

# BROOKE E. MASON

## PhD Candidate

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## OBJECTIVE

I am motivated to move society towards a more just and sustainable future. Through research, I seek to improve water management by enabling the next generation of autonomous water systems by combining domain knowledge from computing, data science, machine learning, and control theory. Through service, I work to improve diversity, equity, and inclusion at my institution and in my community.

## AT A GLANCE

- Systems Researcher**  
I am investigating the fundamental underpinnings for autonomous water systems by integrating embedded electronics, systems analysis, hydrodynamics, and control theory.
- DEI Advocate**  
I am implementing diversity, equity, and inclusion (DEI) practices to create safe and supportive spaces within my lab group, department, and community.
- Mentor & Educator**  
I am helping students achieve their goals and become global citizens through relationships built on mutual respect, listening, advising, and encouragement.
- Open-Source Coder**  
I am creating and maintaining open-source scientific libraries for autonomous water systems. I am also a founding member of open-storm.org, an open-source smart water consortium.

## EDUCATION

- Ph.D. in Civil Engineering**  
**University of Michigan**  
📅 Sept 2018 – Present 📍 Ann Arbor, MI
  - Thesis: *Improving watershed water quality with autonomous stormwater systems*
  - Focus: *Intelligent Systems*
  - Courses: dynamic infrastructure systems; infrastructure sensing; open channel flow; streams, lakes, & estuary analysis
- M.S. in Electrical and Computer Engineering**  
**University of Michigan**  
📅 Sept 2018 – Present 📍 Ann Arbor, MI
  - Focus: *Signal Processing & Machine Learning*
  - Courses: matrix methods; probability & random processes; linear systems theory
- M.S. in Civil Engineering**  
**University of Toledo**  
📅 Jan 2017 – Aug 2018 📍 Toledo, OH
  - Thesis: *Real-time control of a bioretention cell for enhanced phosphorus capture*
  - Focus: *Environmental Engineering*
- B.S. in Environmental Engineering**  
**University of Toledo**  
📅 May 2015 – Dec 2016 📍 Toledo, OH
- B.S. in Environmental Policy & Analysis**  
**Bowling Green State University**  
📅 Aug 2008 – May 2012 📍 Bowling Green, OH

## HONORS

- Fellowships & Scholarships**
  - DOW Sustainability Fellowship (2020)
  - Rackham Merit Fellowship (2018-19)
  - NSF GRFP Honorable Mention (2018)
  - William & Jean Clark Rhodes Scholarship (2017-18)
  - Engineering Alumni Affiliate Scholarship (2017-18)
  - Dean Wemmer Scholarship of Excellence (2017-18)
  - Special Dean Assistantship (2017)
  - Gretchen Koo Memorial Scholarship (2016-17)
  - Tillotson Scholarship (2016-17)
  - Building Ohio's Sustainable Energy Future Scholarship (2015-16)
  - Second Degree Scholarship (2015-16)
  - Nontraditional Student Scholarship (2015-16)
- Awards**
  - People's Choice Presentation Award, Clean Water Science Network (2021)
  - Edward A. Bouchet Graduate Honor Society (2020)
  - 2<sup>nd</sup> Place Poster, Borchardt Conference (2020)
  - NSF Research Exchange Travel Award (2020)
  - Outstanding Teaching Assistant (2017)
  - Chi Epsilon Civil Engineering Honor Society (2016)
  - Dean's List & President's List (2015-16)
  - Ciba Travel Award in Green Chemistry (2015)
  - Falcon Top 10% Award, Who's Who Among American Universities & Colleges (2010-11)
  - Environmental Studies Academic Achievement Award (2009-10)
  - Resident Advisor of the Year, Bowling Green State University (2009-10)
  - Sophomore Community Service Award, Bowling Green State University (2009-10)

- Certificates**
  - Professional Development DEI Certificate, University of Michigan (2020-21)
  - Culture of Diversity Certificate, University of Toledo (2015)

## COMPETENCIES

- Programming Languages**
  - Python
  - C
  - Matlab
  - Julia
- Hydrodynamic Modeling**
  - EPA SWMM
  - PySWMM
  - EPANET
- Embedded Platforms**
  - Cypress PSoC
  - Arduino
- DevOps**
  - Git
  - UNIX Shell

## PUBLICATIONS

### Journal Articles

- Mason, B. E., Mullapudi, A., Gruden, C., & Kerkez, B. (2021b). Real-time control improves phosphorus removal in bioretention cells. *Urban Water Journal* (submitted).
- Mason, B. E., Mullapudi, A., & Kerkez, B. (2021a). Stormreactor: An open-source python package for the integrated modeling of water quality and water balance. *Environmental Modelling & Software* (under revision).
- Mason, B. E., Rufi-Salís, M., Parada, F., Gabarrell, X., & Gruden, C. (2019). Intelligent urban irrigation systems: Saving water and maintaining crop yields. *Agricultural Water Management*, 226. doi:10.1016/j.agwat.2019.105812
- Celik, I., Mason, B. E., Phillips, A. B., Heben, M. J., & Apul, D. (2017). Environmental impacts from photovoltaic solar cells made with single walled carbon nanotubes. *Environmental Science & Technology*, 51, 4722–4732. doi:10.1021/acs.est.6b06272

### Working Manuscript

- Mason, B. E., Schmidt, J., & Kerkez, B. (2021c). *Insights from a real-time green infrastructure monitoring network*. Water Research & Technology (in preparation).
- Mason, B. E., & Kerkez, B. (2021d). *Emergent watershed properties resulting from real-time control*. Advances in Water Resources (in preparation).
- Tobias, M., Mason, B. E., Li, J., Nassauer, J., & Kerkez, B. (2021e). *Optimizing the human experience in real-time controlled stormwater infrastructure*. Blue-Green Systems (in preparation).

### Books

- Mason, B. E. (2017). A comprehensive overview of university and college recycling programs. In A. Kumar & D.-S. Kim (Eds.), *Sustainability practice and education on university campuses and beyond* (pp. 29–49). doi:10.2174/9781681084718117010005

## SELECTED TALKS

- **Mason, B. E.** and Kerkez, B. (2021). Emergent watershed properties resulting from real-time control. *SimHydro 2021*, Virtual.
- **Mason, B. E.**, Mullapudi, A., and Kerkez, B. (2021). Extending SWMM's water quality toolbox. *Environmental and Water Resources Institute Congress*, Virtual.
- **Mason, B. E.**, Mullapudi, A., and Kerkez, B. (2020). Improving pollutant removal with real-time control of stormwater networks. *Borchardt Conference: 25<sup>th</sup> Triennial Symposium on Advancements in Water & Wastewater*, Virtual.
- **Mason, B. E.**, Building Smarter Stormwater Systems. (2020). ASCE EWRI Women Water Nexus Short Conference Session, Virtual.
- **Mason, B. E.**, Water + Tech = 'Smart' Water. (2020). University of Washington, Seattle, Washington.
- McCaffery, R., Montgomery, J., Bartos, M., **Mason, B. E.**, Love, N., and Kerkez, B. (2019). A first-year college course on smart water systems. *AEESP Education & Research Conference*, Tempe, AZ.
- **Mason, B. E.**, Mullapudi, A., Kerkez, B. and Gruden, C. (2018). Pollutant treatment with real-time control of rain gardens. *Ohio Stormwater Conference*, Sandusky, OH.
- **Mason, B. E.**, Mullapudi, A., Kerkez, B. and Gruden, C. (2017). Real-time control of bioretention cells for enhanced phosphorus removal. *Research & Education Symposium, Michigan State University*, East Lansing, MI.
- **Mason, B. E.**, Celik, I., Phillips, A., Heben, M., and Apul, D. (2017). Life cycle environmental impacts of single-walled carbon nanotube PV cells. *20th Annual Green Chemistry & Engineering Conference*, Portland, OR.
- **Mason, B. E.**, Ilke, C., Phillips, A., Heben M., and D. Apul, D. (2017). Life cycle environmental impacts of single-walled carbon nanotube PV cells. *Choose Ohio First Scholar Showcase*, Columbus, OH.
- **Mason, B. E.**, Ilke, C., Phillips, A., Heben M., and Apul, D. (2015). Life cycle analysis of carbon nanotube photovoltaic cells. *GreenUp: Michigan Green Chemistry and Engineering Conference*, University of Michigan, Ann Arbor, MI.

## RESEARCH OVERVIEW

### Autonomous Water Systems

#### Introduction

- To manage stormwater and its pollutants without exponential costs, and to hedge impacts from climate change, we can leverage recent technological advances, such as sensors and real-time data algorithms, to enable the next generation of autonomous water systems.

#### Intellectual Merit

- Coordinated, autonomous stormwater systems will use sensors and actuators to adapt watersheds to individual storms, reducing flooding and maximizing treatment through real-time monitoring and control at the system-scale.
- Investigating the fundamental knowledge gaps of autonomous water systems by integrating water resources, environmental engineering, control theory, systems analysis, and machine learning.


#### Research Objectives

- There is a demonstrated need to accurately model water quality processes and real-time control at the system scale. To that end, I built an open-source Python package which integrates the EPA's Stormwater Management Model's water balance engine with a new water quality module. (*Completed*)
- To develop a watershed-scale control strategy, we must first understand the treatment performance of the watershed's building blocks, series and parallel infrastructure assets. Through the investigation of these building blocks, I expect to uncover fundamental insights into how flows should be routed through watersheds to maximize pollutant treatment. (*Underway*)
- Based on the data derived from the previous two objectives, I will investigate a systems framework to control water quality in real-time at the watershed scale. (*Future Work*)

#### Broader Impacts

- Developing an interdisciplinary, integrated systems framework for autonomous water system.
- Improving the ability of water system managers to make informed decisions by providing real-time monitoring and control capabilities.


## SOFTWARE

 **StormReactor**  
Python package for modeling stormwater pollutants and water quality based real-time control.

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Available at:


[github.com/kLabUM/StormReactor](https://github.com/kLabUM/StormReactor)

 **notoriOS**  
A non-preemptive operating system for sensor nodes that includes the ability to take measurements, control attached devices, and communicate with a web server.

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Available at:

[github.com/kLabUM/notoriOS](https://github.com/kLabUM/notoriOS)

 **perfect-cell**  
General purpose firmware for cellular-enabled PSoC m0tes.

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Available at:

[github.com/open-storm/perfect-cell](https://github.com/open-storm/perfect-cell)

## SERVICE

### Graduate Student Advisory Council Member

#### Department of Civil & Environmental Engineering, University of Michigan

📅 June 2019 – Present 📍 Ann Arbor, MI

- Advising the department in matters of student climate and serving as an information resource to current students.
- Organizing social and professional events for graduate students.
- Serving as the departmental liaison to the College of Engineering's Graduate Student Advisory Council.

### Control Board Member

#### Women Water Nexus Committee, Environmental & Water Resources Institute

📅 July 2020 – Present 📍 Virtual

- Developing a network of women scientists and engineers to promote water research with a focus on the education of future women scientists.
- Helped organize, plan, and moderate sessions for a virtual research lecture series.

### Interview Committee Member

#### University of Michigan

📅 Jan 2021 📍 Ann Arbor, MI

- Interviewed candidates for the new diversity, equity, and inclusion coordinator position in the Department of Civil & Environmental Engineering.

### Diversity, Equity, & Inclusion Committee Student Member

#### University of Michigan

📅 July 2020 – Present 📍 Ann Arbor, MI

- On the skill building subcommittee, I am creating a departmental DEI certificate program and an assessment of DEI comfort levels.
- On the mentoring subcommittee, I organized a peer mentor training, gathered data on existing mentoring programs, and worked on a mentorship assessment.

### Student Co-Chair

#### AEESP Research & Education Conference

📅 May 2017 – June 2017 📍 Ann Arbor, MI

- Selected to work with the student chairs from surrounding colleges and universities to help organize and promote the conference.

## EMPLOYMENT

### Engineering Intern

#### Brendle Group

📅 June 2016 – Aug 2017 📍 Denver, CO

- QA/QC'd greenhouse gas data and wrote the annual report for the National Ski Area Association's (NSAA) 2016 Climate Challenge.
- Organized and hosted three educational seminars for the ski resorts on a variety of topics.
- Drafted the annual contract, project budget, project timeline, marketing timeline, and more for the 2017 Climate Challenge.

### Sustainability Specialist

#### University of Toledo

📅 Aug 2012 – May 2015 📍 Toledo, OH

- Coordinated the utility rebate program and other sustainability and energy reduction projects. Secured over \$435,000 in rebates, \$25,000 in recycling revenue, and \$96,000 in grants.
- Completed the first comprehensive greenhouse gas inventory and a plan to reduce emissions by 7% with savings of \$1 million.
- Managed the processing of over one million pounds of recycling with one full-time and nine student employee direct reports.

## TEACHING

### Teaching Assistant

#### University of Toledo

📅 Jan 2017 – Dec 2017 📍 Toledo, OH

- Courses: statics, fluid mechanics, professional development, and freshman orientation.
- Tasks included teaching, grading, Blackboard management, quiz creation, exam revisions, holding office hours and exam review sessions, and developing lesson plans.

### Mentor

#### Clean Water Science Network Mentorship Program

📅 Sept 2020 – Present 📍 Virtual

- Mentor an undergraduate student in Latin America to deepen their knowledge on water and different environmental issues and provide information on pursuing graduate studies in water-related degrees in the US.

### Mentor

#### University of Michigan

📅 Sept 2019 – Present 📍 Ann Arbor, MI

- Mentor several undergraduate students through the Meet Your Mentor: Chat with a Grad Mentoring Program.
- Mentor several new graduate students through the Peer Mentoring Program.

### Research Mentor

#### University of Michigan

📅 Sept 2019 – May 2020 📍 Ann Arbor, MI

- Mentored three students through the Undergraduate Research Opportunities Program.
- Research projects focused on developing sensor firmware, web applications, and autonomous water quality sensor nodes.

## PROFESSIONAL MEMBERSHIPS

- International Water Association (2021)
- SWAN's Rising Smart Water Professionals (2020)
- American Society of Engineering Education (2020)
- Women Who Code (2020)
- Association of Environmental Engineering and Science Professors (2017)
- American Society of Civil Engineering (2016)

## REFERENCES

Available upon request.