

**Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 074-B

Trace Organic Contaminants in Groundwater from Stormwater Infiltration

Category: B. Water Resources

Sub-Category:

Total Project Budget: \$ 910,000

Proposed Project Time Period for the Funding Requested: June 30, 2024 (4 yrs)

Summary:

Organic contaminants may be transported to groundwater from stormwater infiltration. Contaminants may be carried downstream to drinking water sources or receiving streams with unknown consequences for human and ecological health.

Name: Sarah Elliott

Sponsoring Organization: U.S. Geological Survey

Job Title: _____

Department: _____

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Mounds View MN 55112

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Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Contaminated stormwater runoff originating from urban and residential settings. Three different practices used to infiltrate stormwater which may transport contaminants to underlying groundwater and connected drinking wells or surface waters.

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



PROJECT TITLE: Trace organic contaminants in groundwater from stormwater infiltration

I. PROJECT STATEMENT

Trace organic contaminants (TrOCs) are present in stormwater runoff at concentrations that rival wastewater treatment plant effluent. When stormwater is infiltrated, it may transport TrOCs to groundwaters that serve as drinking water sources or that discharge to surface waters. **We will measure the mass inputs and associated toxicity of 400 TrOCs to groundwaters receiving infiltrated stormwater using passive samplers.** This data will provide planners and water resource managers with knowledge for informed decision-making regarding stormwater management.

Stormwater is increasingly recognized as a substantial TrOC source and/or pathway in the environment.

Recent research in the Twin Cities Metropolitan area documented the presence of more than 100 TrOCs in stormwater runoff, including pharmaceuticals, industrial compounds, pesticides, and personal care products. Results also show that untreated stormwater can affect vertebrate biological functions related to hormones, tissue repair, and fat metabolism.

Recent efforts to reduce stormwater discharges to surface water promote infiltration of stormwater runoff using green infrastructure practices such as bioinfiltration basins, tree trenches, and permeable pavements. The amount of stormwater currently infiltrated by green infrastructure is relatively small but is expected to increase because new developments must consider infiltration for stormwater management. **Groundwater contamination may affect human health through drinking water and ecological/biological health in connected surface waters.**

This work will help establish a reasonable level of concern for stormwater infiltration to groundwater in Minnesota municipalities and address how site design may influence TrOC transport in the environment. We will focus on different types of infiltration practices, site designs, and landscape settings to optimize the project’s value toward informing management decisions regarding infiltration BMP design and installation.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1 Title: Measure TrOCs and toxicity in groundwater and untreated stormwater

Description: Groundwater and untreated stormwater at up to five stormwater infiltration sites and groundwater at up to two wastewater rapid infiltration sites will be sampled. Passive samplers will be used to characterize the chemical and toxicological profile of: (1) groundwater up- and downstream of stormwater infiltration sites four times over two years, (2) untreated stormwater two times over two years, and (3) groundwater downstream of wastewater facilities four times over two years. Samples will be analyzed for approximately 400 TrOCs including pharmaceuticals, pesticides, and organic wastewater chemicals. A subset of samples will be analyzed using a suite of established biological assays that can quantify biological activity/toxicity associated with poor health outcomes.

ENRTF BUDGET: \$727,800

Outcome	Completion Date
1. Select BMP and wastewater rapid infiltration sites	January 2021
2. Collect (passive) water-quality samples (58 environmental and 12 QA/QC sample)	November 2022
3. Chemical and toxicological analyses of water-quality samples	February 2023

Activity 2 Title: Measure groundwater levels upstream and downstream of infiltration sites to estimate water flows



**Environment and Natural Resources Trust Fund (ENRTF)
2020 Main Proposal**

Description: Pressure transducers installed at all sites will continuously record water level upstream and downstream of infiltration sites to monitor flow rates and effects on local groundwater levels. Computer-based hydrogeological data modeling will estimate infiltration rates and input or removal rates of individual TrOCs.

ENRTF BUDGET: \$65,600

Outcome	Completion Date
1. Install pressure transducers at all sites	May 2021
2. Download, process, and analyze data	January 2023

Activity 3 Title: Calculate contaminant loading to groundwater, screen chemical data against toxicity data, compare chemical data and biological activity across site types

Description: Data will be thoroughly quality assured and made publicly available upon completion of USGS review. Contaminant loads will be calculated to determine TrOC mass inputs to groundwater and compare different infiltration practices. To understand potential ecological and human-health impacts, TrOC data will be compared against publicly available toxicity databases to identify biological targets of measured TrOCs. Results will be disseminated to the scientific community, water resource managers, and public through scientific report(s), local and/or national conferences, and communication with relevant agencies/groups (e.g. MPCA, MDH, MDA, UMN, MN Stormwater Research Council)

ENRTF BUDGET: \$116,600

Outcome	Completion Date
1. Quality assured data	April 2023
2. Data analysis & interpretation	August 2023
3. Report preparation	May 2024

III. PROJECT PARTNERS AND COLLABORATORS:

The project team has considerable experience investigating TrOCs and potential biological effects in the environment, wastewater, and the environment. The Principal Investigator, Elliott (USGS), has studied the occurrence of TrOCs in Minnesota’s water resources for 10 years and is an expert in data management and analysis. Richard Kiesling (USGS) is an expert in water-quality sampling and statistical analysis. David Fairbairn (MPCA) has expertise in TrOCs, stormwater, water resources, and analysis. Dalma Martinović-Weigelt (UST) has expertise in toxicology and analysis of complex biomolecular datasets. All project partners will contribute to study design, site selection, data analysis and interpretation, and dissemination. Data management, quality assurance, and reporting will be completed by USGS to meet rigorous Federal standards and ensure that the final data are publicly available.

IV. LONG-TERM IMPLEMENTATION AND FUNDING:

This project will enhance and support ongoing research on the occurrence of TrOCs and biological effects of TrOCs in stormwater and groundwater, and the ability of stormwater infiltration to remove these harmful contaminants and their toxicity. Most existing stormwater TrOC research has focused on surface water impacts, with groundwater impacts rarely considered, let alone quantified. This study will provide valuable information to urban planners and water resource management decisions on application of infiltration practices to manage Minnesota stormwater and wastewater streams, which will provide great returns for health and water resource protection throughout Minnesota.

V. SEE ADDITIONAL PROPOSAL COMPONENTS: A, B, F

Attachment A: Project Budget Spreadsheet
 Environment and Natural Resources Trust Fund
 M.L. 2020 Budget Spreadsheet



Legal Citation:
 Project Manager: Sarah Elliott
 Project Title: Understanding contaminant transport to groundwater from stormwater infiltration
 Organization: US Geological Survey
 Project Budget: \$910,000
 Project Length and Completion Date: 4 yrs, June 2024
 Today's Date: April 15, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	\$ 449,903	\$ -	\$ 449,903
USGS Personnel: Hydrologist (67% salary, 33% benefits) Three individuals, one at 28% FTE over three years, one at 14% FTE over three years, and one at 13% FTE. Project management, study design, staff and other resource scheduling, project budgeting, chemical data review and analysis, groundwater level analysis and interpretation, report preparation, results dissemination. \$103,482			
USGS Personnel: Technician (75% salary, 25% benefits) Two individuals at 18% FTE over 2 years and one individual at 2% FTE over 1 year. Monitoring well installation and abandonment, equipment installation, sample collection and processing, water level measurements, review and approve water level data.			
USGS Personnel: Research chemist (74% salary, 26% benefits) One individual at 5% FTE over two years. Passive sampler construction, extraction, data quality assurance and analysis. \$87,200			
USGS Personnel: Water-quality specialist (74% salary, 26% benefits) One individual at 18% FTE over three years. Study design, quality control, technical assistance, data analysis and interpretation. \$48,840			
USGS Personnel: Administrative assistant (70% salary, 30% benefits), IT specialist (68% salary, 32% benefits), and database assistant (78% salary, 22% benefits). One individual each at 22%, 28%, and 2% FTE over four years. Administrative support for funding agreements, cost accounting, and billing. Technology support to meet USGS standards and requirements. Database support to meet USGS			
USGS Personnel: Program Manager (70% salary, 30% benefits) 28% FTE over four years. Project supervision, staff and other resource scheduling, quality control and technical support. \$45,581			
Professional/Technical/Service Contracts			
Contract with University of St. Thomas to assist with toxicity data analysis and interpretation was selected through a competitive bid process	\$ 10,197	\$ -	\$ 10,197
Equipment/Tools/Supplies			
Sampling supplies: hardware (metal holder & casing) for 10 passive samplers, 56 passive samplers, solvents for passive sampler extraction, organic blank water, methanol, gloves, 168 1L bottles, gloves,	\$ 125,000	\$ -	\$ 125,000
Equipment rental: 14 pressure transducers for 24 months at \$79 per month	\$ 20,000		\$ 20,000
Well drilling and sealing supplies such as well casings, well screens, clay, cement, protective casings, use of Geoprobe.	\$ 33,000		\$ 33,000
Printing			
Open access fees for 2 scientific journal reports	\$ 10,000	\$ -	\$ 10,000
Travel expenses in Minnesota			
Local travel to sites for sample collection and downloading transducer data for an estimated 8 trips per site and 200 miles.	\$ 6,000	\$ -	\$ 6,000
Other			
Shipping costs for samples to analyzing laboratories and rental equipment.	\$ 5,000	\$ -	\$ 5,000
Chemical analysis of 70 samples and toxicity analysis of 16 samples	\$ 250,000		\$ 250,000
Conference registration. 3 at \$300 each	\$ 900		\$ 900
COLUMN TOTAL	\$ 910,000	\$ -	\$ 910,000

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		\$ -	\$ -	\$ -
USGS Cooperative Matching Funds will be used to cover indirect costs for USGS portion of the study	Pending	\$ 235,000		
State:		\$ -	\$ -	\$ -
In kind:		\$ -	\$ -	\$ -
Salary for David Fairbairn will be provided in-kind for technical assistance with study design and data interpretation	Secured	\$ 30,000		
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		\$ -	\$ -	\$ -

What are the human and ecological health concerns of infiltrating stormwater?

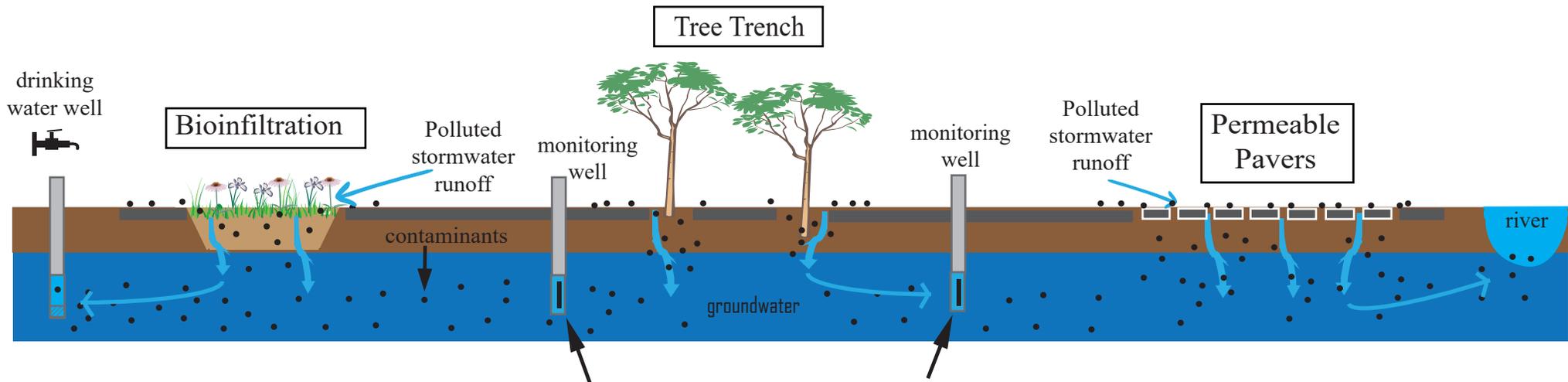


Stormwater runoff picks up contaminants from the landscape:

- Fertilizers
- Pet waste
- Vehicles
- Pesticides
- Pharmaceuticals



Various infiltration practices are used to reduce the volume of stormwater directly entering nearby surface waters.



Installing passive samplers in monitoring wells upgradient and downgradient of infiltration practices can provide data about the presence of contaminants in groundwater from infiltrating stormwater.

Sarah Elliott, Hydrologist

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Biography

Sarah has 10 years of experience participating in and leading projects focused on understanding the presence and effects of trace organic contaminants in the environment. Sarah has experience with relatively large-scale projects and collaborating with scientists from Federal and State agencies. Sarah has a record of completing projects on time and within budget and effectively communicating results to cooperators and/or stakeholders.

Education

2008, B.A., Environmental Science, Policy, and Management, University of Minnesota

2010, M.S., Water Resources Science, University of Minnesota

Selected Publications

Elliott, S.M., Erickson, M.L., Krall, A.L., Adams, B.A., 2018, Concentrations of pharmaceuticals and other micropollutants in groundwater downgradient from large on-site wastewater discharges. PLoS ONE, 13(11): e0206004. <https://doi.org/10.1371/journal.pone.0206004>.

Kiesling, R.L., Elliott, S.M., Kammel, L.E., Choy, S.J., Hummel, S.L., 2018, Predicting the occurrence of chemicals of emerging concern in surface water and sediment across the U.S. portion of the Great Lakes Basin, Sci Tot Environ, in press, doi: 10.1016/j.scitotenv.2018.09.201

Fairbairn, D.J., Elliott, S.M., Kiesling, R.L., Schoenfuss, H.L., Ferrey, M.L., Westerhoff, B.M., 2018, Contaminants of emerging concern in urban stormwater: Spatiotemporal patterns and removal by iron-enhanced sand filters (IESFs). Water Res, 145, 332-345. doi: 10.1016/j.watres.2018.08.020

Westerhoff, B.M., Fairbairn, D.J., Ferrey, M.L., Matilla, A., Junkel, J., Elliott, S.M., Kiesling, R.L., Woodruff, D., Schoenfuss, H.L., 2018, Effects of urban stormwater and iron-enhanced sand filtration on *Daphnia magna* and *Pimephales promelas*, Environ Toxicol Chem, 37, 2645-2659. doi: 10.1002/etc.4227

Organization

The U.S. Geological Survey's mission is to provide unbiased science about the natural hazards that threaten lives and livelihoods, the water, energy, minerals, and other natural resources we rely on, the health of our ecosystems and environment, and the impacts of climate and land-use change. USGS scientists develop new methods and tools to enable timely, relevant, and useful information about the Earth and its processes. With respect to water resources, USGS scientists work with local partners to monitor, assess, and conduct targeted research on the wide range of water resources and conditions, including streamflow, groundwater, water quality, and water use and availability.