

**Environment and Natural Resources Trust Fund
2015 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 041-B

Determining Stormwater Pollution Sources to Improve Urban Waters

Category: B. Water Resources

Total Project Budget: \$ 538,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2015 - June 2018

Summary:

Urban lakes are highly polluted by excess nutrients. Determining the major sources of nutrients to stormwater will lead to cost-effective strategies for improving urban water quality, to benefit all Minnesotans.

Name: Sarah Hobbie

Sponsoring Organization: U of MN

Address: 1987 Upper Buford Cir, 100 Ecology,
St. Paul MN 55108

Telephone Number: (612) 625-6269

Email shobbie@umn.edu

Web Address _____

Location

Region: Metro

County Name: Anoka, Carver, Dakota, Hennepin, Ramsey, Scott, Washington

City / Township:

Alternate Text for Visual:

We will determine the relative importance of major sources of polluting nutrients to urban waters, lawn runoff into streets, litterfall into streets (flowers, seeds, leaves), and atmospheric deposition into streets, to give decision-makers information to develop more cost-effective strategies to improve water quality by stopping nutrients at their source, and preventing them from polluting urban lakes and streams.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	



I. PROJECT STATEMENT

We will determine the relative importance of major sources of polluting nutrients to urban waters, to give decision-makers and managers information to develop more cost-effective strategies to improve water quality by stopping nutrients at their source (city streets), thereby preventing them from polluting urban lakes and streams. For example, our study will enable cities to target street sweeping where litterfall and airborne sediments dominate nutrient pollution to streets, education of homeowners about proper yard care where lawn runoff dominates, and investment in downstream best management practices where rain inputs dominate.

Urban waters remain highly polluted, despite millions of dollars aimed at water quality improvement.

Lakes and streams are part of Minnesota’s identity, providing all kinds of benefits. Yet, 150 lakes are legally “impaired” by nutrient enrichment in the 7-county Twin Cities metro region, and only one has been restored.

Knowing the relative importance of different pollution sources to urban runoff can lead to cost-effective solutions to water pollution. Although we know that high nutrient loading from urban runoff causes urban water pollution, the extensive stormwater monitoring by various agencies cannot discern the amount and relative importance of the three main sources of pollution to urban runoff: “litterfall” (flowers, seeds, leaves that drop into streets), lawn runoff, and atmospheric deposition (nutrients that fall into streets in rain, snow, or air-borne sediment). Knowledge of sources could enable cities to target the most important pollution sources, to get the greatest return on investment in water quality management to meet federal stormwater regulations.

We will quantify the importance of different sources of nutrient pollution to streets and stormwater, generating publicly available, web-disseminated pollution source maps for streets in the Twin Cities metro area, showing lawn runoff (Activity #1), litterfall (Activity #2), and atmospheric deposition (Activity #3). Estimates of one of these sources, litterfall, for the city of Prior Lake has generated state-wide interest in the potential to use street sweeping to manage water quality, including from St. Paul, Minneapolis, Edina, Rochester, Blaine, Waconia, Brooklyn Center, and Golden Valley, and watershed districts and management organizations.

Our project will bring together experts in hydrology, ecology, engineering, and nutrient pollution to provide new knowledge and tools to help solve urban water quality problems and increase the use and enjoyment of city lakes and streams by all Minnesotans.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Quantify nutrient pollution source #1: urban lawn nutrient runoff **Budget: \$142,000**

There are no existing estimates of urban lawn nutrient runoff for the Twin Cities, making it difficult for cities to know where it would be cost-effective to educate homeowners about proper yard care to improve water quality. We will use a coupled hydrologic-nutrient model to estimate contributions of lawns to nutrient runoff under different fertilization rates, slopes, rainfall, and snowfall. These estimates will be scaled to the Twin Cities metro area using Lidar-derived estimates of slope and newly available detailed land cover maps.

Outcome	Completion Date
1. A coupled hydrologic-nutrient lawn runoff model.	December 2016
2. Publicly available maps of lawn nutrient runoff for Twin Cities metro area streets.	June 2017

Activity 2: Quantify nutrient pollution source #2: litterfall nutrients **Budget: \$185,000**

Except for Prior Lake, there are no estimates of yearly litterfall nutrient inputs to Twin Cities streets, making it difficult for cities to know where it would be cost-effective to increase street sweeping efforts to improve water quality. We will estimate litterfall nutrient inputs at the scale of the entire Twin Cities Metro Area, using relationships between canopy cover over streets and litterfall nutrient inputs to streets developed from our past research in Prior Lake and newly available detailed tree cover maps.

Outcome	Completion Date
1. Estimates of annual litterfall nutrient fluxes to streets under high canopy conditions, to augment litterfall nutrient fluxes already determined for low and moderate canopy	December 2016



conditions with past funding.	
2. Publicly available maps of litterfall nutrient fluxes to all Twin Cities metro area streets.	June 2017

Activity 3: Quantify nutrient pollution source #3: atmospheric deposition of nutrients Budget: \$167,000

Atmospheric nutrient deposition is not monitored currently in the Twin Cities, making it difficult for cities to know where high rates of deposition would make stormwater ponds or similar management cost-effective to improve water quality. We will measure nutrients in atmospheric deposition in residential neighborhoods, commercial/industrial areas, and downtown areas and scale to the Twin Cities using detailed land cover maps.

Outcome	Completion Date
1. Estimates of nutrients in atmospheric deposition for different urban land covers (residential neighborhoods, commercial/industrial, and downtown areas)	December 2016
2. Detailed maps of deposition for all Twin Cities metro area streets.	June 2017

Activity 4: Compare total pollution sources with stormwater nutrient exports Budget: \$44,000

We will compare total nutrient pollution inputs to streets (calculated in Activities 1-3) with stormwater nutrient exports for 12 watersheds to help cities and watershed districts/management organizations understand whether watersheds with particular sources of pollution are more likely to export those pollutants to stormwater and contribute to downstream pollution of urban lakes and rivers, so that they can target management efforts in those watersheds. Met Council and four WDs/WMOs will be covering nearly all monitoring costs, except for funds we request to fill gaps in some monitoring periods.

Outcome	Completion Date
1. A comparison of yearly nutrient pollution inputs to streets with yearly stormwater nutrient exports for 12 watersheds.	June 2018

III. PROJECT STRATEGY

A. Project Team/Partners

Project Team: PI Sarah Hobbie (UMN) is a plant and soil ecologist who will lead litterfall work; co-PI Jacques Finlay (UMN) is a biogeochemist who will lead atmospheric deposition work and comparisons with stormwater export monitoring data; co-PIs Lawrence Baker (environmental engineer) and Bruce Wilson (hydrologist) (both UMN) will lead lawn runoff modeling work. Hobbie, Finlay, and Baker will receive salary from the project. Wilson requires no salary. All will collaborate to advise two postdoctoral researchers, a research technician, and undergraduate students who will conduct much of the modeling and measurement efforts.

Project Partners (no ENRTF funds): Capitol Region Watershed District, Mississippi Watershed Management Organization, Ramsey Washington Watershed District, South Washington Watershed District, and Met Council will be covering nearly all costs for monitoring stormwater runoff that can be compared directly to the nutrient input estimates. All partners have been enthusiastic about our past and ongoing efforts to understand nutrient pollution in the Twin Cities metro area, and have welcomed our analyses of their extensive monitoring data.

B. Project Impact and Long-Term Strategy. The research will fill key knowledge gaps in understanding urban lake nutrient pollution by revealing the importance of three sources of nutrients to stormwater and producing web-accessible maps of these sources that can be used by planners and managers to find cost-effective solutions to cleaning up urban water pollution.

C. Timeline Requirements. The proposed project will be completed in the allotted three-year period, with Activities 1-3 occurring during years 1 and 2, and Activity 4 occurring in years 1-3.

2015 Detailed Project Budget

Project Title: Determining stormwater pollution sources to improve urban waters

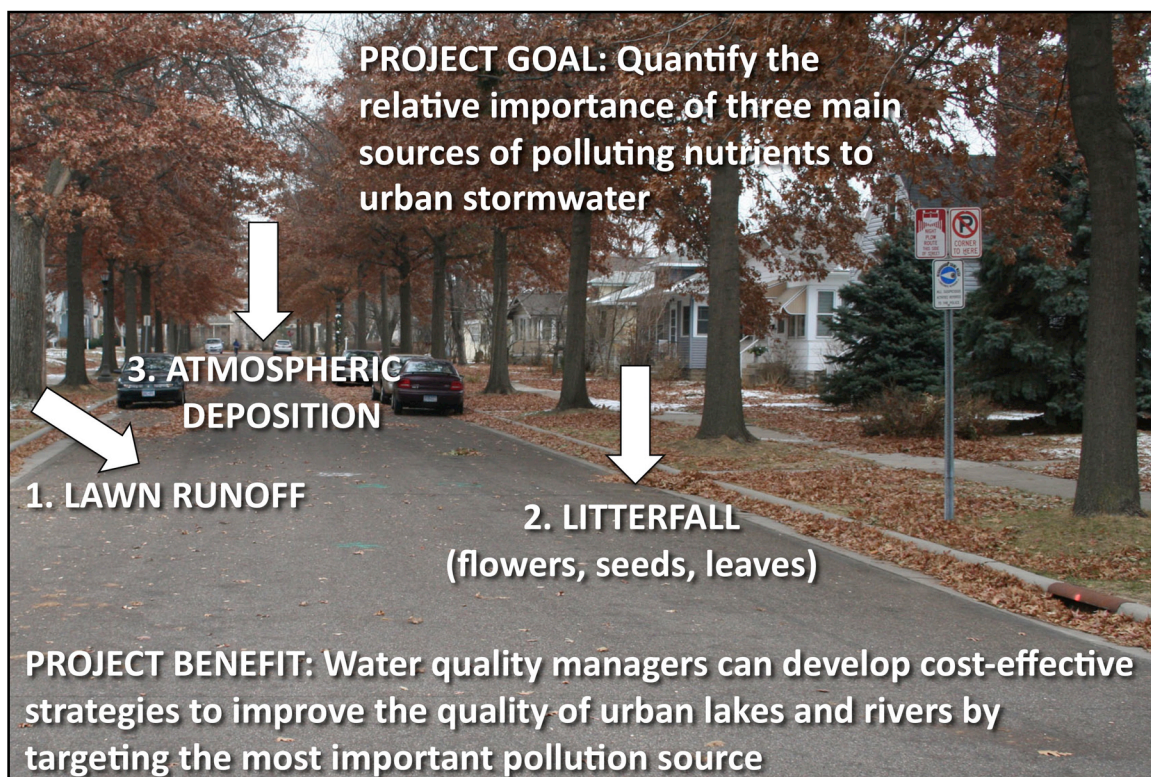
IV. TOTAL ENRTF REQUEST BUDGET 3 years

<u>BUDGET ITEM</u>	<u>AMOUNT</u>
Personnel: Sarah Hobbie - 1 summer month in years 1 & 2 (75% salary, 25% fringe) to serve as project manager and lead the research on litterfall, and contribute to the development of the lawn runoff model and to the design of the atmospheric deposition sampling program.	\$ 34,000
Lawrence Baker - 1 month in years 1 & 2 (75% salary, 25% fringe) to co-advise a postdoctoral research associate to develop the lawn runoff model and develop maps of lawn runoff, litterfall, and atmospheric deposition maps.	\$ 27,000
Jacques Finlay - 1 summer month in years 1 & 2 (75% salary, 25% fringe) to advise a postdoctoral research associate to carry out the atmospheric deposition research and contribute to the development of the lawn runoff model and be the liaison with partner agencies to expand watershed sampling efforts.	\$ 27,000
Bruce Wilson - No salary requested (0% salary, 0% fringe). Wilson will work with Baker to co-advise a postdoctoral research associate to develop the lawn runoff model and develop maps of lawn runoff, litterfall, and atmospheric deposition maps.	\$ -
Postdocs - Two postdocs full-time in years 1 & 2 and one postdoc for 6 months in year 3 (83% salary, 17% fringe) One postdoc will develop the lawn runoff model and maps of lawn runoff, litterfall, and atmospheric deposition for the Twin Cities Metropolitan Area. A second postdoc will work full time to sample atmospheric deposition and to assist with developing maps of lawn runoff, litterfall, and atmospheric deposition for the Twin Cities Metropolitan Area, and conduct stormwater export comparisons.	\$ 257,000
Technician - 75 % time (73% salary, 27% fringe)	\$ 108,000
Undergraduates - 2 undergraduates at 50% time during the academic year in years 1 and 2, plus 3 undergraduates at 100% time during the summer in years 1 and 2 (95% salary, 5% fringe)	\$ 51,000
Equipment/Tools/Supplies: Computer supplies and lab/field supplies Supplies include chemicals to conduct nutrient analyses, filtration equipment, collectors for atmospheric deposition, paper bags for collecting leaf litter samples, sample bottles to hold stormwater samples, etc.	\$ 19,000
Travel: Travel is requested to visit sampling stations by car to collect atmospheric deposition samples and to collect stormwater samples from 12 watersheds	\$ 7,000
Additional Budget Items: GIS fees	\$ 4,000
Lab analyses. Funds are requested to pay for litterfall nutrient analyses	\$ 4,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 538,000

V. OTHER FUNDS (This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)

<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
Other Non-State \$ To Be Applied To Project During Project Period: N/A	\$ -	N/A
Other State \$ To Be Applied To Project During Project Period: N/A	\$ -	N/A
In-kind Services To Be Applied To Project During Project Period: Indirect Costs (52% MTDC) associated with this proposal	\$ 279,000	Secured
Funding History: \$10,000 - Institute on the Environment Mini-Grant., "Citizen Phenology Network to Inform Water Quality Management" \$30,428 – Water Resources Center Competitive Grants Program. "Tracing nutrient sources at the land-water interface in urban environments" \$400,000 - Institute on the Environment Discovery Grant, "Connecting People, Trees, and Water in Urban Ecosystems" \$285,970 - EPA Section 319(h): "Quantifying phosphorus load reductions from street sweeping"	\$ 726,398	
Remaining \$ From Current ENRTF Appropriation: N/A	\$ -	N/A

Determining stormwater pollution sources to improve urban waters



Determining stormwater pollution sources to improve urban waters

PROJECT MANAGER QUALIFICATIONS AND ORGANIZATION DESCRIPTION

Project Manager: Sarah E. Hobbie

Professional Appointments and Preparation

Director of Graduate Studies, Ecology, Evolution and Behavior Graduate Program, 2011-present
Professor, University of Minnesota, 2011-present
Associate Professor, University of Minnesota, 2004-2011
Assistant Professor, University of Minnesota, 1998-2004
Postdoctoral Scholar, Stanford University, 1995-1998
Ph. D. Integrative Biology, University of California at Berkeley, 1995
B.A., *magna cum laude*, Biology, Carleton College, 1986

Expertise

Carbon and nutrient dynamics, decomposition processes, urban biogeochemistry

Honors and Service (selected)

Graduate and Professional Teaching Award, 2014; Member, National Academy of Sciences, elected 2013; Institute on the Environment Resident Fellow, 2010-2012; Aldo Leopold Leadership Program Fellow, 2008; McKnight Land-Grant Professorship, 2000-2001; National Science Foundation; Postdoctoral Research Fellowship, 1995-1997; NASA Global Change Graduate Fellowship, 1992-1995; National Science Foundation Doctoral Dissertation Improvement Grant, 1992-1994; National Science Foundation Graduate Fellowship, 1989-1992; Phi Beta Kappa, 1986; National Merit Scholar, 1982-1986

Project Management Experience and Qualifications

Principal or co-principal investigator on >30 research grants from National Science Foundation, US Department of Energy, University of Minnesota. Among others, Hobbie has managed two projects directly related to the proposed ENRTF research. She is principal investigator for a University of Minnesota Discovery Grant focused on understanding nutrient flows from land to water in cities (the primary research highlighting the need for the proposed ENRTF research) and co-lead investigator for an EPA 319 grant for which her laboratory developed protocols for quantifying the input of nutrients to streets from litterfall for the city of Prior Lake. With Stormwater U, UMN's Extension Service program focused on stormwater, Hobbie helped develop pilot practitioner workshops to introduce cities and agencies to the results of the Prior Lake study.

Peer-reviewed publications

>160 peer-reviewed publications

Organization Description

The **University of Minnesota** is one of the nation's largest universities, with 68,000 students, offering baccalaureate, master's, and doctoral degrees. Its mission includes research and discovery, teaching and learning, and outreach and public service.