on the adequacy of the Stormwater Management Program, to consider oral and written input, and to make appropriate adjustments, an opportunity for input is provided at a public meeting held each year prior to submittal of the Annual Report to the MPCA. Notice of the public hearing was sent to environmental groups, related governmental entities, all Minneapolis neighborhood groups, and other interested parties on May 18, and was also published in Finance and Commerce.

This year's public hearing was held on Tuesday, June 7, 2016. No testimony or questions were presented at the public hearing. Written comments were accepted until Friday, June 17, 2016. Written comments were received from the Bassett Creek and Shingle Creek Watershed Management Commissions, and from two private citizens. The comments that were received are on the following pages, along with the City's responses, in keeping with permit requirements for the Annual Report. To summarize, the comments from the watershed organizations provided updated information that the City can use for the next edition of the SWMP, and the two private citizens were responded to directly. Also included on the following pages are comments received in 2015 from the Minneapolis Citizens Environmental Advisory Committee (CEAC) along with the City's responses.

Minneapolis Community Environmental Advisory Committee (CEAC)

July 16, 2015

Dear Mayor Hodges and Minneapolis City Council:

Thank you for the opportunity to comment on the Stormwater Management Plan (SWMP) for the City of Minneapolis, updated in 2014. The plan lays out, in great detail, several programs that would lead to an increase in water quality throughout the city. Members of the Community Environmental Advisory Commission (CEAC) found the SWMP to provide strong guidance for relevant parties, but would like to offer a few comments that seek only to enhance the strengths of the document and improve its likelihood for success.

The comments below offer general observations given in response to themes in the document and have been approved by CEAC. More specific comments are attached separately.

- **Call out specific opportunities to connect community outreach to behavior change.** Areas throughout the document where addressing stormwater management issues involve community behavior change should be enhanced. A more explicit plan is needed focusing on the human element of behavior change that goes beyond providing information. Resources are available at the University of Minnesota and from other sources to aid in developing a more holistic community outreach program that will be more effective at achieving the desired natural resource outcomes. Another work plan sheet stating an intentional and strategic community engagement plan should be developed, and the ethos of such a plan should be built into the several SMPs which deal with community engagement and education.

  Response: Thank you for this input – we will add the suggestion of developing a specific Community Engagement Plan to address stormwater management issues involving community behavior change to SMP No. 3.7 - Source Control Education and Outreach Program (pages 45-46 of the SWMP). City staff will engage the CEAC Water Committee in our development of an approach for the Community Engagement Plan, and identifying where community engagement and education opportunities can be built into additional SMPs.

- **Leverage partnership opportunities.** The public should be considered as participants in the process, and the city should take advantage of the opportunity to work with several partner organizations and volunteers to reduce resource pressures on city staff. For example, the Master Water Stewards program's purpose is to increase the force of people in the community doing water pollution prevention by training and developing community leaders. As the pilot project in Minnehaha Creek Watershed wraps up this year there will be about 100 Certified Master Water Stewards. The program is expanding to include MWMO and other watersheds next year including an on-line curriculum. It will be growing a team of trained and enthusiastic community members ready to work with the city to prevent stormwater-related pollution. There are several instances in the SWMP to utilize this volunteer body to advance the goals and work of the city.

  Response: Thank you for this input. For the next update of Table 6 in the Appendix (Public Education Activities by Other Entities), we will add sections to describe the Master Water Stewards Program. City staff will also discuss this and other partnership opportunities with the CEAC Water Committee.

- **Prioritize green infrastructure options in new development or reconstruction projects making it easier for developers and contractors to make the right choice.** A menu of green infrastructure options provided at the start of project planning could help to influence developers and planners to use green infrastructure options even when it is not required. This is particularly important when public works and transportation projects can be leverage to provide additional stormwater management benefits. Developing this menu and providing suggestions for ways to promote its use and effectiveness is something that the CEAC Water Subcommittee would be willing

to support during this current term.

Response: A comprehensive development publication of guidelines and regulations, titled the City of Minneapolis Stormwater and Sanitary Sewer Guide, will be published online soon, to assist applicants and design professionals. Some examples of types of stormwater Best Management Practices are included in the Guide. Also available to developers, contractors, property owners and design professionals, such as civil engineers, geotechnical engineers, landscape architects, architects, geologists, and planners, is the Minnesota Stormwater Manual which has many examples and design/engineering toos and tips. It is available as a "wiki" on the MPCA website, at https://www.pca.state.mn.us/water/minnesotas-stormwater-manual

Thank you again for the opportunity to provide comment. We look forward to the opportunity to work with city staff to continue to improve water quality in Minneapolis.

Sincerely,

Anna Abruzzese, Chair

CEAC Members: Dylan Bradford Kesti, Anna Abruzzese, Andrew Murray, Alejandro Ojeda Saint-Martin, Allan Campbell, Jen Kader, Eduardo Cardenas, Shalini Gupta, Roxxanne OBrien, Lisa Daniels, Michelle Stockness, Darrell Gerber, Meleah Houseknecht, James Nash, Brian Ross, Tony Hainault, Adam Arvidson

CEAC Detailed Comments to Stormwater Management Program
(July 2015)

Thank you for the opportunity for the individuals signed below to comment on the Stormwater Management Program (SWMP) for the City of Minneapolis, updated in 2014. The SWMP is a requirement under the Municipal Separate Storm Sewer System (MS4) Phase I permit issued to the City of Minneapolis and the Minneapolis Park and Recreation Board. The plan lays out, in great detail, several programs that would improve water quality throughout the city. We find the SWMP to be a well thought out and thorough document especially with regard to scientific and engineering related elements.

We do offer some more detailed comments, suggestions, and requests for clarification:

- Page 13: Aren't there other types of loans besides bonds that are used to pay for capital project work?
  Response: Some projects are paid for out of cash balances. For financing capital projects over the longer term, municipal bonds are generally the city's means for financing infrastructure needs.

- Page 15: In Table 1-4 there should be a row for mercury/methylated mercury since Mercury in Fish Tissue is one a common impairment for water bodies receiving Minneapolis municipal stormwater.
  Response: Table 1-4 was prepared primarily for pollution parameters monitored by Minneapolis under its MS4 Permit. Minneapolis is not required to monitor mercury in stormwater because the MPCA has determined that the predominant means of transport of mercury is by atmospheric deposition. Stormwater runoff is not a secondary means of transport. For further information, see Minnesota Statewide Mercury Total Maximum Daily Load, MPCA, March 27, 2007. As part of the analysis for the TMDL, the City of Minneapolis conducted a pilot study of monitoring for mercury in stormwater runoff for the MPCA. Subsequent to the pilot study, mercury is not a required parameter under the MS4 permit.

- Page 15: In Table 1-4, under coal plants, they also can release lead.
  Response: It would be helpful to have a citation to include in the list of source documents, and then we can add lead to Table 1-4 under the Coal Plants/Incinerators column.

- Page 15: In Table 1-4, Fertilizers/Pesticides/Soil Treatments is missing e.coli (primarily from large ag sources but could be if individuals use untreated manure), cyanide (sodium cyanide and hydrogen cyanide used as a predacide/rodenticide and as an insecticide.), sulfate (likely ammonium sulfate, elemental sulfur, or gypsum to change pH or use along with other pesticides like glyphosate), pH (see intentional changes to soil pH above).
  Response: It would be helpful to have a citation to include in the list of source documents, and then we can add E. coli, cyanide, sulfate and pH under the Fertilizers / Pesticides / Soil Treatments column.

- SMP 1.1 or SMP 2.1: Explicitly list opportunities to grow and leverage the people in the community who can do some of the public education, non-point source projects, etc. One example is the Master Water Stewards (MWS) program at Freshwater Society (http://freshwater.org/master-water-stewards-a-community-approach-to-protecting-water/). The purpose of MWS is to increase the force of people in the community doing water pollution prevention by training and developing community leaders. As the pilot project in Minnehaha Creek Watershed wraps up this year there will be about 100 Certified Master Water Stewards. The program is expanding to include MWMO and other watersheds next year including an on-line curriculum. It will be growing team of trained and enthusiastic community members ready to work with the city to prevent stormwater related pollution. There are also other

programs that the city might leverage.
Response: Please see response to "Leverage Partnership Opportunities", above.

- SMP 2.1: The 311 expansion to include environmental reporting is good but it is still limited. The smartphone apps tell you to call the phone number instead of making tools available in-app to report environmental violations. This should be expanded and coupled with other violations covered by the inspectors in order to provide GPS info and photos. It also needs to be advertised and encouraged as ways for the community to assist in addressing elicit discharges.
Response: City staff are developing additional training for the 311 program, as part of SMP No. 3.9, Coordinated Staff Training Program. Staff will also be working with the 311 program to improve apps, and to publicize environmental reporting options to the community.

- SMP 2.2: The workplan is focused on more passive forms of public outreach -- make the information available in case someone comes looking for it. However, how/why would someone come looking for it? How is that going to result in changes reducing water impacts? There needs to be a workplan component to make sure that the information is used to bring about the changes needed. Who are partners to work with that can increase the effectiveness and reduce the resource pressures on city staff? Some could be pushed down to individual sections but there needs to be an overarching stated intent to be more intentional and strategic.
Response: Please see response to "Call out specific opportunities to connect community outreach to behavior change", above.

- SMP 3.7: Inserts with information included in billing will not reach those electing to have e-billing. What methods are being used to reach these individuals?
Aware that the number of people receiving mailed utility bills is diminishing, other methods are needed, and discussion of alternatives will be part of the Community Engagement Plan process discussed above.

- SMP 3.8: For street stenciling, why are "Drains to Lake" and "Drains to Creek" stencils only available in English. Include options for multi-lingual stencils or using images?
Response: Thank you, this suggestion will be considered for future stencil orders.

- SMP 3.9: Could the training be expanded to or required of any private contractor operating within the city? (Special Service Districts, Parking lots, etc.) Is there any check-in to ensure compliance? Is there any measurement or tracking is in place to demonstrate progress?
Response: Providing training to contractors is definitely an initiative that City staff plans to explore in the future. Ensuring or measuring compliance or progress varies by program, and can be discussed further with the CEAC Water Committee.

- SMP 4.1 & 4.2: Programs only call for a general "establishment of vegetative cover" without criteria for what type of vegetative cover is acceptable. Given anecdotal and first-hand experience in use of fast-establishing seed to establish ground cover without regard to long term impact, this language should be tightened. For instance, while sweet clover is great for erosion control and quickly establishes, it should not be included in the seed mix for vegetative cover. Is there specific language governing this elsewhere, or could it be included here that non-native, invasive, and/or overabundant seed stocks should not be incorporated?
Response: MnDOT Specifications -- http://www.dot.state.mn.us/pre-letting/spec/2016/2016-spec-book.pdf

are the typical required standards. There are different seed mixtures for temporary cover, and permanent establishment. Sweet clover, listed as an example in the question, is not included in any of the MnDOT seed mixtures.

- SMP 5.1: How are sites selected? What criteria is used? Who is doing the evaluation? What barriers are there that could limit the number of "problem properties" that are able to be reviewed? Could volunteer groups with training, like Master Water Stewards, or non-city staff be utilized?
  Response: SMP No. 5.1 relates to construction activities and development projects proposed by property owners/developers. City staff review the proposed projects for compliance with city requirements. As parts of the comment/questions are not clear, city staff will seek clarification when we meet with the CEAC Water Committee.

- SMP 5.2: Who is inspecting and certifying the projects? Is this another area where volunteers or non-city staff could be used?
  Response: City staff inspects and certifies. While volunteers would not be used to replace city staff for these activities, we can discuss ideas with the CEAC Water Committee. (It is not clear who is meant by "non-city staff".)

- SMP 5.4: When streets are redone, what options are being considered to leverage the opportunities to gain additional stormwater benefits by reducing volume, pollutant load, and/or rate and at what point in the project development process is this considered? Is there a menu of options to choose from such as bump outs, tree boxes, raingardens the project managers can select from where applicable? Does the land covered in this category include MPRB boulevards?
  Response: Street projects, whether MPRB parkways, City or County streets, or projects by other road authorities, need to comply with requirements on MPCA General Construction NPDES Permits and City Ordinances including Chapter 54, Stormwater Management. Outside of these regulatory requirements, additional opportunities sometimes arise to leverage stormwater management Best Management Practices. Life cycle cost-benefit analysis is an important consideration for choosing options.

- SMP 5.5:
  - What are the projects, and who is developing them? What is the criteria?
    Response: A number of flood mitigation projects have been carried out by Public Works in line with reports to the City Council following the 1987 and 1997 flood events. The most recent project built as a result of the report on the 1997 flood event was the 37th Avenue N Greenway Flood Project, also known as Phase 1 of the Flood Area 5 Project, in north Minneapolis in about 2011-2013 . At this time, a three-year citywide hydrologic and hydraulic modeling project is being carried out related to flood mitigation that will inform recommendations to the City Council regarding future flood mitigation projects.

  - Is the flooding data going to be public? This would help with outreach and in aiding the development of ownership from the local community. The information makes the problem less of an unknown, increasing the likelihood for enduring behavior change. Also, use Master Water Stewards for outreach and project implementation.
    Response: Yes, recommendations based on the modeling project will be public.

- SMP 5.6: What pilot programs are being considered? Who proposes these, and what mechanisms are in place to allow for public input/idea generation?
  Response: Past pilot projects have included such projects as pervious pavers at the city's animal control shelter, tree trenches with silva cells as part of the Marq 2 project (downtown along Marquette and Second

Avenues), and several rock infiltration installations (14th Av N at N Second Street, W 54th Street between Penn and Upton, Riverside Avenue, and 25th Avenue SE near the U of M Transitway. Documentation of 'lessons learned' from these pilot projects will be completed. A more recent pilot is use of iron-enhanced sand filters in the 37th Avenue North Greenway Flood Project, for which water quality monitoring is underway. The results of the 'lessons learned' and the water quality monitoring can be shared with the CEAC Water Committee, when available.

- SMP 6.1.2: For the public involvement metrics, would there be interest amplifying an "Adopt-a-Storm Drain" program? Local schools, neighborhood groups, etc. may be interested in this opportunity in addition to Master Water Stewards.
  Response: The city's Adopt A Drain program is described on the following web page:
  http://www.minneapolismn.gov/publicworks/stormwater/adoptadrain

- SMP 6.1.11: To whom will this mapping data be available? Will it be a part of the information available through the open data policy? Can it be provide in an easy to understand and use form for the general public? Interactive web GIS technologies can make it simple for community members to find out where their stormwater goes.
  Response: The mapping is used to carry out operation and maintenance of the system. Upon request, data is provided for capital/construction projects. A new map of stormwater drainage areas, by receiving water body, will soon be posted to the city's web site. Migration to the open data initiative will also occur over time.

- SMP 6.3: Will the manuals developed be available for public consumption/as examples for best management practices? Also, for fleet washing and other heavy water use practices, is stormwater reuse being considered as a way to even further reduce runoff volume?
  Response: It is unclear what is meant by 'manuals'. We can discuss further with the CEAC Water Committee. Fleet washing of the city's vehicles is nearly all done indoors, where the wash water is discharged to the sanitary sewer system, not the storm system.

- SMP 6.5: Sweeping up of excess deicers when an excess occurs should be included in the practice. Also, parks should not encourage excess use of deicers by making the correct method the easy method (appropriate application tools) and by not leaving the deicers easily accessible to the public (i.e., not immediately next to the door with a giant cup available for anyone to grab and use).
  Response: These are helpful suggestions and will be incorporated into training and other applications.

- SMP 6.6:
  - Is any consideration being given to design the right-of-ways to better intercept the flow? Breaking up impervious surface and using catchments of different kinds has been mentioned elsewhere in the SWMP, but not here. In other words, is consideration being given to design elements that direct water into boulevards, medians, sunken islands, etc.?
    Response: This has been done on several pilot projects but is not yet standard practice. See response to earlier question about pilot projects.

  - Assessment – add tracking of infrastructure changes
    Response: This comment is unclear, we will ask the CEAC Water Committee for clarification.

  - "Public participation" needs to be more specific – and needs to be meaningful. Showing up to a

meeting shouldn't be the only thing that counts – what does participation actually look like on the ground? How are communities beyond white, middle class, property owners being reached?
Response: The suggestion is unclear, we will ask the CEAC Water Committee for clarification.

- Will roots be left intact during sidewalk construction? After finding the role sidewalk construction played in the loss of trees to high winds it should be explicitly stated that this work will not damage or threaten important natural stormwater management elements except where absolutely necessary.
Response: This has been a topic of much discussion and various changes to approaches and practices over the years. Most recently, Minneapolis staff participated with the U of M on the study referred to in the question, based on the extensive losses of trees to 2011 storms. An update will be obtained, and shared with the CEAC Water Committee.

- Leveraging of groups like Master Water Stewards should be called out in this SMP.

- SMP 8.2: Can the language be made any stronger? Increasing specificity for how outreach will be done will help, as would as identifying language for non-city contractors. Possible suggestions are: "Working through neighborhood associations, business associations, and other similar groups, increase the number of property managers and maintenance staff..." or "Ensure all special service districts, commercial districts, or other areas of the city with high levels of impervious surfaces or deicer use follow city-stated BMPs" or something to that effect. Remove the "coffee shop employee" reference and instead reference the need for proper training of all employees especially at businesses those with heavily trafficked sidewalk areas.
Response: The 'coffee shop employee' was just one example of a person working at a business with a heavily trafficked sidewalk area. As the workplan develops, considerably more specificity will be identified, and CEAC's suggestions are helpful toward that end.

Thank you again for the opportunity to provide comment. We look forward to the opportunity to work with city staff to continue to improve water quality in Minneapolis.

Response: Thank you very much for the comments! There are many useful and detailed suggestions! We look forward to discussing all of these questions and responses with Committee members.

From:	Stout, Elizabeth A.
To:	Gratia Reynolds
Cc:	Eberhart, Lois E. (Lois.Eberhart@minneapolismn.gov)
Subject:	RE: Storm water
Date:	Thursday, June 02, 2016 10:14:00 AM

Gratia,

Thank you for submitting comments on the city's Stormwater Management Program. We will be considering everyone's comments and using them to help us improve our program throughout the city.

In regards to your comment about promoting sweeping up leaves, the city has recently started an Adopt a Drain program. I would encourage you to take a look at the website and sign up and perhaps others in your neighborhood would be interested as well.

www.minneapolismn.gov/AdoptaDrain

If you have any questions or would like any additional information please feel free contact me.

Thank you.

Liz

Elizabeth Stout, P.E.
Water Resources Regulatory Coordinator

City of Minneapolis Public Works – Surface Water & Sewers Division
City of Lakes Building, 309 South Second Avenue
Minneapolis MN 55401

Office: 612-673-5284
Elizabeth.Stout@minneapolismn.gov

-----Original Message-----
From: Gratia Reynolds [mailto:grandmagratia@yahoo.com]
Sent: Thursday, May 26, 2016 6:12 PM
To: Stout, Elizabeth A.
Subject: Storm water

How could we promote sweeping up leaves. & seeds that accumulate in the street gutter? I'm the only one here who sweeps up.

What about an expired drugs deposit spot at drug stores to keep that out of water?

Gratia
Sent from my iPhone

From: t4peace@juno.com
To: Stout, Elizabeth A.
Subject: RE: Stormwater Management Plan Comments
Date: Wednesday, June 08, 2016 7:52:08 PM

Thank you for your reply. In the city, I meant runoff from yards, surface parking lots, etc., which pollute lakes and rivers, are still an issue even though farm runoff is not. There is also a potential concern for runoff from municipalities spraying parks, etc., for mosquito control. If the Mississippi is still the main supply of drinking water, those concerns are very important, as typical water treatment does not filter out all chemicals and VOCs.

Many thanks for your work on this,
Trina Porte

---------- Original Message ----------
From: "Stout, Elizabeth A." <Elizabeth.Stout@minneapolismn.gov>
To: "t4peace@juno.com" <t4peace@juno.com>
Cc: "Eberhart, Lois E." <Lois.Eberhart@minneapolismn.gov>
Subject: RE: Stormwater Management Plan Comments
Date: Thu, 2 Jun 2016 15:14:12 +0000

Trina,

Welcome back to Minnesota and thank you for submitting comments on the city's Stormwater Management Program. We will be considering everyone's comments and using them to help us improve our program throughout the city.

While agricultural runoff is not a significant problem within the city of Minneapolis, urban runoff and associated pollutant discharges to our lakes and creeks is a concern. To help with this issue, the city has recently started an Adopt a Drain program to encourage residents to keep trash and debris out of the stormwater system. www.minneapolismn.gov/AdoptaDrain

The city is also working on city-wide flood modeling to impartially evaluate flood susceptibility. That is a multi-year program and when completed the city will be using the results to help us plan for future projects where they are needed.

If you have any questions or would like any additional information please feel free to contact me. Thank you.

Liz

Elizabeth Stout, P.E.

Water Resources Regulatory Coordinator

City of Minneapolis Public Works – Surface Water & Sewers Division

City of Lakes Building, 309 South Second Avenue

Minneapolis MN 55401

Office: 612-673-5284

Elizabeth.Stout@minneapolismn.gov

From: t4peace@juno.com [mailto:t4peace@juno.com]
Sent: Thursday, May 26, 2016 4:32 PM
To: Stout, Elizabeth A.
Subject: Stormwater Management Plan Comments

Dear Ms. Stout,

Thank you for taking public comments on our local NPDES planning and updates. I recently served on a municipal planning board in New Lebanon NY for seven years, and learned much about the impacts of storm and floodwaters there. Now that I am back in Minneapolis, I've joined my neighborhood Zoning and Project Review Committee so that I can hopefully continue to put what I learned to good use. If there is any future opportunity where I could be of assistance to you, please do not hesitate to contact me, as I enjoy sharing information very much--particularly in service of public well-being.

Logically, the top priorities for NPDES would seem to be:

1. The prevention of toxins from entering natural water bodies and municipal drinking water systems.

2. The prevention of pollution and flooding in all developed areas, particularly those typically ignored by infrastructure development and maintenance considerations, such as impoverished urban neighborhoods, economically challenged rural areas and small towns, and small producer farmlands.

3. The enhancement and preservation of unpolluted wetlands, as they sequester millions of gallons of storm and floodwater--thus safeguarding millions of acres of developed and agricultural land when there are large storm events.

4. Developing effective mechanisms for dealing with conventional farm runoff--especially since the EPA lost its suit with the USDA on controlling CAFO [agricultural feedlot] runoff in planning for hundred year storm events--since this issue has created health dangers in practically all of MN's ponds and lakes that prevent both swimming and fishing.

Thank you very much for your work on our behalf,

Trina Porte, Minneapolis

From: Laura Jester
To: Stout, Elizabeth A.
Cc: Karen Chandler, Barr; Jim de Lambert, St. Louis Park
Subject: RE: Public comment opportunity on the Minneapolis Stormwater Management Program
Date: Tuesday, June 14, 2016 8:12:14 PM

Hello Liz,

Thank you for the opportunity to comment on the City's Stormwater Management Program Plan. I did not review the document in great detail because it's the city's Local Surface Water Management Plan that should be updated by September 2017 to become consistent with the policies established in the 2015 Bassett Creek Watershed Management Plan. BWMC staff will carefully review the LSWMP when its submitted for review.

However, I do have a few comments on the Stormwater Management Program:

- It does not appear some or all of the links to documents on the Minneapolis website are working. In particular, links on page 10 to the LSWMP and the MPLS Greenprint Sustainability Initiatives are not working.
- In Table A-6, page 150 under WMWA, please revise the Bassett Creek contact to Laura Jester.
- The "WMWA" section of Table A-6 could be broken into three distinct sections: WMWA, Shingle Creek, and Bassett Creek to distinguish the activities of each organization.
- Whether or not these sections are broken out, please add the development of the Bassett Creek Watershed Map as a tool used to educate the public about the watershed, its lakes and streams and history, and their role in helping to improve and protect water quality.
- In Table A-6, page 151, under WMWA – "Metro Blooms – Bassett Creek" – I think this may be in reference to an older project and may not be needed in the table.
- In Table A-6, page 151, under WMWA – the Bassett Creek website has not only information on water quality and environmental stewardship, it also includes a "latest news" section, information on its capital projects, meeting materials, a document library, an event calendar, information on its lakes and streams, and documents and requirements for developers.
- In Table A-6, page 151, under WMWA, last line – WMWA coordinates the Watershed PREP 4th grade education program. Bassett does not have its own separate classroom education program. Information Watershed PREP can be found here: http://www.westmetrowateralliance.org/watershed-prep.html.
- You could also add in Table A-6 that the BCWMC provides education to residents in various settings including community events, press releases, Facebook page, website, presentations to groups, and outreach to affected properties during capital projects. (This is similar to the "public event presentations and educational displays" listed for Shingle Creek.)
- In general, it could be noted that each year the Education Committee of the BCWMC recommends specific actions and corresponding budgets to the Commission to implement the BCWMC Education and Outreach Plan (Appendix B in the 2015 Bassett Creek Watershed Management Plan: http://www.bassettcreekwmo.org/application/files/1614/4676/6440/Appendix_B_Education_and_Outreach_Plan.pdf .

Again, thank you for the opportunity to comment. Please let me know if you have any questions.

Sincerely,

Laura Jester
Administrator, Bassett Creek Watershed
Management Commission
www.bassettcreekwmo.org
laura.jester@keystonewaters.com
Ph: 952-270-1990

From: Stout, Elizabeth A. [mailto:Elizabeth.Stout@minneapolismn.gov]
Sent: Wednesday, May 18, 2016 12:04 PM
To: Eberhart, Lois E.; Council Members; Hodges, Betsy A.; Cooper, Bob I.; Prest, Gayle A.; Pilger, Debra; Rachael Crabb; Karen Chandler; 'Laura Jester'; sheila62sdmn@yahoo.com; Anne Weber; mzellar@cleanwater.org; wclark@fmr.org; Randy J Anhorn; James Wisker; Becky Houdek; ksigford@mncenter.org; ron.struss@state.mn.us; kate.drewry@state.mn.us; beth.neuendorf@state.mn.us; Snyder, Doug; Judie Anderson; stevemorse@mepartnership.org; solomonsimon@hotmail.com; judy.sventek@metc.state.mn.us; steve.hirsch@state.mn.us; Stout, Elizabeth A.
Cc: Kotke, Steven A.; Cerney, Lisa K.; Collin, Steve E.; Kennedy, Mike D.; Moriarity, Kelly M.; Danen, Kevin J; Kennedy, Stephen R.; Pulscher, Mary; Mike Perniel; Conover, Corey M.; Hanlon, Patrick W.; Huff, Daniel A.; Menshek, Peggy Y; Hjelle, Brette L.; Swanson, Jennifer; Kessler, Katrina S
Subject: Public comment opportunity on the Minneapolis Stormwater Management Program

To:
All Minneapolis Neighborhood Organizations ***(BOB COOPER, PLEASE FORWARD TO THEM)***
Bassett Creek Watershed Management Commission
Blue Water Association
Citizens Environmental Advisory Committee ***(GAYLE PREST, PLEASE FORWARD TO THEM)***
City of Saint Paul
Clean Water Action
Friends of the Mississippi River
Hennepin County
Metropolitan Council Environmental Services
Minnehaha Creek Watershed District
Minnesota Center for Environmental Advocacy
Minnesota Department of Agriculture Pesticide Management Division
Minnesota Department of Natural Resources Water Division
Minnesota Department of Transportation
Minnesota Environmental Partnership
Mississippi River Revival
Mississippi Watershed Management Organization
Shingle Creek Watershed Management Commission
Minneapolis City Council Members
Minneapolis Park & Recreation Board Commissioners ***(DEB PILGER, PLEASE FORWARD TO THEM)***
Mayor Betsy Hodges

From:
Liz Stout, PE, City of Minneapolis Water Resources Regulatory Coordinator
Debra Pilger, Minneapolis Park & Recreation Board Environmental Management Director

Subject:
City of Minneapolis Stormwater Management Program Public Comment Period

National Pollutant Discharge Elimination System (NPDES) is a program created in 1990 by the United States Environmental Protection Agency (EPA) to protect water quality through the regulation of the discharge of pollutants to lakes, streams, wetlands, and other surface waters. The Minnesota Pollution Control Agency (MPCA) is the local authority responsible for administering this program, and specific permits are issued to regulate different types of municipal, industrial and construction activities.

PURPOSE OF THIS EMAIL: We welcome your input! Providing an opportunity for public input into the development of Stormwater Management Program (SWMP) priorities and programs is one of the requirements of the current National Pollutant Discharge and Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase I Permit issued jointly to the City of Minneapolis and the Minneapolis Park & Recreation Board (MPRB) in January 2011. The first SWMP, prepared and submitted by the City and the MPRB, was approved by the Minnesota Pollution Control Agency (MPCA) in June 2013. The SWMP was subsequently updated and submitted in September 2014.

Each year before submission of an Annual Report, one of the Permit requirements is to provide an opportunity for additional public input on SWMP priorities and programs, to be taken into account for future modifications to the Program. The current Stormwater Management Program can be found at the following link:

http://www.ci.minneapolis.mn.us/www/groups/public/@publicworks/documents/webcontent/wcms1p-144838.pdf

IF YOU WOULD LIKE TO MAKE COMMENTS:

IN PERSON You can make comments IN PERSON at a Public Hearing that is scheduled before a meeting of the City Council's Transportation & Public Works Committee on Tuesday, June 7, 2016 at 9:30 AM. The Public Hearing will take place in City Council Chambers in Room 317 City Hall, 350 South 5th Street, Minneapolis MN 55415.

IN WRITING Or you can make WRITTEN comments. Comments must be received by Noon on Friday June 17, 2016. The comments will be taken into consideration for future modifications to the Program. Any comments received will be included in the Annual Report in Appendix C.

MAIL: City of Minneapolis, Department of Public Works
Surface Water & Sewer Division c/o Liz Stout
STORMWATER MANAGEMENT PLAN COMMENTS
Room 300 City of Lakes Building
309 2nd Avenue S
Minneapolis MN 55401-2268
FAX: 612-673-2048
EMAIL: Elizabeth.stout@minneapolismn.gov

If you have any questions, please feel free to contact either Liz Stout or Deb Pilger. Our contact information appears below. Thank you!

Elizabeth Stout, P.E.
Water Resources Regulatory Coordinator

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AND

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Shingle Creek Watershed Management Commission

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June 16, 2016

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

RE: STORMWATER MANAGEMENT PLAN COMMENTS

Dear Liz:

The Shingle Creek Watershed Management Commission has reviewed Minneapolis' Stormwater Management Plan and offers the following comments regarding Table A-6 of the Appendix. This table sets forth Public Education Activities by Other Entities, and for the West Metro Water Alliance and the Shingle Creek WMC it contains several outdated programs and does not reflect newer initiatives. We recommend the following revisions:

- Add the Shingle Creek WMC's website reference: shinglecreek.org.
- Update WMWA's website reference: westmetrowateralliance.org.
- Eliminate the following programs which are no longer offered: Educate Policymakers, Workshop Series, and Patrick Henry High School Program
- Add the following programs:
  - Citizens Assisted Lake Monitoring Program (CAMP) - Shingle Creek. Same description as Bassett Creek; Ryan Lake is monitored through CAMP.
  - Education Grants – Shingle Creek. Applicants such as youth groups, lake associations, and neighborhood organizations can receive up to $1,000 to help fund education efforts, demonstration projects, and outreach about water quality issues. (Metric is number of grants awarded.)
  - Watershed PREP – WMWA. A fourth-grade elementary school program developed and delivered by WMWA contract educators to meet science standards in classroom curricula, which teaches kids about watershed concepts and how to help improve the quality of their local lakes and streams. A number of schools public, private, and charter in Minneapolis, have participated in this program. (Audience is students and metrics are # classrooms and students served)
  - Pledge to Plant for Pollinators and Clean Water –A campaign developed by WMWA to encourage landowners to replace turf grass and impervious surface with native vegetation. (Audience is property owners and metrics are number and size of plantings.)

I have also attached the 2015 WMWA report for your use and information. If you have any questions or need additional information, please contact Judie Anderson at judie@jass.biz or Diane Spector at dspector@wenck.com.

Thank you for the opportunity to comment on the Stormwater management Program.

Sincerely,

Andy Polzin, Chair
CITY OF PLYMOUTH COMMISSIONER
AP:DS w/encls.

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