



Freshwater Collaborative of Wisconsin 2020-2022 Report



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The Freshwater Collaborative of Wisconsin supports a statewide network of freshwater research and training opportunities across the 13 University of Wisconsin (UW) institutions. The Office of Socially Responsible Evaluation in Education (SREED) at UW-Milwaukee is helping the Freshwater Collaborative strengthen its capacity for monitoring through developing an evaluation strategy, creating data collection tools, and generating. The current report summarizes the progress made by 72 projects and the overall Freshwater Collaborative.

Summary Findings

The Freshwater Collaborative increased collaboration across UW System through its steering committee, curriculum working group, and regular engagement with UW System administrators, faculty and staff. Through supporting efforts at the 13 UW universities, students participated in research and gained hands-on experience related to some of Wisconsin's most pressing freshwater needs. The Freshwater Collaborative's progress suggests it has laid a strong foundation for developing a skilled and diverse professional workforce that will help serve Wisconsin's freshwater science needs.

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Background of the Freshwater Collaborative of Wisconsin

Water is Earth's most vital resource. In Wisconsin the importance of water cannot be overstated. All Wisconsin communities and industries depend on the protection of the state's water systems. Higher education institutions possess a distinct potential in the reimagination and execution of water-preserving strategies, as they are often the centers of thought production.

The processes of taking thought into action, connecting theory with practice, and moving from novel research to standards and norms are critical to preserving and protecting our water systems. Research conducted at the University of Wisconsin System institutions takes what is learned in academia and applies that knowledge to improve the world around us. Through the Wisconsin Idea — which states that what universities do should enhance the lives of every person in the state of Wisconsin — initiatives like the Freshwater Collaborative can lead in addressing the critical need for water interventions by equipping industry and government with prepared water professionals. By connecting groundbreaking water research done by UW students and faculty and training the next generation of freshwater professionals to continue and expand this work, the Freshwater Collaborative helps to create solutions that tackle threats to public health and well-being.

The Freshwater Collaborative is helping its partners to lead the nation in water-related science, technology, and economic growth through supporting research that addresses the state of Wisconsin's most salient water-related challenges. Thought leaders across UW System identified 10 Grand Water Challenges¹ of state and worldwide importance. The 10 Grand Water Challenges form the foundation of professional training, research, and technology development initiatives supported by the Freshwater Collaborative. They are:

1. Agricultural Water Management
2. Industrial Water Engineering and Technology
3. Water Quality Safety and Emerging Contaminants
4. Great Lakes Management, Protection, and Restoration
5. Water Infrastructure: Collection, Distribution, Treatment
6. Water Business, Law, and Finance

¹ See Appendix A for detailed descriptions of the 10 Grand Water Challenges

7. Watershed Management and Restoration
8. Water Security, Protection, and Resilience
9. Healthy Recreational and Transportation Water Use
10. Aquaculture, Aquaponics, and Water Food Systems

These challenges demonstrate the breadth of water issues, guide the efforts of the Freshwater Collaborative, and clarify the role of each participating UW institution. The 10 Grand Water Challenges were also informed by the goals of the Speaker's Task Force on Water Quality, established by State Representative Robin Vos, and comprising legislators from around the state.

In 2019, the Freshwater Collaborative received its first financial support from two entities: the UW System and the Wisconsin Economic Development Corporation (WEDC), a public-private partnership agency designed to foster local business development across the state². WEDC awarded **\$670,000** and the UW System awarded **\$1.4 million** in initial funding to increase the number of freshwater science opportunities for undergraduate and graduate students across the 13 UW universities. With that initial investment, universities were awarded funds to boost ongoing work, jumpstart opportunities for students and faculty, and aid in building the infrastructure needed to scale the Freshwater Collaborative over time. Projects supported by these funds were awarded via the **UW System grants program**.

In July 2021, the Wisconsin State Legislature approved \$5 million per biennial budget to the Freshwater Collaborative. The Joint Finance Committee released those funds in February 2022. Projects supported by the first fiscal year of funds were awarded via the Freshwater Collaborative's **first request for proposals (RFP #1)**. Projects supported by the second fiscal year were awarded via RFP #2. Funding from all sources has supported 80 grants across all 13 UW System institutions.³ These initiatives all focus on one or more of the 10 Grand Water Challenges. This report presents initial progress of the Freshwater Collaborative realized through September of 2022. Outcomes from RFP #2 will be covered in a subsequent report.

Feedback from students, faculty, and academic staff were used to examine progress across three areas:

² More information on the Wisconsin Economic Development Corporation can be found here: <https://wedc.org>

³ This report includes data on the first 72 of 80 projects supported by the Freshwater Collaborative of Wisconsin as of September 2022. Eight of the projects were funded through RFP #2.

In what ways has the Freshwater Collaborative created a system of shared leadership and collaboration across UW System's water programs?

How has the Freshwater Collaborative increased student research opportunities, demonstrated value to students, and increased student engagement in water programming?

How has the Freshwater Collaborative supported moving water research into action?

The Freshwater Collaborative is working with The Office of Socially Responsible Evaluation in Education (SREED) at UW-Milwaukee to monitor the statewide implementation and impact of the Freshwater Collaborative. The Freshwater Collaborative is leveraging the work of SREED to inform system improvements and to gather feedback from partners and stakeholders. Partners of the Freshwater Collaborative both contribute to and benefit from involvement in the initiative. These include students, faculty, and academic staff at each of the UW System universities, non-profit and for-profit industry partners, community members, and the Wisconsin Legislature. This report examines the work done by the Freshwater Collaborative in support of the 80 funded initiatives and the progress realized across initiatives. As the reach of the Freshwater Collaborative increases over time, future reports will examine the compounding impact of work realized by its funded projects.

In what ways has the Freshwater Collaborative created a system of shared leadership and collaboration across UW System's water programs?

The Freshwater Collaborative increased collaboration across UW System through its steering committee, communication with provosts and chancellors at the 13 UW universities, collaborative curriculum development, and funding of collaborative hands-on experiences and research that brought together faculty, staff, and students from across UW System.

Freshwater Collaborative Steering Committee

The Freshwater Collaborative's steering committee includes faculty and staff representatives from each of the 13 UW universities and one representative from UW System. Through monthly virtual meetings and multiple in-person meetings, **steering committee members bring the interests, needs, and assets of their institution to the planning and implementation of programming across the UW System and Wisconsin.** Topics discussed at these meetings include cross-campus curriculum development, the structure and focus for the Freshwater Collaborative grants program, direction for the Freshwater Collaborative's strategic plan, and development of a mission statement, a vision statement, and strategies for industry, community, and government partnership formation.

In early 2021, each UW university submitted a six-year plan created in collaboration with their provost, Freshwater Collaborative steering committee member, and additional campus leadership (specific leadership varied by campus). The six-year plans included what each UW school could bring to the Freshwater Collaborative (i.e., water courses offered and to be developed, existing partnerships, facilities, etc.) and what they hoped to get from the Freshwater Collaborative. The steering committee worked with the Freshwater Collaborative administrative team in facilitated meetings to integrate learnings from the six-year plans into the Freshwater Collaborative's strategic plan. This was done to leverage each UW university's strengths, provide support where appropriate, and ensure centralized water curriculum and internship efforts amplify the unique water programming at each UW university.

Each UW institution received \$10,000 to support participation in the Freshwater Collaborative steering committee. This investment allowed freshwater leaders at each campus to dedicate time to the Freshwater Collaborative. On multiple occasions, steering committee members have cited

challenges in administration and coordination of Freshwater Collaborative initiatives due to time and capacity limitations, as each steering committee member has faculty/staff commitments to their respective institutions. Many of them are also developing and leading Freshwater Collaborative–funded program at their institutions. Additionally, support and resources for freshwater-related programs differ across UW institutions, which exacerbates challenges for steering committee members at institutions with less resources and support. Based on this feedback, **it would be valuable to explore options for coordination and administrative support for Freshwater Collaborative initiatives.**

Collaboration Throughout UW System

The Freshwater Collaborative’s leadership regularly engages UW faculty and staff at a systemwide level through meetings, presentations, individual conversations, campus visits, and email updates. Part of this involved two meetings that included all steering committee members and campus provosts to establish a shared foundational understanding of the Freshwater Collaborative’s mission, goals, and future activities with these stakeholders. **These meetings supported campus buy-in, increased understanding of the needs within and across UW universities, and identified the conditions necessary for statewide and university systemwide collaborative programming.** This regular communication encourages investment from UW universities at multiple levels. This relationship building has been essential in prompting cross-campus collaborations among UW universities, such as student field experiences, research, and collaborative curriculum development. One program lead of a Freshwater Collaborative–supported initiative noted:

“The Freshwater Collaborative support to bring together partners to offer water-focused workshops for students and teachers was integral in supporting the successful outreach programs we were able to offer this summer.”

UW Water Policy Network

The Freshwater Collaborative supported the UW Water Policy Network, which creates an institutional structure for collaboration around water policy initiatives among faculty, researchers, and students throughout UW System. It also connects UW universities to key members of Wisconsin’s water sector. The UW Water Policy Network’s focuses on engaging partners and communities through presentations, facilitated discussions, and the development of

a searchable database of UW Water Policy Network faculty and researchers. Upon completion, this database will help partners identify researchers with expertise in specific freshwater areas across different regions of Wisconsin. The UW Water Policy Network is also planning a statewide conference on Wisconsin's phosphorus rules to be held in February 2023. The UW Water Policy network is coordinated by UW-Milwaukee's Center for Water Policy⁴ with a leadership team comprising representatives from UW-Milwaukee, UW-Stout, and UW-Eau Claire.

Progress Toward Centralized Curriculum Development

The Freshwater Collaborative steering committee and leadership created a curriculum development working group to identify a plan of action and define the structure for multiple interdisciplinary freshwater certificates. The certificates will include course offerings from all 13 UW universities and will be open to students across the UW System. **The goal of these certificates is to prepare undergraduate and graduate students, as well as working professionals, to address the 10 Grand Water Challenges. Certificate programs will be designed to provide content, training, and skills deemed essential by freshwater leaders in government, nonprofit, community, and industry.** In addition, the Freshwater Collaborative funded the development or enhancement of 30 courses that allow UW universities to offer a broader array of freshwater courses to students.

The Freshwater Collaborative's administrative team, the curriculum working group, and UW Extended Campus have established the following action plan for the Freshwater Collaborative's centralized curricula (Table 1).

⁴ More information about UW-Milwaukee's Center for Water Policy can be found at <https://uwm.edu/centerforwaterpolicy/>

Table 1: Action plan for Freshwater Collaborative centralized curricula

Collaborator	Tasks
Freshwater Collaborative Curriculum Working Group	<ul style="list-style-type: none"> • Identify lead campuses for the development of each certificate • Identify faculty at UW universities willing to participate in certificate development • Develop certificate outlines, certificate description (i.e., academic catalog description), detailed certificate course outlines, objectives, and learning outcomes • Identify external partners to be involved • Identify Grand Water Challenges to be addressed
UW Extended Campus	<ul style="list-style-type: none"> • Serve as a liaison between the Freshwater Collaborative and a market research firm that will evaluate each certificate for feasibility • Ensure the certificates are available on each campus • Help develop a process for revenue sharing for collaborative courses • Help develop a uniform credit transfer agreement • Help identify frequency of course offerings
UW Provosts and UW System	<ul style="list-style-type: none"> • Help establish Faculty Curriculum Advisory Group • Approve a process for revenue sharing for collaborative courses • Help develop a uniform credit transfer agreement • Identify a lead department on each campus <ul style="list-style-type: none"> ○ Department may vary according to certificate ○ Determine allowances for counting courses for both certificates and majors • Identify certificate academic advisors

Collaboration Among UW Universities

In 2019, the Freshwater Collaborative began granting awards to support collaboration across UW universities in the areas of research, course development, student experiences, and career development. **Thirty-nine funded projects involved collaboration between two or more UW universities.** Table 2 summarizes projects at each UW university and the number of projects focused on building collaboration between UW universities. Some of these collaborations include:

- Thirty courses and field experiences, many of which are open to students across the UW System,
- A collaborative certificate in Surface Water Studies through UW-Stout and UW Oshkosh with eventual course enrollment open to students at any participating UW campus,
- Twenty-nine research projects carried out by investigators and/or students at multiple UW universities,
- Collaborative authorship on six journal manuscripts describing research conducted by students and faculty at multiple UW universities,
- Seven research experiences that brought together students from multiple UW universities, and,
- Six programs focused on K-12 students and educators connecting them with faculty and staff from multiple UW universities.

Some funded programs were not only collaborative through their activities but created the foundation and structure for future collaborations. For example, the project *Establishing a Network for Cross-Campus Courses at the Nexus of Agriculture and Water*, developed by faculty at UW-Green Bay, UW-Madison, UW-Platteville, UW-River Falls, UW-Stevens Point, and UW-Stout.⁵ The Freshwater Collaborative provided three grants for this project over two grant periods; one for course development, one to support student participation in the field trip course, and one to leverage the network and increase the number of participating UW universities. The multiday field trip course developed as part of the project will initially be offered to 15 to 20 students from four UW universities in fall 2022. In spring 2023 the course will expand to include

⁵ More information about the Network for Cross-Campus Courses at the Nexus of Agriculture and Water can be found here: <https://freshwater.wisconsin.edu/ag-water-network/>

students from six campuses. This project also convenes virtual networking sessions with UW System faculty, leveraging both the expertise of faculty across UW universities and the regional variations in Wisconsin agriculture.

Table 2: Number of collaborative projects funded by the Freshwater Collaborative across UW universities.

UW school	Total number of projects funded	Number of collaborative projects funded
UW-Eau Claire	11	11
UW-Green Bay	10	6
UW-La Crosse	12	9
UW-Madison	11	10
UW-Milwaukee	11	9
UW Oshkosh	11	6
UW-Parkside	5	3
UW-Platteville	8	6
UW-River Falls	12	7
UW-Stevens Point	3	2
UW-Stout	15	7
UW-Superior	4	1
UW-Whitewater	8	6

Student Collaboration Across UW System

The Freshwater Collaborative supports student experiences, collaborative research, and course development projects that create opportunities for students to engage with faculty, staff, and students across UW universities. For example, the *Summer Research Experience Program for Undergraduates in the University of Wisconsin System* offered students opportunities to contribute to Water@UW-Madison⁶ research projects. The program paired students from UW-Eau Claire, UW-La Crosse, and UW-Platteville with faculty researchers and graduate students at

⁶ More information about Water@UW-Madison can be found here: <https://water.wisc.edu>

UW-Madison. It promoted group interactions among students within the program and among other summer research experience programs on the UW-Madison campus.

The Freshwater Collaborative supported three grants to UW-Whitewater and UW-La Crosse that connected UW-Whitewater students researching the effects of neonicotinoids insecticides⁷ on aquatic invertebrates and UW-La Crosse students researching the effect of neonicotinoid insecticides on fish.

Across programs, students gained broader exposure to the strengths and diversity of UW universities and Wisconsin's freshwater while expanding their support and professional networks. One professor noted:

“[The] student team developed a strong camaraderie throughout the project that has resulted in a growing peer-to-peer support network within the lab and department, clearly underscoring the value of undergraduate research as a key high-impact practice.”

Programs that bring together students from multiple institutions may serve as pilots for cross-UW System collaborative projects. **Gathering feedback from project leads and students involved with these courses, research projects, and student experiences could produce valuable information and learnings to inform future Freshwater Collaborative projects.** Additional courses and field experiences will be offered as the Freshwater Collaborative-funded programs continue to develop. Therefore, it is too early to determine the potential of student engagement across UW universities.

⁷ Neonicotinoids are a group of insecticides used on a wide variety of crops, turf, ornamentals, pets (for flea treatment), and other residential and commercial indoor and outdoor uses. Definition sourced from United States Environmental Protection Agency: <https://www.epa.gov/pollinator-protection/epa-actions-protect-pollinators>

How has the Freshwater Collaborative increased student research opportunities, demonstrated value to students, and increased student engagement?

Funding provided to UW universities through the UW System grants program and the Freshwater Collaborative's first Request for Proposals (RFP #1) supported student engagement primarily through opportunities for field and research experiences. Future Freshwater Collaborative RFPs will expand opportunities for student engagement in courses in addition to field and research experiences. Across UW universities, the Freshwater Collaborative provided funding for 29 opportunities involving undergraduate and graduate students conducting research or presenting water-based research findings. These opportunities engaged at least 270 students from UW universities and K-12 students throughout Wisconsin.

Student Engagement Opportunities

Undergraduate students at UW-Madison and UW-Platteville engaged in the *Comparative Wisconsin Freshwater Mussel Assessment: An Undergraduate Research Initiative*, during which they assessed the state of freshwater mussels in southwestern Wisconsin through snorkeling, community surveys, vegetation, and chemical analyses. This work provided students with experiences for conducting research addressing the Agricultural Water Management and Water Quality Safety and Emerging Contaminants Grand Water Challenges. Their findings were presented to the Wisconsin Department of Natural Resources and Trout Unlimited⁸.

A number of students engaged in the Freshwater Collaborative reported valuing their experiences. For example, 11 high school students from southeastern Wisconsin participated in UW-Parkside and UW-Whitewater's *Freshwater Camp: A Summer Field Experience for High School Juniors*.⁹ The program highlighted important freshwater habitats, provided hands-on field and laboratory activities, and presented information on freshwater career and training opportunities. Participants rated most of the activities highly, appreciating their experiences, and stating they would recommend the camp to other students. Participants particularly valued the

⁸ More information about UW-Madison and UW-Platteville's mussel assessment project can be found here: <https://freshwater.wisconsin.edu/uwp-mussel-and-trout-research/>

⁹ More information about UW-Parkside and UW-Whitewater's Freshwater Camp can be found here: <https://freshwater.wisconsin.edu/high-schoolers-explore-freshwater-research-and-careers-at-freshwater-camp/>

chance to spend time with like-minded students. Students participating in the *Summer Research Experience Program for Undergraduates in the University of Wisconsin System*¹⁰, a summer research program for 10 to 15 undergraduates at UW-Madison, also valued their experiences. As one student explained:

“The Water@UW program was incredibly valuable to me as a scientist and a person. I gained a plethora of new research skills that make me feel confident in my ability to be successful in a graduate program. I formed new lifelong friendships and Madison will forever have a special place in my heart. Also, I saw a cow being born--mind blown.”

Faculty and staff need tools for increasing student engagement in the Freshwater

Collaborative. Building upon initiatives like the *Freshwater Camp* and *Summer Research Experience* requires providing project leads and other organizers with tools to successfully reach and engage minors. In the case of the *Freshwater Camp*, organizers detailed their inexperience in working with minors and the legal challenges they faced meeting the requirements for engaging minor students. One possible resource that could support effectively engaging minors is leveraging the precollege liaison¹¹ at each UW school. Precollege liaisons are designated by UW universities to advocate and implement youth protection policies and best practices.

Other possible tools for supporting student engagement might mitigate logistic barriers to engagement. These include providing transportation and stipends to students. As reported by a project lead:

“The camp was offered free of charge to attract low-income students, but these students may have had conflicts with summer jobs or limited transportation to get to either campus for the camp.”

Restructuring programs to fully welcome underserved students must involve accounting for the reality that many underserved students need to work year-round. Providing students with a reasonable stipend for their time and contribution to water-based research has the potential of

¹⁰ More information about UW-Madison's undergraduate summer research program can be found here: <https://freshwater.wisconsin.edu/1181-2/>

¹¹ A list of precollege liaisons by UW school and more details about the role can be found here: <https://www.wisconsin.edu/compliance/landing-page/child-safety/precollege-liaisons-2/>

providing better accessibility for underserved students and inserting diverse perspectives into the field of freshwater science.

Leveraging a Need for Student Voice with Reporting and Feedback

Understanding the ways that the Freshwater Collaborative demonstrates value to students requires gathering their feedback. For context, with the exception of three programs who developed their own student feedback processes, the student feedback shared by programs was anecdotal and not part of a systematic data collection effort. Considering most student feedback efforts were organized by programs, feedback was not comparable across projects. Further, given that feedback was provided to project staff, students may not have had the space to provide confidential feedback about their experiences. As student participation in Freshwater Collaborative-funded projects expands over time, the challenge for collecting, analyzing, and archiving valid and useful feedback compounds. **Going forward, the Freshwater Collaborative would benefit from incorporating collaborative-wide youth voice collection and amplification strategies as they attempt to meet their goal of recruiting and developing talented young freshwater professionals.** This may involve including student voice in the administration and planning of the Freshwater Collaborative.

Like many projects taking place post-2020, project leads detailed the ways that the COVID-19 pandemic has interfered with initial intentions to provide opportunities. The ways they sought to overcome the challenges were also shared:

“While our collaborations were limited physically due to COVID restrictions both at UW-Platteville and in the WI-DNR, we were able to have very high-impact virtual engagement with our collaborators over the course of this project and were able eventually to also engage in-person. This limitation forced my team to be more self-sufficient and to learn via inquiry and experience rather than direct instruction.”

Taking lessons from these projects and similar initiatives, both Freshwater Collaborative administrators and project leads may benefit **from using online systems in tandem with in-person learning opportunities, especially as the efforts to expand programming across the state continue.** This would allow students without the ability to freely travel to benefit from available opportunities.

How has the Freshwater Collaborative supported moving research into action?

Every project or program supported by the Freshwater Collaborative focuses on at least one of the 10 Grand Water Challenges¹². Agricultural Water Management as well as Water Quality Safety and Emerging Contaminants were areas of special focus due to their high priority in multiple communities across Wisconsin. Almost every awarded proposal in the UW System Grants Program and RFP #1 addressed multiple 10 Grand Water Challenges (Table 3). Funded projects focused on the 10 Grand Water Challenges occurred across 43 Wisconsin counties (Table 4).

Table 3: Number of projects focused on each 10 Grand Water Challenges

10 Grand Water Challenges	Number of projects addressing the 10 Grand Water Challenges
<i>Agricultural Water Management</i>	50
<i>Industrial Water Engineering and Technology</i>	12
<i>Water Quality Safety and Emerging Contaminants</i>	53
<i>Great Lakes Management and Restoration</i>	33
<i>Water Infrastructure: Collection, Distribution, and Treatment</i>	21
<i>Water Business and Finance</i>	11
<i>Watershed Management and Restoration</i>	48
<i>Water Security, Protection, and Resilience</i>	23
<i>Healthy Recreational and Transportation Water Use</i>	37
<i>Aquaculture, Aquaponics and Water Food Systems</i>	13

¹² See Appendix A for detailed descriptions of the 10 Grand Water Challenges

Table 4: 10 Grand Water Challenges by targeted counties

10 Grand Water Challenges	Targeted Counties
<i>Agricultural Water Management</i>	Ashland, Barron, Bayfield, Brown, Buffalo, Chippewa, Crawford, Dane, Door, Douglas, Dunn, Eau Claire, Fond du Lac, Florence, Grant, Iron, Kenosha, Kewaunee, La Crosse, Lafayette, Lincoln, Milwaukee, Manitowoc, Monroe, Oneida, Ozaukee, Pierce, Racine, Sawyer, St. Croix, Taylor, Vernon, Vilas, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
<i>Industrial Water Engineering and Technology</i>	Brown, Dane, Door, Eau Claire, Kenosha, Kewaunee, La Crosse, Manitowoc, Milwaukee, Ozaukee, Racine, Washington, Waukesha, Winnebago
<i>Water Quality Safety and Emerging Contaminants</i>	Ashland, Barron, Bayfield, Brown, Buffalo, Chippewa, Crawford, Dane, Door, Dunn, Eau Claire, Fond du Lac, Florence, Grant, Iron, Kenosha, Kewaunee, La Crosse, Lafayette, Lincoln, Manitowoc, Marinette, Milwaukee, Monroe, Oneida, Ozaukee, Pierce, Racine, Sawyer, Sheboygan, St. Croix, Taylor, Vernon, Vilas, Washington, Waukesha, Waupaca, Winnebago, Wood
<i>Great Lakes Management and Restoration</i>	Ashland, Bayfield, Brown, Buffalo, Dane, Door, Douglas, Eau Claire, Fond du Lac, Florence, Iron, Kenosha, Kewaunee, La Crosse, Lafayette, Lincoln, Manitowoc, Milwaukee, Monroe, Oneida, Ozaukee, Racine, Sawyer, Taylor, Vernon, Vilas, Washington, Waukesha, Waupaca, Winnebago, Wood
<i>Water Infrastructure: Collection, Distribution, and Treatment</i>	Ashland, Bayfield, Brown, Buffalo, Crawford, Dane, Door, Eau Claire, Fond du Lac, Florence, Grant, Iron, Kenosha, Kewaunee, La Crosse, Lafayette, Lincoln, Milwaukee, Manitowoc, Monroe, Oneida, Ozaukee, Racine, Sawyer, Taylor, Vernon, Vilas, Washington, Waukesha, Waupaca, Winnebago, Wood
<i>Water Business, Law, and Finance</i>	Ashland, Bayfield, Brown, Crawford, Dane, Douglas, Eau Claire, Grant, Iron, Kenosha, Milwaukee, Ozaukee, Racine, Washington, Waukesha
<i>Watershed Management and Restoration</i>	Ashland, Barron, Bayfield, Brown, Buffalo, Chippewa, Crawford, Door, Douglas, Dunn, Eau Claire, Fond du Lac, Florence, Grant, Iron, Kewaunee, La Crosse, Lafayette, Lincoln, Manitowoc, Marinette, Monroe, Oneida, Ozaukee, Pepin, Pierce, Polk, Racine, Sawyer, Sheboygan, St. Croix, Taylor, Vernon, Vilas, Washington, Waupaca, Winnebago, Wood
<i>Water Security, Protection, and Resilience</i>	Ashland, Bayfield, Brown, Buffalo, Crawford, Dane, Douglas, Door, Eau Claire, Fond du Lac, Florence, Grant, Iron, Kenosha, Kewaunee, La Crosse, Lafayette, Lincoln, Milwaukee, Manitowoc, Monroe, Oneida, Ozaukee, Racine, Sawyer, Taylor, Vernon, Vilas, Washington, Waukesha, Waupaca, Winnebago, Wood
<i>Healthy Recreational and Transportation Water Use</i>	Ashland, Bayfield, Brown, Buffalo, Crawford, Dane, Door, Douglas, Eau Claire, Fond du Lac, Florence, Grant, Iron, Kenosha, Kewaunee, La Crosse, Lafayette, Lincoln, Milwaukee, Manitowoc, Marinette, Monroe, Oneida, Ozaukee, Racine, Sawyer, Sheboygan, Taylor, Vernon, Vilas, Washington, Waukesha, Waupaca, Winnebago, Wood
<i>Aquaculture, Aquaponics and Water Food Systems</i>	Ashland, Bayfield, Brown, Buffalo, Dane, Door, Eau Claire, Fond du Lac, Florence, Iron, Kenosha, Kewaunee, La Crosse, Lafayette, Lincoln, Milwaukee, Manitowoc, Monroe, Oneida, Ozaukee, Pierce, Racine, Sawyer, St. Croix, Taylor, Vernon, Vilas, Washington, Waukesha, Waupaca, Winnebago, Wood

Freshwater Collaborative–supported programs partnered with 141 businesses, corporations, associations, nonprofit organizations, non-government organizations, and government entities. These partnerships provided external partners with direct support and services that expanded their capacity to address critical freshwater science issues and provided students with training from working professionals.

Direct Supports and Services

UW universities provide direct support to partners in multiple industries including recreation, transportation, agriculture, and restoration¹³.

Partnerships focused on Grand Water Challenge Agricultural Water Management addressed key issues like runoff and water management. One example is UW-Stout’s project on predicting “crop per drop” in sandy soils, which provided their agricultural partner, Chippewa Valley Bean, with tools for using water more efficiently during the growing season.

Partnerships also addressed Grand Water Challenge Water Quality Safety and Emerging Contaminants. UW Oshkosh’s Environmental Research and Innovation Center (ERIC)¹⁴ provided water quality support and expertise to 86 business and community partners across the state of Wisconsin. Through ERIC, 22 students from UW Oshkosh, UW-Eau Claire, UW-Stout, UW-River Falls, and UW-Madison analyzed 2,200 water samples and provided technical assistance for partners in 2022. The director of ERIC notes that,

“Businesses such as Koken Farms, J. Rasmussen Plumbing, Nelson Deer Farm, Steinthal Lodge, and Fifth Ward Brewing Company called on these students to help answer water quality questions that were needed for their business, to develop new business, or answer complex questions for their clients.”

Freshwater Collaborative–supported projects also involve collaborations with local, state, and federal government agencies, such as health departments across the state of Wisconsin, the Wisconsin Department of Natural Resources, and the Army Corps of Engineers.¹⁵ For example, UW-Platteville faculty and seven UW-Platteville students participated in a multi-agency mussel

¹³ A complete list of industry partners can be found in Appendix B.

¹⁴ More information about UW Oshkosh’s Environmental Research and Innovation Center (ERIC) at <https://uwosh.edu/eric/>.

¹⁵ A complete list of government partners can be found in Appendix B.

relocation effort associated with a bank stability project on Goose Island in the Mississippi River. This project is designed to protect an existing archeological site from erosion.¹⁶ They also assessed stream restoration efforts of the nonprofit Trout Unlimited¹⁷ and the Wisconsin Department of Natural Resources at eight different stream sites in the Grant, Platte, and Blue River watersheds.¹⁸

As the Freshwater Collaborative evolves, it will continue to develop new workforce development partnerships. One example is UW-Madison and UW-Milwaukee's collaborative proposal, *Freshwater Collaborative of Wisconsin Statewide Internship Program*. This program aims to create a statewide student internship program by expanding their relationships with current industry partners and engaging new ones through their connections with The Water Council¹⁹. The Freshwater Collaborative will monitor the extent of workforce development efforts as the initiative expands.

Expand Knowledge and Understanding on Critical Areas of Freshwater Science

The Freshwater Collaborative supported 29 research initiatives that address the 10 Grand Water Challenges. Most research projects addressed multiple 10 Grand Water Challenges. Twenty-one research projects focused on Agricultural Water Management and 19 focused on Water Quality Safety and Emerging Contaminants. Both are key 10 Grand Water Challenges for water industry, water organizations, and the Wisconsin State Legislature.

Projects focused on **Agricultural Water Management** include:

- Faculty and seven student researchers at UW-Madison and UW-Platteville assessing native freshwater mussel populations in southwestern Wisconsin. This work provided insight into the success of local agriculture water management.²⁰

¹⁶ More information on the Goose Island project can be found at: <https://www.mvp.usace.army.mil/Media/News-Releases/Article/2506958/corps-of-engineers-seeks-comments-on-pool-8-environmental-assessment/> .

¹⁷ More information about Trout Unlimited is available on their website: <https://www.tu.org>.

¹⁸ More information about UW-Platteville's mussel project can be found at <https://www.wisconsin.edu/all-in-wisconsin/story/uw-platteville-student-researchers-support-wdnr-trout-unlimited-conservation-efforts/>.

¹⁹ More information on The Water Council can be found here: <https://thewatercouncil.com>

²⁰ More information on the UW-Madison and UW-Platteville freshwater mussel project can be found here: <https://freshwater.wisconsin.edu/uwp-mussel-and-trout-research/>.

- UW-Stout faculty and five students are developing an easy-to-apply process for predicting agricultural contaminant spread, tailored to users with minimal technical knowledge in farm communities, industrial farms, and state agencies.
- The Wisconsin Agriculture-Water Nexus Network aims to help students understand how Wisconsin's diverse geography affects agricultural water management and what farmers need in order to grow viable crops.²¹

Projects focused on **Water Quality Safety and Emerging Contaminants** include:

- UW-Whitewater's and UW-La Crosse's research on neonicotinoid pesticides. This work may contribute to defining water quality criteria and help Wisconsin regulators understand the impact of agricultural pesticides on aquatic organisms.
- Researchers and students at UW-Eau Claire that examines methylmercury²² metabolism in zebrafish to improve guidelines for freshwater fish consumption, particularly for children and pregnant women.
- UW-Green Bay, UW-Madison, UW-Platteville, and UW-Stevens Point's collaborative work on per- and polyfluoroalkyl substances (PFAS)²³ and nitrate (NO₃) could help predict future groundwater contamination, generate future guidelines to protect groundwater wells, identify Wisconsin groundwater sources at risk, and evaluate a low-cost water treatment to minimize PFAS and NO₃ leaching further.

Dissemination of Findings and Reach of Research

Freshwater Collaborative-supported research has engaged in extensive work to disseminate new knowledge learned about freshwater science. Results from 15 Freshwater Collaborative-supported research projects have been shared with Wisconsin legislators, state leaders, UW alumni, and other critical partners through participation at the annual Research in the Rotunda

²¹ More information on the Wisconsin Agriculture-Water Nexus Network project can be found here:

<https://freshwater.wisconsin.edu/ag-water-network/>.

²² Methylmercury is a form of mercury and a highly toxic organic compound. Definition sourced from the United States Environmental Protection Agency: <https://www.epa.gov/mercury/how-people-are-exposed-mercury#methylmercury>

²³ PFAS are a group of widely used long lasting chemicals manufactured chemicals used in industry and consumer products. Definition sourced from the United States Environmental Protection Agency: <https://www.epa.gov/pfas/pfas-explained>

event in Madison, Wisconsin. Findings have also been shared with industry and government partners through:

- Professional association meetings, including the Wisconsin section of the American Water Resources Association,
- Presentations at industry partner meetings,
- Presentations at neighborhood association meetings,
- Communications to the Wisconsin Joint Finance Committee, and
- Presentations at professional conferences, such as the American Association of Geographers.

Through presentations, communication with property owners, library programs, and museum and aquarium exhibits, research findings have been shared with communities. For example:

- In partnership with Schreiner Memorial Library in Lancaster, Wisconsin, five students at UW-Platteville conducted a hands-on stream invertebrate demonstration for elementary school students.²⁴
- Five students from UW-Eau Claire, UW-Madison, and UW-Superior conducted research with community members in Dubuque, Iowa, in collaboration with the Mississippi River Museum and Aquarium.²⁵ These same students will collaborate with staff from Duluth's Great Lakes Aquarium²⁶ to create an interactive exhibit that teaches the public about microplastics in the St. Louis River Estuary and Lake Superior.

Museum, aquarium, and library collaborations bring information and education about freshwater to communities across Wisconsin and the Midwest, including communities who would otherwise have little access to this information. These programs serve to provide communities with the tools to understand and maintain the health of their waterways and introduce K-12 students to freshwater science.

The Freshwater Collaborative's reach has also been increased through publications and conference presentations, which work to center Wisconsin as a leader in the freshwater science

²⁴ The number of elementary students who attended this program was not provided.

²⁵ More information about the National Mississippi River Museum & Aquarium can be found on their website: <https://www.rivermuseum.com>.

²⁶ More information about the Great Lakes Aquarium can be found on their website: <https://glaquarium.org>.

professional community. Seven project leads have submitted work for publication, and findings from nine Freshwater Collaborative–supported research projects have been shared at academic or professional conferences. Seven additional project leads outlined future plans to submit manuscripts for publication and/or present their findings at conferences.

While Freshwater Collaborative project leads have done a great deal to disseminate findings, many research projects are still in their initial stages. As these projects develop, the extent that findings are disseminated to relevant groups, and the extent to which disseminated work changes communities, will be better understood.

Freshwater Workforce Development

Freshwater Collaborative programming and funding seeks to support Wisconsin’s workforce development by preparing the current and future next water professionals to address the 10 Grand Water Challenges. Partners shared several examples of progress being made toward this end. Through 37 fieldwork, internship, and research programs, students gained experiences with high-demand laboratory skills, computational modeling, applied field techniques, and simulation software. For example:

- Five students at UW-Stout learned how to use commercial fluid simulation software, ANSYS Workbench (with CFX), a skill that one faculty noted is “highly sought after in engineering industry, especially the ones supporting water resources.”
- UW Oshkosh’s Environmental Research and Innovation Center trained students in the exact water analysis techniques and certified methodologies used by industry and private companies. The director noted that this helps students develop “a skillset that is unavailable in a UW class.”
- Six students attending either UW-River Falls or UW-Eau Claire were trained in river monitoring techniques used by professionals. Students put these skills into practice to implement the formal Kinni River Monitoring Plan. This skillset is directly relevant to multiple workforce positions in water resource management.
- The UW-River Falls Ecological Restoration Institute provided students²⁷ opportunities to obtain certifications in the areas of wildland firefighter, chainsaw, ATV, boat, tractor,

²⁷ The number of students certified through this effort was not provided, however, this data will be captured in subsequent reports.

Red Cross first aid, wilderness first responder, and pesticide applicator, all of which are in high demand for a variety of fields.

- Five students at UW-Stout regularly work with commercial drones, providing them the opportunity to practice using an emerging technology and earn an FAA Remote Pilot license through the project.

In addition to technical training related to freshwater science, Freshwater Collaborative–supported programming provided students with experience in project management, community engagement, and freshwater science communication with government, industry, and community partners. Providing these opportunities for students helps support interest in freshwater science and the development of their skillsets to help meet the emerging needs of Wisconsin’s freshwater sector. One professor noted:

“[The conservation] field is increasingly recognizing the need for people with effective ‘people skills’ and not just scientific knowledge. Being able to interact with and learn from community members and landowners is invaluable.”

Thirteen projects involved students interacting with and presenting research to community members, property owners, and partnering organizations. Research projects also provided leadership and project management experience, including training new students, serving as teaching assistants for high school students, co-authoring and contributing to manuscripts, and coordinating sampling and field data collection.

Freshwater Collaborative–supported programs also exposed students to international perspectives in freshwater sciences. One example is the *Academic Programs International (API) International Collaborative Communities Virtual Lab*, a partnership between UW-La Crosse and its education abroad provider API. This program provided UW students²⁸ the opportunity to work collaboratively with team members from different international and domestic backgrounds to produce a feasible action plan to address one of the 10 Grand Water Challenges. This program was held in high regard by students:

²⁸ The number of students who participated in this program was not provided, however, this data will be captured in subsequent reports.

“This lab cultivated more cultural development than I was anticipating. Working in such a diverse environment, I was able to see how different cultures approach problems and how our different perspectives allow us to create more well-rounded solutions.”

The Freshwater Collaborative also contributed to an interdisciplinary field research program in the Yucatán Península, Mexico. This program provided seven students from UW-Milwaukee and UW-Whitewater experience conducting water quality analysis, community engagement, and science communication in an international context.²⁹

Six students from multiple UW universities who participated in four different Freshwater Collaborative-supported programs found jobs after graduation. These students cited the experience and skills they gained from participating in Freshwater Collaborative-supported opportunities as a key contributing factor to their employment. A project lead reported:

“One undergraduate student that recently graduated used her [Quality Assurance/ Quality Control] experience on the project as a selling point to land a position at a local brewery as a quality assurance officer.”

Freshwater Collaborative-supported programming has also worked to develop Wisconsin’s freshwater workforce through experiences for high school students. Eight programs engaged K-12 educators and students from counties throughout the state of Wisconsin. Six of the programs were aimed at high school students and two programs included middle and high school students. Additional students were introduced to freshwater topics and careers in classes taught by middle and high school educators, who participated in a teacher workshop provided by UW-Green Bay or received lesson plans on microplastics developed by UW-Eau Claire, UW-Madison, and UW-Superior.

The K-12 experiences served as an introduction to freshwater science and water-related issues in Wisconsin through instructional sessions and hands-on field and laboratory activities. One faculty stated:

²⁹ More information on the field research program in the Yucatán Península can be found here: <https://freshwater.wisconsin.edu/uw-students-dive-into-hands-on-research-in-bacalar-mexico/>.

“When I was a high school student, I was unaware of the existence of most water-related careers. It wasn’t until I was a junior in college that I realized that I could build a career around the study of water pollution. I wish I had known about these things sooner. This camp is meant to open the eyes of students to the possibility of attending college, of pursuing a water-related major and training while in college, and ultimately obtaining a position in the water sector.”

These K-12 student opportunities also contributed to UW universities’ recruitment efforts by connecting high school students with UW students, faculty, and universities. One program lead shared feedback from a high school participant:

“... [H]e would like a career in natural resources but enjoys field work and field collection more than lab work. He will use this knowledge when charting a path in college and is interested in becoming a game warden.”

Multiple Freshwater Collaborative–supported high school programs also aimed to broaden perspectives in the water sector by serving youth who represent groups underrepresented in the water sector³⁰. This included:

- Eleven high school students from the rural-urban corridor of southeastern Wisconsin participating in a camp co-created by UW-Parkside and UW-Whitewater. Students learned about different freshwater habitats and careers through hands-on field activities and guest speakers;
- UW-Green Bay hosted half-day field trips that served 35 high school students from the Menominee Nation; and
- UW- River Falls created a program that provided 13 students from the rural River Falls School District opportunities to learn basic water quality testing techniques, participate in conservation and watershed management fieldwork, and discuss the impact of water on various systems.

³⁰ It is important to note that data regarding K-12 student characteristics were not collected across programs. The numbers above reflect the data provided by project leads but may not be representative of all students served by Freshwater Collaborative K-12 programs.

The Freshwater Collaborative’s progress suggest it has established a strong foundation for achieving its goals of developing a skilled and diverse professional workforce that will serve Wisconsin’s freshwater science needs. Many Freshwater Collaborative–supported programs are still in their initial phases. Most students who participated in Freshwater Collaborative–supported programs have yet to graduate, and most high school students who participated have yet to enter college. Therefore, a full understanding of the impact of participation in Freshwater Collaborative–supported programs on freshwater workforce development will be better understood as programs and initiatives expand and develop over time.

Summary and Next Steps

The Freshwater Collaborative has made significant progress in:

- Creating the infrastructure necessary to engage critical stakeholders and partners in freshwater,
- Funding research, curriculum development, and student experiences focused on all 10 Grand Water Challenges,
- Funding projects that serve multiple counties across Wisconsin, and
- Establishing multiple partnerships across industry, nonprofit, and government. These partnerships will be critical for identifying future needs for research and training and for turning research into action.

Conceptualizing Collaborations for the Freshwater Collaborative

The Freshwater Collaborative may benefit from further examining its conceptualization for what collaborations with universities, industries, nonprofits, and government institutions should and could involve. This includes defining:

- Collaboration within the scope of Freshwater Collaborative's missions, goals, and capacity,
- How partners work together to move the Freshwater Collaborative's mission into action, and
- The Freshwater Collaborative's role in fostering collaboration in Wisconsin's freshwater sector at large.

These initial definitions, structures, and expectations can serve as a starting point and foundation for sustainable partnerships. It is important that the conceptualization of collaborations evolve as the Freshwater Collaborative, its partners, and the state of freshwater in Wisconsin change over time.

Definition Making

Many proposals spoke to training in *sought-after skills* and research conducted in *areas of need* for freshwater in Wisconsin. However, it was not always clear how these skills and areas of need were identified. Information from meetings with the Freshwater Collaborative administrative

team and the Freshwater Collaborative steering committee, some proposal narratives, and Freshwater Collaborative archives indicate areas of need have often been decided informally. Primarily, through conversations and insights from industry and community partners with whom UW institutions already have relationships.

To provide clarity and transparency to the process, it may be valuable to consider a more formal method, such as establishing an external advisory board with existing partners from freshwater industry, nonprofits, government agencies, and community organizations. Another approach would be to incorporate perspectives from these stakeholder groups into the steering committee. These suggestions are made with the understanding of the complexity of statewide relationship building and that this often takes time.

Community Involvement and Voice

Collaboration and co-creation are essential pieces of the community involvement process. The Freshwater Collaborative administrative team has engaged in initial conversations with critical community groups. For example, the Great Lakes Inter-Tribal Council (GLTIC), the National Society of Black Engineers, and other key individuals from underrepresented groups in the water sector. Although there have been a few documented instances of communities influencing Freshwater Collaborative initiatives, for the most part, community involvement was minor only involving interactions while conducting research or executing programming.

Recommendations for community involvement include:

- Creating space for the influence of communities on the Freshwater Collaborative, such as the steering committee or external advisory board,
- The Freshwater Collaborative demonstrating its commitment to communities involved through supporting and participating in community-led initiatives, and
- Funding programs that have community involvement as a key activity or that respond to community-identified needs.

It is important to note that certain communities, particularly those that are underrepresented in the water sector, may have historic or present relationships that influence their interest or willingness to engage with academia, industry, or government entities. Additionally, some programs may have had community-informed or community-involved efforts, that were not

captured by their reporting. The task for truly building a statewide coalition focused on meeting Wisconsin's freshwater challenges is complex and difficult. It will take time and commitment by the partners engaged in the Freshwater Collaborative to realize this vision.

Continued Monitoring of Freshwater Collaborative-supported Research and Projects

Initial reporting from Freshwater Collaborative projects shows promise. Freshwater Collaborative-supported programming and research addressed all 10 Grand Water Challenges. The majority of projects are ongoing or in their initial phases. Continued monitoring is needed to understand the Freshwater Collaborative's progress in realizing its potential for addressing the 10 Grand Water Challenges.

Capturing Student Experiences

The establishment of systems for monitoring the progress of student participation and its impact are important considerations for future Freshwater Collaborative projects. While projects were generally open and thorough in their reporting, inconsistencies between projects in reporting complicated aggregation. A data system capturing student participation and experiences across the initiative would ensure that needed information is documented to inform oversight and system improvements. This data system could include individual student information such as their background, their course and project engagement, and progress toward working in a freshwater sciences career. The system can be augmented with student surveys and interviews, as permitted. Such a system would provide the Freshwater Collaborative with a valuable tool for monitoring the implementation and impact of the overall initiative and of local Freshwater Collaborative-funded projects. Due to data protections laws, such a system would likely not be able to include minor-aged students. Any efforts to capture the experiences of minor-aged participants would need to be done carefully, locally driven, and project specific.

Appendix A: 10 Grand Water Challenges

The Freshwater Collaborative of Wisconsin has identified 10 Grand Water Challenges facing the state of Wisconsin. These challenges affect many of the state's largest industries, including agriculture, recreation and tourism, shipping, commercial fishing, energy production, manufacturing, mining, and water technology and infrastructure.

Agricultural Water Management

Agricultural water management challenges include problems with irrigation over-withdrawal; nutrient, pesticide, herbicide runoff and contamination of groundwater; hormone and antibiotic release into the environment; and the impact of state and federal farm policy. By collaboratively working to address these challenges, partners hope to lower pumpage, fertilizer and antibiotic costs; reduce contaminant loading to watersheds; improve fisheries; improve drinking water safety; improve resilience; increase soil health and productivity; and increase efficiencies of production and profit margins.

Water Quality Safety and Emerging Contaminants

Challenges in water quality safety are direct threats to public health. Wisconsinites are faced with the collective challenge of reaching safe drinking water compliance and creating effective treatment techniques in order to combat lead poisoning, legacy contamination³¹, emerging contaminants and nanomaterials, nutrient contamination, well contamination, and surface water contamination. When addressed, residents have access to swimmable, fishable water; ingest less lead; have higher water quality; eliminate fish consumption advisories; and reduce beach advisories.

Industrial Water Engineering and Technology

Challenges in industrial water engineering and technology are numerous, including access and risk, efficiency, discharge and treatment, reuse, and workforce capacity. Through the Freshwater Collaborative of Wisconsin's initiatives, partners can develop new intellectual properties, lower

³¹ Legacy contaminants are chemicals once used in the U.S. but are now discontinued or outright banned. In many cases, they linger in soil and water (retrieved from: <https://www.nps.gov/articles/a-legacy-of-contamination.htm>).

costs for businesses, guarantee access to water supply, nurture skilled talent, create an entrepreneurial water community, attract new business to the state, and reduce business risk.

Great Lakes Management, Protection and Restoration

Threats to the Great Lakes include loss of habitats, invasive species, varying water levels, fisheries management, restoration and protection policies, and legacy, emerging and nutrient contamination. Thus, partners work to develop drinkable, swimmable, fishable waters; mitigate the impacts of lake level fluctuation; increase recreation and tourism opportunities; improve recreational fish stocking practices; and protect against invasive species.

Water Infrastructure: Collection, Distribution, Treatment

Costly water and sewer maintenance and replacement, an aging distribution system, non-revenue water loss, reservoir and tank maintenance, overflows, and aging treatment plants plague the water infrastructure in Wisconsin and beyond. By addressing these issues, residents will have access to safe drinkable, swimmable, and fishable waters; reduced environmental impacts; reduced flooding and basement backups; fewer overflow events; and fewer water main breaks.

Water Business, Law, and Finance

Water business, law, and finance stand to benefit from more informed operations management, responsible water use, utility rate management, successful water technology startups, and financed critical infrastructure with the hopes of leading to sustainable water use in manufacturing, economic investment, more water savvy executives, and job creation.

Watershed Management and Restoration

Challenges include loss of habitat, invasive species, varying water levels, fisheries management, and legacy, emerging and nutrient contamination. Results include swimmable, fishable, and drinkable water; mitigation of the impacts of lake level fluctuation; increased recreation and tourism opportunities; improved fisheries; improved recreational fish stocking practices; protection against invasive species; and mitigated algal blooms.

Water Security, Protection and Resilience

Threats include supply, planning and resiliency challenges; catastrophic events; food safety; climate resilience; maritime transportation of potentially harmful goods; spills, flooding, and

drought. Benefits include improved drinking water safety; readiness for catastrophic impacts to water systems; reduced risk to industrial water users.

Healthy Recreational and Transportation Water Use

Wisconsin's public health is challenged by surface water quality, beach safety, legacy contamination in seafood, and ballast water contamination³². Addressing this Grand Water Challenge will help create swimmable, fishable, and drinkable water; improved recreational and tourism opportunities; reduced risk from consuming seafood; and improved public health.

Aquaculture, Aquaponics and Water Food Systems

Challenges include aquaculture and aquaponic technologies; animal and plant science, economies of scale; food safety, food processing technologies, and workforce development. Potential benefits include clean sources of protein; reduced reliance on imported seafood; reduced reliance on unsustainable marine fisheries; healthier seafood; and more jobs.

³² Ballast water is fresh or saltwater held in the ballast tanks and cargo holds of ships. Source: <https://www.invasivespeciesinfo.gov/subject/ballast-water>

Appendix B: Freshwater Collaborative of Wisconsin's Partners

Below is a list of industry partners, governmental agencies, nonprofit organizations and community organizations that are participating in or connected to Freshwater Collaborative-funded projects. Please note, this may not be a comprehensive list as UW institutions are continuously growing their partnerships.

Aldo Leopold Community School	Lost Lake Protection & Rehabilitation District
Alliance for the Great Lakes	Ludwigs Plumbing
Anvil Lake Association	Maiden Voyage Tours
A.O. Smith Corporation	Maiden Voyage Tours
Ashland County Health Department	Manitowoc County Health Department
Atlas Science Center	Manitowoc Marina
Bailey's Harbor Wastewater Treatment Plant	Mayo Clinic
Bailey's Harbor Ridges Sanctuary Lake Organizations	Merten Plumbing and Heating
Bayfield County Health Department	Michigan Tech
Big Arbor Vitae Lake Association	Milwaukee Metropolitan Sewerage District
Big Portage Lake Riparian Owners Association	Milwaukee Public Museum
Big Sand Lake Association	Milwaukee Riverkeeper
Big St. Germain Area Lakes District	Mishicot High School
Butternut-Franklin Lake Association	Monroe County Health Department
Buffalo County Health Department	MP Kelly Plumbing
C. Sweeting Plumbing	Nature Conservancy
C.H. Koch Plumbing & Heating LLC	Nelson Deer Farm/Rush Canyon Ranch
Cargill	NEW Water
Chippewa Valley Bean	NOAA National Marine Sanctuary
Cisco Chain Riparian Owners Association	National Oceanic and Atmospheric Administration
City of La Crosse	Nohr Chapter of Trout Unlimited
City of Oshkosh	NOLS (National Outdoor Leadership School)
City of Racine Health Department	North & South Twin Lakes Protection and Rehabilitation District
Coastal Municipalities: Green Bay, Algoma, Kewaunee, Two Rivers, Manitowoc, Sheboygan, Port Washington, Milwaukee, Racine, Kenosha	Oneida County Health Department
College of Menominee Nation	Parker Lake Association
Country Water Works	Pentair
Crossroads at Big Creek	Racine County Public Health Division
Crystal Lake Association	Ramboll
Department of Agriculture, Trade and Consumer Protection	Red Smith Middle School
De Pere High School	The Renaissance Academy
Door County Health Department	Riveredge Nature Center
Dubuque River Museum & Aquarium	Rock River Partnership
Eagle Lake Management District	Root River Environmental Education Community Center
	Sammons Plumbing
	Sawyer County Health & Human Services

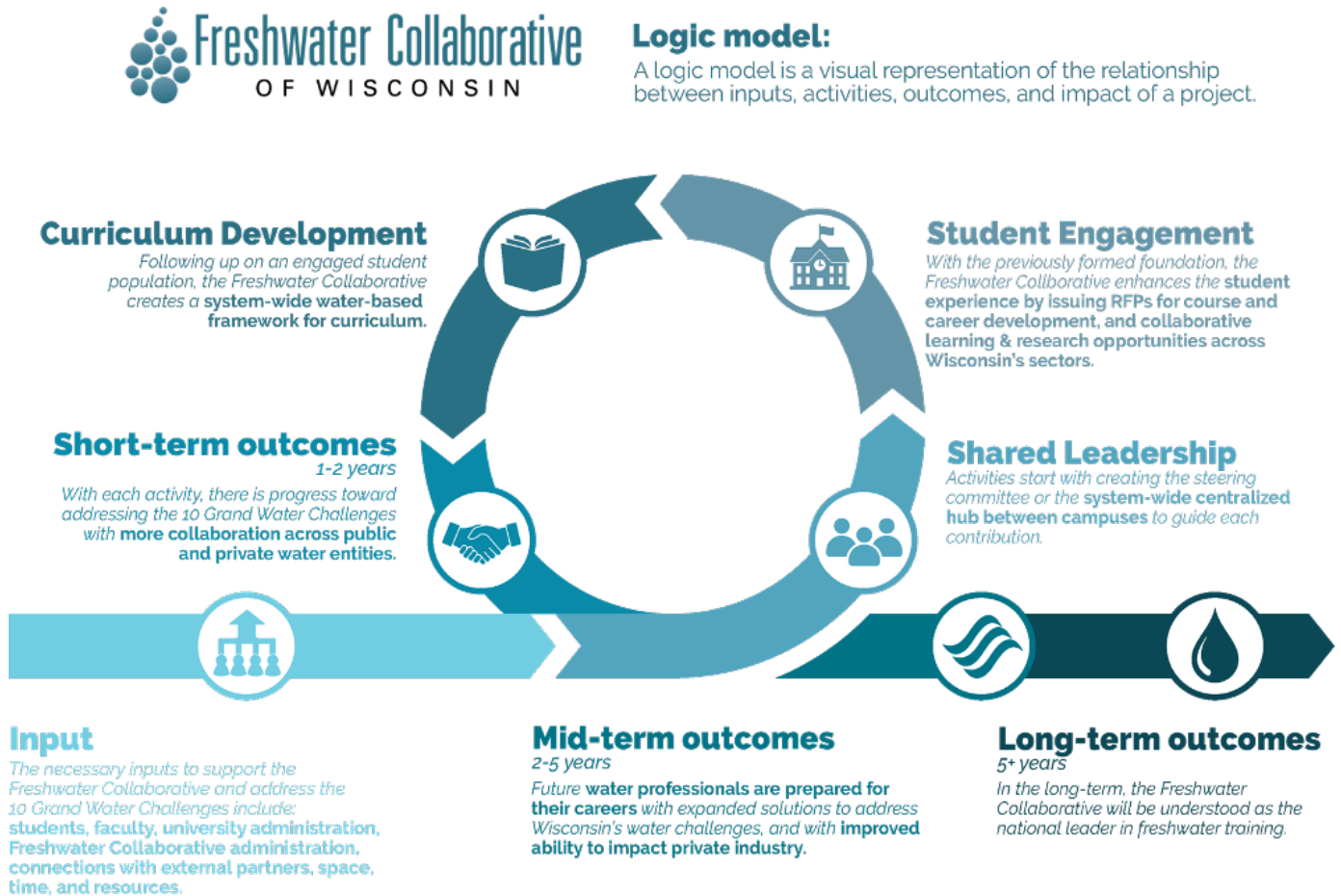
Egg Harbor Marina
 Effigy Mounds National Monument
 F3
 The Farmory Inc.
 Fence Lake Association
 Fifth Ward Brewing Company
 Florence County Health Department
 Fond du Lac County Health Department
 Food Safety Workshop
 Forest Lake Preservation District
 Forest to Brook
 Found Lake Property Owners Association
 Fox Wolf Watershed Alliance
 Great Northern Corporation
 Green Bay Metropolitan Sewage District
 Harbor District Inc.
 Howard-Sauamico Weyawega High School
 Ice Age Trail Alliance
 Indigenous People's Task Force (IkiDowin)
 Iron County Health Department
 Island Outdoors
 J. Rasmussen Plumbing
 Kentuck Lake Protection and Rehabilitation
 District
 Kewaunee County Health Department
 Kinni Corridor Collaborative
 Kinnikinic River land Trust
 Koken Farms
 Kurt Zentner & Sons Inc.
 La Crosse Queen Cruises
 Lafayette County Health Department
 Lake Lorraine, Wis., Community Members
 Lake Superior National Estuarine Research
 Reserve
 Lancaster Public Library
 Lincoln County Health Department
 Little Arbor Vitae Lake Protection and
 Rehabilitation District
 Little St. Germain Lake Protection and
 Rehabilitation District
 Local farms
 Long Lake of Phelps Lake District

Smoky Lake Preservation Association
 South Bay Marina
 Southeastern Wisconsin Regional Planning
 Commission (SEWRPC)
 Southeastern Wisconsin Watershed Trust
 St. Croix Watershed Stewards
 Stantec
 Steintal Lodge
 Taylor County Health Department
 Tomahawk boy scout camp
 Town of Boulder Junction
 Town of Gays Mills
 Town of Plum Lake
 Trout Unlimited
 U.S. Army Corps of Engineers
 U.S. Geological Survey
 Urban Ecology Center
 Veolia
 Vernon County Health Department
 Vilas County Health Department
 Walter Plumbing LLC
 Washington Ozaukee Public Health
 Department
 Water Quality Investigations
 Watertech of America
 Waupaca County Public Health Department
 WellIntel
 White Sand Lake "Lac du Flambeau"
 Winnebago Mental Health Institute
 Winnebago County Health Department
 Wisconsin Department of Natural Resources
 Wisconsin Department of Natural Resources
 -
 Drinking Water & Groundwater
 Wisconsin Department of Natural Resources -
 Great Waters
 Wisconsin Department of Natural Resources -
 Water Quality
 Wisconsin Historical Society
 Wisconsin Sea Grant
 Wood County Health Department

Appendix C: Theory of change, logic model, and supporting frameworks

As a collaborative entity with partners across multiple sectors and all 13 UW universities, the Freshwater Collaborative of Wisconsin's theory of change is multidimensional. Figure 1 presents the process of how the Freshwater Collaborative will move from its inputs and activities to positioning itself as a national leader in freshwater training.

Figure 1: Freshwater Collaborative Logic Model

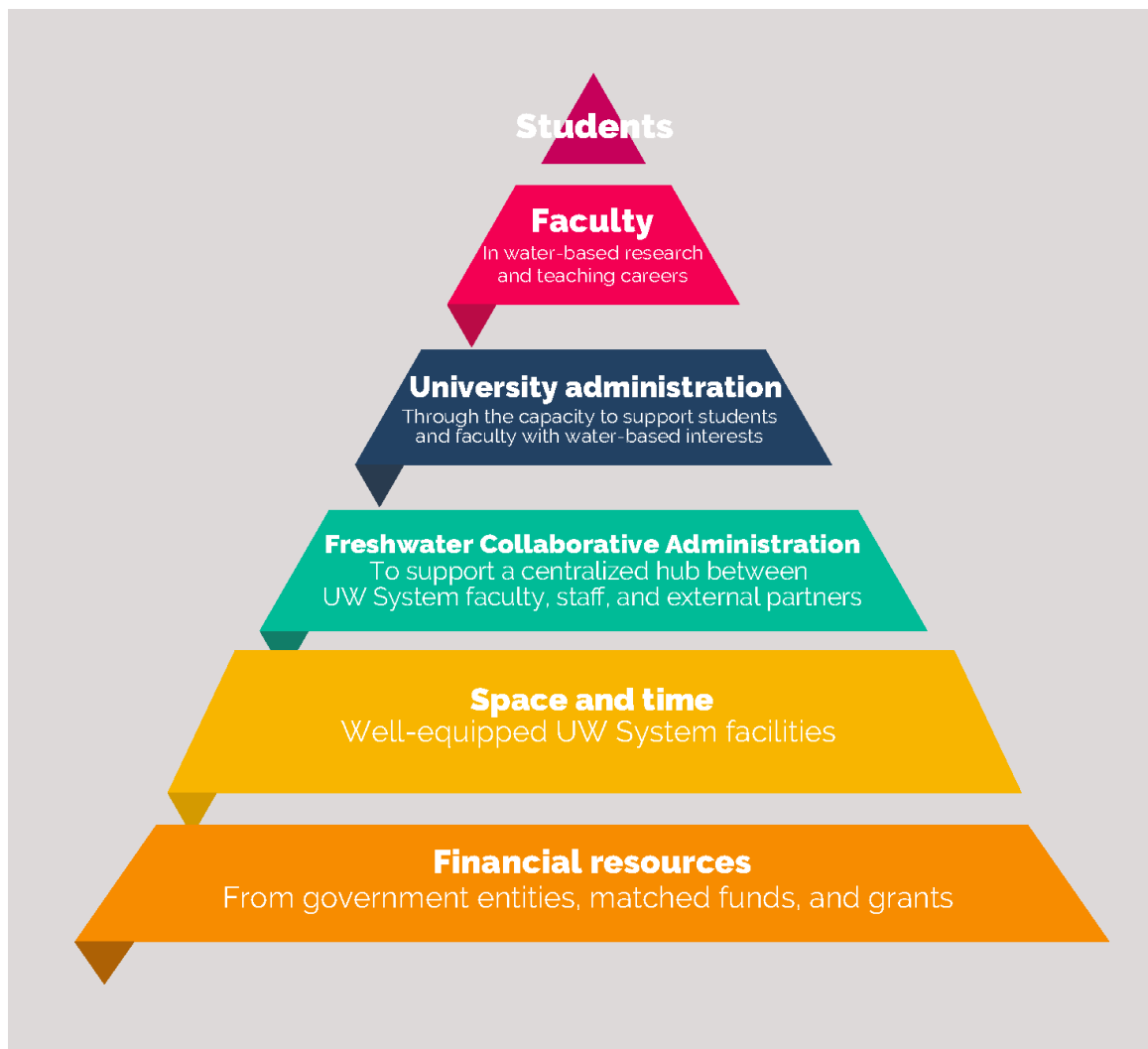


Inputs

The inputs of a logic model detail the resources, materials, and people power required to meet the intended outcomes and goals of a project. The Freshwater Collaborative's inputs (Figure 2) include:

- Engaged steering committee members, research professors, interested students, non-profits, government entities, and businesses;
- Financial resources from industry, federal grants, and government agencies;
- UW System campuses with appropriate facilities for training and research; and
- Online infrastructure including a well-functioning website and other similar communication tools.

Figure 2: Freshwater Collaborative of Wisconsin Inputs



Activities

By leveraging inputs, program organizers can move toward outcomes through activities, or the services that the program intends to provide. Major activities of the Freshwater Collaborative include:

- **Creation of structures for centralized curriculum development.** This is accomplished through meetings with the Freshwater Collaborative steering committee, efforts of the curriculum working group, input from UW System and UW Extended Campus representatives, and course development at UW institutions.
- **Workforce development in the freshwater sector.** This is accomplished through partnership formation with leaders in Wisconsin's freshwater sector, developing experiences that train students in areas of critical need, and provide opportunities for student participation in research, field, and lab activities.
- **Applying research and innovation to serve community, government, and industry partners.** This is accomplished through direct technical support, capacity enhancement, and presentations and communication with partners.

Short-term outcomes

In its initial years, the Freshwater Collaborative is working to accomplish the following:

- Breaking down organizational silos between UW System, industry, and legislative partners through collaborative shared leadership,
- Increasing the quality and quantity of relationships among Freshwater Collaborative partners,
- Increasing the quality and quantity of internships, field experiences, and research opportunities for undergraduate and graduate students,
- Creating a process for course transfers that will support systemwide certificate programs, and
- Communicating with a well-informed legislature.

Long-term outcomes

Over time, the Freshwater Collaborative intends to accomplish the following:

- Broadening perspectives in the water sector within and outside of Wisconsin,
- Increasing the quantity and quality of trained water professionals,
- Contributing to progress in overcoming the 10 Grand Water Challenges, and
- Establishing Wisconsin and the UW System as global leaders in addressing freshwater challenges

Appendix D: Methods

Data Collection

Surveys

Survey project updates were obtained from UW System partners who received Freshwater Collaborative of Wisconsin support from one of two grant programs. The first grant program, the UW System Grants Program, was funded by UW System and the Wisconsin Economic Development Corporation (WEDC).³³ The second, the first Freshwater Collaborative Request for Proposal (RFP #1).³⁴, was funded by Wisconsin State Legislators. Project leads responded based on their award type (e.g., student experience, course development, career development, and collaborative research). For projects with multiple leads, a survey was collected from a representative of each contributing UW institution in order to capture activities and feedback at each UW university. This means some projects required completion of multiple surveys. One hundred seventeen surveys were collected, representing 71 grants.

Table 5: Survey types and number of completed surveys

Survey topic	Sample prompts	Surveys	Projects
UW System Grant Program	Describing opportunities for training and professional development provided to its undergraduate and graduate student participants.	62	30
RFP #1 Student Experiences	Counting students reached and methods used	16	13
RFP #1 Course Development	Describing course contribution to student learning in freshwater	26	16

³³ More information on the Wisconsin Economic Development Corporation can be found here: <https://wedc.org>

³⁴ Funds were distributed in March 2022

RFP #1 Career Development	Sharing partnerships created with UW System and industry partners	5	4
RFP #1 Collaborative Research	Citing work published with students	8	8

Documents Analysis

This work involved analyzing 512 documents such as survey submissions, planning documents, meeting notes, syllabi, student experience surveys, research posters, course and student experience promotional materials, and undergraduate research project descriptions.

Table 6: Sample of documents analyzed

Type of document	Description	Count
Syllabi	Project leads from the course development survey submitted their syllabi for past, current, and future courses	8
Research posters	Details collaborative research conducted alongside other students and project leads	1
Student feedback survey results	Contains student responses to student experience projects	3
Freshwater Collaborative of Wisconsin Spotlight Stories	Each highlights the work of individual projects	10
Freshwater Collaborative of Wisconsin Project Report	A summative report on grantee details	1
Freshwater Collaborative of Wisconsin Steering Committee Meeting Artifacts	Includes PowerPoint and meeting notes from select steering committee meetings	9

Meetings

Transcripts and notes from 34 administrative and planning meetings were analyzed.

Table 7: Sample of meetings analyzed

Type of meeting	Description	Count
Freshwater Collaborative of Wisconsin administration team meetings	Notes and selected transcriptions	11
Freshwater Collaborative of Wisconsin evaluation team meetings	Notes and selected transcriptions from Freshwater Collaborative of Wisconsin and SREED meetings	12
Freshwater Collaborative of Wisconsin proposal review committee	Notes and selected transcriptions from the first and second proposal review processes	3

Data Analysis

Surveys

Project leads periodically complete surveys that document project progress. Survey results are imported to Atlas TI and NVivo for coding. Responses are analyzed and coded to gather more detailed understanding of the implementation and impact of projects. Broader themes identified are based on the saturation of occurrence and relevance to project questions and sub-questions. Two coders reviewed codes to ensure consistency and thoroughness in theme selection.

Project Document Analysis

Supporting documents include such things as syllabi and student feedback surveys. Other documents, including project reports and the spotlight series, were shared throughout the course of the project by administrators and partners. All documents collected were uploaded and coded with NVivo.

Administrative Meeting Notes

Notes from meetings were collected, cleaned, uploaded, and analyzed in NVivo software using an inductive coding structure. Confidential data was removed from meeting transcripts.

Timeline

Although the foundation supporting the conception of this work spans before August 2022, this marks the starting month of SREED and the Freshwater Collaborative’s formal contractual relationship. From August 2022 to January 2023, SREED completed the following tasks:

Table 8: Timeline

August	September	October	November	December	January
<p>Worked with Freshwater Collaborative’s administrative team to build questions, data sources, and data collection processes</p> <p>Assessed the goals, activities and intended outcomes for each project; align each with the broader goals of the Freshwater Collaborative</p>	<p>Created and distributed Qualtrics surveys to project leads</p> <p>Built online shared systems with Freshwater Collaborative data</p>	<p>Built comprehensive logic model for Freshwater Collaborative; began document and discourse analysis</p>	<p>Developed preliminary report that highlighted the comprehensive program model, detailed processes, and described preliminary outcomes</p> <p>Continued document/discourse analysis</p>	<p>Continued development of report</p>	<p>Shared findings with Freshwater Collaborative administrative team</p>

Limitations

Project timeline. Considering the number of surveys, documents, and observations used in this work, evaluators and Freshwater Collaborative administration should plan for additional time to collect, analyze, and share results to ensure use beyond its primary contributors.

This is the first year the Freshwater Collaborative has carried out a formal review of its programming, and the first year using the tools designed.

Incomplete and inconsistent data. Some project leads failed to provide an update about their projects, and some submitted incomplete surveys. Therefore, this report does not reflect complete information from all projects funded by the Freshwater Collaborative. Additionally, the proposals funded in 2019 and the proposals funded in 2021 used different survey designs. This was due mostly to external evaluation expertise being contracted after the 2019 round of funding was distributed. Regarding student participation, project leads did not provide reliable participation data. Thus, the evaluation team was unable to provide much detail about student participation in this report.

Positionality

The Office of Socially Responsible Evaluation in Education (SREED) at the University of Wisconsin Milwaukee (UWM) conducts rigorous evaluations and research on issues relevant to providing students from all backgrounds with equitable education opportunities. The two primary leads on this project are Alexandria Sedar, Evaluator and Research at SREED, and Marlo Reeves, Senior Evaluator and Researcher at SREED. Sedar was a former consultant to the Freshwater Collaborative of Wisconsin administrative team. Oversight of this positionality was provided by SREED Director, Curtis Jones, to mitigate challenges with conflicts of interests.

For more information about this report, please contact Curtis Jones at jones554@uwm.edu or visit www.uwm.edu/sreed.