



# Green Infrastructure and the MS4 Permit: A Compendium of Case Studies

Green Infrastructure Webcast Series

January 25, 2023

# Housekeeping

- This presentation is being recorded and will be made available via <https://www.epa.gov/green-infrastructure/green-infrastructure-webcast-series>
- All participants are muted to minimize background noise.
- Technical issues or questions?
  - Contact us via the Q&A Box.



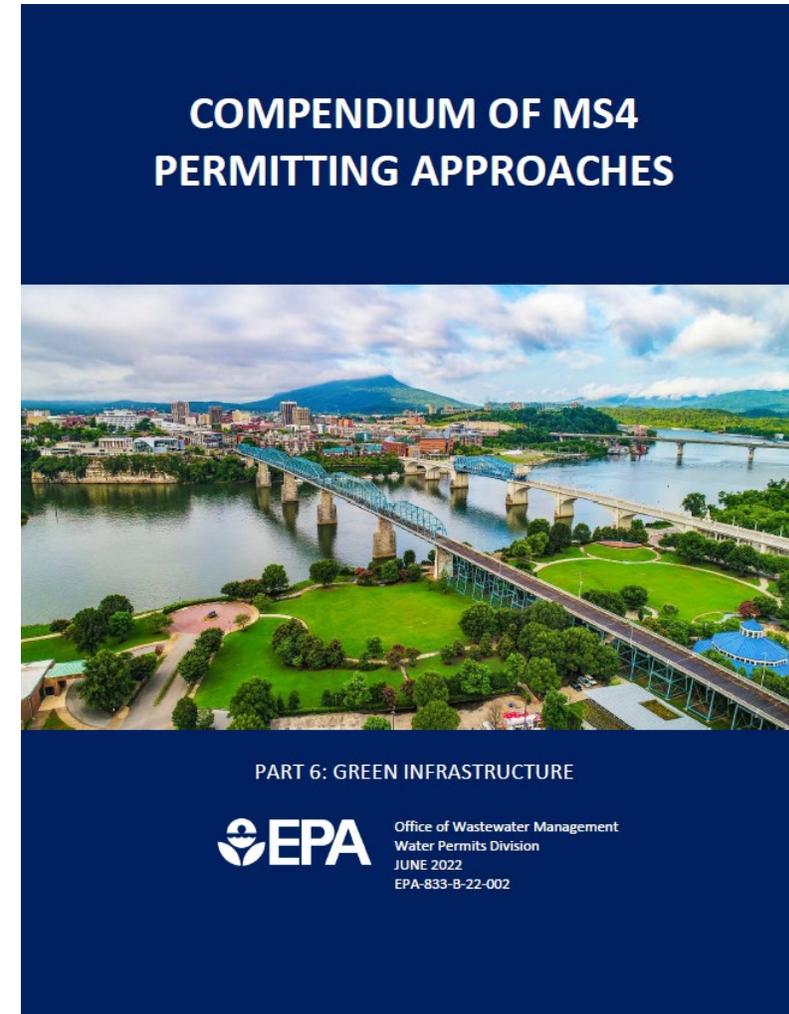
# EPA's Compendium of Green Infrastructure MS4 Permitting Approaches



Permitting approaches that encourage or require green infrastructure in municipal separate storm sewer systems (MS4s) along with examples of how permittees implemented those requirements.

Visit EPA's website:

<https://www.epa.gov/npdes/municipal-sources-resources>





# Permits Included in the Compendium

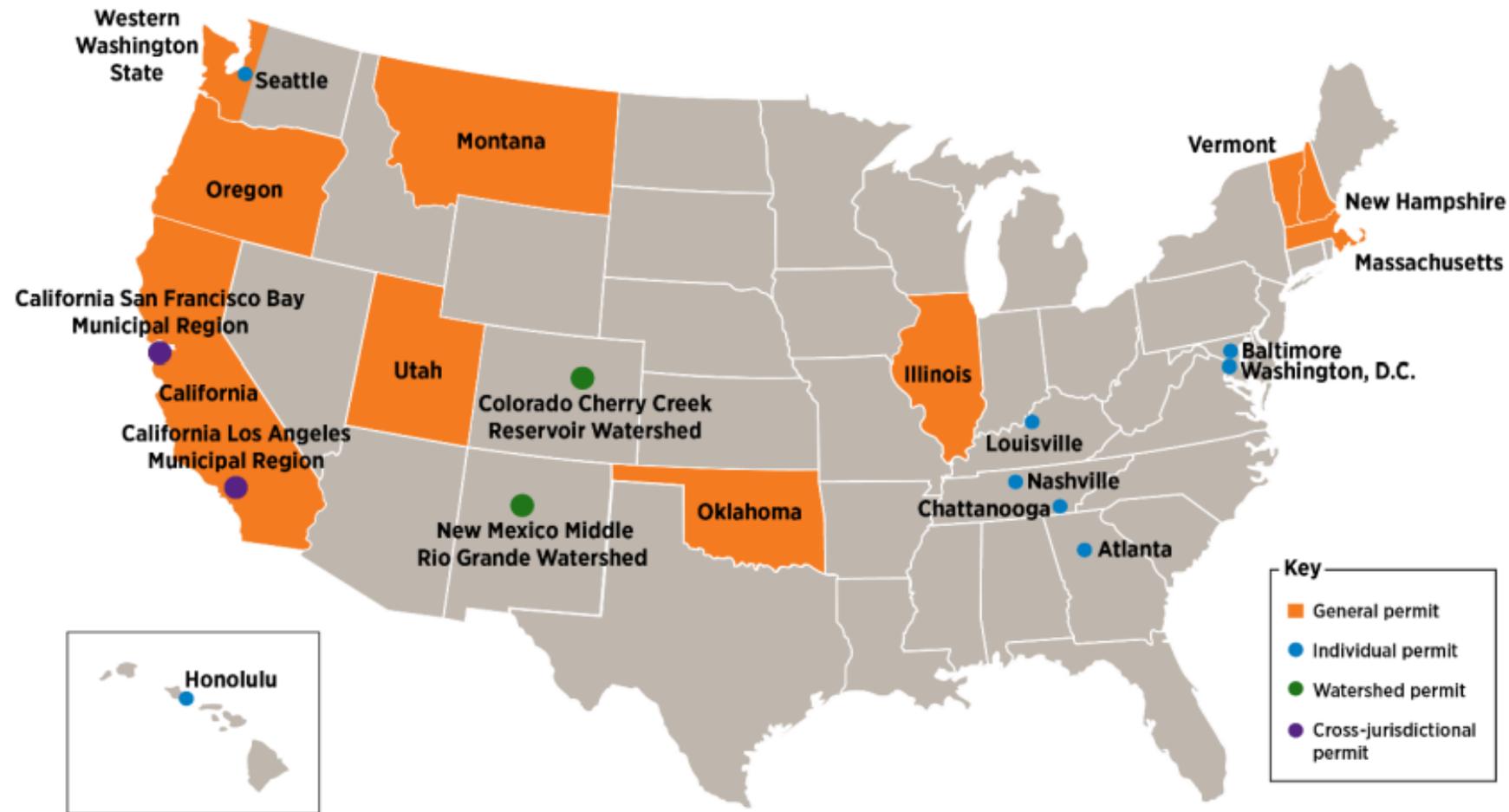


Figure 1. Map of permit excerpts included in the compendium.



# Green Infrastructure Compendium Organization

- The compendium is organized by permit excerpt topic. Many of the sections align with the six minimum control measures required in Phase II MS4 permits.

Public  
Education and  
Outreach

Illicit Discharge  
Detection and  
Elimination

Construction

Post-  
Construction

Pollution  
Prevention

Monitoring

Specific  
Stormwater  
Pollutants

# BE ST RMWATER SMART

Communication Tools to Energize MS4 Public  
Education and Engagement

# Stormwater Smart Goals

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INCREASE  
**AWARENESS**  
of Stormwater Effects

PROMOTE  
**PRACTICES**  
to Manage Stormwater

INSPIRE  
**INVESTMENT**  
in the Community

<https://www.epa.gov/npdes/stormwater-smart-outreach-tools>

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# Increase Awareness

- Know What Happens When it Rains Brochure
- Stormwater Flow infographic
- Social media posts/graphics



*Where stormwater flows, everything goes. Soap from car washing products contains chemicals that can harm fish and other critters. Be #StormwaterSmart!*



*Where stormwater flows, everything goes. Oil and grease leaked from cars wash down drains and into waterways. Be #StormwaterSmart!*

<https://www.epa.gov/npdes/stormwater-smart-outreach-tools>

# Promote Practices

- Take Steps to Protect Our Waterways brochure series
- Stormwater Smart infographic
- Social media posts/graphics
- One page tip sheets for small businesses

If you've been thinking about reducing your environmental footprint, you can take steps to decrease the amount of pollution that flows from your home into local waterways every time it rains. Known as stormwater, once rain or snow hits the ground, it can carry dirt, chemicals, and other pollutants downstream from your home and yard to the rivers and lakes in your community. Here are just a few steps you can take to be stormwater smart at home.

**In the Garden**

- Rain is great for your lawn, but excess rain can run off from your yard and walkways into the street, where it flows from the storm drain into local rivers, lakes, or streams, taking any chemicals you've applied with it.
- Apply fertilizers and pesticides carefully on your lawn or garden and not on pavement.
- Avoid using herbicides and pesticides completely on your lawn and plants, not the pavement.
- When watering your lawn, direct the spray toward your lawn and plants, not the pavement.
- Consider installing a rain garden, which is a depressed area planted with grasses or perennials that collects stormwater.

**In the Driveway**

- Wash your car with biodegradable soap to avoid chemicals flowing downstream, or visit a carwash.
- Direct water from downspouts and car washing to grass areas, so it can soak into the ground rather than hit the pavement.
- Don't hose down your driveway and flush dirt down the storm drain.

**In the Yard**

- Use permeable pavers instead of hard stones or pavement in your yard to help water absorb into the ground.
- Don't take leaves or yard clippings into the storm drain to avoid clogs and debris that could cause flooding.
- Install a rain barrel to help prevent rain from flowing into storm drains (and also save water for dry spells).

**On the Sidewalk**

- Pick up pet waste and keep trash and dry water away from pavement and storm drains, where it can contaminate stormwater that flows downstream.
- During colder weather, avoid oversalting your sidewalks and use an appropriate amount of de-icer—a little goes a long way.
- Sweep sidewalks and put the debris in the trash.

**DID YOU KNOW?**  
If you use a rain barrel to collect water for plants, you can keep your landscape green for free. Every time it rains, you'll collect water that can be used later. Check out [www.epa.gov/epaospr/for more tips to save water!](#)

### STORMWATER SMART AUTO SHOPS

When water from rain, snow, or sleet flows over the ground, it's called "stormwater." Stormwater can pick up paints, chemicals, antifreeze, and oil from your shop or your parking lot. And when that stormwater flows into street gutters, storm drains, and downspouts, it can pollute rivers, lakes, and streams. Below are some simple solutions to help keep local waterways clean and healthy!

- DITCH THE HOSE** Use special oil-absorbing booms or other materials to catch oil or other fluids that run down the street.
- CATCH EVERY DROP** Place an oil spill kit when changing motor oil. Collect the oil in a container. Never dump fluids from vehicles down storm drains, creeks, or other waterways.
- STORE STUFF SAFELY** Keep equipment, car parts, batteries, used oil filters, and fluids indoors in a dry, covered area where you can wash pollutants out of waterways.
- DISPOSE RESPONSIBLY** Dispose of used oil, antifreeze, solvents, paints, tires, and batteries properly to keep pollutants out of waterways.

Insert organization's URL

### STORMWATER SMART CONSTRUCTION IN YOUR NEIGHBORHOOD

When water from rain, snow, or sleet flows over the ground, it becomes "stormwater." Stormwater flows through a catchment area. It can pick up petroleum, oil, and chemicals and carry them downstream to local water bodies. That's why it's important for construction sites to protect the community by putting in best practices, fences, booms, and truck pads to prevent pollution in our rivers, lakes, and streams.

- THE MUD STOPS HERE** Concrete construction should have a pad that catches mud from the street. Regularly clean it out of it. Use oil-absorbing booms, silt, and debris traps to prevent mud from entering storm water pipes.
- GOOD FENCES MAKE CLEAN NEIGHBORS** A fence or other barrier should be installed that traps oil and construction debris from washing downstream from the site where it rains, snow, or sleet falls.
- PROTECT THE PIPES** All storm drains used as construction sites should have a concrete barrier installed there to prevent debris and runoff water from entering storm water pipes.
- SOMETHING LOOKS WRONG? CALL!** If you see a spill, report it to the local health department, fire department, or police. Call your local government office that regulates construction permits.

Insert organization's URL, construction permitting office number

### Stormwater: Where It Flows, Everything Goes

When it rains, snows, or sleet, water hits hard surfaces and takes anything on that surface with it, through drains, pipes, and ditches to local rivers, lakes, and streams.

**Where Stormwater Flows, Everything Goes**

Insert organization's URL

<https://www.epa.gov/npdes/stormwater-smart-outreach-tools>

# Inspire Investment

- Invest in Your Community brochure
- Be Stormwater Smart PowerPoint
- Stormwater Investment Benefits infographic
- Social media posts/graphics
- Green Infrastructure in Action Case Studies



<https://www.epa.gov/npdes/stormwater-smart-outreach-tools>

# Today's Speakers:

## City of Chattanooga Department of Public Works

- **Joshua Rogers**, Water Quality Supervisor
- **Mo Minkara**, Water Quality Manager

## Louisville Metropolitan Sewer District

- **Lori Rafferty**, Certified Flood Plan Manager and MS4 Program Lead
- **Brett Clark**, Engineer Technician and Post-Construction Runoff Controls Program Lead



# Green Infrastructure and the City of Chattanooga MS4 Permit

Mounir Minkara – Water Quality Manager

Joshua Rogers – Water Quality Supervisor





# Discussion Items

- ▶ Chattanooga NPDES Permit Development
  - ▶ Drivers: EPA Scorecard, Code Change, Consent Decree (GI Master Plan), GI Awards Contest
- ▶ Chattanooga Programs
  - ▶ RainSmart
  - ▶ MyTN → RainSmart Yards
    - ▶ NoogaKnox Challenge
  - ▶ HomeGRN → ReLeaf
  - ▶ Green Grants
  - ▶ SOV Market
  - ▶ Developing Programs: SFR Ponds, SGI, Understory Gardens

# NPDES Permit Development

## Pre-2010

- 1993 Stormwater Utility
- 1996 1<sup>st</sup> NPDES Permit
- What was the driver for GI during this time?

## 2010

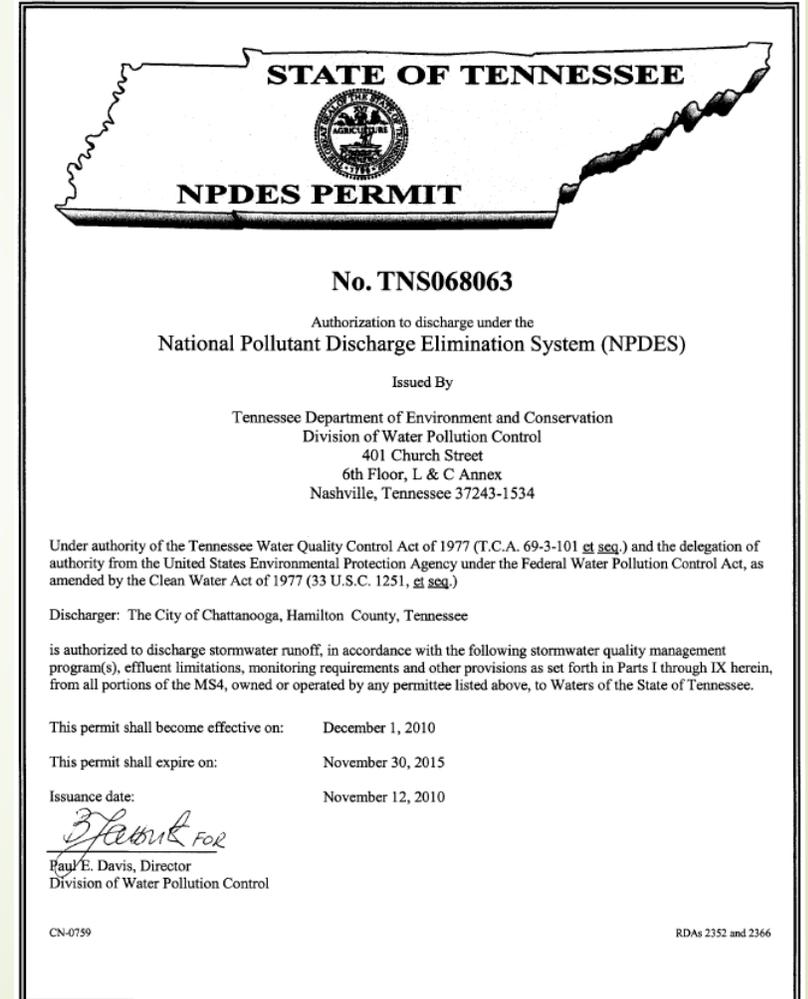
- 2<sup>nd</sup> NPDES Permit
- EPA Scorecard
- Runoff Reduction Requirement

## Present

- Expansion of programs & LOS
- Preparation for next permit

# GI Drivers 2010-2015

- 2<sup>nd</sup> NPDES Permit (2010)
  - EPA Scorecard
  - Runoff Reduction Standards
    - [www.Chattanooga.gov/ResourceRain](http://www.Chattanooga.gov/ResourceRain)
  - Mitigation Options
- LID Design Competition (2013-2014)
  - <https://vimeo.com/105672772>
- Consent Decree (2013)
  - GI Program Plan for CSS
    - <https://clearchattanooga.com/>



**STATE OF TENNESSEE**

**NPDES PERMIT**

**No. TNS068063**

Authorization to discharge under the  
National Pollutant Discharge Elimination System (NPDES)

Issued By

Tennessee Department of Environment and Conservation  
Division of Water Pollution Control  
401 Church Street  
6th Floor, L & C Annex  
Nashville, Tennessee 37243-1534

Under authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101 et seq.) and the delegation of authority from the United States Environmental Protection Agency under the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)

Discharger: The City of Chattanooga, Hamilton County, Tennessee

is authorized to discharge stormwater runoff, in accordance with the following stormwater quality management program(s), effluent limitations, monitoring requirements and other provisions as set forth in Parts I through IX herein, from all portions of the MS4, owned or operated by any permittee listed above, to Waters of the State of Tennessee.

This permit shall become effective on: December 1, 2010

This permit shall expire on: November 30, 2015

Issuance date: November 12, 2010

*Paul E. Davis*  
Paul E. Davis, Director  
Division of Water Pollution Control

CN-0759 RDA's 2352 and 2366



# GI Drivers 2015-Present

## “Green Infrastructure” Incentive Programs

- RainSmart
  - MyTN → RainSmart Yards
    - NoogaKnox Challenge
  - HomeGRN → ReLeaf
  - Green Grants
  - SOV Market
  - Developing Programs: SFR Ponds, SGI, Understory Gardens
- Residential**
- Non-Residential**

# RainSmart

## Residential Reimbursement

- Rain Gardens
  - 21 rain gardens installed; 558,250 gallons infiltrated annually
- Rain Barrels
  - 1,353 rain barrels sold/reimbursed; 74,415 gallons captured per event
- SupportScapes
  - 15 plantings installed in 2022



# RainSmart Yards

## Residential Recognition

- Began in 2019 as MyTennessee (inspired by other national programs)
- 2021 added fee discount for awardees
- 2022 changed name to RainSmart Yards to better reflect the program's purpose



# NoogaKnox Challenge 2022

for a clean Tennessee River, one yard at a time.

Brought to you by UT Extension, WaterWays, and the Cities of Knoxville and Chattanooga

March 21, 2022



# NoogaKnox Challenge



## City Residents Can Save Up To 75 Percent On Water Quality Fee through RainSmart program

BY ABDIEL VALLEJO-LOPEZ | MAR. 22, 2022



- ▶ Mar 21 (World Water Day) to Sept 22 (first day of fall)
- ▶ Open to all homeowners, but tried to focus on elected officials
- ▶ PROMOTION was huge: Mayoral support, press releases, media interviews, etc.
  - ▶ Highest response rates when pushing the fee discount

<https://storymaps.arcgis.com/stories/b700209dd7f94a7ca7ad9a844483a367>

# ReLeaf Tree Program

- Residential free tree giveaway program
  - Spurred by the Easter tornado of 2020
- Began as HomeGRN (Growing Resilient Neighborhoods)
  - Partnered with Reflection Riding Arboretum and Nature Center
- Now partnering with local Electric Power Board
  - <https://epb.com/free-tree-releaf/>





# Green Grants

- ▶ Non-Residential Reimbursement Grant (up to \$200K)
  - ▶ For the installation of green infrastructure/runoff reduction measures with educational components
- ▶ Examples of projects to date:
  - ▶ NDHS: bioretention, pervious concrete, infiltration basin, naturalized basin, tree islands
  - ▶ Penske: bioretention ponds
  - ▶ CCS: bioretention pond and swale
  - ▶ CCSE: infiltration basin, disconnected impervious, bioretention
  - ▶ Bethlehem Center: bioretention, tree islands



<https://www.facebook.com/watch/?v=644527336255753>



1:06 / 2:13

**From Playground to Park**

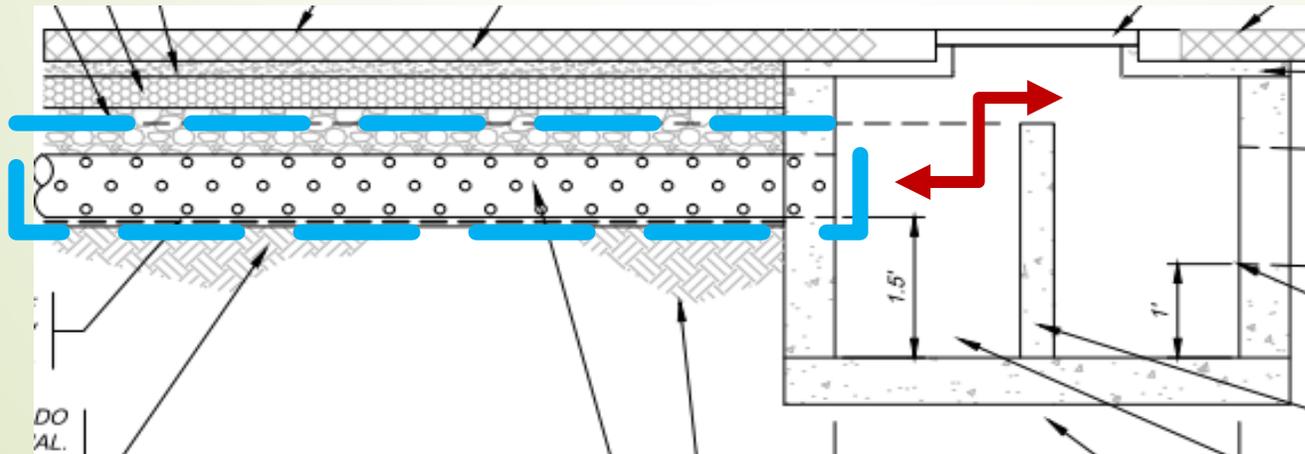
Like Comment Share

82 · 4 comments · 5.4K views



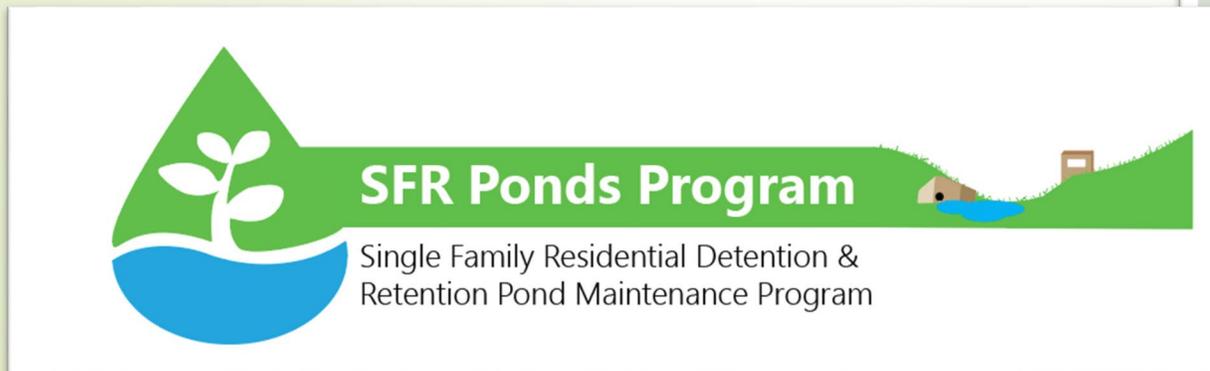
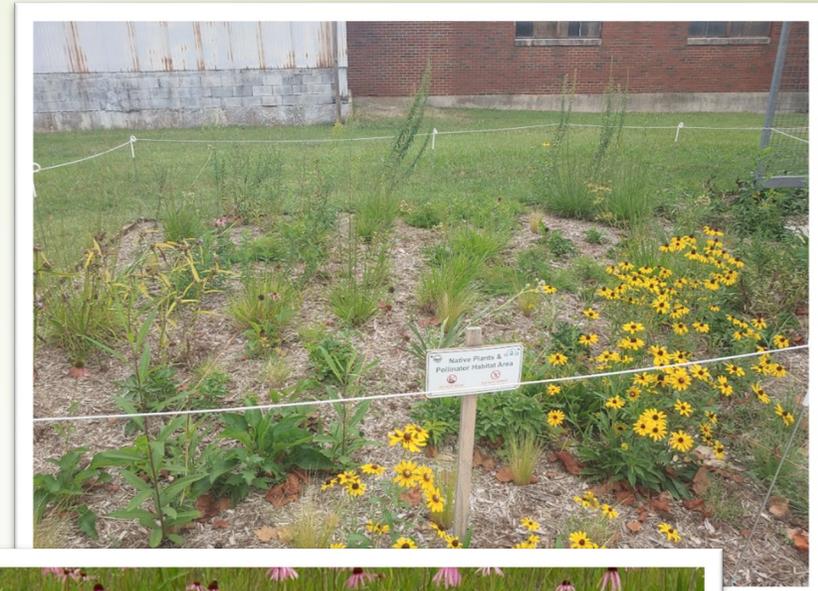
# SOV Market

- Stay-On-Volume = runoff reduction requirement in cubic feet for new development and significant redevelopment in Chattanooga
- SOV coupons generated for overdesign or retrofit
- Value of coupon is market based
  - Mitigation Fee = \$45/CF
- Coupons given to date = 52,280 CF



# Developing Programs

- Single Family Residential Ponds Program
  - City maintenance w/ option to retrofit
- Southern Grasslands Initiative
  - Native grassland installation on City lands
- Understory Gardens
  - Integrated Pest Management



**GRASSLAND RESTORATION IN PROGRESS**

We are establishing a sustainable landscape using native plants and grasses.

This will provide habitat for pollinators like butterflies, add beauty and interest, and filter stormwater runoff.

Please keep off site.

For questions, call 643-6311 or visit [www.chattanooga.gov/parks](http://www.chattanooga.gov/parks)

Logos for: City of Chattanooga Water Quality, Southeastern Grasslands Initiative, USDA NRCS U.S. Department of Agriculture National Resource Conservation Service, Lyndhurst Foundation, and Reflection Riding.

# Green Infrastructure and the City of Chattanooga MS4 Permit

Mounir Minkara

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# Louisville MSD's Green Infrastructure Program



Lori Rafferty, PE, CFM  
Brett Clark

January 2023



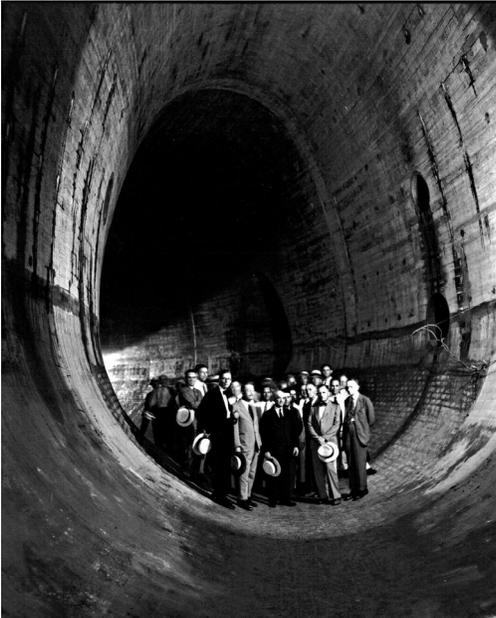
# Louisville, KY

- Largest community in Kentucky with a population of approximately 630,000
- Home of the Kentucky Derby, Muhammad Ali, and Louisville Slugger bats



# Metropolitan Sewer District

## Sanitary Sewers



## Stormwater

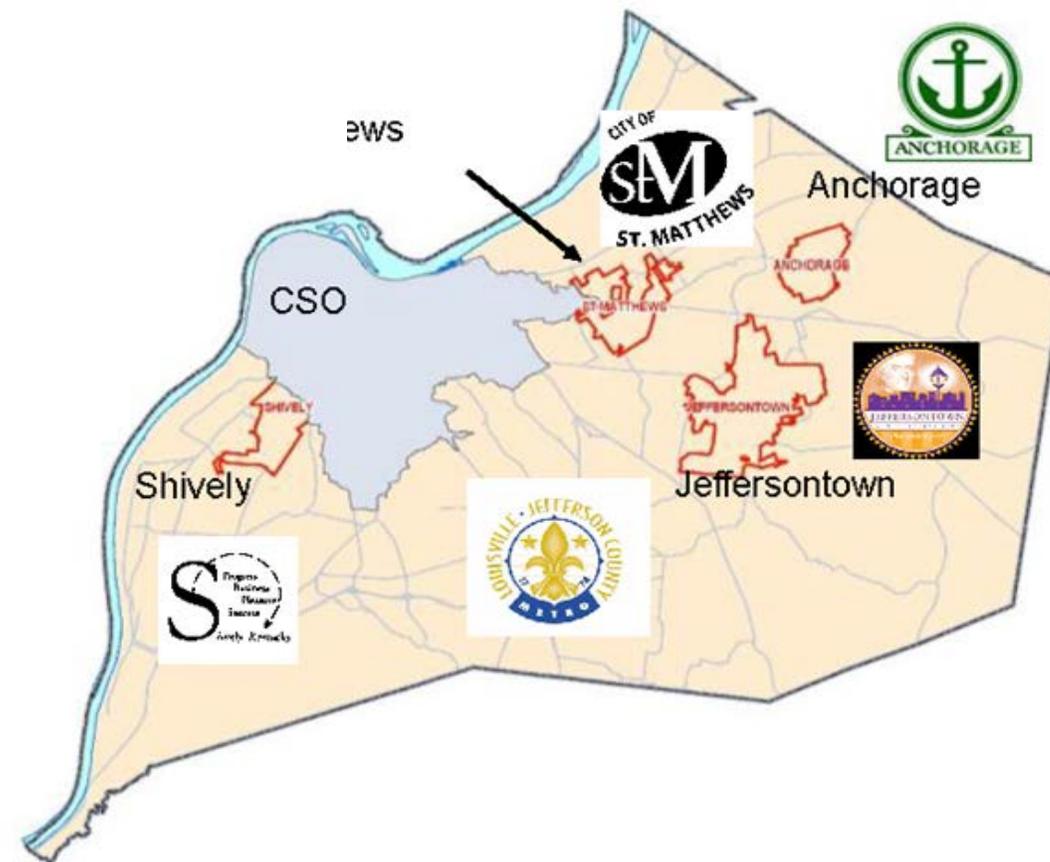


## Flood Protection



# MS4 Permit

- Louisville's 1<sup>st</sup> MS4 permit was issued in 1990 as Phase 1 community
- Louisville Metropolitan Sewer District is the lead agency
- 5 Co-permittees
  - Louisville Metro Government
  - City of Jeffersontown
  - City of Shively
  - City of St Matthews
  - City of Anchorage



MSD and Co-Permittees MS4 Service Area

# Post-Construction & the MS4 Permit

- 1<sup>st</sup> included in 2011 MS4 permit
- Required to develop, implement, and enforce a program to address post-construction stormwater runoff
- Develop and adopt a post-construction ordinance
- Conduct site plan reviews
- Maintain an inventory and map
- Require long maintenance agreements from property owners
- Provide at training for inspectors, plan reviewers, and plan preparers
- Implement Green Infrastructure Demonstration Projects



# Post-Construction Runoff Controls

- Permit requires treatment of the 80<sup>th</sup> percentile rain event (0.6") runoff volume from impervious surface
- Applicable to developments  $\geq$  1 acre of disturbance (including greater common development)
- Post Construction Chapter added to Design Manual in 2011 (updates in 2016 & 2020)
- Private development requirement started in 2013
- Post-construction requirements are required throughout the county (including the combined sewer area)



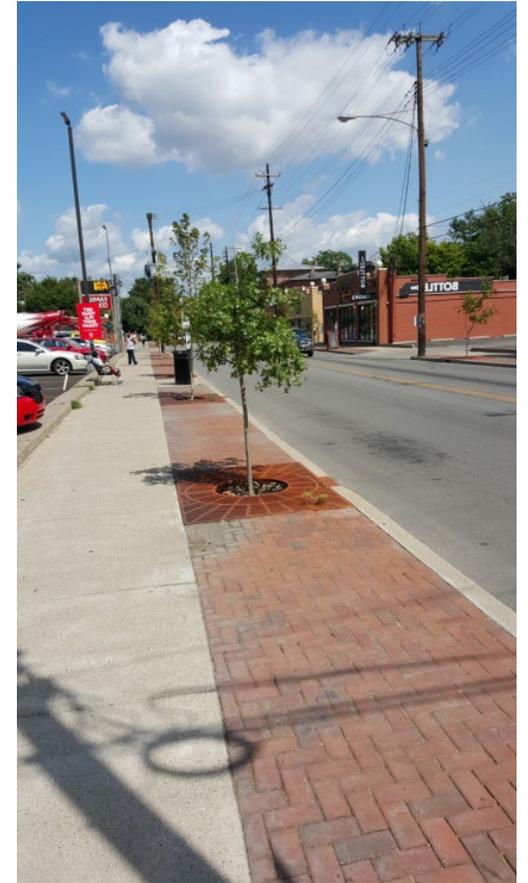
# Post-Construction Water Quality BMP Options

- Rain gardens
- Constructed wetlands
- Green wet & dry basins
- Green roofs
- Permeable Pavers
- Tree Boxes
- Vegetated Buffers
- Water Quality Units
- Infiltration Trenches
- Infiltration Basins

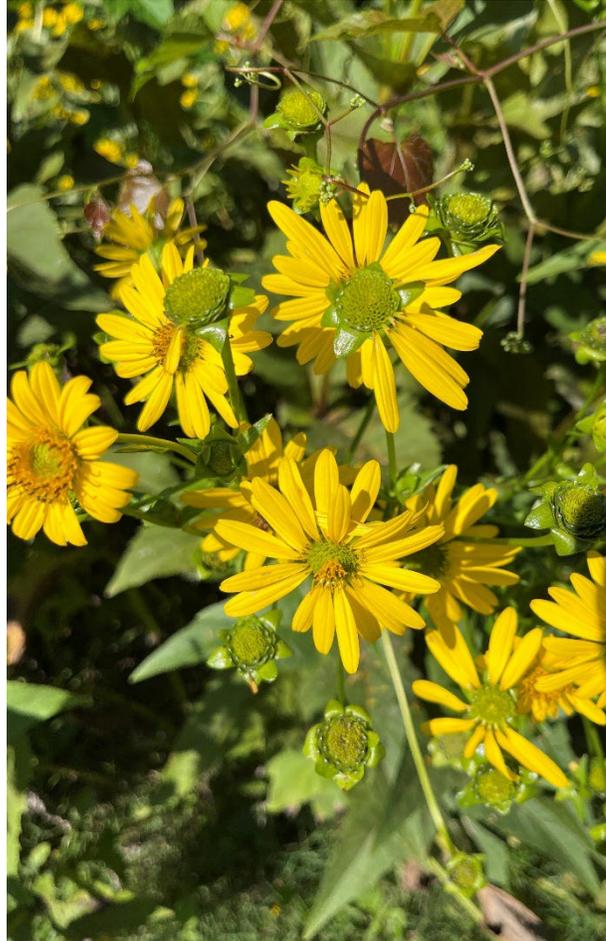


# Demonstration Projects

- MSD partnered with private groups to construct approximately 100 post-construction water quality infrastructure demonstration projects
- Projects were intended to show the public, engineers, and contractors that green infrastructure was feasible
- Approximately \$45 million spent since 2010

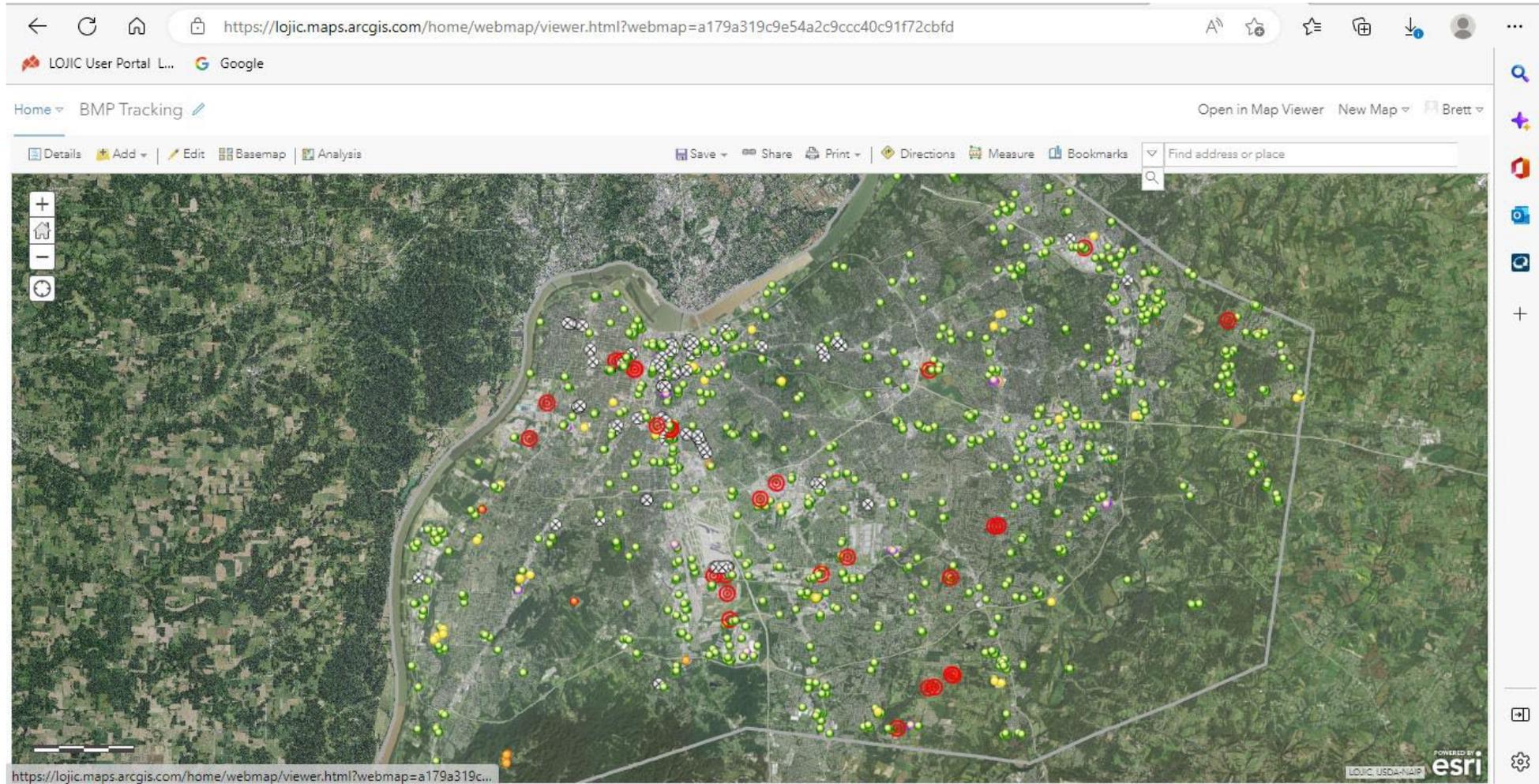


# Design Manual Updates

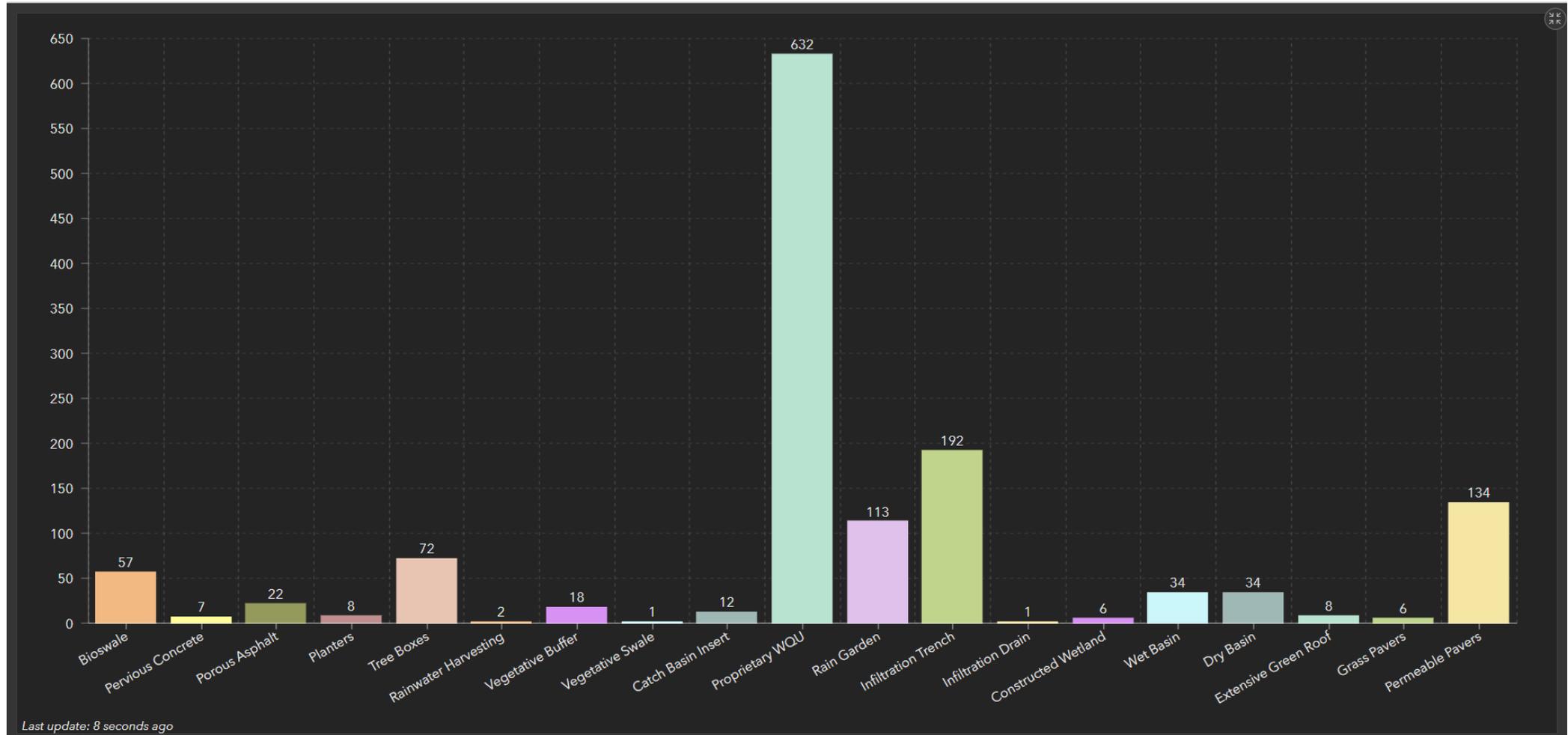


- Updates to the original design manual were completed for program improvements (2016, 2020)
- 2020 Updates included:
  - Removal of pervious concrete and asphalt as BMPs
  - Required better accessibility for BMPs for long-term maintenance
  - Required pretreatment and underdrains
  - Improved exhibits showing standards for each BMP
  - More specific requirements, instead of suggestions, i.e. “must” instead of “should”

# Over 1,100 Post-Construction BMPs & Growing...



# Over 1,100 Post-Construction BMPs & Growing...



# Inspection

- Required at least every 5 years
- Goal is every 3 years
- Updated inspections forms
- Mobile inspection app
- Annual Self Inspection **REQUIRED**
- 3<sup>rd</sup> Party inspection assistance

Verizon LTE 7:32 AM 84%

Cancel Collect Submit

**GMP:HUNT PROPERTIES (...)**  
38.251405°N 85.733139°W

Last Annual Report Date:  
10/15/2020, 7:32 AM Today

Mon Oct 12	4	29	
Tue Oct 13	5	30	
Wed Oct 14	6	31	
Today	7	32	AM
Fri Oct 16	8	33	PM
Sat Oct 17	9	34	
Sun Oct 18	10	35	

LTMOA Link:

Maintenance Plan Request Date:

Maintenance Deadline:  
5/4/2020, 12:00 AM

No Response Warning Date:

Collector LTE 7:33 AM 84%

Post Construction Inspection

**Bioretention:**

Access adequately maintained?

Satisfactory

Unsatisfactory

NA

Comments:

Litter and leaves removed? No blockages at inlet or overflow?

Satisfactory

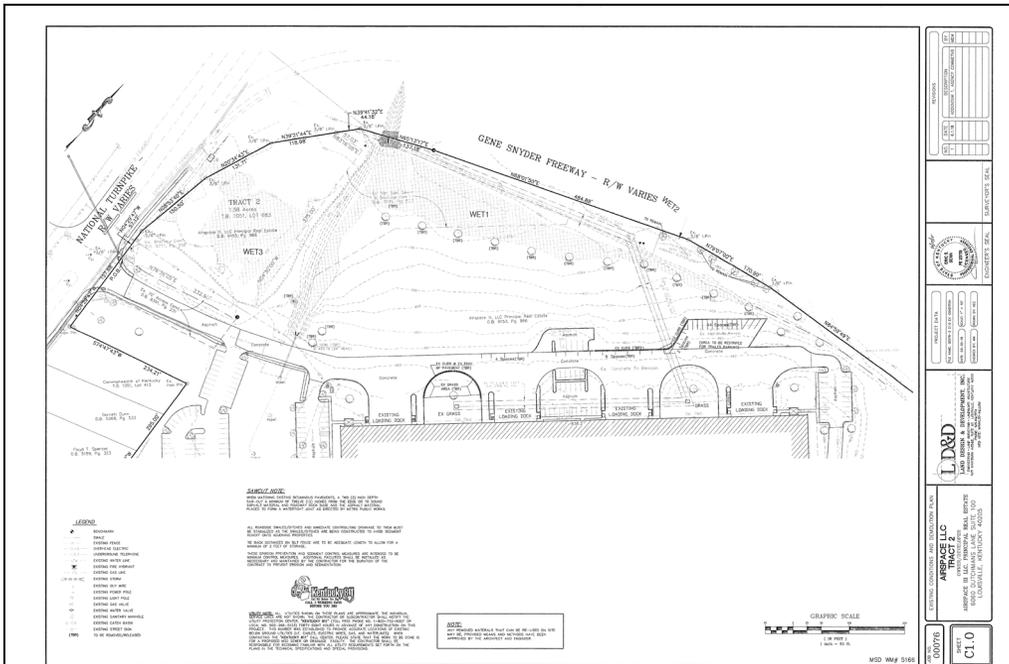
Unsatisfactory

NA

Comments:

# Design Challenges

- Infiltration testing
- BMP location/accessibility
- Water quality unit depth
- Pre-construction field conditions

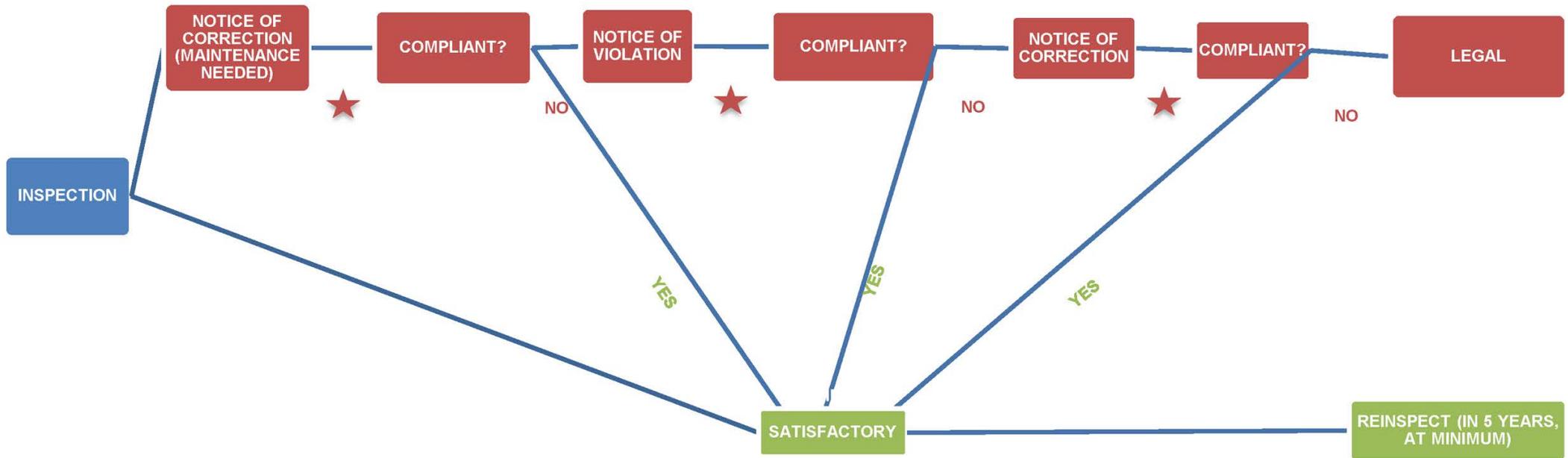


# Maintenance Challenges



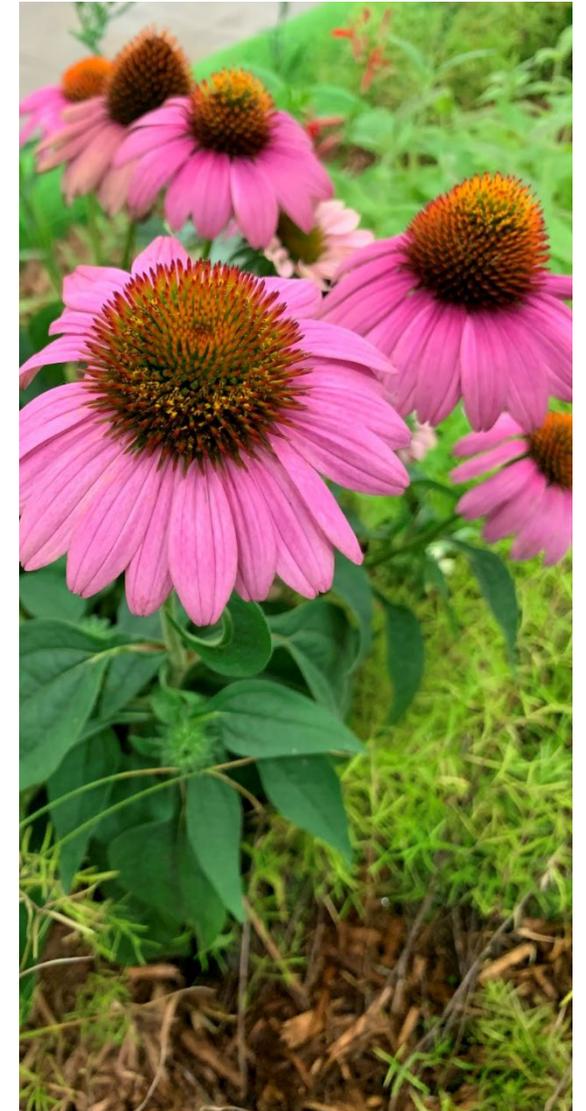
# Inspection/Enforcement Flowchart

★ 60-120 DAYS,  
DEPENDING ON SEVERITY



## Fee-In-Lieu-Of Option

- Alternative to meet water quality requirements
- Option approved in 2022
- Funds used to construct regional green infrastructure projects to meet the water quality requirements
- Fee is based on square footage of impervious area
- Use of Fee-In-Lieu-Of Option must be approved, preference is to use on-site BMPs



# Fee-In-Lieu-Of Example – St. Mary & Elizabeth Hospital



# Fee-In-Lieu-Of Example – SW Cell Tower



# MSD Main Office Rain Garden Pilot Project

- Two rain gardens installed
- 10,855 sq ft of roof area treated
- Installed in 2009



# MSD Main Office Rain Garden



2020



2022

# Proposed MSD Main Office Rain Garden



Gresham  
Smith

# Churchill Downs Demonstration Projects

- Churchill Downs participated in MSD's Financial Incentive Program to construct two underground infiltration basins
- Large parking lots underlain with sandy soils in the combined sewer system
- Basins designed for 2.13" of rainfall
- Drainage area = 54 acres, 92% impervious



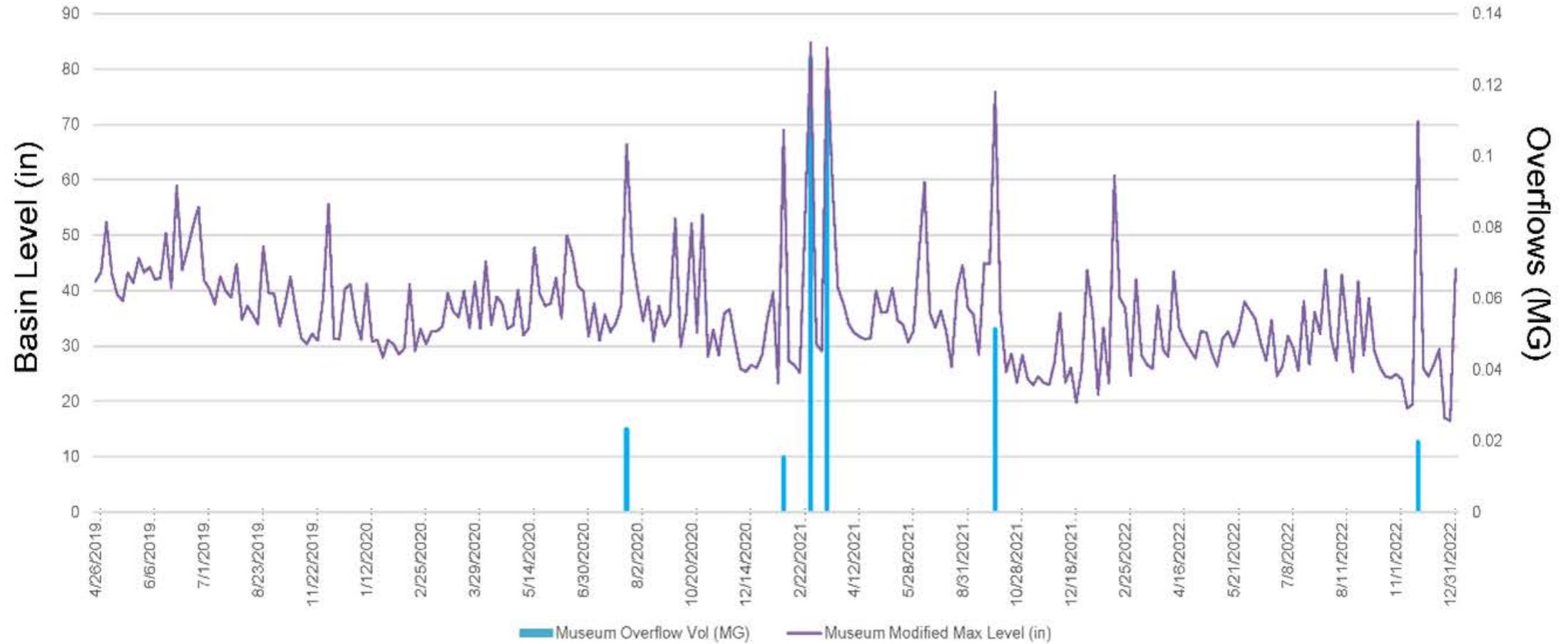
\*GOOGLE EARTH

# Churchill Downs

- System manufactured by Contech Engineering Solutions, LLC
  - 8' dia. perforated CMP pipes and header rows
- Outfall to combined sewer 5' above invert of system
- Volume is about 6 MG (2.7 MG infiltration/3.3 MG detention)
- Basins are estimated to reduce overflows by 7MG and flow through the treatment plant by 27MG in an average year



# Churchill Downs Museum Basin



# Questions?



## WATER QUALITY & FLOODPLAIN

- **Lori Rafferty, PE, CFM**  
lori.rafferty@louisvillemSD.org
- **Brett Clark**  
brett.clark@louisvillemSD.org