Welcome to *The Current*, the North Central Region Water Network's Speed Networking Webinar Series

Beyond Hydrology: Exploring the Benefits of Green Stormwater Infrastructure: 2PM CDT

1. Submit your questions for presenters via the chat box. The chat box is accessible via the purple collaborate panel in the lower right corner of the webinar screen.
2. There will be a dedicated Q & A session following the last presentation.
3. A phone-in option can be accessed by opening the Session menu in the upper left area of the webinar screen and selecting "Use your phone for audio".

This session will be recorded and available at northcentralwater.org and learn.extension.org.

Today's Presenters:

- **John McMaine**, Assistant Professor and Extension Water Management Engineer, South Dakota State University
- **Kelsey McDonough**, Postdoctoral Research Scientist, University of Bayreuth, Germany
- **Lisa Merrifield**, Community and Economic Development Specialist, University of Illinois Extension

Follow @northcentralh2o and #TheCurrent on Twitter for live tweets!

John McMaine

Dr. John McMaine is an assistant professor in Agricultural and Biosystems Engineering and water management engineer state specialist with South Dakota State University Extension. He received his PhD in Biosystems Engineering from Oklahoma State University. He received BS and MS degrees in Biosystems and Agricultural Engineering from the University of Kentucky.

His research and outreach interests center around agricultural and urban water management, water quality, and contaminant transport and fate. In his current role, he researches water management technologies that are environmentally and economically sustainable and provides guidance for South Dakotans to translate water management research into practices.

SDSU Extension

Green Infrastructure - The paradigm and the processes

John McMaine, PhD

Assistant Professor & Water Management Engineer

Agricultural and Biosystems Engineering

South Dakota State University

Urban Development

- Increases impervious area
- Greater peak flow and total volume
- New pollutants
- No barrier preventing pollutants from entering water body

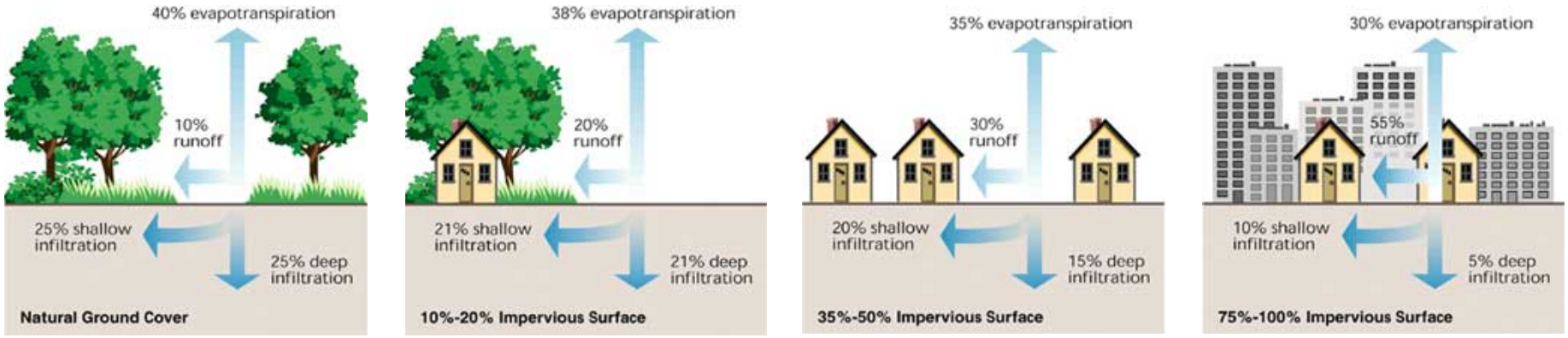
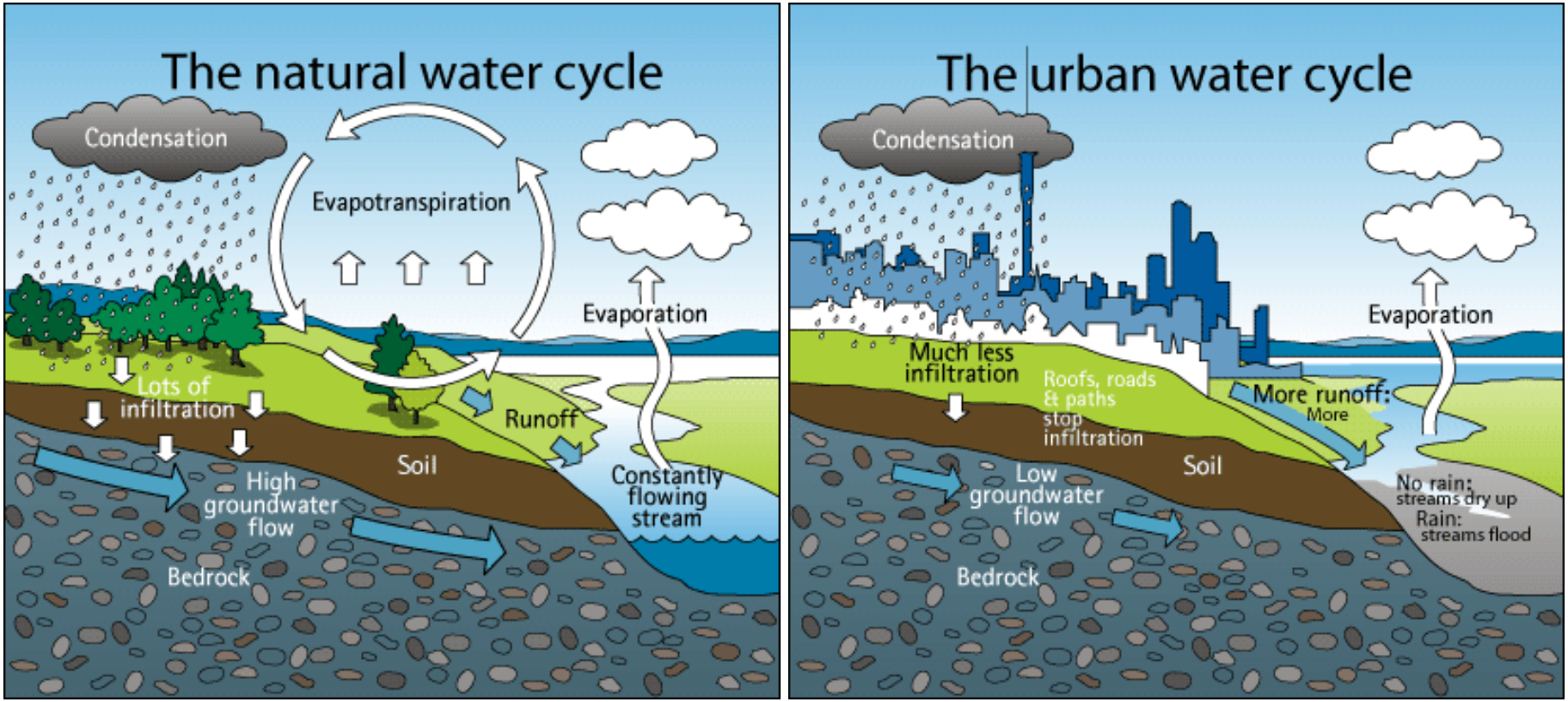


Image Credit – epa.gov

The urban water cycle



Aukland Council

Green Infrastructure

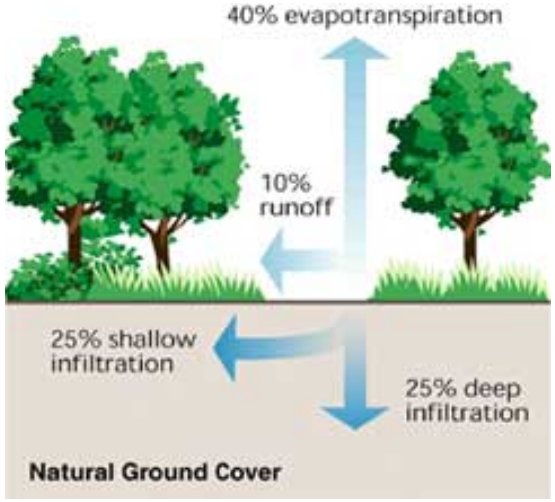
- Initial focus on water quantity and quality
- Imitate pre-development hydrology
- Reduces water quantity, improves water quality

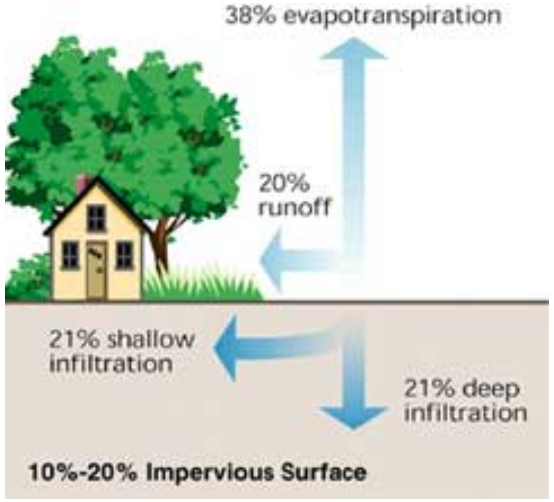
Questions for the Great Plains and North Central Region

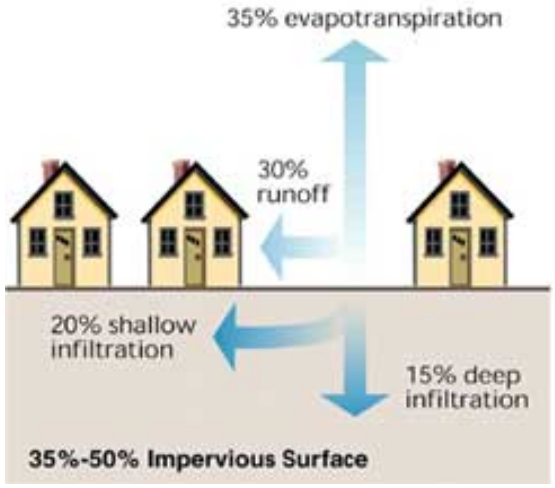
- Climate – Intense storms and drought
- Few population centers – Limits local awareness and perception
- Understand and validate performance across increasing complexities in
  - Scale (parcel vs. neighborhood vs. watershed)
  - Function (water quantity and water quality vs. ecosystem services)
  - Time (initial design to intermediate and long-term considerations)

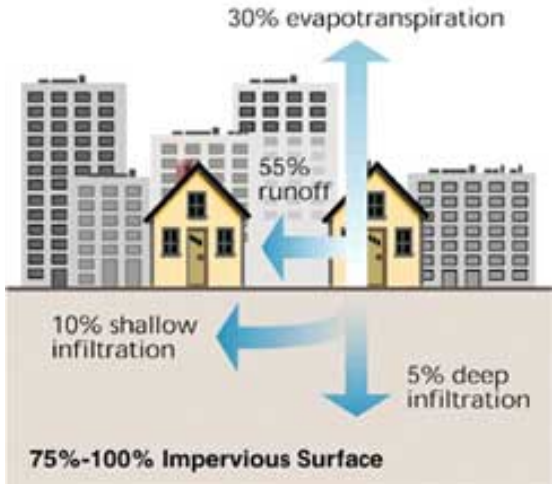
Vogel, J.R., Moore, T.L., Coffman, R.R., Rodie, S.N., Hutchinson, S.L., McDonough, K.R., McLemore, A.J., McMaine, J.T. (2015) Critical Review of Technical Questions Facing Low Impact Development and Green Infrastructure: A Perspective from the Great Plains. Water Environ. Res., 87, 849

Who impacts runoff?









What are current barriers?

- Homeowners
  - Knowledge – about problem, about practice
  - Experience – designing solution, implementing solution
  - Belief – does this really work? can it work for me?
- Developer
  - Municipal code
  - Return on investment
- Municipality
  - Demonstration that it works
  - Ability to write municipal code that ensures a solution

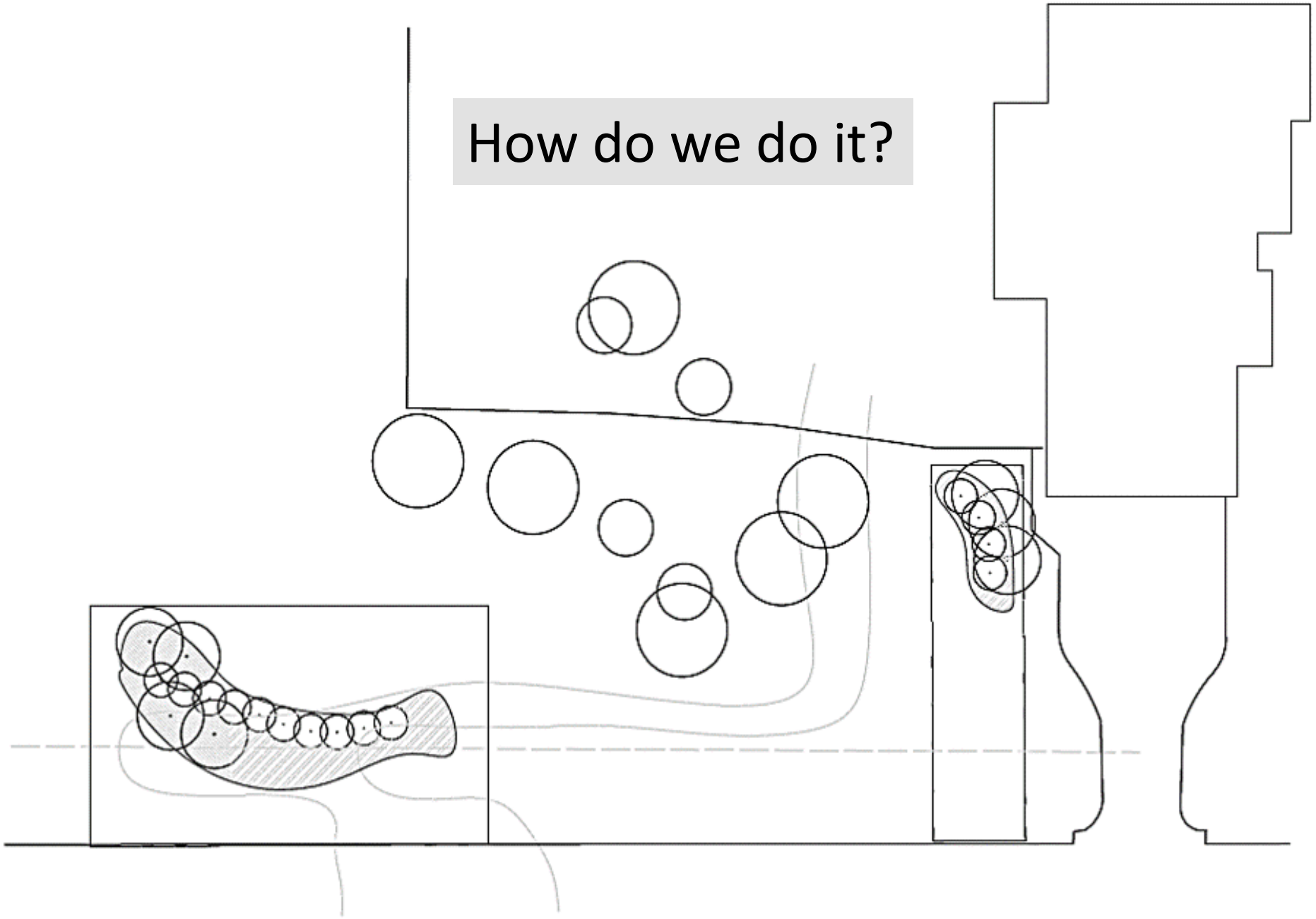
Note – Identification of barriers are based on personal experience

Working with South Dakota Homeowners

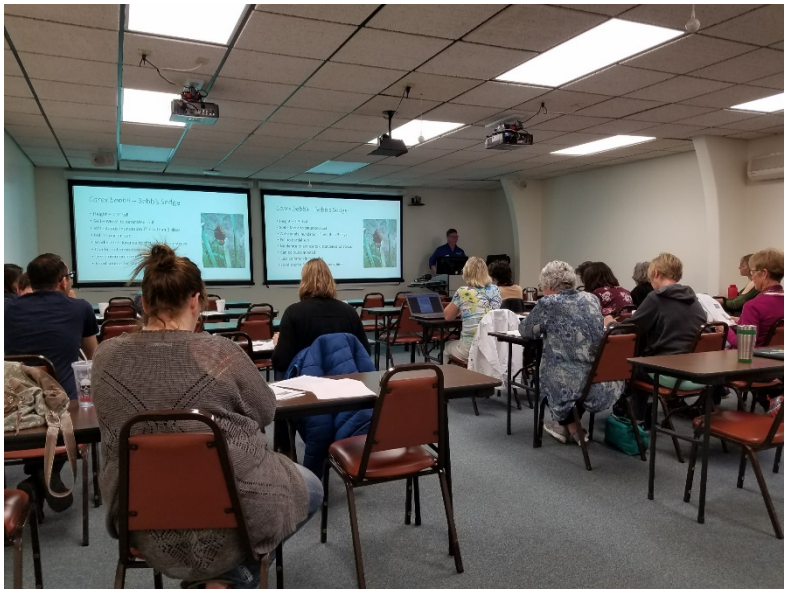

What is the problem?
Source: KQED

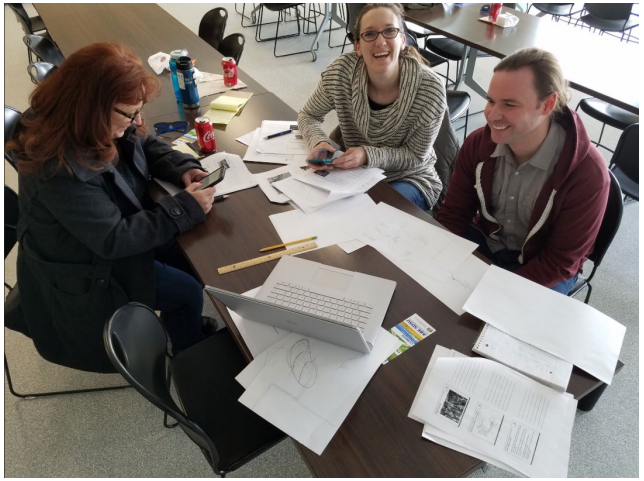

What can we do?

How do we do it?



Learn by doing (design)





Learn by doing (construction)

Working with volunteers is opposite of Field of Dreams –
If they come, we will build it…

Demonstrating success

Where do we go from here?

- Demonstrate success at small- and large-scale
- Demonstrating success allows for change…
- …but does not ensure change

- Shift the paradigm with economic impact
- Green infrastructure adds value in other ways
- Stakeholder barriers must be considered and strategically addressed

SDSU Extension

Contact Information

John McMaine, PhD

Agricultural & Biosystems Engineering

217 Agricultural Engineering
South Dakota State University
Brookings, SD 57007

(605)688-5610 (Office)

john.mcmaine@sdstate.edu

@SDSUExtWaterMan

iGrow.org

NORTH CENTRAL REGION WATER NETWORK

Kelsey McDonough

Kelsey McDonough is a postdoctoral research scientist in the Professorship of Ecological Services at the University of Bayreuth, Germany. Her research aims to understand the impact of land use change and climate change on the spatiotemporal provision of ecosystem services and water resources through modeling and statistical analysis. Her current work aims to develop land use/land cover strategies that offset future climate change impacts and enhance ecosystem service provision throughout Bavaria, Germany. Prior to joining the University of Bayreuth, Kelsey completed her doctoral and master's degrees in Biological and Agricultural Engineering at Kansas State University. She obtained her bachelor's degree in Biological Engineering from North Carolina State University.

UNIVERSITÄT BAYREUTH

Ecosystem Services Benefits of Green Infrastructure

Kelsey McDonough, PhD
Postdoctoral Research Scientist
Professorship of Ecological Services (PES)
University of Bayreuth
Kelsey.McDonough@uni-bayreuth.de

What are ecosystem services?

MA (2005): the benefits that people obtain from ecosystems

Figure Source: https://freshwaterwatch.thewaterhub.org/content/ecosystem-services

What are ecosystem services?

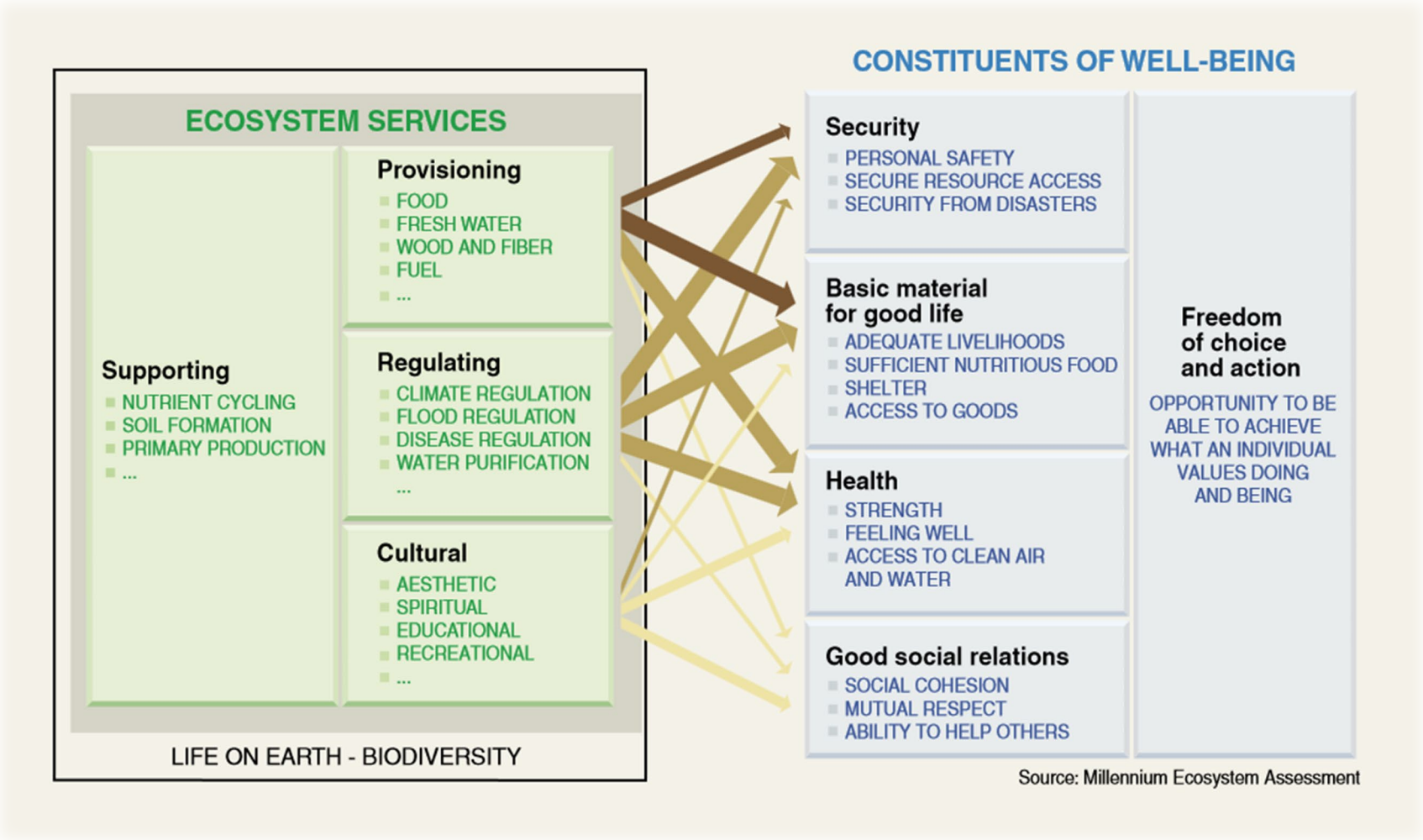


Figure Source: Millennium Ecosystem Assessment (2005)

What are ecosystem services?

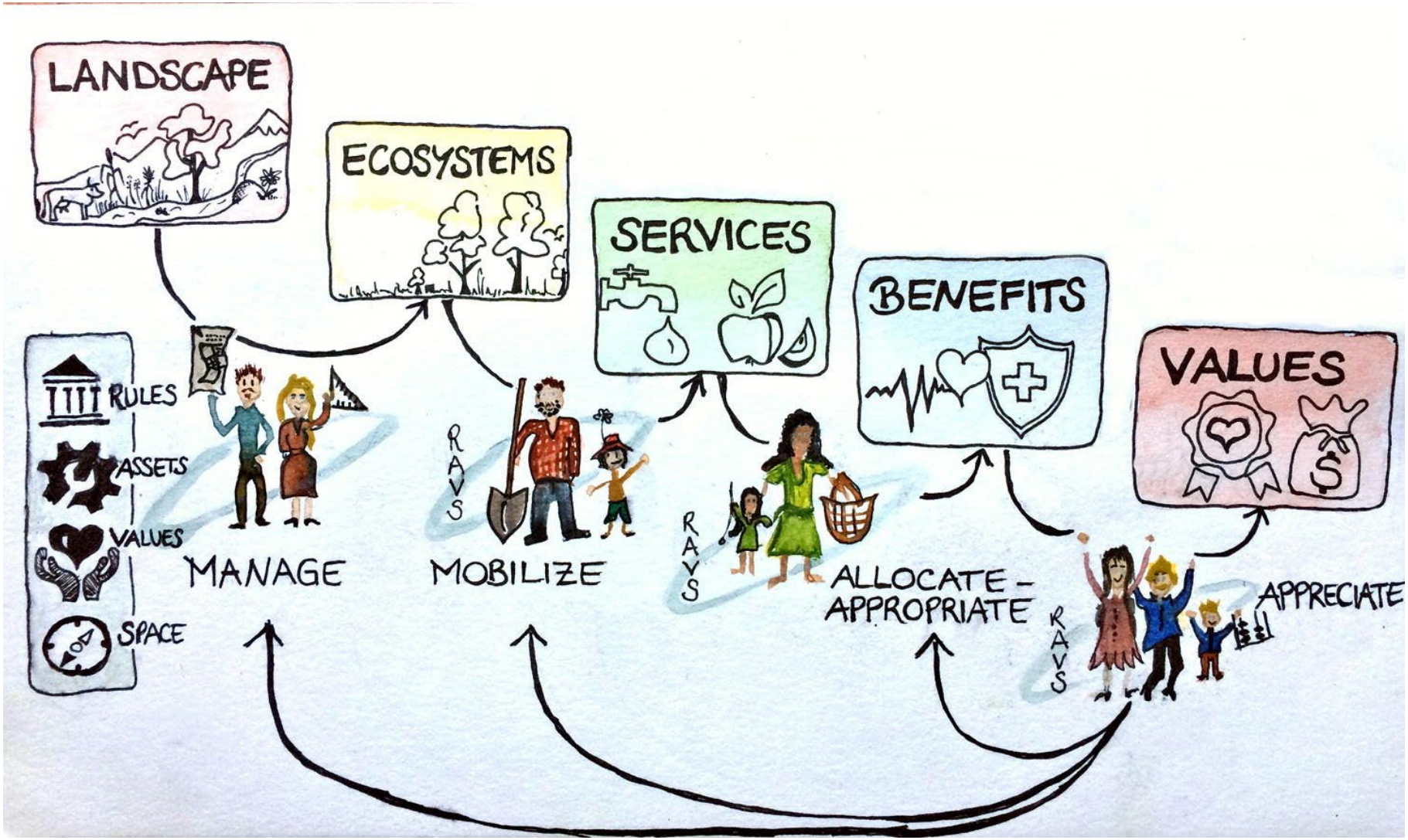
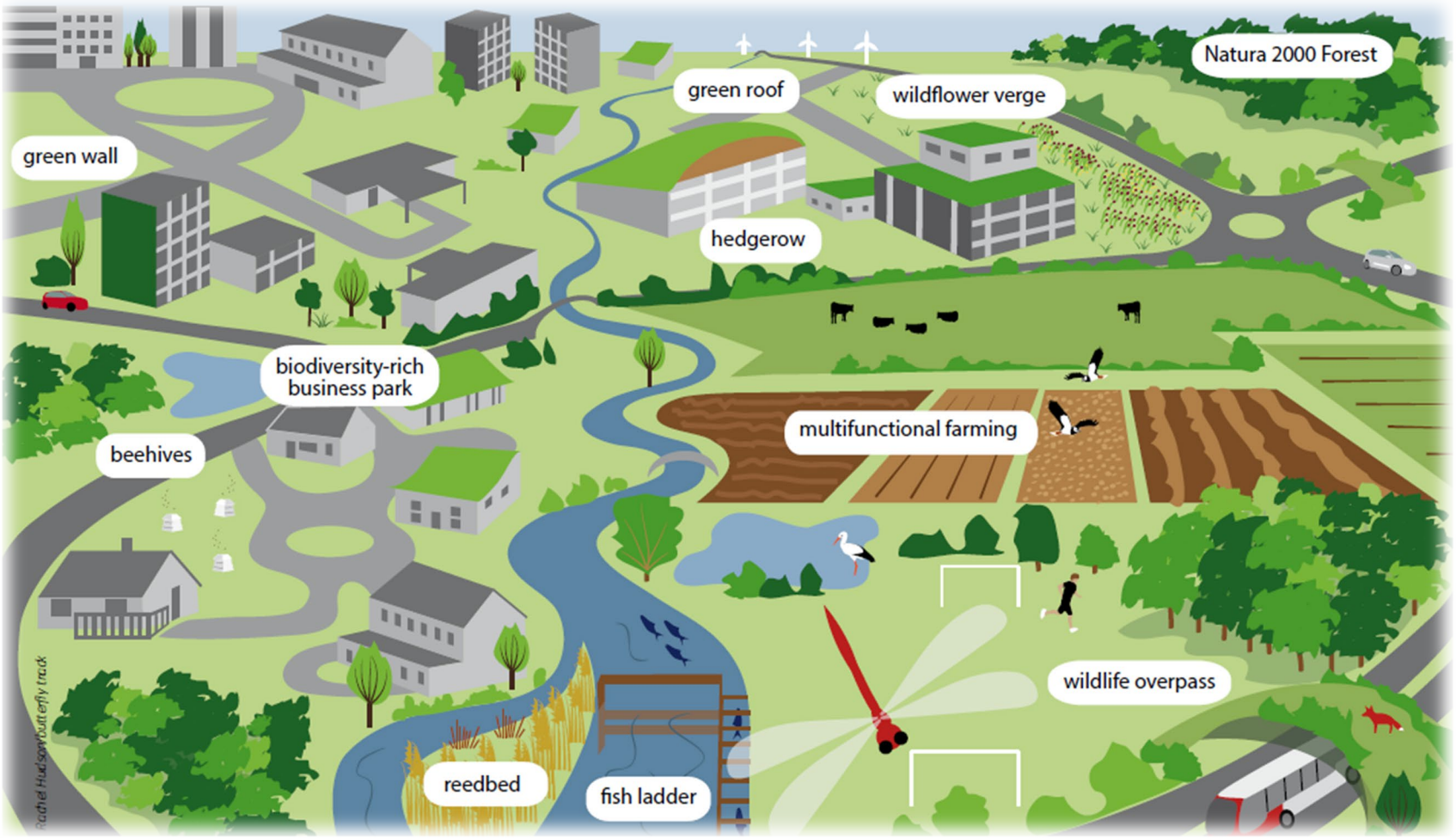


Figure Source: Fedele et al. (2007)

What ecosystem services are provided by green infrastructure?



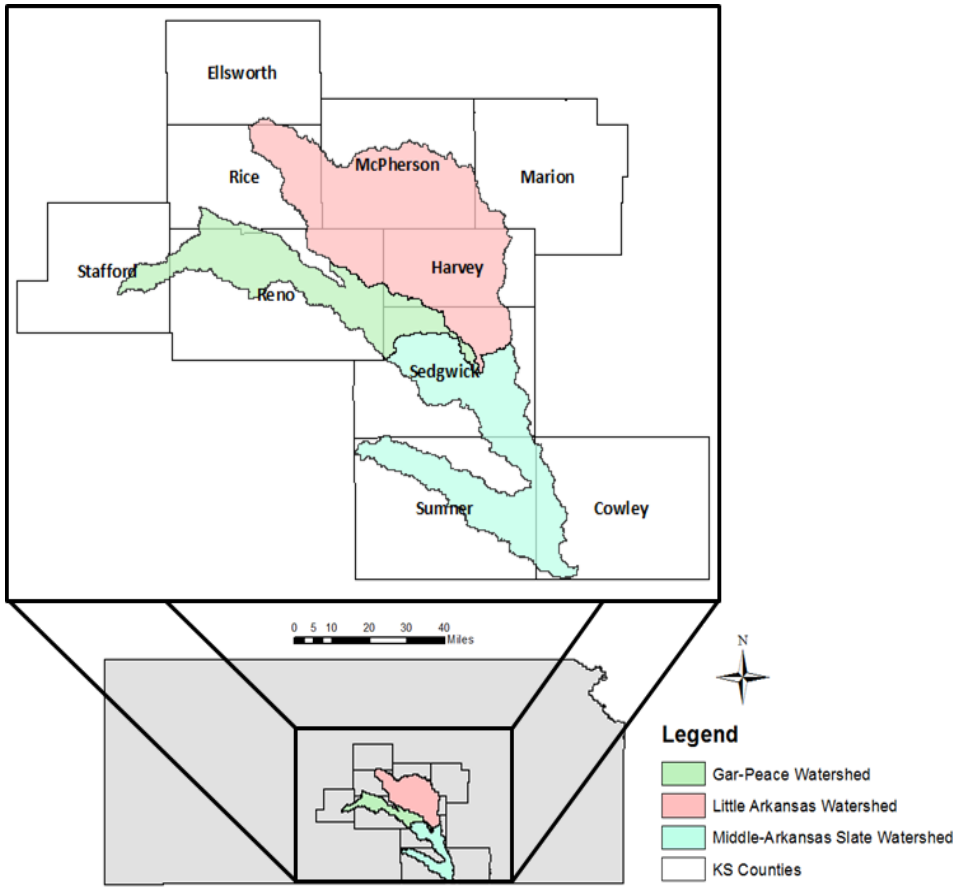
(Figure Source: European Commission (2013) Building a green infrastructure for Europe)

Research Project: Quantifying the relationship between ecosystem services and urban best management practices

Quantifying the relationship between ecosystem services and urban best management practices

Wichita, Kansas

- 342 square miles
- Water quality impairments due to excess bacteria, nutrients, & sediment



McDonough et al. (2017). Understanding the relationship between stormwater control measures and ecosystem services in an urban watershed. *Journal of Water Resources, Planning and Management.* 143(5).

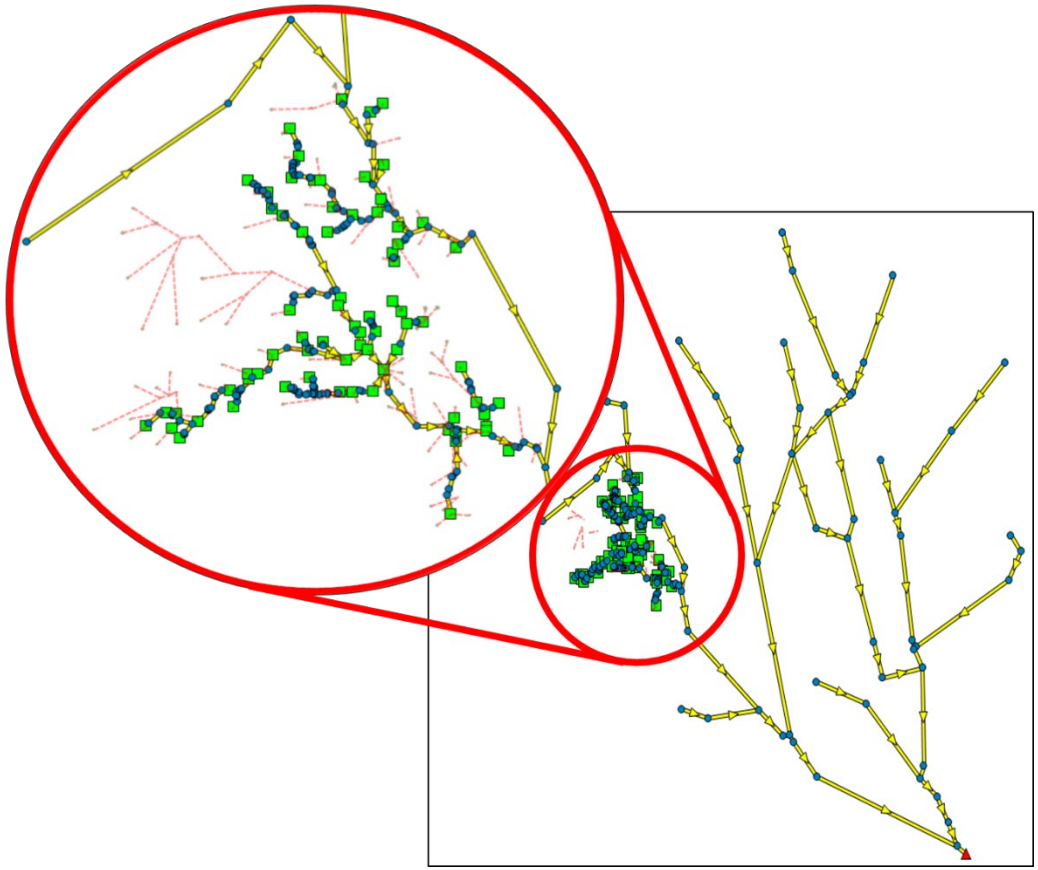
Quantifying the relationship between ecosystem services and urban best management practices

Ecosystem services analyzed:

- Freshwater provision
- Erosion regulation
- Flood regulation

Urban best management practices:

- Bioretention cell
- Rain barrels
- Green roofs



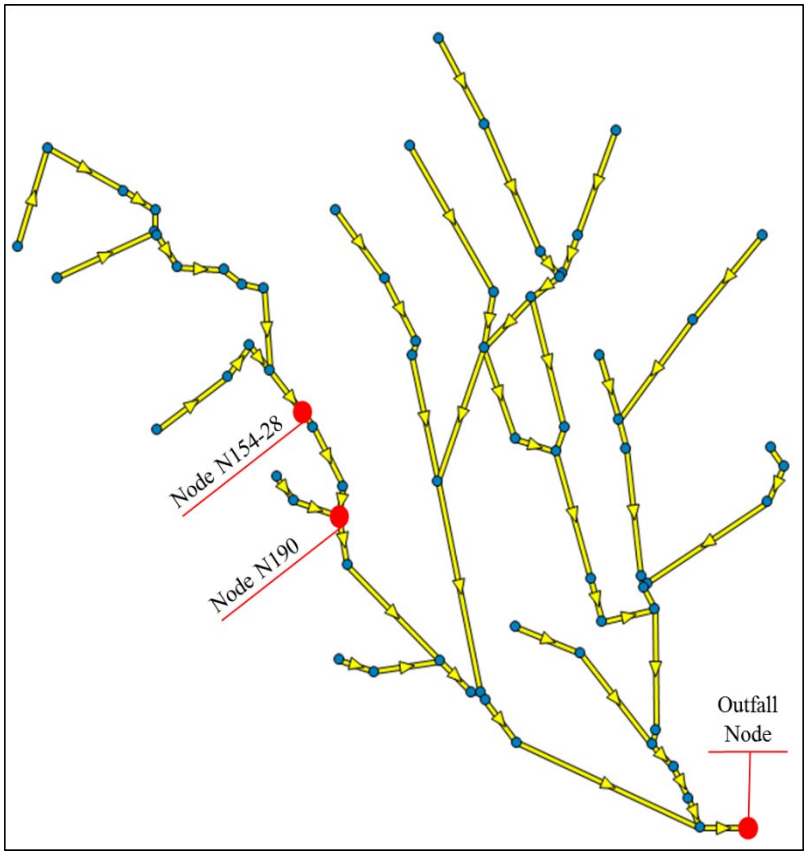
Quantifying the relationship between ecosystem services and urban best management practices

Node N190:

- Bioretention cells that capture 10-100% of impervious runoff provide excellent erosion regulation and freshwater provision services

Outfall Node:

- Bioretention cells increase erosion regulation and freshwater provision services, but not to desired level

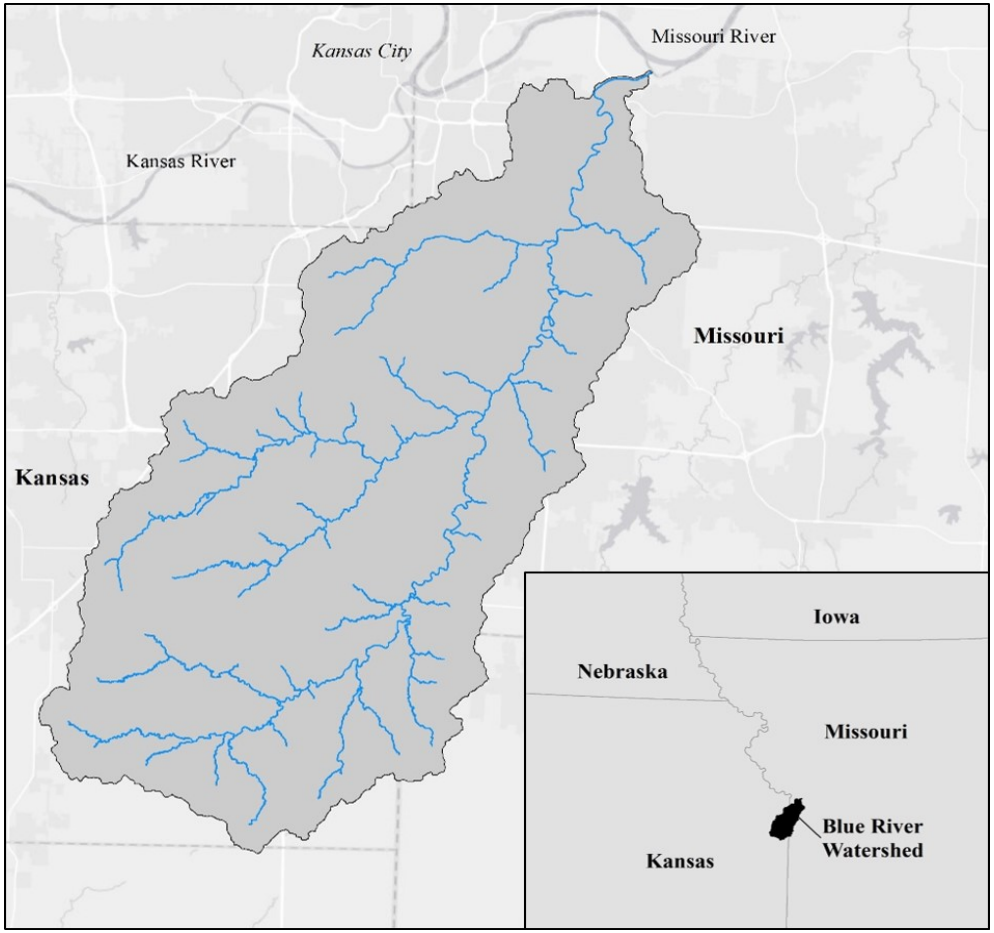


Research Project: How do spatial patterns of land cover provide flood mitigation ecosystem services in the urban landscape?

How do spatial patterns of land cover provide flood mitigation ecosystem services in the urban landscape?

Blue River Watershed (Kansas City, Kansas & Missouri)

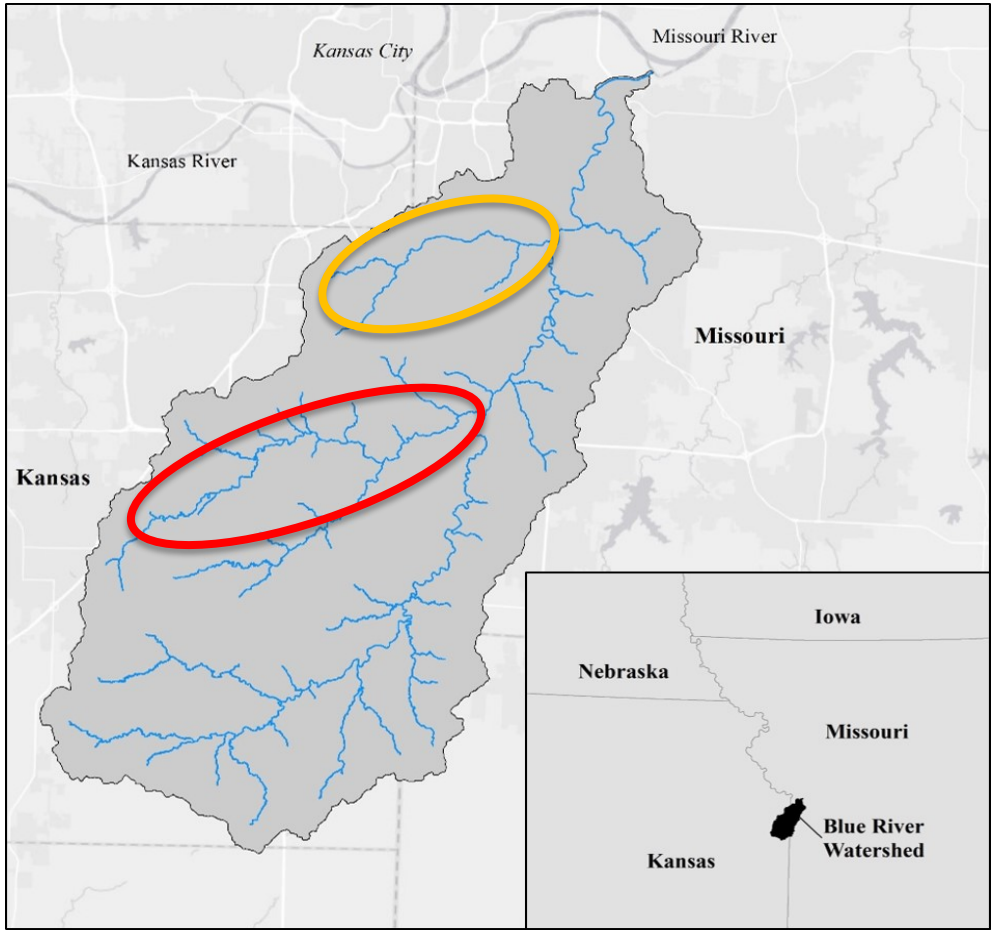
- 435 square miles
- Located within the greater Missouri River Basin



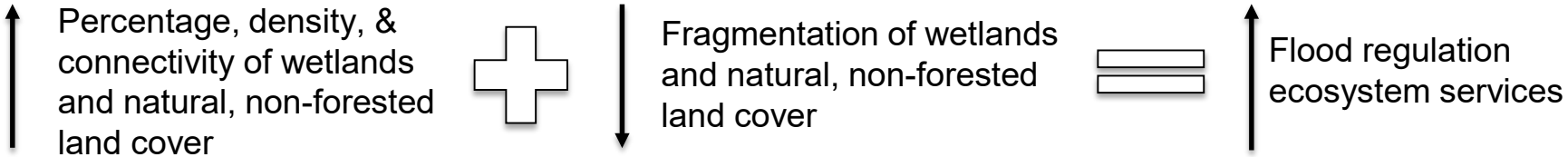
How do spatial patterns of land cover provide flood mitigation ecosystem services in the urban landscape?

Blue River Watershed (Kansas City, Kansas & Missouri)

- 435 square miles
- Located within the greater Missouri River Basin
- Flooding issues within Indian Creek and Brush Creek subwatersheds



How do spatial patterns of land cover provide flood mitigation ecosystem services in the urban landscape?



How do spatial patterns of land cover provide flood mitigation ecosystem services in the urban landscape?

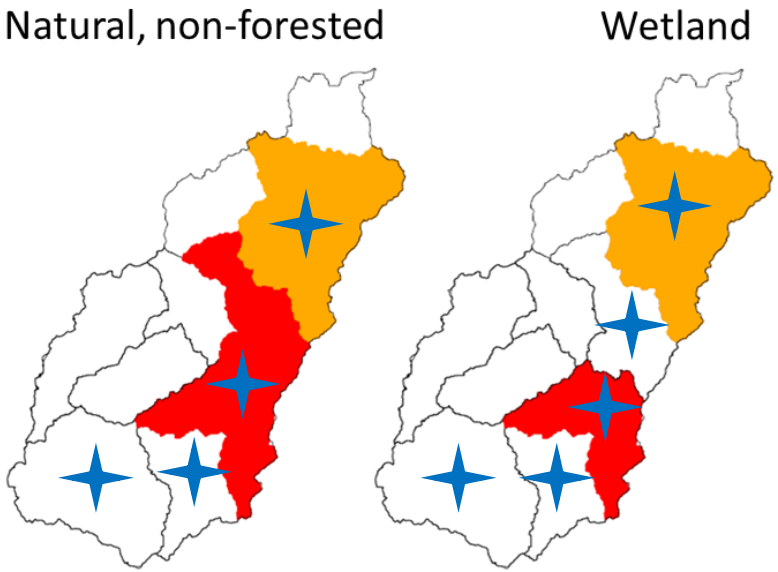
↑ Percentage, density, & connectivity of wetlands and natural, non-forested land cover

+

↓ Fragmentation of wetlands and natural, non-forested land cover

=

↑ Flood regulation ecosystem services



Areas where people will benefit from flood mitigation services:

- p value < 0.01
- p value: 0.01 – 0.05

Areas to provide the actual service through land use/land cover:

- denotes service-providing subcatchment

Ongoing Research:
AQUAKLIF and LANDKLIF

Ongoing Research: AQUAKLIF and LANDKLIF

AQUAKLIF: Investigate the effects of agricultural best management practices and climate change on ecosystem services in Bavaria

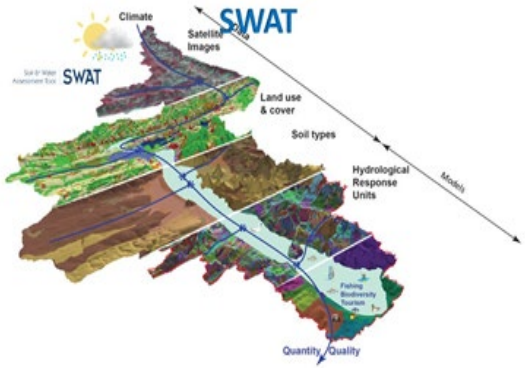
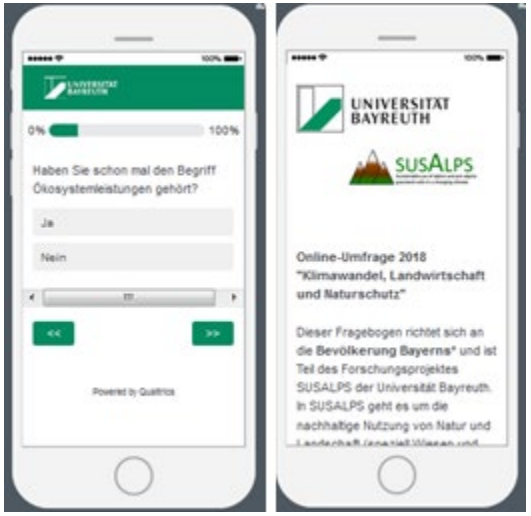


Figure Source: https://indico.cern.ch/event/143994/contributions/170181/attachments/133377/189256/SWAT_gridification_summary.pdf

Figure Source: https://www.gifex.com/fullsize1-en/2011-05-20-13710/Germany_map_2007.html

Ongoing Research: AQUAKLIF and LANDKLIF

LANDKLIF: Understand the effects of climate change under given land use changes on relevant ecosystem services for Bavaria



Ongoing Research: AQUAKLIF and LANDKLIF

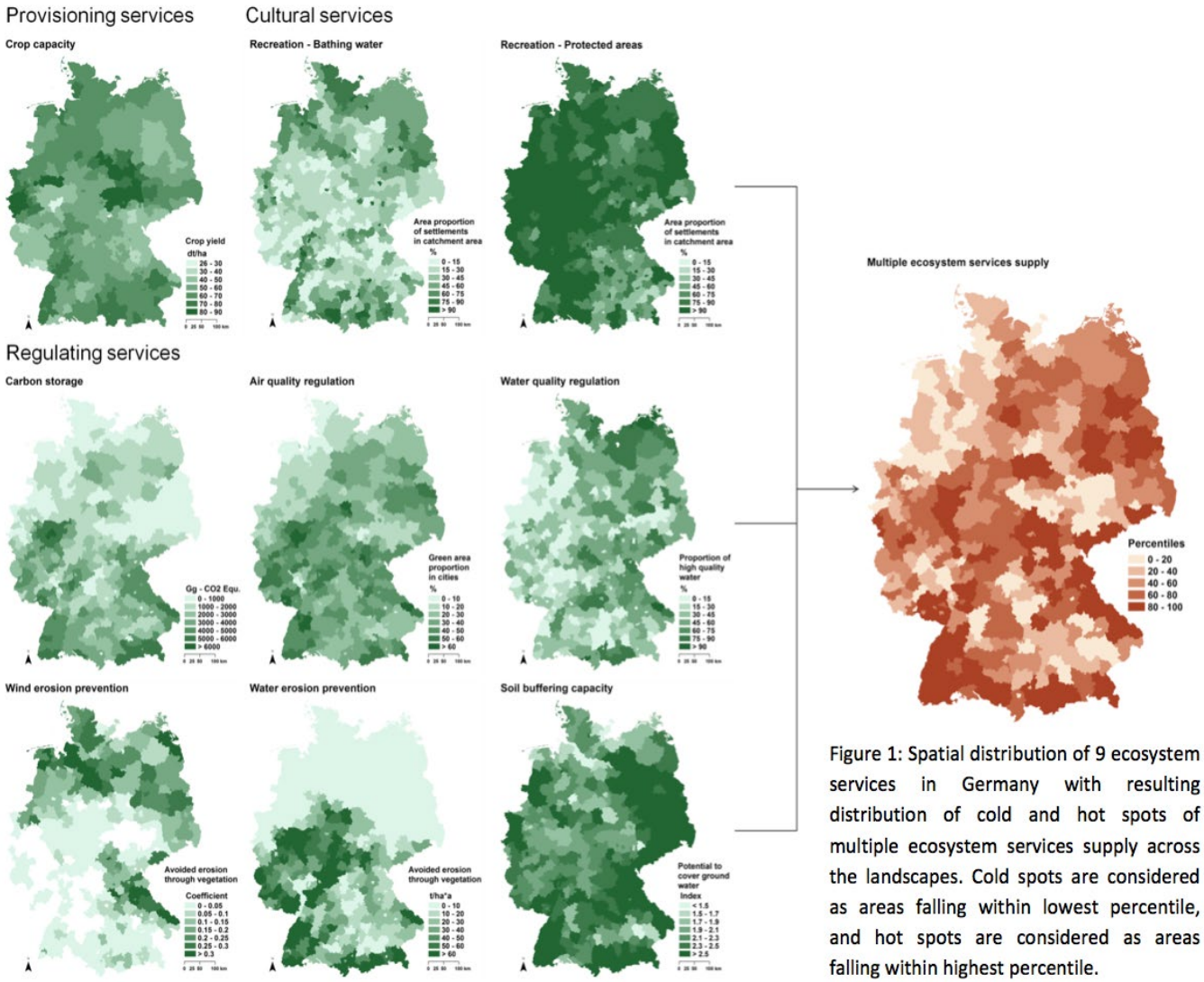


Figure 1: Spatial distribution of 9 ecosystem services in Germany with resulting distribution of cold and hot spots of multiple ecosystem services supply across the landscapes. Cold spots are considered as areas falling within lowest percentile, and hot spots are considered as areas falling within highest percentile.

Figure Source: Rabe et al. (2016) Ecological Indicators 70: 357-372.

Questions?

Contact:
Kelsey McDonough, PhD
Kelsey.McDonough@uni-bayreuth.de

NORTH CENTRAL REGION WATER NETWORK

Lisa Merrifield

Lisa Merrifield is the sustainable community specialist within University of Illinois Extension's Community and Economic Development Team. She works with University of Illinois faculty, Extension specialists, Extension Educators and community leaders to identify opportunities and approaches that help local governments and organizations address the challenges they face. Prior to joining Illinois Extension, Lisa served as assistant director for the Illinois Water Resources Center and Illinois-Indiana Sea Grant and as the executive director of the Great Lakes Regional Pollution Prevention Roundtable. Lisa has over 20 years of experience working to build sustainability in Illinois and around the Great Lakes. She has a bachelor's degree in environmental science and a Master's degree in Urban Planning with a focus on natural resource planning.

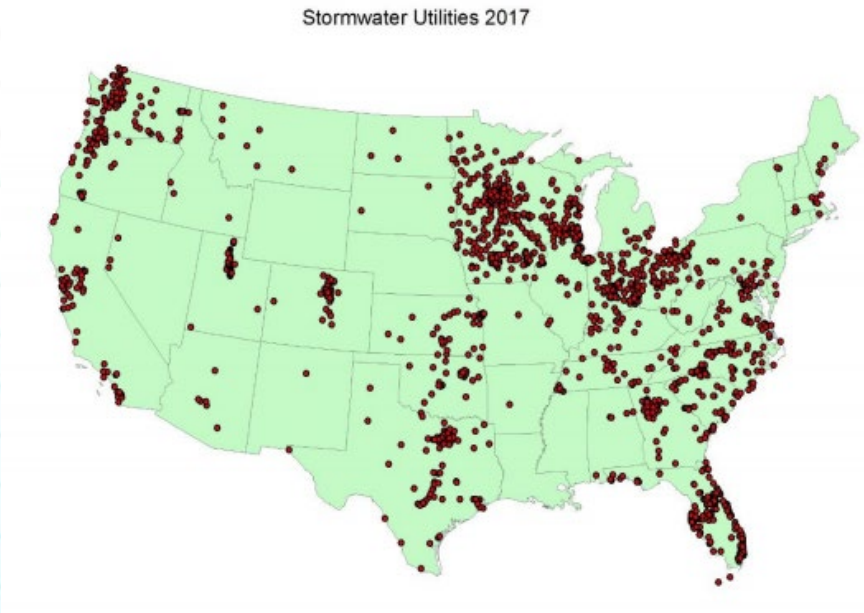
Economic and Societal Benefits of Green Infrastructure

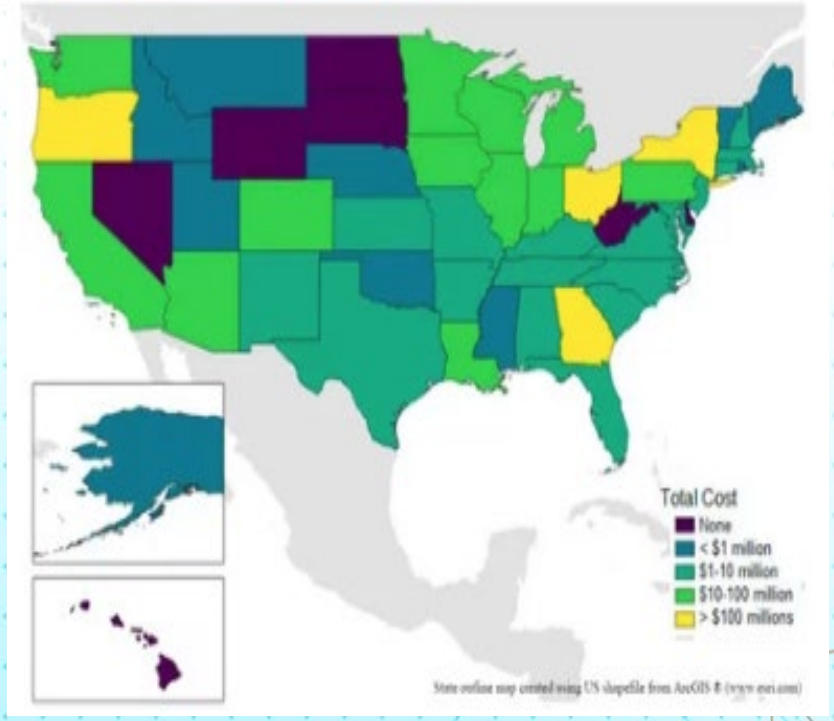
Lisa Merrifield
Community and Economic Development Specialist
lmorrisn@Illinois.edu
@LisaMerri
@ILextCED

Photo from Eliana Brown

Learning Objectives

- Understand where and why communities are incorporating green stormwater infrastructure into infrastructure plans.
- Identify the economic and societal reasons.
- Consider the opportunities for workforce development and improved societal equity.
- Become familiar some of the financing mechanism and tools.





https://www.wku.edu/seas/documents/swusurvey2017b.pdf

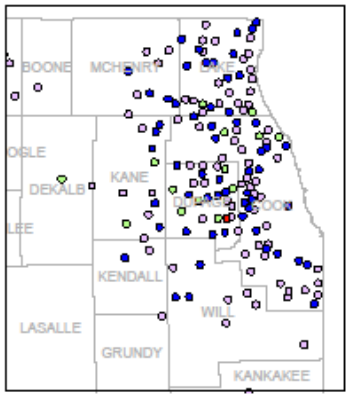
Zimmerman, R.; Brenner, R.; Llopis Abella, J. Green Infrastructure Financing as an Imperative to Achieve Green Goals. *Climate* **2019**, *7*, 39.

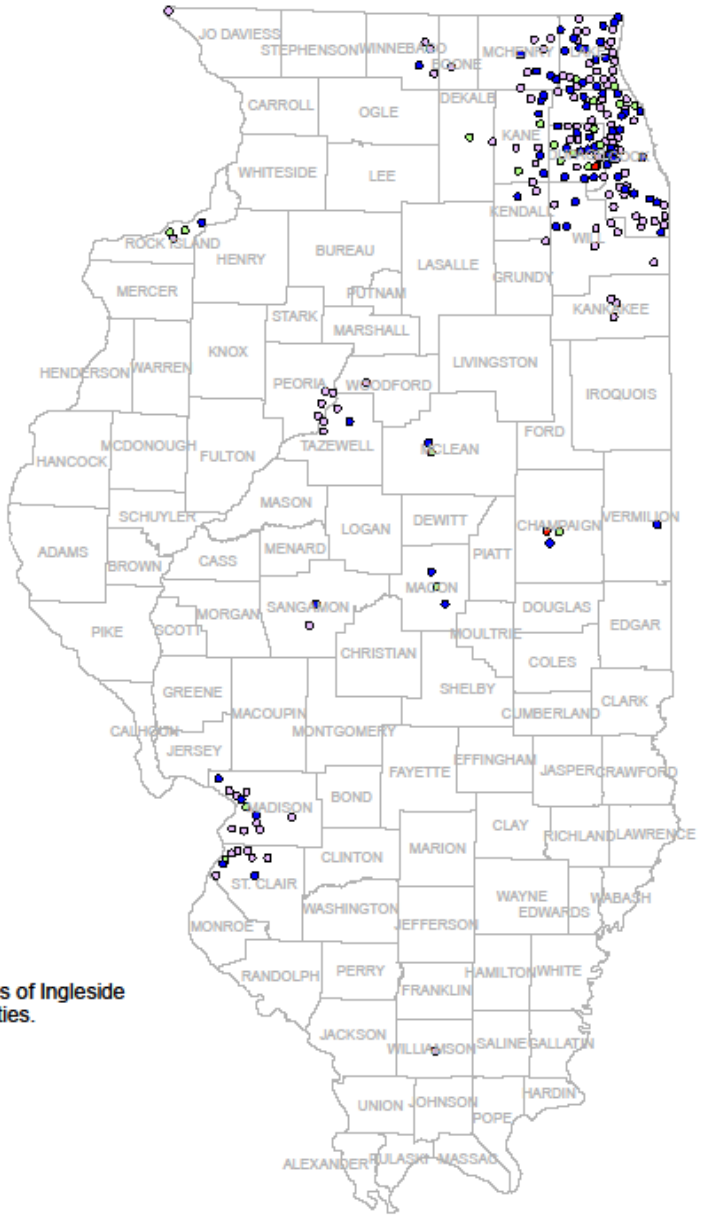
Illinois

Review of 212 communities with IEPA Municipal Separate Storm Sewer Permits

- 67% of communities had at least one GI practice
- 36 communities had over 3 practices
- Street sweeping programs were the most common, followed by
  - rain barrel programs,
  - raingardens,
  - green infrastructure grants,
  - stormwater utility fees,
  - bioswales

Number of GI Practices in Illinois MS4 Communities





Legend

Number of GI Practices

- 5 or More
- 3 - 4
- 1 - 2
- 0

Note: The unincorporated communities of Ingleside and Mossville are also MS4 communities.

ILLINOIS Extension
COLLEGE OF AGRICULTURAL, CONSUMER & ENVIRONMENTAL SCIENCES

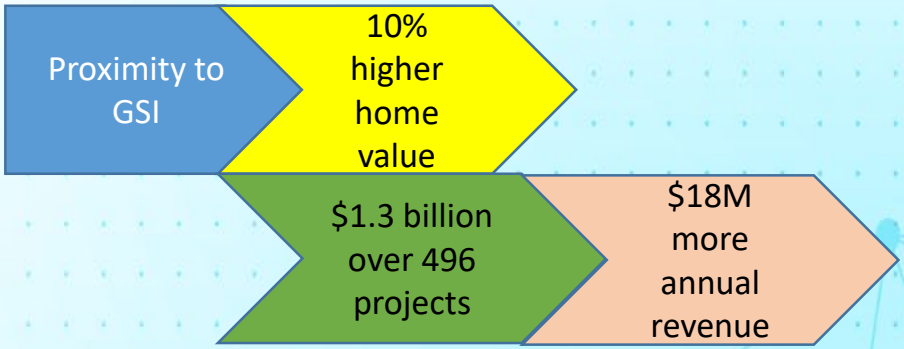
Why?

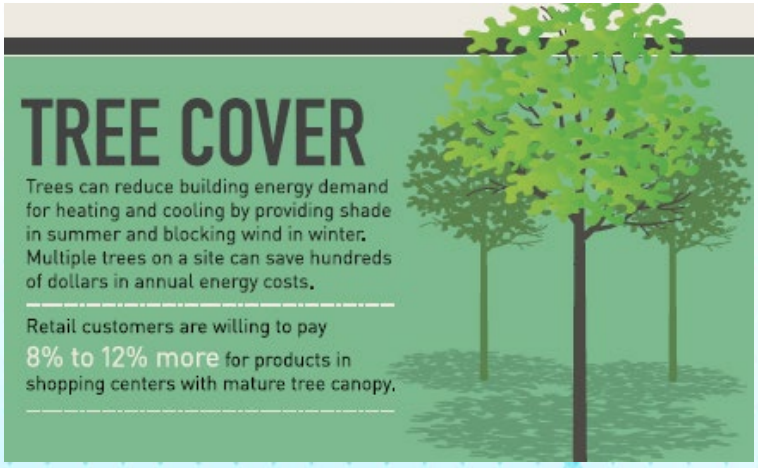
- 1972 Water Quality Act: regulates discharge of pollutants into water
- National Pollutant Discharge Elimination System: Requires cities, towns, and counties over 50,000 to obtain state permits to discharge into waters
- Municipal Separate Storm Sewer System Permits/Combined Sewer Overflow Permits: Many states incorporate GSI guidelines
- Sustainability goals
- Flood mitigation and natural disaster programs

Economic benefits

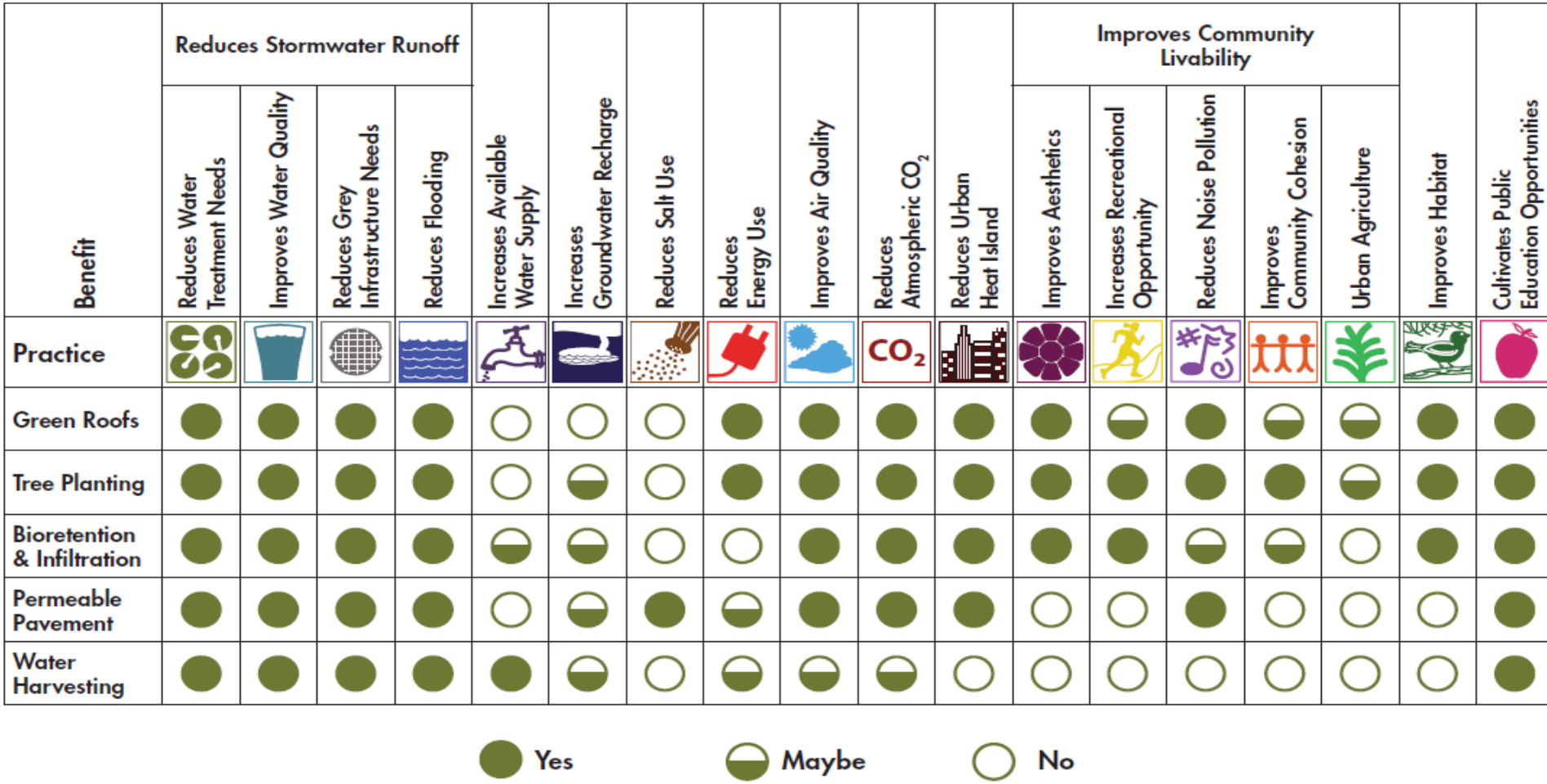
From Philadelphia Water Department
Green City, Clean Water Program

- $500 million in economic benefit
- $1.3 billion in societal benefits
- $400 million in environmental benefits





https://www.nrdc.org/sites/default/files/commercial-value-green-infrastructure-report.pdf



Source: CNT 2010. The Value of Green Infrastructure.
https://www.cnt.org/publications/the-value-of-green-infrastructure-a-guide-to-recognizing-its-economic-environmental-and

Equity and Social Justice

- Equity can be
  - Equality: everyone had equal access
  - Need: people in places with higher need receive more services
  - Demand: services are distributed based on willingness to pay
- Green infrastructure can provide recreational space to communities with equality issues and need issues

Maintenance and job opportunities

- Maintenance is often a concern
  - Research indicates that maintenance for GSI isn't more expensive than gray infrastructure
  - But the costs go towards ongoing maintenance (people and jobs) rather than deferred maintenance (pipes and heavy equipment)
- Workforce development
  - Approximately 200,000 GSI jobs are available
    - Semi skilled positions with pay comparable to similarly skilled positions
    - Construction, landscaping, groundskeeping, and water/wastewater
    - Water Environment Federation's National Green Infrastructure Certification Program is trying to standardize

Maintenance and job opportunities

Green Infrastructure Maintenance Training programs, like those offered in conjunction with the NGICP (National Green Infrastructure Certification Program), have been implemented by utilities and municipalities across the country. As the amount of green infrastructure increases, there is also an opportunity for job creation, especially for economically disadvantaged communities. The MWMO is studying the feasibility of developing a Green Infrastructure training program and seeks input from member communities and partners.

Green Infrastructure Career Development Program:

- Audience: *Youth, Young Adults, Unemployed and underemployed adults*

Green Infrastructure Professional Development Program:

- Audience: *Public Works, city/park maintenance crews, water resources professionals, landscaping contractors, etc.*

Building an Equitable and Just Green Infrastructure and Workforce

Project deliverables:

- Network map of GSI partners: Extension, Sea Grant, NGO, etc…
- State and local policy review for all states in the region
- Listening sessions for stakeholders and key informants in select cities
- Summit of key partners to identify gaps and opportunities

NORTH CENTRAL REGION WATER NETWORK

ILLINOIS Extension
COLLEGE OF AGRICULTURAL, CONSUMER & ENVIRONMENTAL SCIENCES

Sea Grant Michigan

PARKLAND COLLEGE GO AHEAD

PURDUE EXTENSION

SDSU Extension

UW Extension University of Wisconsin-Extension

think BIG thinkbigstrategies.com

UNIVERSITY OF MINNESOTA EXTENSION

LAKE SUPERIOR NATIONAL ESTUARINE RESEARCH RESERVE

Institute of Agriculture and Natural Resources
NEBRASKA EXTENSION

Northeast Ohio Regional Sewer District

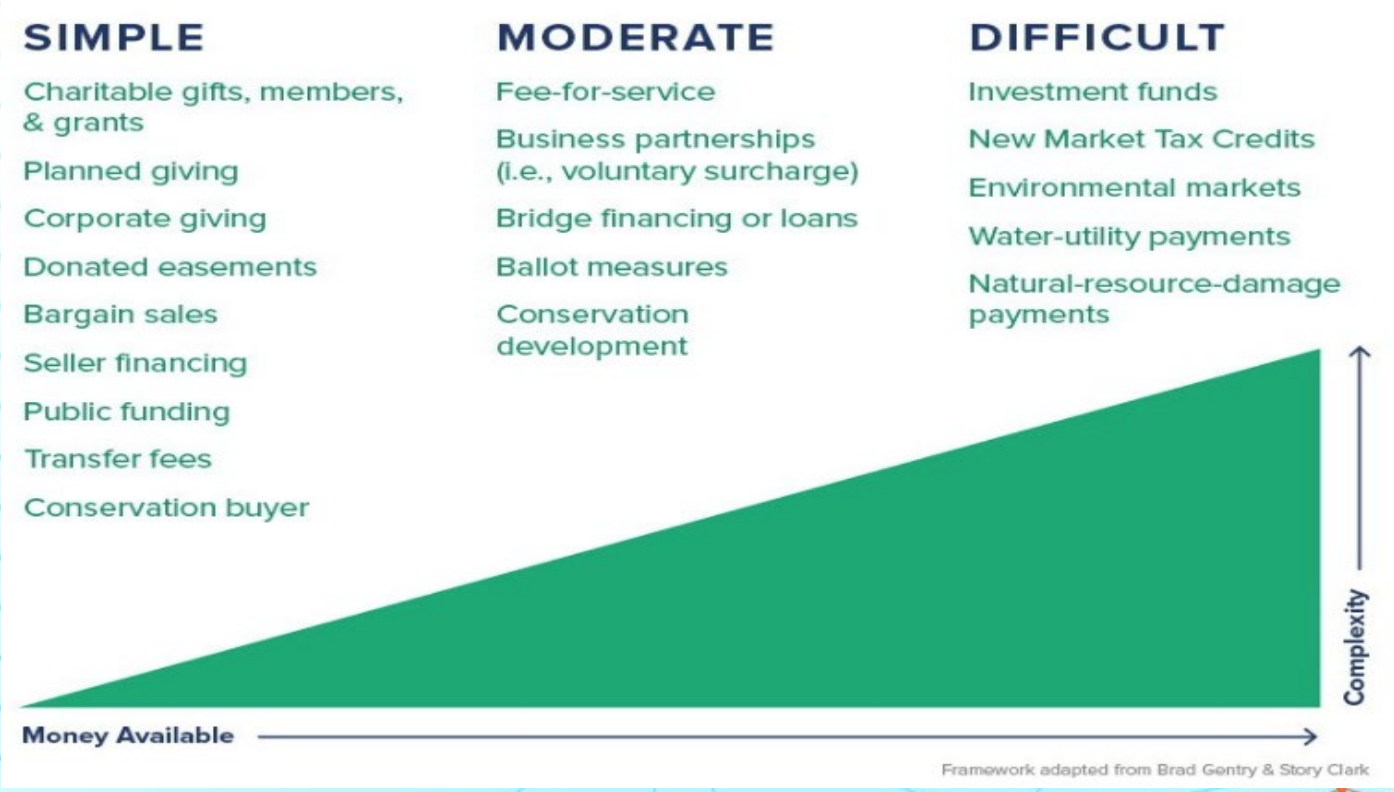
How do you pay for it?

Table 2. Distribution of financial tools by financial source.

	Grant	Bond	Loan	Tax	User Fee	Donation	Developer
Public	61	8	3	20	2	0	0
Private	0	0	0	0	0	8	1
Mixed	7	0	1	0	0	13	0
	Grant	Bond	Loan	Tax	User Fee	Donation	Developer
Public	64.9%	8.5%	3.2%	21.3%	2.1%	0.0%	0.0%
Private	0.0%	0.0%	0.0%	0.0%	0.0%	88.9%	11.1%
Mixed	33.3%	0.0%	4.8%	0.0%	0.0%	61.9%	0.0%

Zimmerman, R.; Brenner, R.; Llopis Abella, J. Green Infrastructure Financing as an Imperative to Achieve Green Goals. *Climate* **2019**, *7*, 39.

How do you pay for it?



https://www.conservationfinancenetwork.org/2017/11/27/launching-the-conservation-finance-network-toolkit

Thank you!

Lisa Merrifield
Community and Economic Development Specialist
University of Illinois Extension
lmorrisn@Illinois.edu
@LisaMerri
@ILextCED

Question and Answer Session

We will draw initial questions and comments from those submitted via the chat box during the presentations.

Today's Speakers

John McMaine – john.mcmaine@sdstate.edu
Kelsey McDonough – kelsey.mcdonough@uni-bayreuth.de
Lisa Merrifield – lmorrisn@illinois.edu

Thank you for participating in today's *The Current*!

Visit our website, northcentralwater.org, to access our webinar archive!

Our next webinar will be on Wednesday, June 12, 2019 at 2pm CT and will focus on groundwater. Visit northcentralwater.org/the-current for more information!