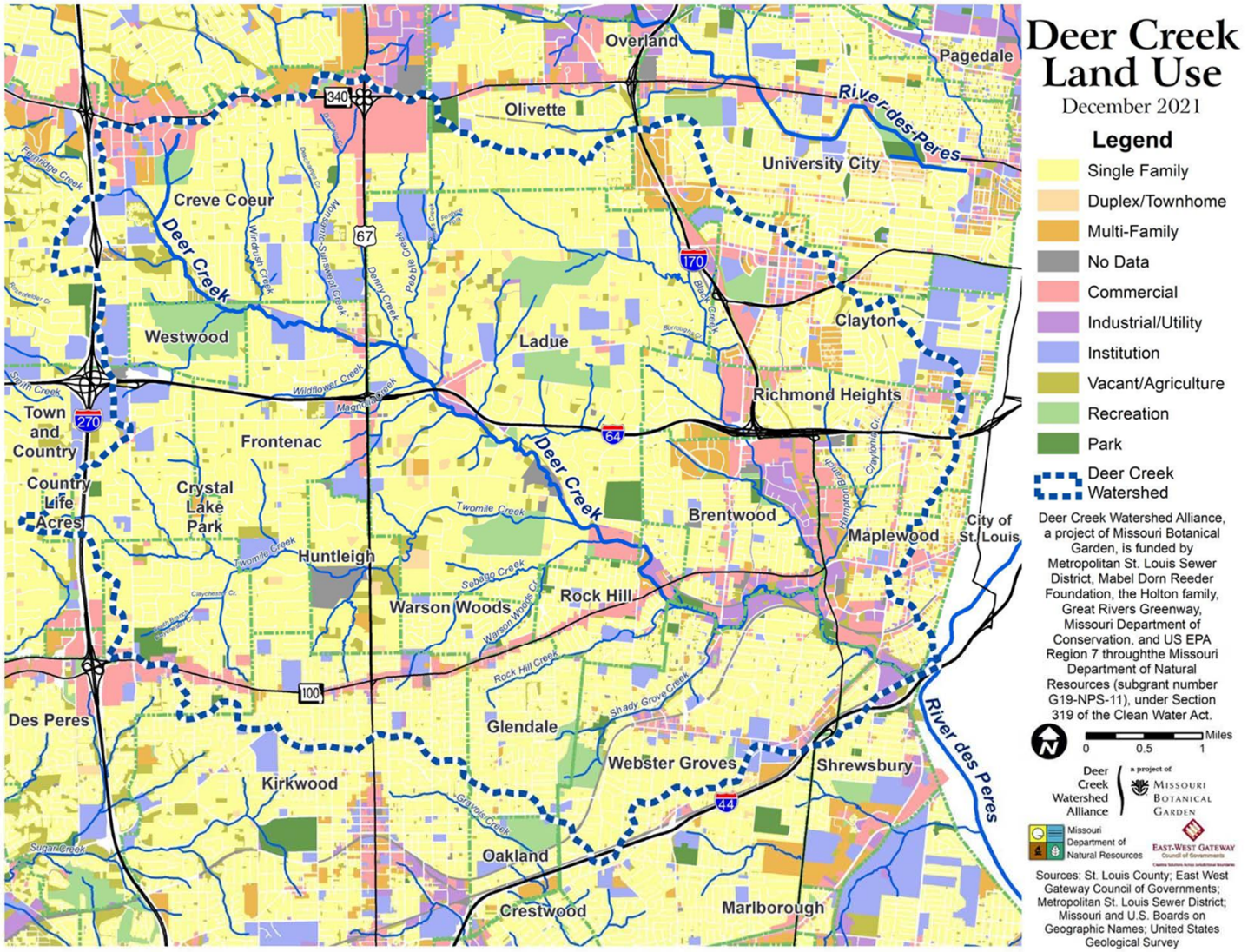
Deer Creek Watershed Alliance Initiative
Planning and Implementation

Stacy Arnold, Watershed Planner
Deer Creek Watershed Alliance, a project of MOBOT

Water Resources Advisory Committee Meeting, Aug. 1, 2023

What do we know?



How do we organize?

Building Partnerships

Deer Creek Watershed Alliance, a project of Missouri Botanical Garden, is funded by Metropolitan St. Louis Sewer District, Mabel Dorn Reeder Foundation, the Holton family, Great Rivers Greenway, Open Space Council for the St. Louis Region, Missouri Department of Conservation, and US EPA Region 7 through the Missouri Department of Natural Resources (subgrant number G22-NPS-09), under Section 319 of the Clean Water Act.

- Missouri Botanical Garden
- Metropolitan St. Louis Sewer District
- East-West Gateway Council of Government
- Great Rivers Greenway
- Open Space Council
- MO Stream Team & MO Stream Teams United
- Missouri Department of Conservation
- Missouri Department of Natural Resources & U. S. EPA
- Local municipalities
- Shaw Nature Reserve
- Litzsinger Road Ecology Center
- River des Peres Watershed Coalition

St. Louis Audubon Society – Bring Conservation Home

Bring Conservation Home is a private lands habitat restoration assistance and certification program serving the St. Louis, Missouri metropolitan area. Participants benefit from a visit from a trained Habitat Adviser, who reviews the owner's personal landscape goals and performs an assessment using the program criteria. The Habitat Adviser provides a written report with recommendations on native landscaping, invasive plant removal, stormwater management, and other wildlife stewardship practices.

Monitoring Partners

To assist the Missouri Department of Natural Resources, Water Protection Program and the Missouri Botanical Garden, Deer Creek Watershed Alliance project; Randy Sarver of the Department's Environmental Services Program, Water Quality Monitoring Section initiated a Cooperative Stream Investigation project to collect samples in 2021, 2022, and 2023 with the assistance of Steve McCarthy a Missouri Stream Team, Level 3, VWQM volunteer of Stream Team 5099. Litzsinger Road Ecology Center (LREC) collects monitoring data as well. The U.S. Geological Survey (USGS) works with LREC staff to obtain stream flow measurements during various seasons. Washington University in St. Louis has analyzed water quality data compiled from Deer Creek water quality monitoring to help inform the watershed planning process.

Stewardship Partners

The Great Rivers Missouri Master Naturalists, Missouri Stream Team, Open Space Council, St. Louis Master Gardeners, and Webster Groves Green Keepers recruit volunteers for watershed stewardship events.

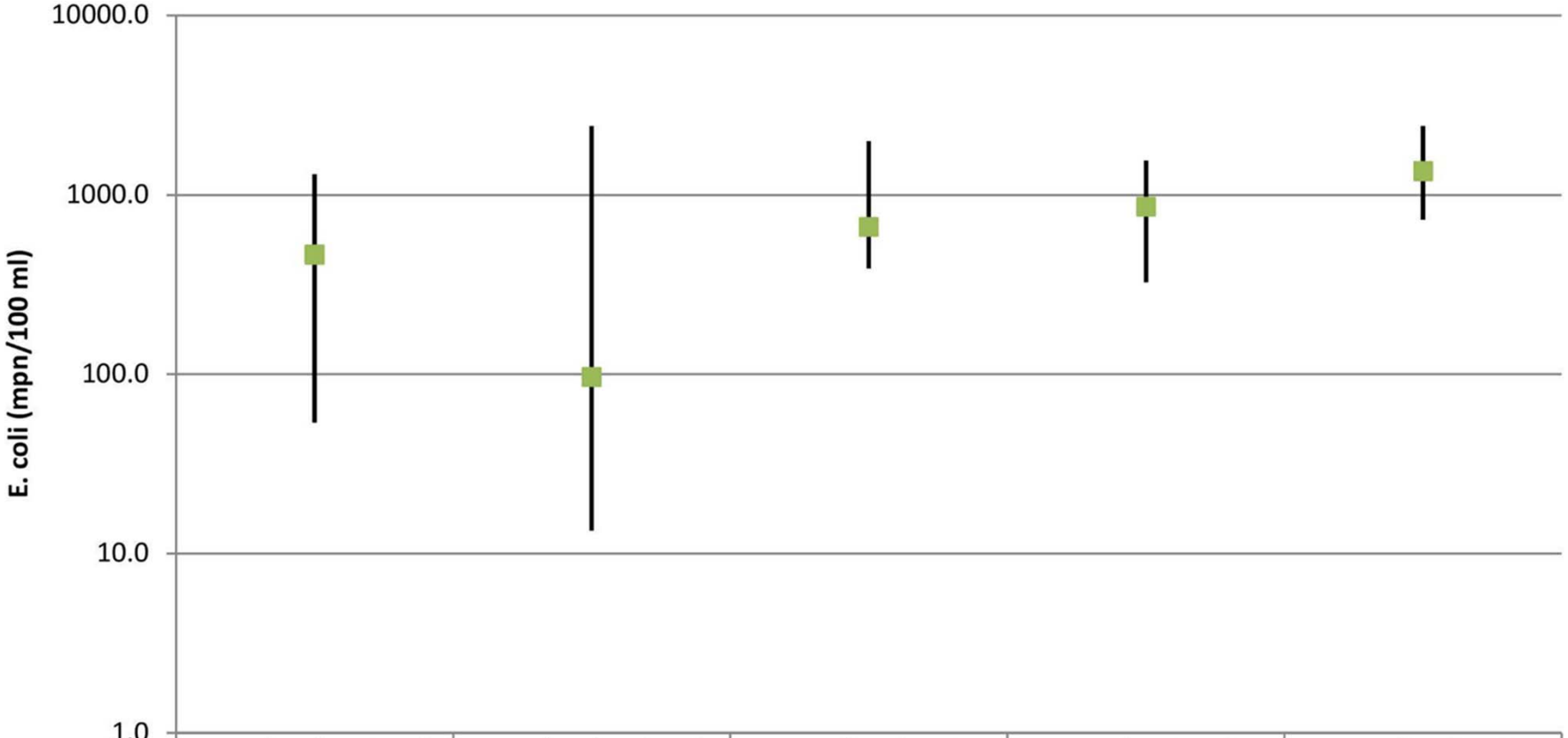
What are our problems?

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Stream Name	WBID	303(d) chloride	TMDL chloride	303(d) *E. coli*	TMDL *E. coli*
Deer Creek	3826	2006		2012	2019
Deer Creek	4077				
Deer Creek	4078				
Two-mile Creek	4079			2016	
Two-mile Creek Trib.	4080				
Black Creek	3825	2006		2012	2019
Black Creek Trib.	3973				
Shady Grove Creek	3956				

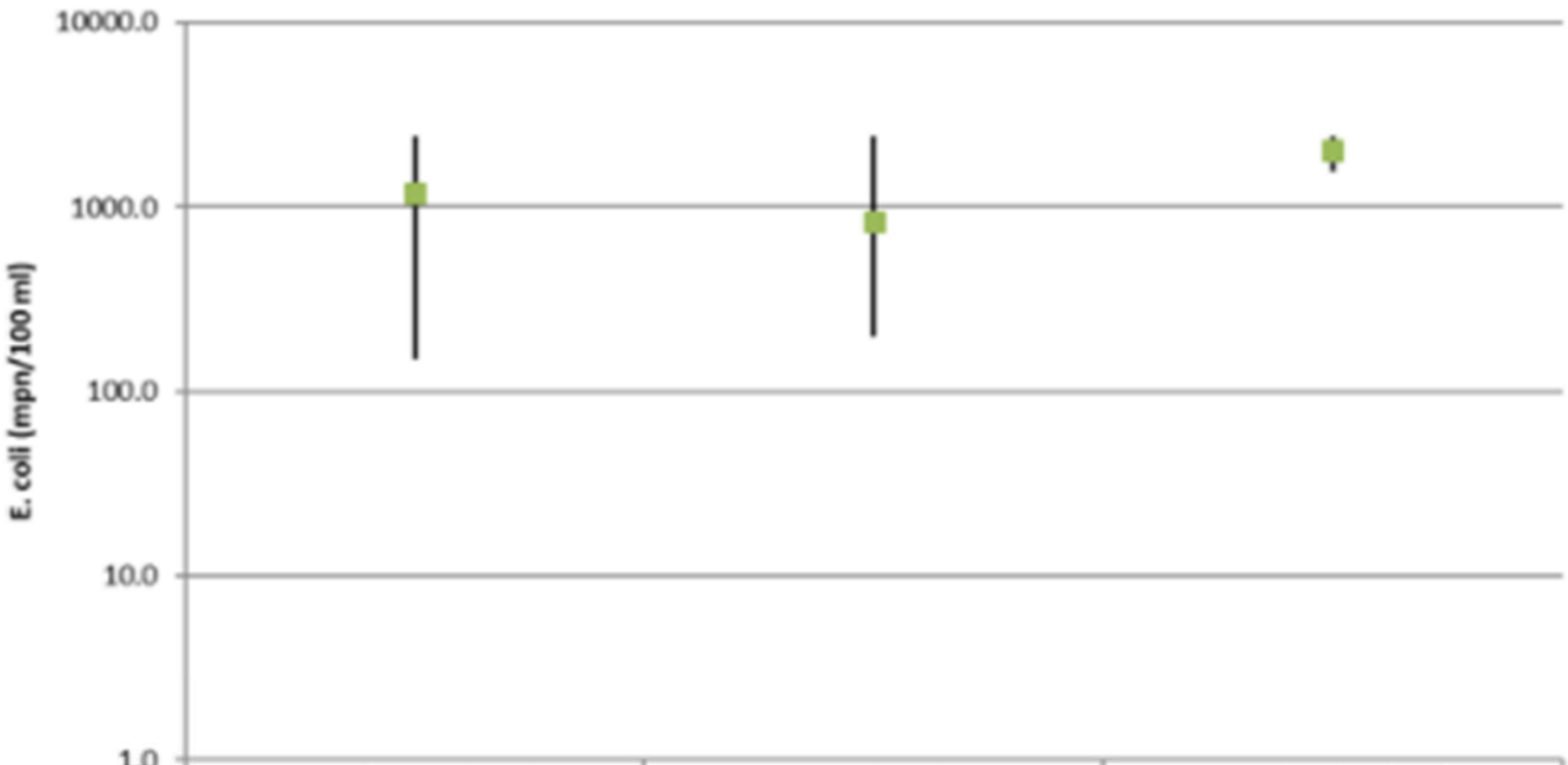
A TMDL for chloride for Deer Creek and Black Creek is being prioritized as high and is identified on the 2020 303(d) List as being scheduled for 2025. A TMDL for *E. coli* for Twomile Creek is being prioritized as medium and is scheduled for 2026-2030 on that list too.

Deer Creek CSI Project
E. coli Data (Log_{10} Scale)
4/22/2021 - 9/23/2021

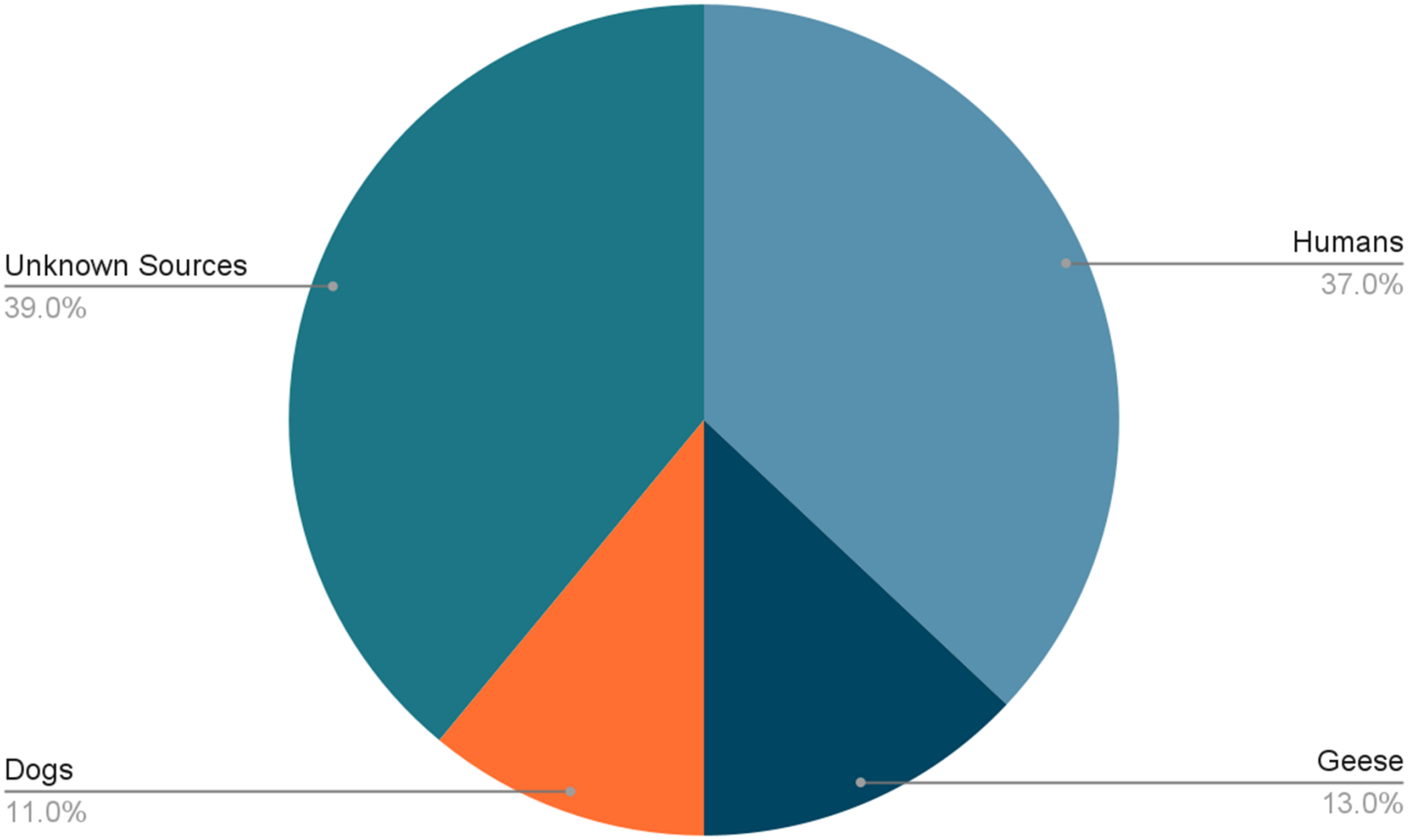


	4078/5.9/0.1 (n=6)	4078/6.4/0.1 (n=6)	4078/6.0 (n=6)	4078/6.5 (n=6)	4078/6.7 (n=6)
Maximum	1299.7	2419.6	1986.3	1553.1	2419.6
Minimum	53.8	13.4	387.3	325.5	727.0
Geomean	464.3	96.6	663.0	857.4	1358.3

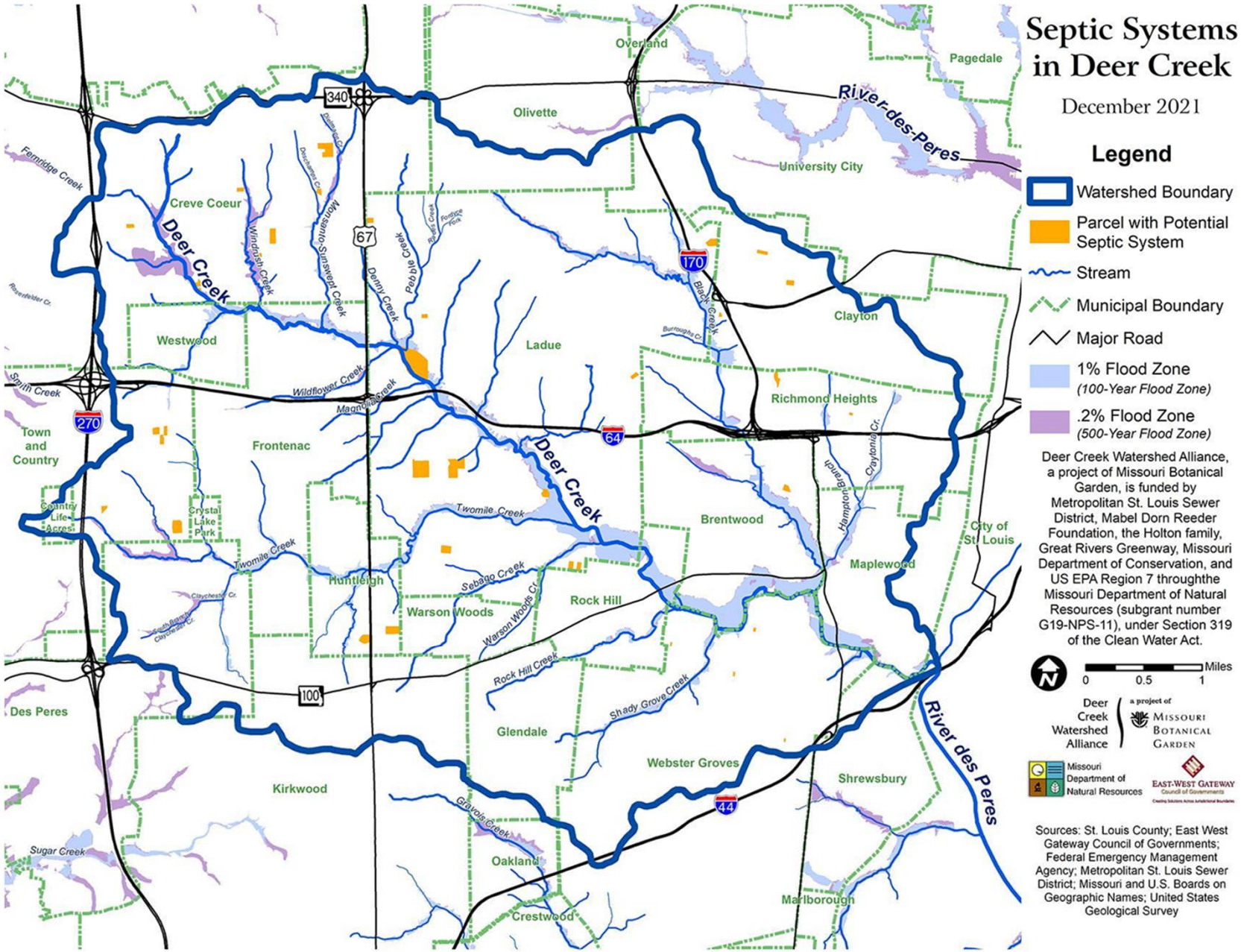
Windrush Creek CSI Project
E. coli Data (Log_{10} Scale)
4/6/2022 - 10/12/2022



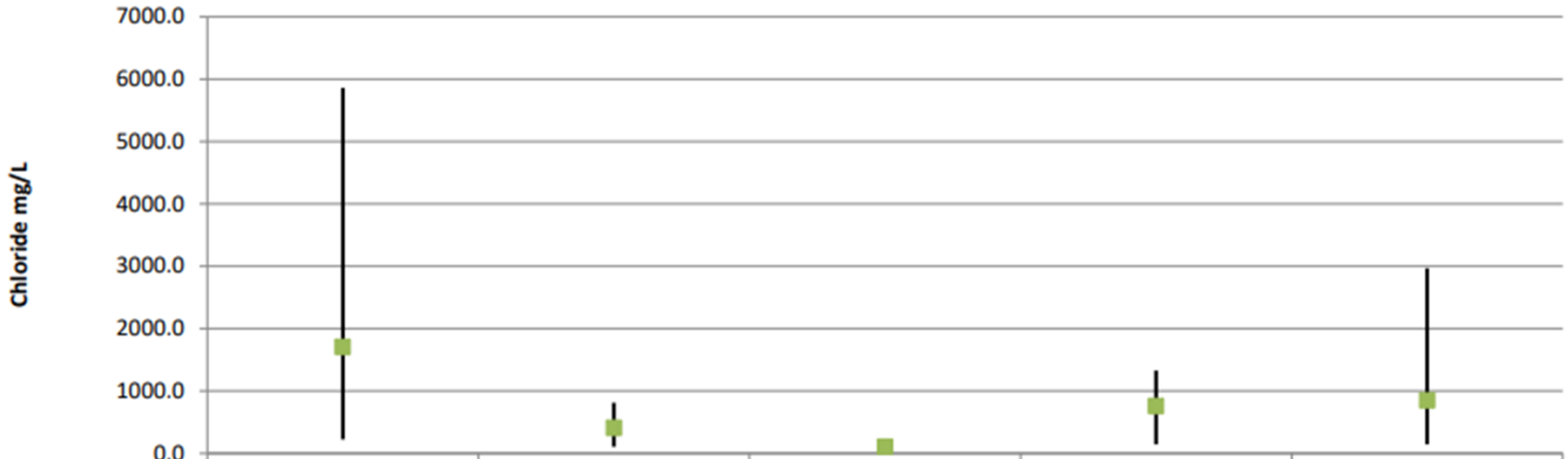
	4078/5.3/0.1 (n=7)	4078/5.3/0.4 (n=7)	4078/5.3/0.8 (n=7)
Maximum	2419.6	2419.6	2419.6
Minimum	148.3	198.9	1553.1
Geomean	1189.3	832.0	2053.0



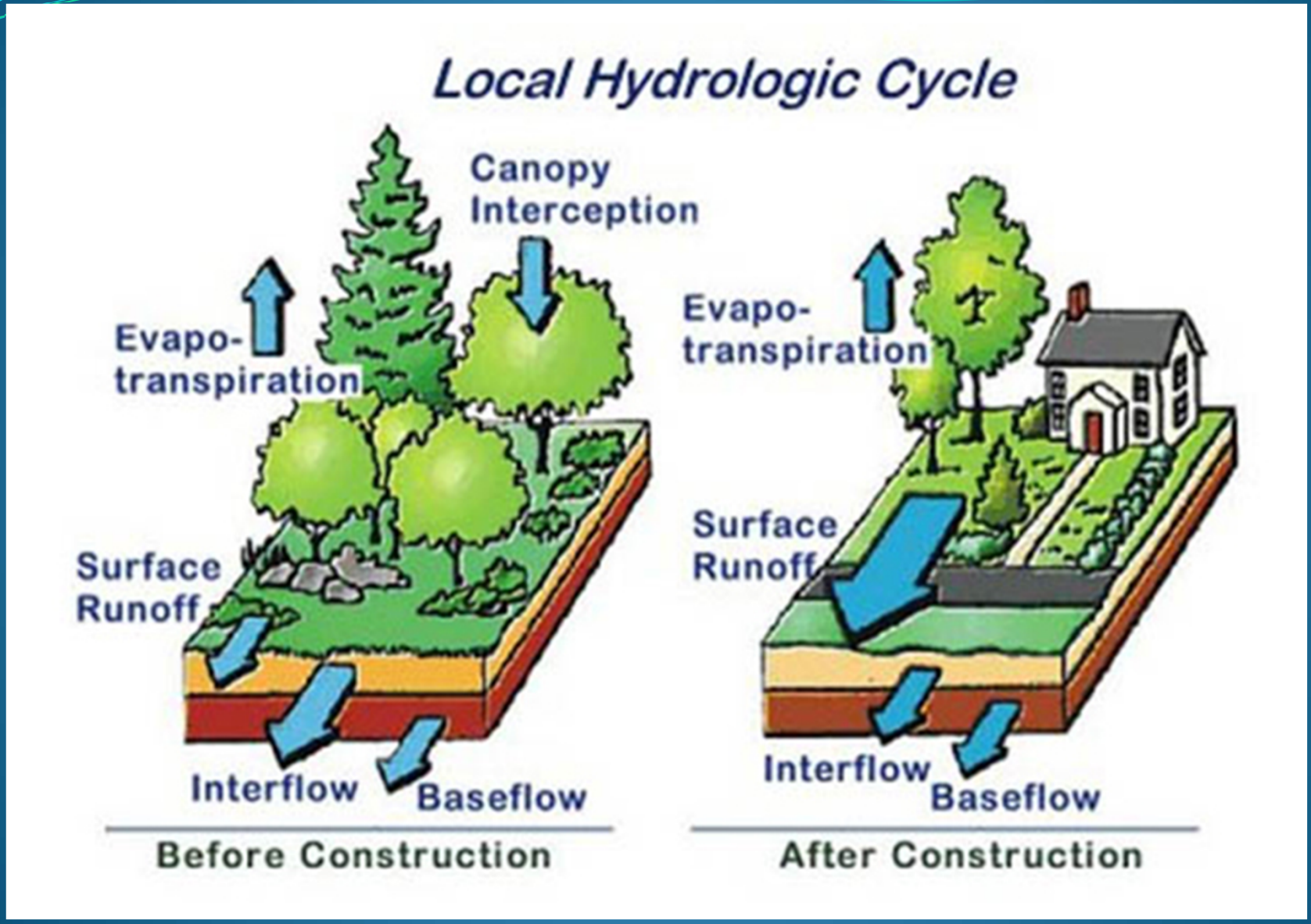
Average percentages of sources of *E. coli* at base flow on Upper River des Peres Site (USGS, 2010)


Septic Systems in Deer Creek
December 2021
Legend
Watershed Boundary
Parcel with Potential Septic System
Stream
Municipal Boundary
Major Road
1% Flood Zone
(100-Year Flood Zone)
.2% Flood Zone
(500-Year Flood Zone)
Deer Creek Watershed Alliance, a project of Missouri Botanical Garden, is funded by Metropolitan St. Louis Sewer District, Mabel Dorn Reeder Foundation, the Holton family, Great Rivers Greenway, Missouri Department of Conservation, and US EPA Region 7 throughthe Missouri Department of Natural Resources (subgrant number G19-NPS-11), under Section 319 of the Clean Water Act.
Miles
0
0.5
1
Deer Creek Watershed Alliance
a project of Missouri Botanical Garden
Missouri Department of Natural Resources
East-West Gateway Council of Governments
Sources: St. Louis County; East West Gateway Council of Governments; Federal Emergency Management Agency; Metropolitan St. Louis Sewer District; Missouri and U.S. Boards on Geographic Names; United States Geological Survey
Overland
Pagedale
Olivette
University City
Creve Coeur
Westwood
Ladue
Clayton
Richmond Heights
Town and Country
Frontenac
Brentwood
City of St. Louis
Maplewood
Huntleigh
Warson Woods
Rock Hill
Des Peres
Glendale
Webster Groves
Shrewsbury
Kirkwood
Oakland
Marlborough
Crestwood
Deer Creek
River des Peres
Fenridge Creek
Wildwash Creek
Monsanto-Swanwept Creek
Denny Creek
Pebble Creek
Black Creek
Wildflower Creek
Magnolia Creek
Twomile Creek
Sebago Creek
Warson Woods Cr.
Rock Hill Creek
Shady Grove Creek
Gravois Creek
Sugar Creek
Crayton Cr.
Hamptonbranch
Country Life Acres
Crystal Lake Park
340
67
270
64
170
44
100

Deer Creek CSI Project
Chloride Data
11/23/2021 - 2/23/2022



	4078/5.9/0.1 (n=6)	4078/6.0 (n=6)	4078/6.4/0.1 (n=6)	4078/6.5 (n=6)	4078/6.7 (n-6)
Maximum	5860.0	810.0	179.0	1330.0	2970.0
Minimum	224.0	107.0	77.7	144.0	143.0
Overall Average	1707.2	408.4	105.0	759.4	850.8

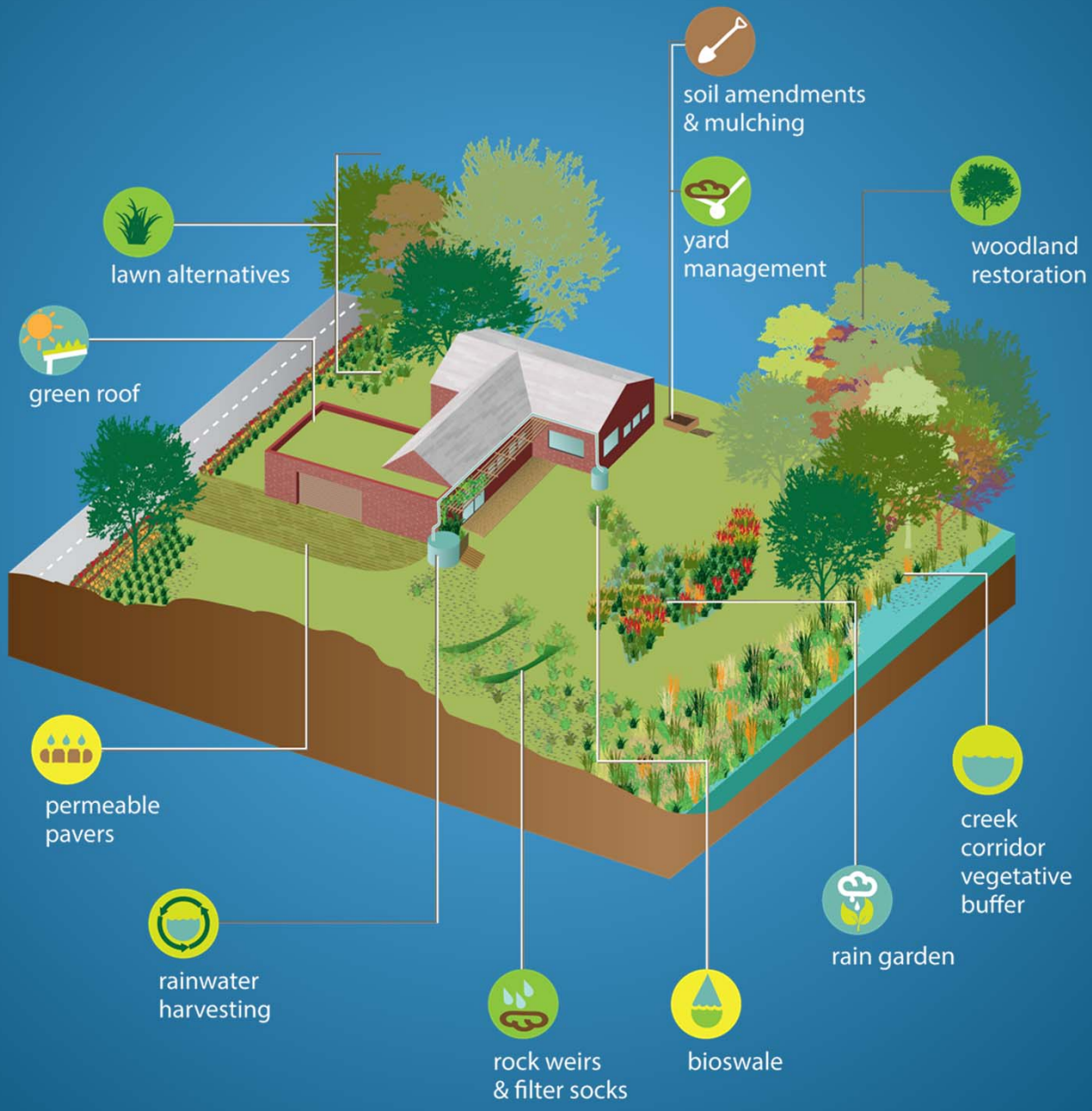

Local Hydrologic Cycle
Canopy Interception
Evapo-transpiration
Surface Runoff
Interflow
Baseflow
Before Construction
Evapo-transpiration
Surface Runoff
Interflow
Baseflow
After Construction

What do we want to accomplish?

The goal of the Deer Creek Watershed Alliance is to improve water quality, with a focus on native soil and plant-based solutions.

Picture courtesy of Missouri Botanical Garden PlantFinder

Rainscaping Guide & Cost-Share Program



Rain Garden Type Comparison

Right Feature Right Place

Native Soil Rain Garden

- Less expensive
- Less risk of clogging
- Improves over time
- Improves soil structure
- Healthy plants
- Increased organic matter

Engineered Bioretention Rain Garden

- Can be installed where soil is heavily compacted
- Immediate high impact
- Improves soil texture

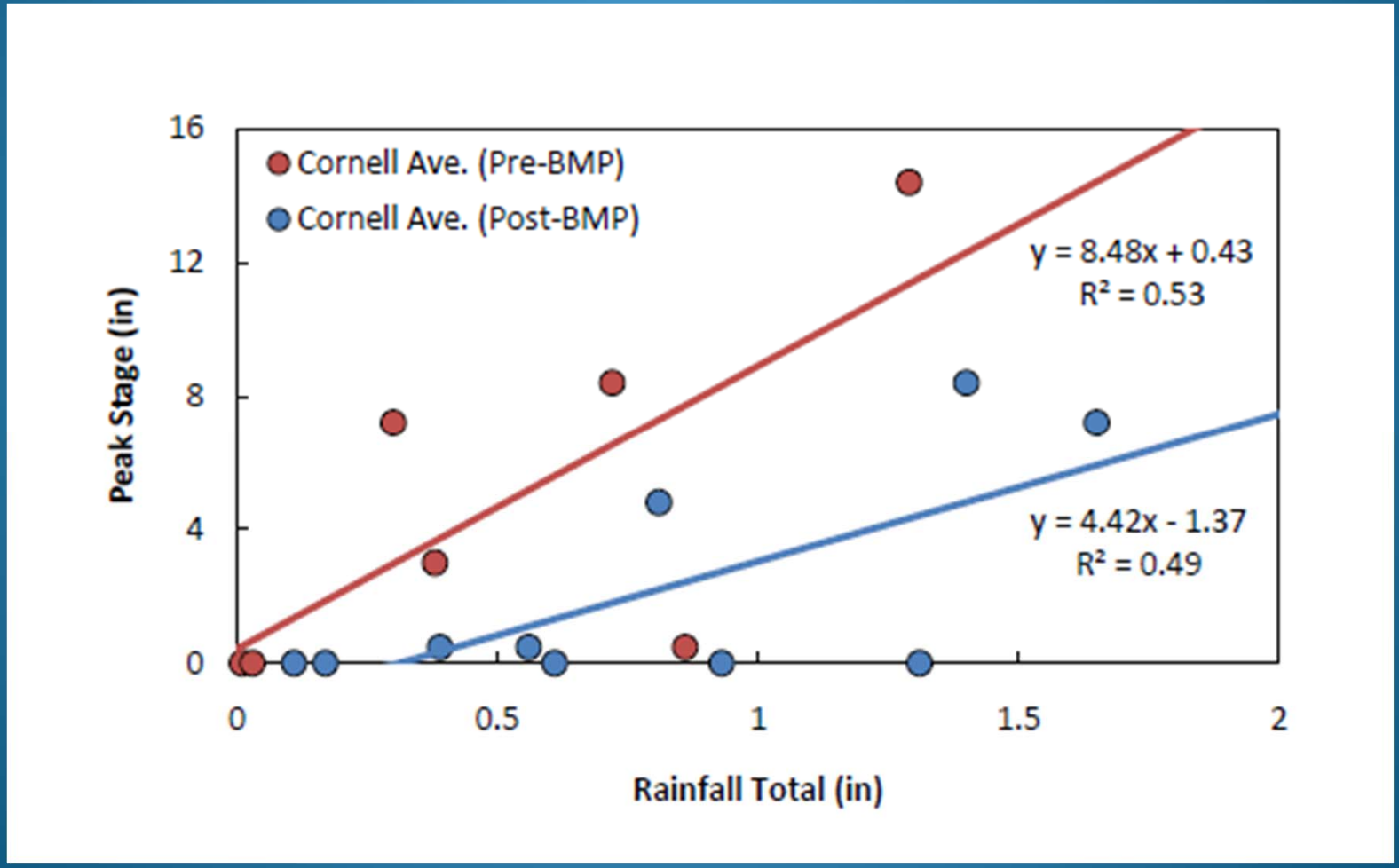
USGS Five Year Study

Madison Wisconsin Case Study Infiltration Rates

	Turf-Clay	Prairie -Clay
Prior to Planting	.1 inch/hr	.1 inch/hr
Median rate over 5 years	.28 inch/hr	.88 inch/hr

How do we measure our success?

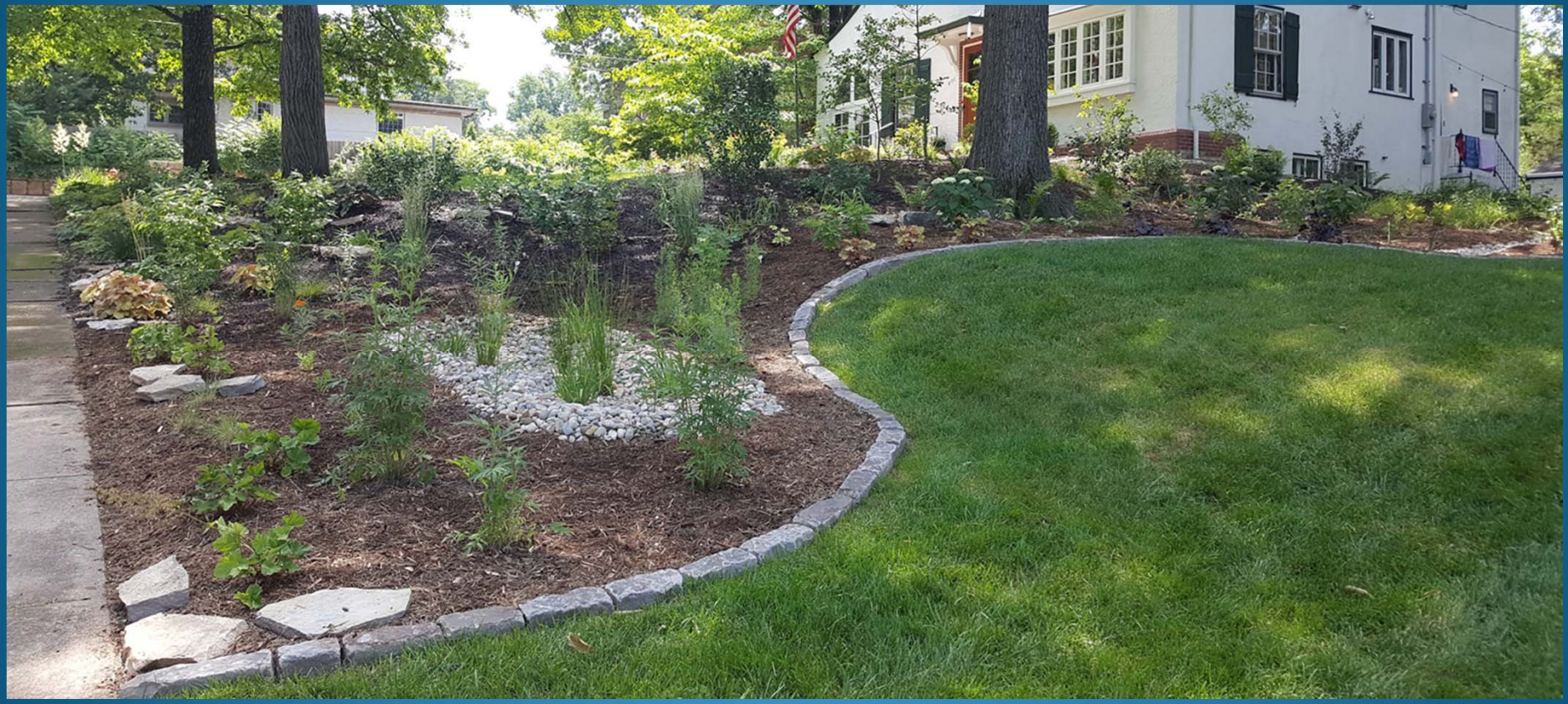
Monitoring Results

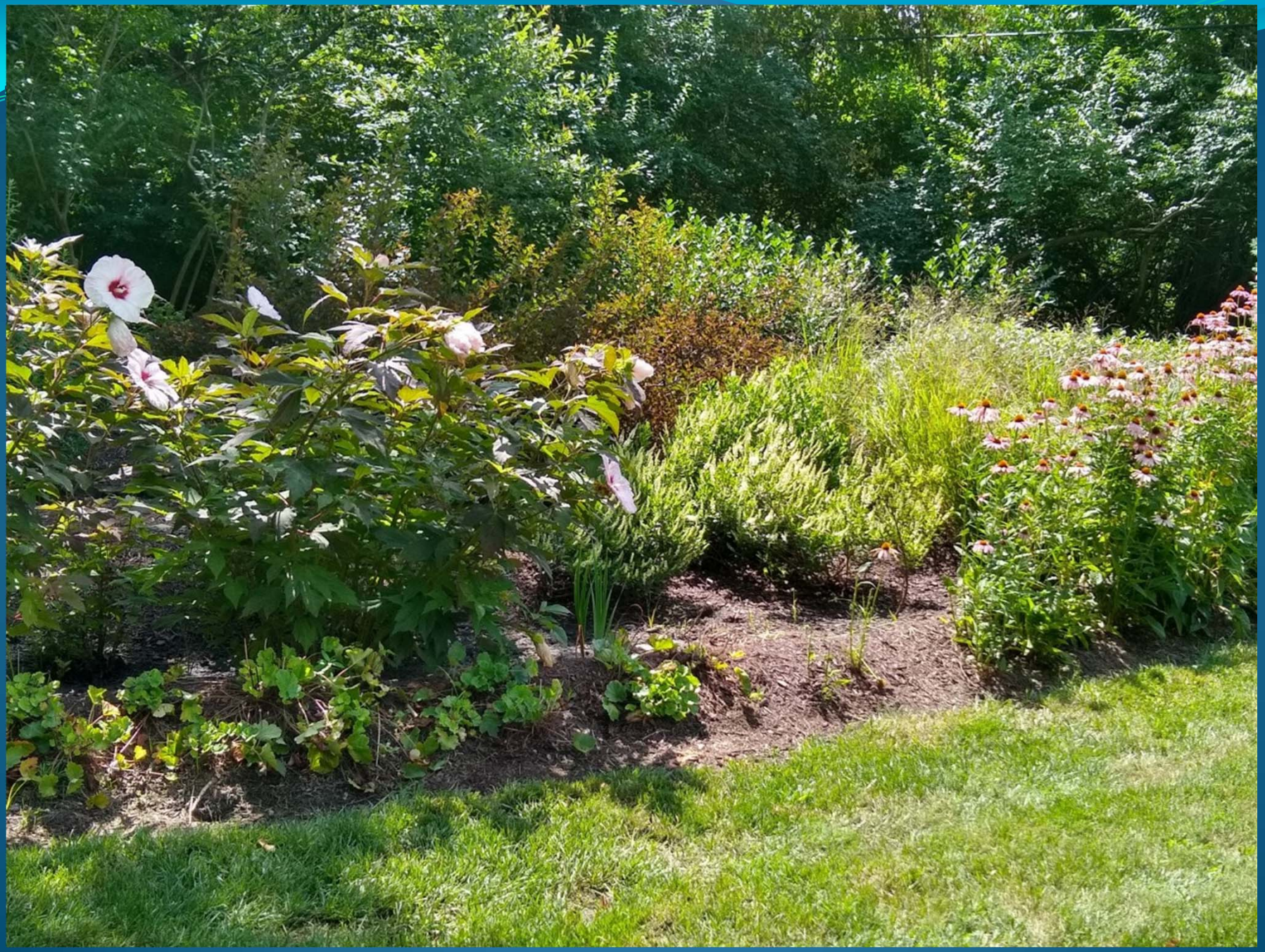


Since the Deer Creek Watershed Alliance Initiative planning efforts began in 2008, more than 466 rainscaping projects have been installed in the watershed to date, currently resulting in load reductions of 187.5 tons of sediment, 109 lbs. of nitrogen, and 21.5 lbs. of phosphorus per year from Deer Creek.

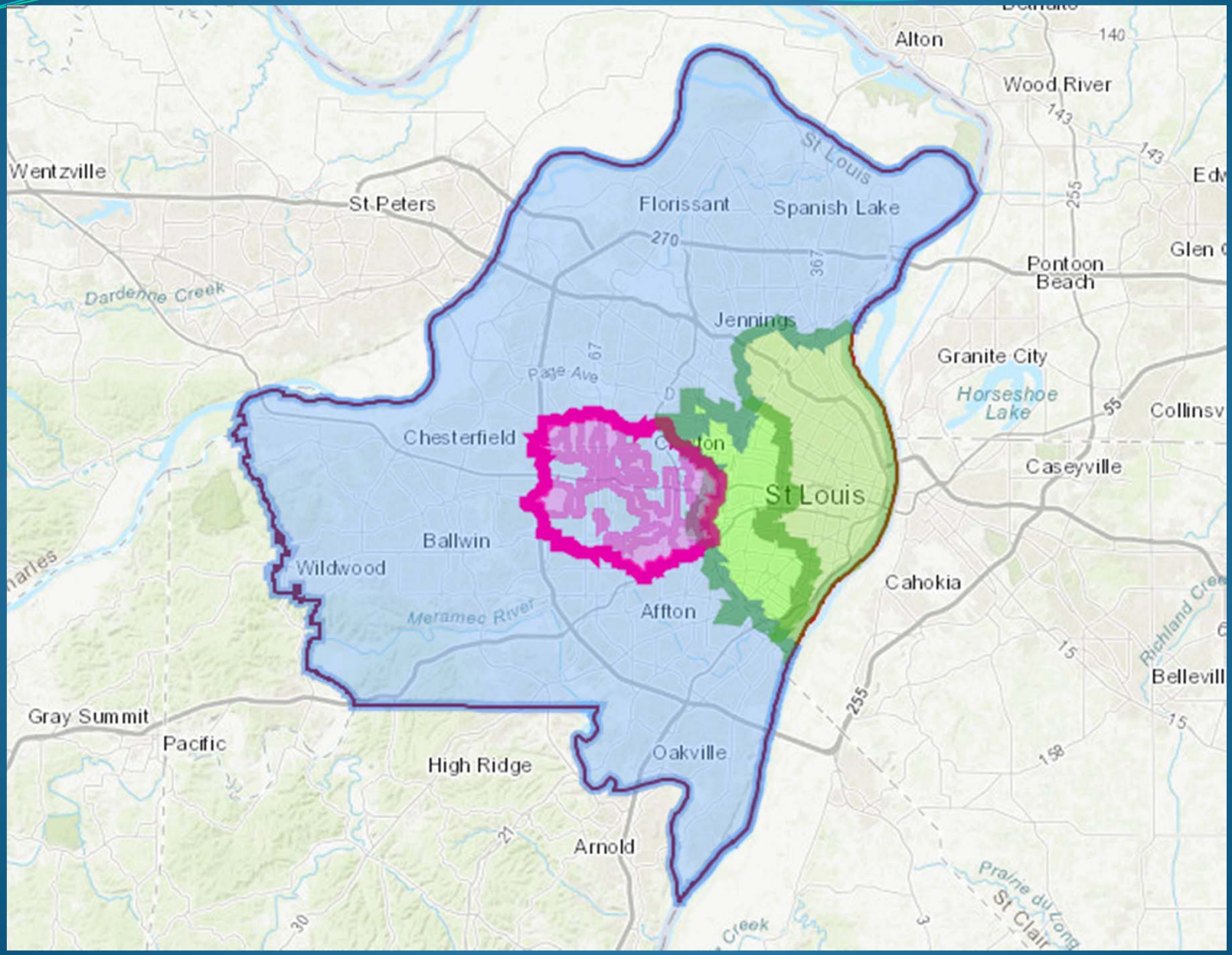

Holocaust Museum
Trader Joe's
Costco Wholesale
Wellston
University City
Clayton
Frontenac
Saint Louis
STL Zoo
Queeny Park
Town and Country
Huntleigh
Des Peres
Shrewsbury
Oakland
Sam's Club
KEYES SUMMIT
ST LOUIS HILL
141
270
61
64
100
44
366

deercreekalliance.org/rainscaping_projects

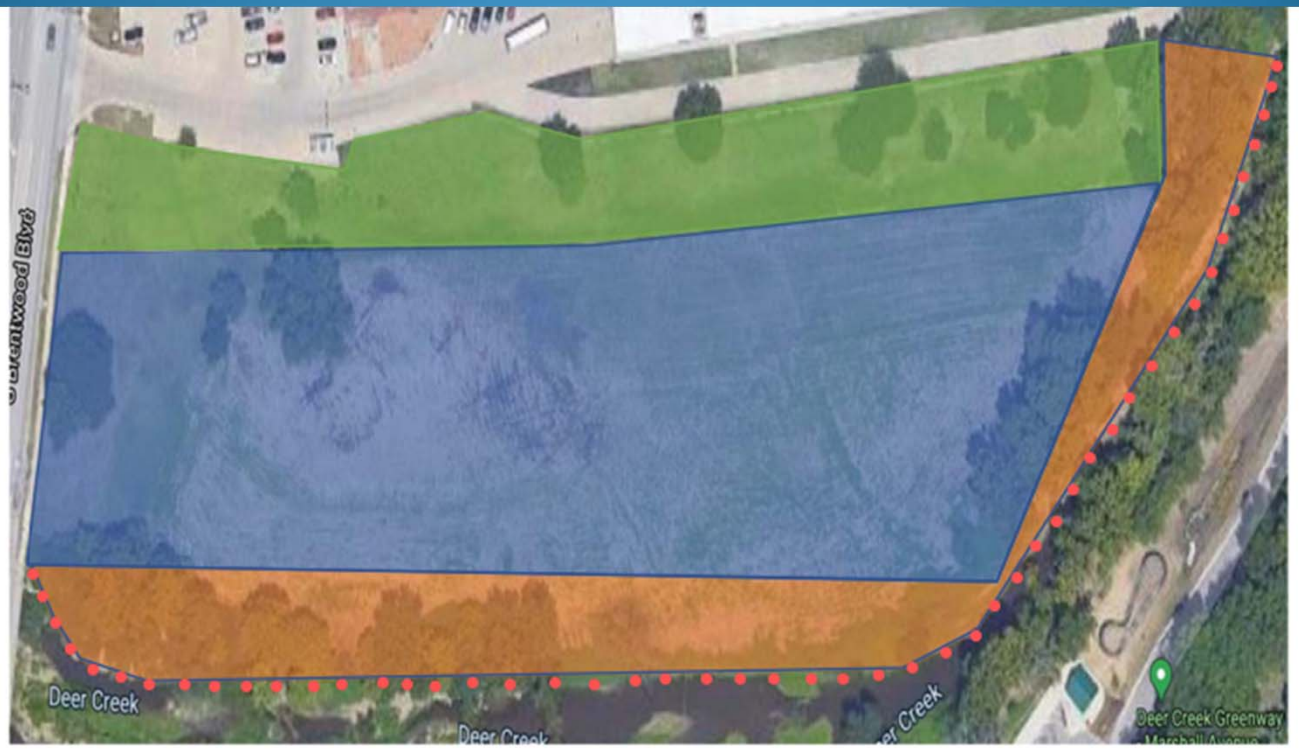




deercreekalliance.org/cost-share



DCWA Technical Advisory Group Bi-State Metro Wetland Restoration Design Charrette in April 2017, sponsored by Great Rivers Greenway, City of Brentwood, and other partners



= Zone 1: Hillside

= Zone 2: Wetland Arboretum

= Zone 3: Riparian Corridor

= Zone 4: Stream Bank

How do we engage the community?

There are three committees that have met annually to contribute to the development of the watershed management plans in addition to providing project implementation input.

Those three committees are:

- A Steering Committee allowing watershed residents to have direct input in the plan
  - This committee keeps watershed citizens updated through quarterly email newsletters and workshops and invites citizens to participate in meetings as well as public engagement projects.
- A Community Leaders Task Force made up of all entities with jurisdictional authority in the watershed
- A Technical Advisory Group made up of engineers, landscape architects, horticulturalists, ecologists, and other technical experts

The *Deer Creek Watershed Management Plan* at **deercreekalliance.org/plan** was accepted by MoDNR and U.S. EPA in February 2023.

2023 PLAN DETAILS

View and download the 2023 Deer Creek Watershed Plan as a combined document or by section below:

- Table of Contents [767 KB]
- Forward [539 KB]
- Chapter 1: History of Watershed Planning and Stakeholder Engagement [1.31 MB]
- Chapter 2: Watershed Data Inventory [3.02 MB]
- Chapter 3: Identifying Impairments [1.67 MB]
- Chapter 4: Estimating Load Reductions [662 KB]
- Chapter 5: Management Measures [867 KB]
- Chapter 6: Technical and Financial Assistance [1.13 MB]
- Chapter 7: Public Information and Education [567 KB]
- Chapter 8: Schedule [594 KB]
- Chapter 9: Milestones [79.2 KB]
- Chapter 10: Performance [78.4 KB]
- Chapter 11: Monitoring [654 KB]

Table 4-16. Summary of present and target pollutant loads

Pollutant	Present pollutant load, level, or value	Target pollutant load, level or value
E. coli	Average Existing load and mean concentration = 2.46E+12 counts/day or 9,161 counts/100mL for Black Creek (WBID 3825) Average Existing Load and mean concentration = 8.26E+12 counts/day or 6,628 counts/100mL for Deer Creek (WBID 3826) Average Existing Load = 1.97E+11 counts/day for Twomile Creek (WBID 4079)	Not to exceed geometric mean of 126 cfu/100mL for Deer Creek (WBID 3826) Category A and 206 cfu/100mL for Black Creek (WBID 3825) and Twomile Creek (WBID 4079) Category B Use for State of Missouri standards for Whole Body Contact during the recreational season. Average reduction in *E. coli* loading needed is 83% reduction in Black Creek, 70% reduction in Deer Creek, and 57% reduction in Twomile Creek to achieve these standards.
Chloride	Average Existing Load = 84,593 lbs/day for Deer Creek (WBID 3826)	Baseline concentration of chloride plus sulfate shall not exceed 1,000 mg/L, and on its own, chloride shall not exceed 230 mg/L (chronic) during non-winter months. And on its own, chloride shall not exceed 860 mg/L (acute) during winter months when road salt is being applied on roads. Average reduction in chloride loading needed is 65% reduction in Deer Creek.

Table 4-8 below provides the estimated number of these types of rainscaping BMPs to be installed in 5-year periods and the minimum estimated load reduction for *E. coli* and secondary pollutants of concern.

Table 4-8. Rainscaping BMPs to be installed in 5-year periods with minimum estimated load reductions

Implementation Schedule	Project Activity	Expected Deliverable Units to be Completed	Deliverable Units	Minimum Estimated Load Reductions after Implementation of each 5-Year Period			
				Annual TSS Removed (lbs)	Annual TP Removed (lbs)	Annual TN Removed (lbs)	*E. coli* (counts/day)
Years 1-5 (2020-2025)	Rainscaping Cost-Share Program in remaining Rounds 2023 & 2024	40*	BMPs	600	2	10	8.98E+07
	Ladue Riparian Corridor Restoration Plantings	5.38	ACRES	1,885	6	27	8.80E+08
	Brentwood Wetland Restoration	6.75	ACRES	10,261	28	85	1.84E+09
Years 6-10 (2026-2030)	Rainscaping Cost-Share Program	100	BMPs	1,420	4	20	2.69E+08

Removal Rates for Chloride

It is apparent that the most effective chloride reduction strategy is to reduce the amount of road salt used since the largest exceedances of state water quality standards are observed in the cold-weather months. Applying brine or a 23% dissolved salt water mixture to roads as an anti-icing pretreatment practice to get roadways ready for winter storms can dramatically decrease the amount of salt used, expense, and the amount of salt that ends up in streams. According to the Public Works Department in the city of Webster Groves, which is partially located in the Deer Creek Watershed, approximately 200 tons less of rock salt was used due to their voluntary efforts to brine before winter storms in 2019-2020.

During a recent study, the contributions to chloride in urban stormwater from winter brine and rock salt application were compared by monitoring stormwater runoff from residential areas in six paired cities in St. Louis County during the winters of 2016–2017 and 2017–2018. One of the three cities included in this study that has adopted the use of brine is Webster Groves. The study concluded that the use of brining by city governments resulted in a 45% average reduction of chloride loads conveyed to streams, demonstrating that brining is a highly viable BMP for local municipal operations (Haake and Knouft 2019).[6] Likewise, the state of Michigan's Chloride and Sulfate Implementation Plan states that during-storm direct liquid application (DLA) or applying a brine solution (23% salt/ 77% water) has been found to require 50% less salt.
https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Programs/WRD/NPDES/chloride-sulfate-implementation-plan.pdf?rev=07c3a64eed2849a6aae7130eda1fe384

Therefore, the removal rate for chloride for brining will be considered to be 45% which is the more site specific and conservative number from these two studies. If at least 5 or one-quarter of the municipalities in the watershed are encouraged to convert to brining through educational efforts every 5 years, this will yield an 11.25% removal rate for chloride by educating municipal landowners about brining. In twenty years, if all the municipalities have converted to brining, a 45% removal rate will be achieved through education. The additional removal rates needed will be achieved by educating residential landowners in the watershed.

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[6] Haake, D.M., J.H. Knouft. (2019) Comparison of contributions to chloride in urban stormwater from winter brine and rock salt application. *Environmental Science & Technology*, 53, 11888-11895.

This is a

RAINSCAPING WATER QUALITY IMPROVEMENT PROJECT

Capturing rain where it falls

www.deercreekalliance.org/cost-share

Deer Creek Watershed Alliance

a project of Missouri Botanical Garden

MSD

Missouri Department of Natural Resources

EPA United States Environmental Protection Agency

The Rainscaping Cost-share program is funded by Metropolitan St. Louis Sewer District, Mabel Dorn Reeder Foundation, and US EPA Region 7 through the Missouri Department of Natural Resources (subgrant number G19-NPS-11), under Section 319 of the Clean Water Act.