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LakeLine

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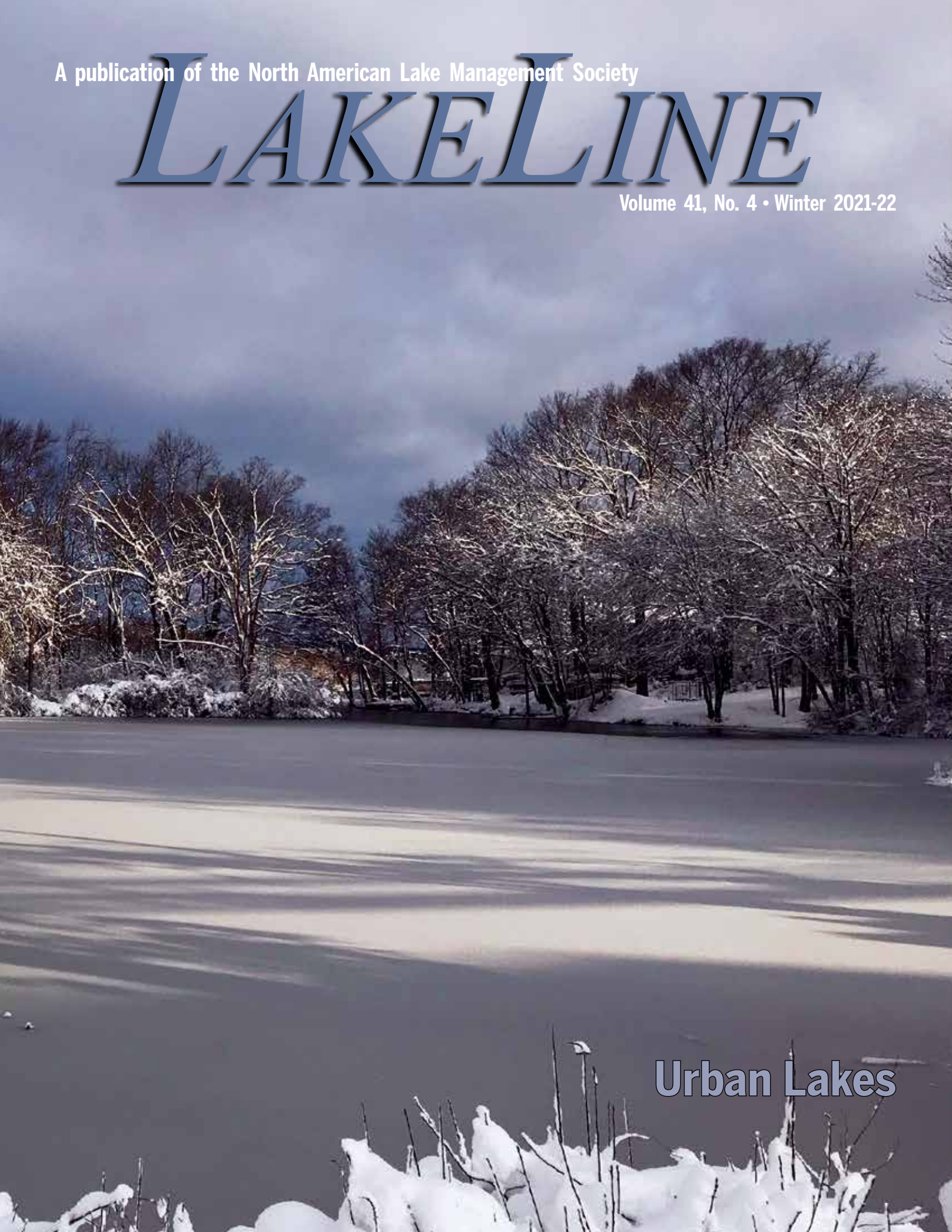

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Contents

Volume 41, No. 4 / Winter 2021-22

On the cover:
"Snow Covered Ashley Cove, Lake Hopatcon," photo by Donna Macalle-Holly, 2021 NALMS Photo Contest entry.

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From Amy Smagula **the Editor**

Happy New Year to our *LakeLine* readership! As we start off 2022, we are working on a line-up of topics for upcoming issues of *LakeLine*, to highlight some of the activities and efforts that the North American Lake Management Society (NALMS) has underway, as well as to highlight some milestones we will mark in the coming year. As you read through this issue you will see a call for articles for the topics of the upcoming issues, and we hope you will contribute some of your knowledge and expertise in the form of an article for one of these topics.

This issue of *LakeLine* puts the spotlight on those waterbodies within or adjacent to highly developed areas like cities or towns, rather than in a more naturally formed landscape. Large or small, natural, or constructed, these *urban lakes* are generally surrounded by few natural features and are more often surrounded by impervious infrastructure like roads, parking lots, and buildings of various types. Some of these urban systems could be fed primarily by storm drains or overland flow, rather than natural streams. As such, the water quality of these waterbodies can often be impaired due to their location in the landscape. Additionally, there is a complex network of connections to these ponds that can often be overlooked, that goes beyond the science itself, and involves history, culture, community, and other intangible yet critical facets.

The articles in this issue include and build off from the Urban Lakes sessions held as part of the Annual Symposium of the North American Lake Management Society (NALMS), held virtually in November 2021. A summary of the symposium was prepared by **Philip Forsberg**, the Director of Programs and Operations for NALMS, and it starts on page 4. **Mark Rosenkranz**, NALMS Region 10 Director, and Chair of the NALMS Justice, Equity, Diversity, and Inclusion Program (JEDI), worked to pull together the talks on urban lakes and the communities and culture that surround them. Mark provides an overview of the impetus behind this session in his introduction piece on page 6 of this issue, and introduces the articles included from **Michele A. Sam**, **Emilie Henry**, and **Steve Souza**, that were write-ups of the talks they gave in this NALMS session. The article from **Vinicius Taguchi** is also a version of the talk he presented in this same symposium session. His article is showcased in our Student's Corner.

In addition to the articles that are included from the Urban Lakes session, we also have an article that was submitted by **Neal D. Mundahl**, from Winona State University in Winona, Minnesota. Neal highlights Lake Winona in his article, documenting the changing water quality and ecological conditions of this eutrophic urban lake, as well as the work by local citizens groups who recognized the value of this urban resource, and their work to rehabilitate the system over the years.

We also hear about a useful shoreline assessment tool, Foreshore Integrated Management Planning, put to good use in British Columbia by Living Lakes Canada. **Bruce Mac Donald**, **Jason Schleppe**, and **Georgia Peck** write about the evolution and implementation of this method for assessing and protecting shoreline areas.

Our resident Lakespert, **Steve Lundt**, has a call to action for urban lakes. He highlights the numerous functions of these resources and asks for individuals and communities to embrace the values of these waterbodies and work to make them thriving systems.

Finally, please take some time to learn about our new NALMS president, **Chris Mikolajczyk**, who took office in November, by reading through his President's Message.

Thank you for reading and do please consider contributing an article for a future issue of *LakeLine*. We'd love to hear about your lake work or your lake story.

Amy P. Smagula is a limnologist with the New Hampshire Department of Environmental Services, where she coordinates the Exotic Species Program and special studies of the state's lakes and ponds.

(From the President, continued from p. 3 . . .)

As life begins to return to a new normal (again, we hope), Lakes Appreciation Month this coming July will take on added significance for many of us. For me, I am fortunate to be able to return to the northeast to see my clients, staff, and co-workers, as well as spend time with family around the lakes of my youth in both New Jersey and New York. I hope that you, too, can spend time at your favorite lake and reconnect with family and friends as this summer approaches.

Christopher Mikolajczyk, CLM, is a senior project manager and certified lake manager for Princeton Hydro and conducts the management, oversight, and coordination of aquatic ecology and water resource projects in three main areas: aquatic resource restoration and management, aquatic ecosystem sampling and investigations, and stormwater quality modeling and management. Chris is the current president of NALMS.

From Chris Mikolajczyk the President

Happy New Year to all of you! I'm finally settling into the home we built here in Colorado Springs after moving from New Jersey in June of 2020. Ever sell a house during a pandemic? It's a good time. Building a new one is an even better time! In all seriousness, my family and I are incredibly fortunate to live in such a beautiful state. A state where water is much scarcer than New Jersey, and the protection of that water is viewed as even more crucial.

In October of 1972, as a two-year-old toddler, my parents have told me the story of my first visit to the local park, Mindowaskin Park, located in Westfield, New Jersey. As the story goes, we got out of the family car and as soon as I saw the small waterbody present in the park, Mindowaskin Pond, I made a beeline straight toward it. I never stopped. I ran right off the small stone wall and straight into the water, where my mother proceeded to then rescue me. I lost my Sesame Street sneakers in the process. Word on the street is this is how the Clean Water Act was developed at the United States Environmental Protection Agency (USEPA), but alas, this is not the truth. That being said, in 2022 we will celebrate the 50th anniversary of the Clean Water Act, the primary version of the modern federal law in the United States that governs water pollution. The law that is responsible for the restoration and resurgence of the lakes and water resources that we all love so much. Stay tuned as NALMS looks to celebrate the anniversary of the legislation that has done so much for our nation's waters and wetland resources. On a side note, in September of 2016, I was able to assist in the drawdown and oversight of the dredging and restoration of Mindowaskin Pond. Never did find my sneakers.

For 2022, I would like to highlight an important role that NALMS is taking on with the 314 working group. As you may/may not know,the Clean Lakes Program was established in 1972 as Section 314 of the Federal Water Pollution Control Act, to provide financial and technical assistance to states in restoring publicly owned lakes. The program has funded a total of approximately $145 million of grant activities since 1976, to address lake problems but there have been no appropriations for the program since 1994. The Section 314 Clean Lakes Program was reauthorized in September 2000 as part of the Estuaries and Clean Water Act of 2000, but no funds have been appropriated. The 314 working group, led by Kellie Merrell, Region 1 Director and Eric Howe, of the Lake Champlain Basin Program, is seeking the restoration of funding specifically to Section 314 of the program, along with the current Section 319 funding, which addresses non-point source watershed management. As president in 2022, I will do whatever I can do to assist this group in this important mission. I feel that lakes can use all the help they can get both internally and externally, if necessary.

Planning continues for the Joint Aquatic Sciences Meeting, to be held in May of 2022 in Grand Rapids, Michigan. This is a unique event that brings together nine different scientific societies, all of which are part of the Consortium of Aquatic Science Societies:

- American Fisheries Society
- Association for the Sciences of Limnology and Oceanography
- Coastal and Estuarine Research Federation
- Freshwater Mollusk Conservation Society
- International Association for Great Lakes Research
- North American Lake Management Society
- Phycological Society of America
- Society for Freshwater Science
- Society of Wetland Scientists

The theme for this conference is "Rapid Changes ~ Collaborative Solutions." The call for abstracts has been announced and closed January 17th. NALMS is looking forward to welcoming as many of you as possible into Grand Rapids, a beautiful location nearby to one of our Great Lakes, Lake Michigan! Further information can be found at: https://jasm2022.aquaticsocieties.org/. We hope to see you there!

Planning is now well underway for the NALMS 2022 Annual Symposium in Minneapolis, Minnesota, with the theme: "Leveraging Experience to Manage Diverse Lakes, Landscapes, and People." The call for abstracts will be announced early in the new year. We are looking forward to welcoming as many of you as possible in Minneapolis, and I can't think of a better place to have a lakes conference than in the Land of 10,000 Lakes! Hopefully, some of the local lakes will be frozen so that we can have a good old-fashioned game of shinny like I used to in the Adirondacks of New York during my undergrad years. I know my son (pictured, in grey) would be up for the game! All the information will soon be found on the NALMS homepage: www.nalms.org/.

(From the President, continued on p. 2 . . .)

Conference Summary by Philip Forsberg

NALMS held its 41st International Symposium online November 15–19 with approximately 690 attendees participating in the symposium and pre– and post–symposium workshops. Originally scheduled to be held in Oklahoma City, Oklahoma, NALMS announced in September that the symposium would shift to an online event for the second year in a row due to the COVID-19 pandemic. Thanks in large part to our Oklahoma City host committee from the Oklahoma Clean Lakes and Watersheds Association (OCLWA), we were able to transition from an in-person conference to online in record time. The 2022 symposium is scheduled to be held in Minneapolis, Minnesota, and we're working to return to Oklahoma City in the near future.

A full slate of nine workshops on a wide variety of topics was on the schedule for Monday and Friday of the symposium week. Workshop topics included algal ecology and control methods, algal identification, the use of sensors to collect and analyze water quality data, ecology of cyanobacteria, communications, aeration/oxygenation, and stormwater management. The NALMS Justice, Equity, Diversity, and Inclusion (JEDI) Program sponsored a three-part workshop focused on transforming your hidden racial bias. Students and early career professionals participated in a workshop, which included one-on-one mentoring, preparing résumés and cover letters, and tips for interviewing. Thank you to all our workshop presenters for their flexibility in moving from in-person to online!

As we did in 2020, the online symposium offered presentations in a couple of formats. Interactive Sessions featured pre-recorded presentations with moderated live question-and-answer discussion with the presenters. General Sessions consisted of unmoderated pre-recorded presentations with Q&A through the symposium platform's chat functionality.

The symposium technical sessions were bookended by opening and closing plenary sessions. The opening plenary session featured a presentation by Emily Stanley, a professor and Wayland Noland Distinguished Chair in the Department of Integrative Biology and Center for Limnology and the leader of the North Temperate Lakes Long Term Ecological Research program at the University of Wisconsin–Madison. Her talk focused on examples of long-term change in lakes drawn from 40 years of data on two sets of Wisconsin lakes. The closing plenary session, which immediately followed two sessions sponsored by the NALMS JEDI Program, featured a talk by Nancy Schuldt, the Water Projects Coordinator for the Fond du Lac Band of Lake Superior Chippewa, on manoomin, or wild rice, and its cultural and economic importance to the indigenous Anishinaabeg people in the Great Lakes region of Canada and the United States. Manoomin is recognized as being ecologically important as habitat and serves as an indicator of a high-quality, diverse aquatic ecosystem.

The plenary presentations, along with the contributed presentations, are available to symposium registrants on the symposium platform, Whova, for six months after the symposium as part of the registration fee.

The annual Clean Lakes Classic 5K was once again held as a virtual run. Participant times were submitted on the honor-system. Thank you to our shirt sponsor, Princeton Hydro, and to Gantzer Water for their support of prizes for the 2021 Clean Lakes Classic.

A new addition to the Clean Lakes Classic tradition was the Kenneth H. Reckhow Scholarship Fund. One female and one male graduate student participant in the event were randomly selected to receive $500 for use toward their education. The 2021 recipients are Emily Waterman (University of Oklahoma, Geospatial Technologies and Environmental Science Master's Program) and Marc James Rand (Department of Mechanical Engineering, University of Bath).

The annual NALMS awards presentations recognized the accomplishments and contributions of NALMS members and other worthy recipients to lake management. The Secchi Disk Award, the Society's most prestigious award, given to a member who has made extraordinary contributions to the goals and objectives of the Society, was awarded to Julie Chambers.

Thank you to all who attended this year's symposium! We look forward to seeing you in person next November in Minneapolis for NALMS 2022!

Jody Connor Student Awards 2021

Each year NALMS presents student awards to the best student presentation and best student poster at the annual NALMS symposium. This year the student awards are sponsored by PhycoTech, Inc. The NALMS Board renamed the student award as the Jody Connor Student Award in memory of Jody Connor, a long-time friend of NALMS who was active on the Education Committee and participated in the reviews of student presentations and posters.

The first-place winner receives a check for $200 and a plaque. Honorable mention or second place winners receive a plaque. The Student Awards Committee is chaired by Frank Browne and Alex Horne. Members of the committee include Amy Smagula, Harry Gibbons, Holly Waterfield, Jennifer Graham, Ann St. Amand, Matt Albright, and Dick Osgood. The awards are based on scientific merit, research design, visual aids, clarity, and presentation. There were no poster presentations this year.

The 2021 first-place winner of the Jody Connor Student Presentation Award was Muwanika Jdiobe of Oklahoma State University, Stillwater, Oklahoma for the presentation "Design and Development of a Water Observatory: An Autonomous Environmental Sampling System for In situ Sensing of Lakes and Rivers."

This year we have two second place winners. Katherine (Katie) Low from the University of New Hampshire, Durham, New Hampshire won the second-place award for her paper "Shifting Baselines: Fish Presence Reduces Food Web Stability by Altering Consumer Diet Composition." Katie won the first-place award in 2019. Yetkin Ipek of Oklahoma State University, Stillwater, Oklahoma won the other second-place award for the paper "Growth and Ionome-Wide Responses of Phytoplankton to Relative Supplies of Nitrogen, Phosphorus and Trace Metals: From Chemostats to Grand Lake." Oklahoma State University won two of the three student awards this year.

Students are encouraged to present scientific papers at the NALMS symposium; it provides an excellent way to present research data and maybe win an award.

We thank PhycoTech, Inc. for sponsoring the student awards!

2021 NALMS Photo Contest Results

Thank you to the wonderful photographers who contributed photos to this year's NALMS Photo Contest. We had a total of 37 photo entries, which may just be a photo contest record for NALMS! The winners of the 2021 contest are:

Winner of the Popular Choice Category: Skaha Lake Fire: A changing climate in British Columbia, by Mike Sokal

Winner of the Editor's Choice Category: Sangchris Lake State Park, Illinois, by Peter Berrini

Each winner will receive a $250 Amazon gift card, thanks to the generous support of Yokogawa Fluid Imaging Technologies, the sponsor of the 2021 NALMS Photo Contest.

Introduction to Urban Lakes and NALMS' Justice, Equity, Diversity & Inclusion (JEDI) Work

Mark Rosenkranz

In this edition of *LakeLine* you will see several papers about urban lakes, which were previously presented during the North American Lake Management Society's (NALMS) 2021 annual symposium, which was held virtually. The Urban Lakes track at the symposium was included to highlight the role these waterbodies play in communities that may not have other recreational or subsistence options. Historic planning decisions may have led to legacy water quality impairments that persist to this day, leading to limited affordable restoration options. Below is an introduction to three of the articles that were originally presented at NALMS 2021.

Michele A. Sam, spoke about what being place-based and indigenous-led means, applied through her work supporting Living Lakes Canada (LLC). Historically, Indigenous Peoples have been brought into the discussions after the water research project has been established, only to be marginalized during the implementation stage, and often ignored in the dissemination phase. Together with LLC, a webinar series was offered as a learning platform to ensure Indigenous Peoples are involved with planning and implementing water research projects from the beginning, and why. Appreciating the role of Indigenous Peoples' place based knowledge is integral to the planning process and overall sustainability of projects including making real life meaning of the results and affecting changes to policy that directly impact Indigenous Peoples' relationship and responsibilities for water in their homelands.

Emilie Henry helped the Flathead Basin Commission and the City of Kalispell develop a two-phase program to inventory, sample, and prioritize outfalls for further study. This collaborative and preemptive approach will help maintain water quality in the basin as further development threatens water quality in the future. The Confederated Salish and Kootenai Tribes were involved in the planning process, and preliminary work highlighted the need to work more closely with the Tribes to identify barriers to stormwater management.

Urban lakes are often heavily used waterbodies that serve a vital role in communities that have limited recreational options. As a result of heavy use and stormwater infrastructure, these lakes can have legacy environmental issues that continue to impair water quality. Steve Souza talks about how to improve these waterbodies through a focus on community engagement, education and outreach, and additional funding to implement restoration measures.

The outreach, inclusion, and restoration themes of the previous three talks are built upon by Vinicius Taguchi. Vini talks about the negative impact a restoration project may have on the local population, in his article for the Student Corner. Legacy environmental racism may have led to ignoring or exacerbating pollution in these systems. However, without engaging the local community any restoration efforts may lead to gentrification, which could exclude the population that built their lives around the resource.

These talks were part of the Justice, Equity, Diversity, and Inclusion (JEDI) sessions that highlighted work in urban and underserved communities. The NALMS diversity focus was initiated during our 2019 mid-term meeting in Denver. A breakout meeting discussed ways to improve diversity in the membership and board of directors for the organization. Out of that came the JEDI task force that held regular meetings to discuss how diversity could be promoted and integrated into all aspects of NALMS operations. In 2021, the task force was rolled into an official NALMS Program, ensuring a JEDI focus continues to be an integral part of the organization.

This program was brought to light in a large part due to the efforts of Perry Thomas and Lisa Borre, presidents in 2020 and 2021, respectively. Their leadership ensured JEDI was a focus, which meant they encouraged discussion about racism and exclusion in the environmental sciences, and provided guidance with tools and resources so the board could become educated about the issues. This effort will continue to be a focus in 2022, under the leadership of Chris Mikolajczyk, as we plan for an in-person conference in Minneapolis.

As we continue with our program, we will assess our efforts with an annual survey. Our goal is to create a conference environment that is welcoming to all, providing a forum for those who have not had a voice when advocating for environmental justice. We hope to include educators, citizen scientists, and any who are concerned about the environment in their communities. The articles you will read in this magazine will become a regular occurrence in *LakeLine*, so I hope you take the time to consider how you can help sustain our aquatic environment wherever you happen to be.

Mark Rosenkranz has been the NALMS Region 10 representative since 2018, and in that time has served as temporary Chair of the Communications Committee; served on the Conference Committee and Development Committee; and has been Chair of the JEDI Program since its inception. During his time on

(Rosenkrantz, continued on next page >)

What Does It Mean to Be **"Indigenous Led"** in Relationships with Water in a Time of Truth & Reconciliation?

Michele A. Sam

Hu sukiłq̓ukni kin wam . . . I am grateful you have arrived . . . here within this publication and are going to read this.

I am Ktunaxa, and I am also academically trained and educated. I have had the benefit over the past 30+ years of learning from bilingual Ktunaxa knowledge-holders and language speakers who were raised by their grandparents before they were subject to the genocidal tendencies of property and protection rights that grounded Residential Schools and Child Welfare systems. What this means is that I still follow a Ktunaxa oral tradition, and worldview, despite writing and utilizing English to do so. I continue to be Ktunaxa in my homelands, in relationship with the landscapes and waterways, as my ancestors have. What follows is written from that worldview. If you have heard my voice, watched a presentation of me, read the following as if we are in dialogue, as that is how I intend you to read this.

Reconciliation in its many forms is inherently about relationships, the foundation of which are a conflict in which truths are purposefully managed, if truths are mentioned at all. More often, truths are denied, require proof and evidence, or are subject to filtering. Appreciate that reconciliation is "the development of good relations where they have never truly existed before" (Alderdice 2015). As such, truth-telling and dialogue are a core process within Reconciliation as a purposeful change process. The trouble has been that within normative day-to-day "business as usual" agendas, change processes of any sort, as they are, often have no time, space, or place of its own.

Within the collective and predominately "normative" lived experiences, that has been entrenched through the intellectual imperialism of a Western, Educated, Industrialized, Rich and Democratic (WEIRD) (Henrich et al. 2010) worldview, we assume and assert that "we are all same" while at the same time, we take note of and recognize diversity and difference as 'a thing' which is at once "left" to someone else to take on and apply "liberally." And while the call is resounding once again in our collective consciousness, that Indigenous Peoples' voices and knowledge is imperative in supporting the large-scale changes necessary for all that ails humanity these days – climate change; access to clean and healthy water – how prepared are we to listen, and to hear what is said when it challenges all we know to be true?

Globally, the conflicts that require a "reconciliation process" are reflective of what is called an "intractable conflict." I am simplifying here, the bulk of Dr. Daniel Bar-Tal and other scholars in the topic, but an intractable conflict is complex and complicated and pretty much all-encompassing of lived experiences and histories/her-stories over generations, is state-sanctioned, and often for the "greater good." Indeed, humanity, wherever it exists is currently caught in an intractable conflict, as we exist within impacted ecosystems, and watersheds, whose biodiversity continues to be in harm's way after generations of developmental trauma and impacts of our direct and indirect actions and activities, that we now monitor in waterways – in all its many forms and systems. Water did not impact itself. Our normative ideologies did and continue to do so. And the monitoring of the health of water is evidence of such an intractable conflict.

To ensure reconciliation is purposefully undertaken and Indigenous-Led, first we will have to work through what we don't know. This includes how and why and when water became something other than our relative, and how/why it now requires "monitoring" and interventions for its health and well-being, when "all living things," including human beings, are absolutely dependent upon water according to some. I would say we are all inherently interdependent with water.

I am a Ktunaxa human being, and as a result of being born, I am a nation state (Canada) defined Indigenous, used to be Aboriginal, First Nation, and am still a card-carrying status Indian. I concur elsewhere (Sam 2019) with global scholars that my existence is within the parameters and systems of intractable conflict, as are yours. Paramount to

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(< Rosenkrantz, continued from previous page)

the Board, he has helped edit the Operations Manual and worked with the JEDI Program to ensure JEDI is included in all aspects of NALMS. Mark has been the staff limnologist with Lake Oswego Corporation since 2002, managing water quality on an urban lake in the Portland, Oregon, metropolitan area. He received a master's in environmental management from the Center for Lakes and Reservoirs at Portland State University and is a Certified Lake Manager with NALMS.

addressing, resolving to hear and heed Indigenous Peoples' knowledge is an appreciation and acceptance to being Indigenous-Led. And that means the foundation of approaches to the climate crises and water issues, as it is, stems from a recognition that from water all food comes. We know that from various disciplines and fields of study and science. Without water there is no life.

In the Ktunaxa version of creation, humans emerged from the water monster. The human beings, all of us, because we are the youngsters of creation, have a responsibility to care for water and the landscapes. And in creation, we are taught how to care for all living things, the gifts, and challenges, if only we knew how to listen. For the Ktunaxa, from time immemorial we have had an ability to interpret, and to help teach each other how to listen and interpret for future generations. Water was not a commodity – it has been and continues to be an intimate relative.

"Knowledge and land are intimately bound to one another just as the natural world is alive and spiritually replete. This is a significant point of contrast with Western Science where knowledge of nature is distinct and separable from nature. This difference is fundamental. It contributes to, and reciprocally sustains, divergent metaphors of knowledge" (Whitt 1999).

Globally, there have been "reconciliation processes" that are place -based (nation-state-ascribed such as in Australia, South Africa, and Northern Ireland) to learn from, including an approach to reconciliation that is *not* only at an individual level, but also at the group level. There is usually "unfinished business" as Lord John Alderdice calls it (Lord Alderdice 2015) within the group and community level, that requires what Bernard Janse van Rensburg of the South African Truth and Reconciliation Commission calls "strategic interventions in the quest for symbolic 'reparation of the nation'" (in Lord Alderdice 2015). These reconciliation processes however are limited regarding relationships with landscapes and waterways.

Most recently through United Nations Climate Change conference in Glasgow, Scotland, the call to hear Indigenous Peoples' voices and interpretation of knowledges was reaffirmed. Again, how? While the media shouts out to all who can hear, to listen to Indigenous Peoples' voices, as our knowledge is helpful, grounded, and absolutely scientific, just not separated in ways you might be familiar with, Indigenous Peoples like myself have been busy.

You probably don't know that, you probably don't see that, because for most, Indigenous Peoples have died off, or are still a "problem," or – fill in your perception here. If we are lucky, you might just be able to say, "I don't know."

Indigenous Peoples have been speaking out since contact. We were and are still, disadvantaged by the systems in place, such as education, and so we aren't getting to those places necessary to make us visible. And where we get to speak, when, why, and how tend to be managed within the regular and routinized approaches that, honestly, got us, you and me, into the current situation we all find ourselves in now. This context is a fundamental issue to contend with.
In order to be able to hear what I have to say, among many others, one must be prepared to hear a truth or two which is uncomfortable and challenging given the context of the world as it is constructed for us, *and*, you will have to recognize that *I* am not *you*. I have not had the same lived experiences nor am I that removed from Ktunaxa worldview and cosmology, despite living here and now. I am only a few generations from a time when my people were in direct relationship with our environments, including water. We still know and carry out our side of the responsibilities. I raise my children to "know." They have the "ability to respond."

I was excited to be asked to present at NALMS and share what Living Lakes Canada (LLC) and I had been up to. In 2021, we agreed to a series of workshops in support of reconciling relationships between Living Lakes Canada and Indigenous Peoples within the Columbia Basin, in effort toward a more informed model of engagement for water monitoring. I offered a series called "Pre-Engagement Ethics for Indigenous Peoples Relationships" to a complement of LLC staff, COVID-style.

We focused upon building non-Indigenous staff awareness of the foundation of Intractable Conflict, White Privilege and Fragility (DiAngelo 2011) – I added Fear and Fatigue – in order to be able to recognize an applied Indigenous Peoples knowledge lens is necessarily distorting at times. We decolonized the Justice, Equity, Diversity, and Inclusion (JEDI) backpack: JEDI models imply an already established framework to "be included within," which by extension and application is a far more insidious assimilation model.

Perhaps because it is a wee bit less recognizable and usually comes from a place of well-intended but misinformed ideologies, JEDI leaves the normative face values intact and follows a residual policy model for development, implementation, and change, which results in more of the same while looking like change is happening. It is a step, definitely, but it does little for Indigenous Peoples' self-development.

A point of caution here! Indigenous Peoples, are *not* all the same – Indian, Native American, Native, etc. In fact, there is a reason for the United Nations Declaration on the Rights of Indigenous Peoples to have that "S" at the end of Peoples. This point is often glazed over, and when one thinks of how Indigenous Peoples continue to be approached in that "one size fits all' manner, despite, again, an ascribed understanding and a scientifically proven point of biodiversity, things get complicated and complex fast. Indigenous Peoples are in interdependent relationship with our homelands and waterways, and so we are as different as the landscapes and waterways are.

LLC and I developed three webinars for the Place-Based Indigenous Peoples located within the "Columbia Basin," Video Gallery – Living Lakes Canada. Each session was unique to each of the three Indigenous peoplehoods – according to their protocols, culture, and location. The context – the Columbia Basin – is considered "shared territory" by Indigenous Peoples to varying degrees. The Ktunaxa acknowledge that we shared our homelands and waterways, prior to contact with the Sinixt, Sylix, Okanagan, and the Secwepemc with "sharing protocols" were in place. But with development and the nation state, what they were back then, are now unrecognizable as we are also not in the

social, spiritual, and cultural space and form we once were, and as a result are also in need of reconciliation processes, including decolonization, which is a direct result of development and its impacts.

What I hope you have glimpsed from this submission is the importance of doing differently, to take to heart and mind, the work of building new relationships and redressing old ones. And that to do differently is to embrace the unique place-based context of the Indigenous Peoples, you find yourself in relationship with for the sake of all our relations – we are in essence all water beings.

Hu sukiɬ̓ukni na qu¢xałsiɬ ʔaktimunała kwiɬqa qapsin.

Thank you for taking/making the time to discuss these big ideas.

mas

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Assessing & Mitigating Stormwater Pollution in **the Flathead Watershed, MT**

Emilie Henry

A collaborative approach

Flathead Lake, the largest natural freshwater lake west of the Mississippi River, and its surrounding drainage basin are essential resources in northwest Montana (Figure 1). Nested within the larger Columbia River Watershed (Figure 2), the Flathead Basin serves as an ecologically, socially, economically, and culturally vital resource for residents in the neighboring Flathead and Lake counties. The Flathead Basin is unique in that it harbors some of the cleanest waters in the country, owing largely to its relatively undeveloped status. Although there are areas of urbanization, the Flathead Basin contains vast stretches of natural wilderness and remains far less densely populated than some similarly sized watersheds in other parts of the country.

However, the area is experiencing unprecedented rates of growth that threaten the basin's pristine waters. According to the U.S. Census Bureau, the population of Flathead County has increased by approximately 14 percent over the past decade, with no slow-down in sight. Considering this growth and the impending water quality threats it presents, the Flathead Basin Commission (FBC) and the City of Kalispell partnered up to investigate stormwater in the Flathead Basin.

Created by the Montana legislature in 1983, the FBC is a non-regulatory government agency whose mission is to protect the water quality and natural resources of the Flathead Basin through partnerships, consensus-building, education, and community involvement. The 23-member commission is composed

Figure 1. Flathead Lake.

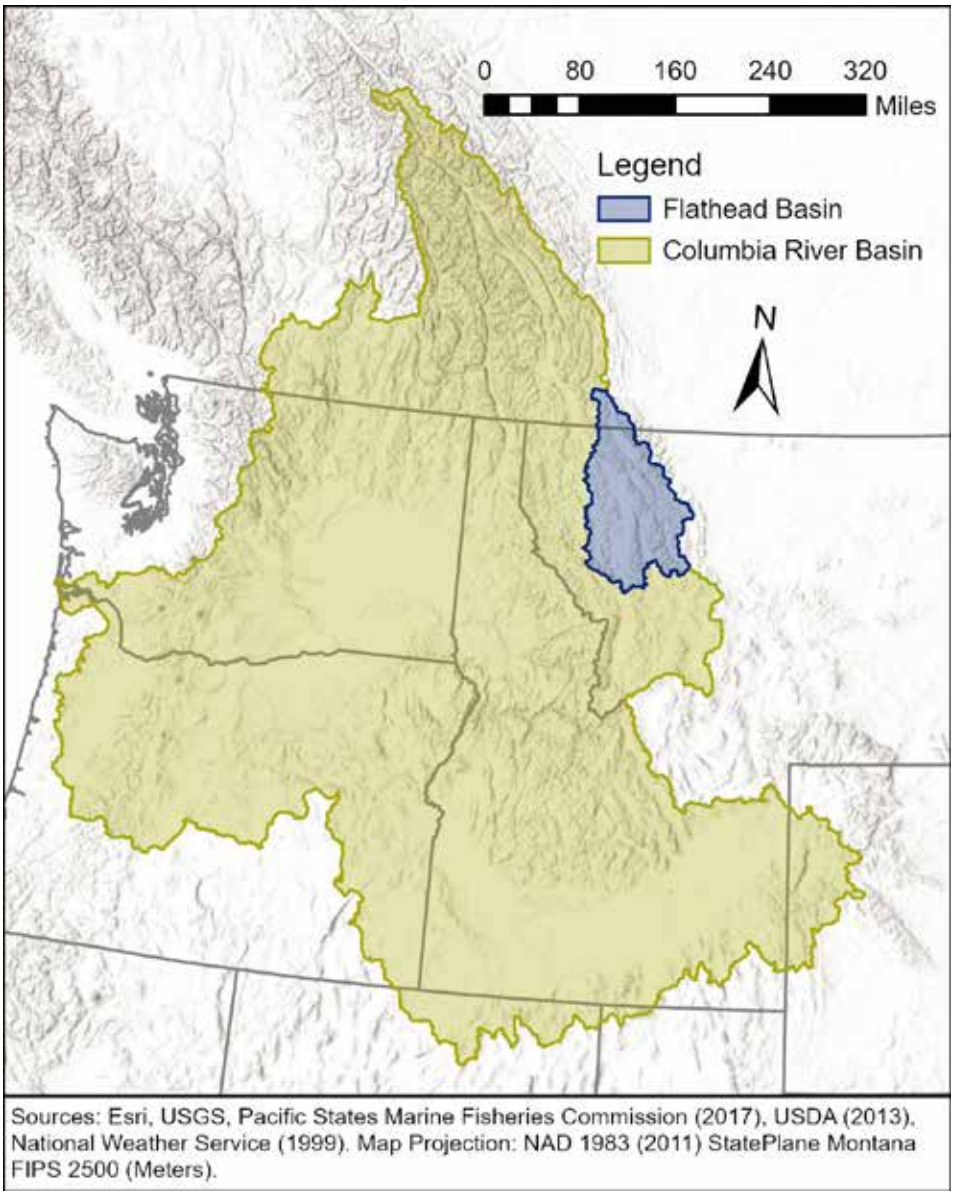

Figure 2. Map of the Flathead Basin in the context of the Columbia River Basin.

of governor-appointed residents and local, state, tribal, and federal agency representatives who seek to identify the basin's water quality threats and work together to determine and implement the most effective solutions. FBC's most recent endeavors center around nonpoint source pollution, including stormwater and onsite wastewater treatment systems.

The City of Kalispell is the only permitted municipal separate storm sewer system (MS4) in the Flathead Basin and, therefore, is the only urban area in the watershed whose stormwater quality is regulated by the state. As a result, the majority of stormwater in the Flathead Basin discharges directly into local streams, rivers, and lakes untreated. It is because of this fact that FBC was interested in learning about how stormwater is managed in other areas of the watershed. To launch this investigation, the City of Kalispell and FBC jointly hosted an AmeriCorps member.

Phase I: Inventory and modeling

The project is divided up into two phases which were completed in 2020 and 2021, respectively. The primary goal of Phase I was to begin to frame the problem of stormwater pollution in the Flathead Basin. To accomplish this, first, a comprehensive inventory of stormwater infrastructure in the basin was created. This inventory was compiled into a digital map and includes the following elements of stormwater infrastructure: catch basins (otherwise known as storm drains), which allow runoff to enter into the stormwater system; storm lines, which transport stormwater; storm manholes, which are points of access to the underground stormwater system; outfalls, which are where stormwater discharges from the stormwater system, most often into an open waterbody; and urban sub-basin boundaries, which outline areas of the landscape that drain to a single outfall. The urban areas included in the inventory are Kalispell, Whitefish, Columbia Falls, Evergreen, Bigfork, Lakeside, Polson, and Ronan (Figure 3). To develop the inventory, municipalities were contacted to request access to their existing, digital infrastructure data. Of the municipalities contacted, only Kalispell, Whitefish, and Bigfork has existing, digital infrastructure records. If a municipality did not have a digital map of their stormwater assets, citizen science events were organized to help map the stormwater system. Volunteers helped map systems in Polson, Lakeside, and Evergreen using everyday items, such as compasses and tape measures. The infrastructure in Ronan and Columbia Falls were digitized from previously published reports.

Through the creation of the inventory, it was discovered that the capacity for effective management and maintenance of stormwater infrastructure in the urban areas across the watershed varied greatly. For example, Kalispell has a detailed, digital inventory of their assets that is regularly updated, and they possess the staff, equipment, and procedures necessary for proactive infrastructure maintenance. Polson, on the other hand, does not have access to mapping and asset management tools and, therefore, did not possess a digital record of their infrastructure prior to 2020, meaning updates to their infrastructure records were difficult. Polson also has far fewer staff and lacks the equipment necessary to perform maintenance on their infrastructure. Furthermore, some urban areas, such as Lakeside and Evergreen, do not have a central stormwater system and instead are comprised of a variety of privately and county-owned infrastructure, which presents another unique challenge to ensuring effective infrastructure management and maintenance.

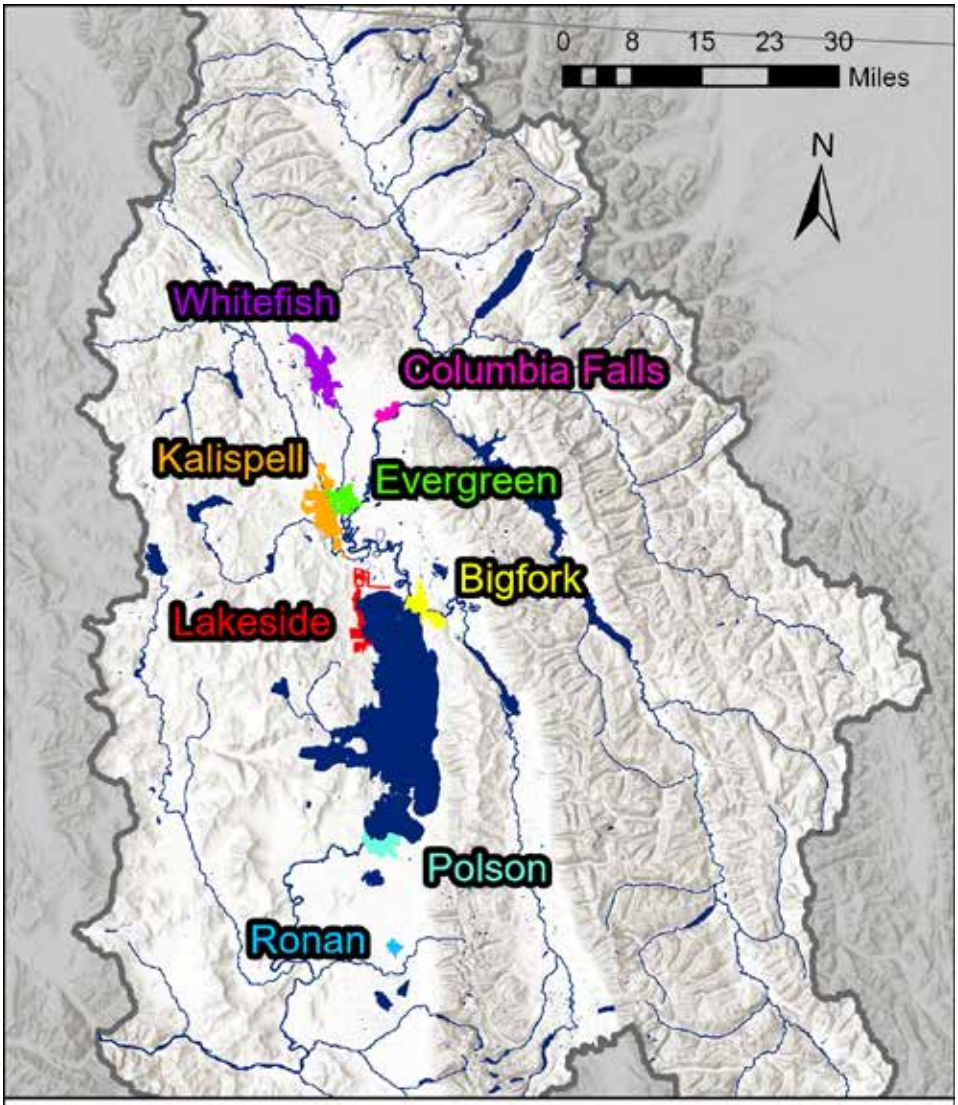

Figure 3. Urban areas in the Flathead Basin.

Once the inventory was complete, a model for prioritizing urban sub-basins across the Flathead Basin based on their polluting potential was developed. The model takes into account four sub-basin characteristics: the area of the sub-basin, the percent area covered by developed (or urban) land use classes, the degree of land use mixing (or the presence of multiple, interspersed land use classes within the sub-basin), and the impairment status of the receiving waterbody. Large, highly developed sub-basins with a high degree of land use mixing were considered to have a higher polluting potential, and sub-basins discharging into impaired waterbodies were considered a higher priority than those discharging into unimpaired waters. Using a matrix, an overall ranking for each sub-basin was calculated between 0 (low priority) and 7 (high priority). Of the 212 sub-basins in the inventory, 9 were identified by the model as high priority, receiving a cumulative score of 6 or 7, all of which are in Kalispell or Whitefish (Figure 4). With the inventory and these model results, FBC was able to gain a preliminary picture of how stormwater is being managed in the Flathead Basin and where some potentially high-polluting areas may be.

Phase II: Recommendations for mitigation

After the problem of stormwater pollution in the watershed was framed, Phase II was initiated in early 2021. The goal of Phase II was to develop recommendations of future project objectives that would mitigate stormwater pollution in the Flathead Basin. Utilizing research about other stormwater programs across the country, the recommendations are intended to translate the knowledge acquired in Phase I into on-the-ground solutions to both retroactively improve and proactively protect water quality in the Flathead Basin. Four potential project objectives and recommendations informed by the two phases of the stormwater project were developed and have been presented to FBC for consideration.

First, the sub-basin prioritization model could be validated through increased stormwater monitoring using automatic sampling equipment. In 2020, a simple grab sampling program was initiated at four outfalls across the watershed. This type of sampling involves visiting an outfall during a rain event and collecting discrete samples of the stormwater discharging at that time. In this way, it requires minimal technical expertise, but staff needs to be ready to deploy each time it rains. The use of an automatic sampling device, on the other hand, collects samples of stormwater throughout the duration of a storm event without needing a staff person on-site. While these devices are more costly and necessitate a higher level of technical expertise to operate, automatic samplers produce more accurate estimates of pollutant loading than grab sampling techniques. Therefore, it is recommended that FBC utilize automatic sampling devices to characterize the runoff from the high-priority outfalls identified by the model to validate the model's accuracy and improve it accordingly.

The second recommendation is to work with municipalities in the watershed to increase their capacity for effective management and maintenance of stormwater assets. As previously mentioned, there is a large disparity between different cities' abilities to manage and maintain their stormwater infrastructure. Resolving this disparity will involve conversing with city governments to discuss the Phase I findings, to identify what specific barriers they face to effective stormwater management and maintenance, and to systematically remove such barriers. In areas where infrastructure is privately

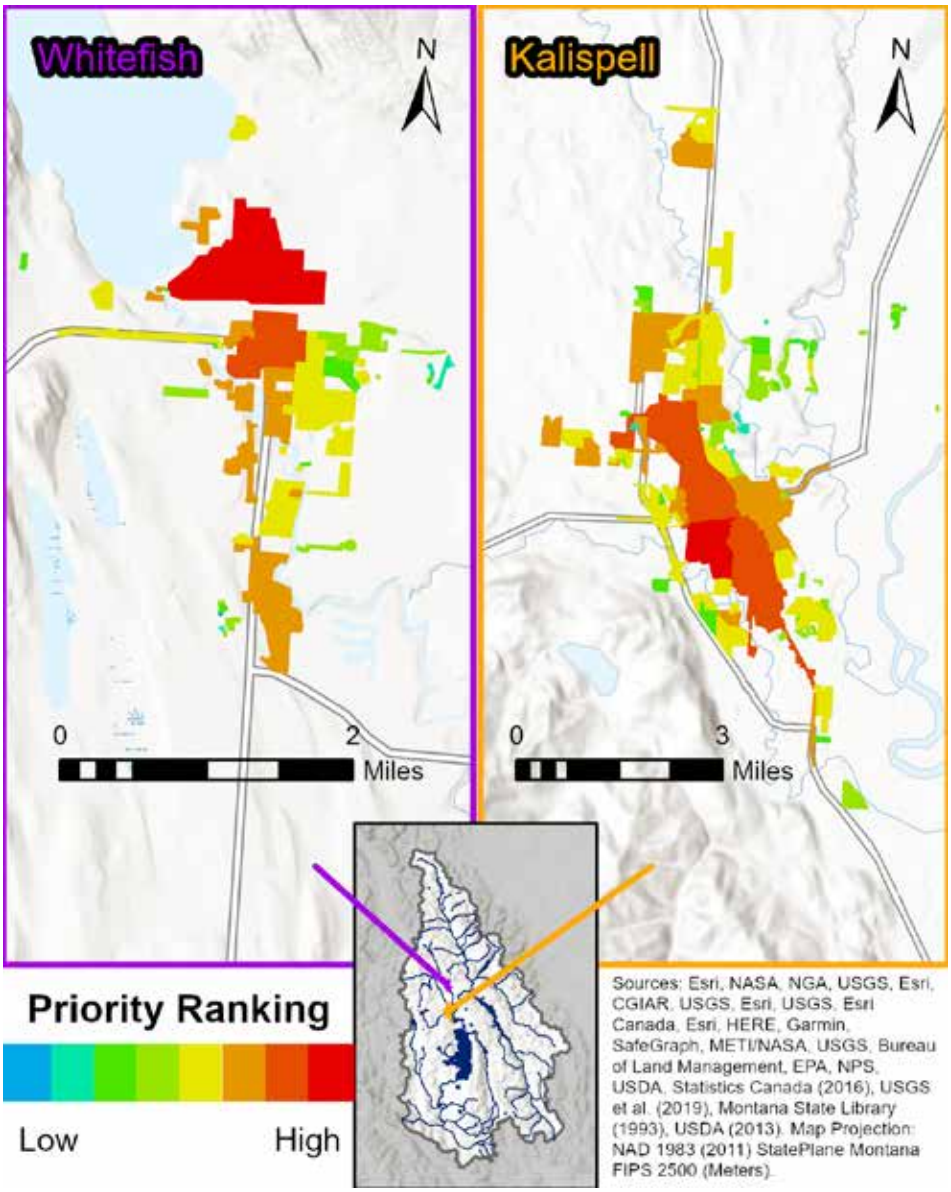

Figure 4. Results of sub-basin prioritization model for Kalispell and Whitefish.

owned, the process could involve hosting workshops for infrastructure owners to learn how and why to maintain their infrastructure and incentivizing such practices.

The third recommendation is to partner with experts to develop structural best management practice (BMP) retrofit recommendations for high-priority sub-basins. Structural BMPs are physical structures designed to prevent or reduce the amount of pollution generated by nonpoint sources. Some examples of BMPs include detention basins, bioretention facilities, and proprietary filtration and separation devices. These recommendations would identify specific BMPs for each high-priority sub-basin based on the characteristics of the runoff at each site. They would also need to consider the amount of land available, cost of implementation, and long-term maintenance needs. Because it targets high-polluting areas of the watershed, this solution is a retroactive one, seeking to improve already degraded water quality discharges within these sub-basins.

The fourth and final recommendation is to develop a campaign for incentivizing the use of green stormwater infrastructure (GSI) in new development. GSI is designed to mimic the natural hydrology of an area by promoting infiltration of stormwater runoff. In this way, GSI primarily functions to reduce the volume of stormwater runoff, which reduces flooding and erosion potential. In contrast to the previous recommendation, this solution seeks to proactively protect against future stormwater pollution by encouraging more sustainable stormwater management practices in new development. An important first step to develop this campaign will be to conduct reviews of the codes and ordinances for municipalities and counties in the Flathead Basin to identify and address barriers to GSI implementation that may be written in the design criteria. This project may also involve developing an economic impact analysis for designers to compare the triple bottom line benefits of GSI to those of traditional, grey stormwater management techniques.

It is also important to note that none of the aforementioned recommendations can be accomplished without public support. Because the quality of the majority of stormwater in the Flathead Basin is unregulated, voluntary action and resident buy-in will be key in getting any of these projects off the ground. Therefore, FBC is also planning to continue and actively increase its support of education and outreach programs and to work with partners to develop new ones that will help the public understand nonpoint source pollution and empower residents to take action to protect water quality.

In the coming year, FBC will review these recommendations internally and with partners in the watershed to determine their feasibility and relative priorities. Many of the recommended projects will require substantial resources, both in terms of staff capacity and funding; therefore, they will require short- and long-term planning that include grant and partnership opportunities.

The Flathead Basin is approaching a crossroads where inaction will almost certainly lead to the degradation of the area's pristine resources. As a non-regulatory entity dependent on consensus-building and comprised of the many local, state, federal, tribal, and citizen representatives needed to facilitate action, FBC is uniquely poised among its partners to improve and protect water quality against stormwater pollution in a manner that can garner public support. Time is of the essence to translate knowledge and ideas into action to defend the Flathead Basin's future, and FBC and its partners are eager to be at the forefront of that movement.

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Emilie Henry is an AmeriCorps Member serving with the City of Kalispell and the Flathead Basin Commission. She focuses on addressing stormwater pollution in the Flathead Watershed by collecting and analyzing data, fostering relationships with partners and decision-makers, and supporting education and outreach initiatives.

UPCOMING IN *LAKELINE*

SPRING 2022: Topics in Fisheries — The spring issue of *LakeLine* will explore topics related to fisheries and fisheries management. We already have a few articles lined up for this issue, including topics related to aquatic habitat, the Reservoir Fisheries Habitat Partnership, and some selected projects that will be highlighted. We do have room for one or two more articles, so please do consider reaching out with article ideas if you have some work you'd like to share.
Articles are due by March 15, 2022.

SUMMER 2022: Lake Sediments — This issue of *LakeLine* will focus on lake sediments, including an overview of their make-up, encompassing both internal and external sources of material. Articles looking at lake sediment as habitat for aquatic life, nutrient dynamics, dredging, sediment mapping and classification, and more are welcome.
Articles are due by June 15, 2022.

FALL 2022: Celebrating the 50th Anniversary of the Clean Water Act — October 18, 2022 marks the 50th anniversary of the Clean Water Act. The fall 2022 issue of *LakeLine* will highlight some of the important outcomes of this landmark act on protecting and restoring water resources across the landscape. We will highlight some special projects and collaboratives planned to commemorate the anniversary, but would also like to hear from you about specific programs, projects, or partnerships that evolved as a result of the Clean Water Act over the years. Summer 2022 is also a National Lake Assessment (NLA) field season, so we hope to include some highlights from that work, as well as summaries of data or reports from the last round of NLA sampling that took place in 2017. We will also accept high-quality digital images of field and/or laboratory work supporting the Clean Water Act initiatives. Please include a caption with any photo you submit, and include dates/names and some background information related to the photo(s).
Articles and photos are due by September 15, 2022.

Urban Lake Restoration Challenges – Getting More Done Even When Faced with "LES"

Stephen J. Souza, Don Brockel, Jack Szczepanski, and Peter Avakian

What makes urban lakes special?

Urban lakes are unique water features, often serving as important community destinations and social hubs. In a lot of ways, they are analogous to an "oasis within a concrete desert." Although many urban lakes are not "swimming lakes," on a per-areal-unit basis and per-user-unit basis, urban lakes are often more extensively utilized than many larger "recreational" lakes. Additionally, urban lakes are most often used by overburdened and underprivileged communities that lack the means or ability to simply "pack up" and head out to the country for some fresh air and time on the water. Unfortunately, the water quality, aesthetics, and recreational usability of urban lakes is often impaired and lacking. As a result, the community is left with a waterbody incapable of meeting community needs and satisfying recreational expectations. To make matters worse, because of their history of poor water quality, urban lakes become viewed as "throw away" waterbodies, usually being bypassed for lake restoration funding and lake management research.

Most urban lakes are very shallow and rely on stormwater runoff as the main source of inflow. Stormwater runoff is inherently an inconsistent source of inflow, especially during the summer. Plus, it tends to be high in nutrients, sediments, and other contaminants. The shallower nature of urban lakes combined with lack of mid-summer inflow, facilitates water column heating and thermal stratification, which can lead to dissolved oxygen impairments. Shallow water depths also favor the widespread colonization of invasive aquatic plants and problematic filamentous mat algae blooms. Thus, their morphometric, pollutant loading, and hydrologic properties make them more susceptible to wide-spread water quality impairments, hyper-eutrophication, and harmful algae blooms (HABs).

The challenges arising from "LES"

Limnologically, these are some of the same problems that impact many lakes and challenge lake managers. However, there is another set of challenges more specific to urban lakes and urban lake managers. For urban lakes, these challenges can be categorized as a problem of **LES** – that is **Legacy, Environmental, and Societa**l issues that hinder the attainment of lake management goals and achievement of significant and sustainable water quality improvements.

- **Legacy** issues pertain to the basic origin of these waterbodies as local regional stormwater facilities as well as historical pollutant inputs, in cases including municipal and industrial discharges. But these legacy issues also pertain to a history of insufficient representation and lack of funding.
- **Environmental** issues pertain to the aforementioned poor quality of source water, intermittent inflow dominated by stormwater runoff and physiochemical features that promote HABs.
- **Societal** issues are those arising from systemic discrimination and environmental justice issues that impede the ability of urban lakes to implement water quality improvements and meet the passive and active recreational needs of those that rely on and make use of urban lakes.

Collectively, LES leads to many urban lakes being classified as low value and not worth managing or restoring. Compounding matters, the communities relying on urban lakes are often underrepresented and lack the political voice needed to support restoration and management projects. Without such political support it becomes difficult to step out of the shadows of the larger recreational lakes and obtain the funding needed to make improvements.

Overcoming the lake management challenges arising from LES requires:

- a source of consistent funding targeting urban lakes;
- engagement of community leaders to take on a more proactive role and become a voice for urban lakes;
- outreach, education, and engagement of the community in the restoration and management process; and
- implementation of a balanced lake restoration program that prioritizes proven watershed management measures to address the root causes of water quality impairments but includes basic lake maintenance activities that increase lake usability.

The Deal Lake Commission's approach to overcoming "LES"

Deal Lake is located in Asbury Park, New Jersey (NJ). Created in the late-1800s by the damming of an estuary, the lake is New Jersey's largest coastal lake. The 143-acre lake is relatively shallow (maximum depth 8.9 feet; mean depth 5.3 feet) and its 5.9 mi^2, highly developed watershed is dominated by high-density residential land use, with a population density is 10,700/mi^2. As would be expected, the lake has its share of

problems exemplified by periodic HABs, storm-induced turbidity, significant influx of floatables, and sediment in-filling. Still, the lake is heavily used, with a recreational history dating back into the early 1900s. Although not a "swimming lake," its recreational use is robust, including fishing, paddle boarding, rowing, and boating. The lake is routinely stocked with various game fish by New Jersey Department of Environmental Protection (NJDEP).

The Deal Lake Commission (DLC) was chartered by State decree in 1974 to serve as the Stewards of Deal Lake. Comprised of one member from each of the seven municipalities abutting the lake, the DLC has a long history of showing how to get more done for urban lakes even when faced with LES. To do so the DLC has done the following:

Legacy – *Establish a presence*. To overcome the lack of representation, create and maintain contact with state, county, and local government representatives and secure a place as the only urban lake that is part of the Public Lakes Alliance of NJ. They have also been active in the North American Lake Management Society (NALMS) and New Jersey Coalition of Lake Associations (NJCOLA).

Environmental – *Improve the lake's water quality and ecology*. This required using federal and state grants and local funding to implement in-lake and watershed projects conducted in accordance with a data-based, NJDEP-approved, lake restoration and watershed management plan.

Societal – *Get the community involved*. This has involved conducting education and outreach programs, actively engaging the community, getting involved in citizen-based science programs, distributing, and sharing information via the DLC website and social networking platforms and being involved in NALMS and NJCOLA.

Cumulatively, the basic formula followed by the DLC to do more when faced with LES is as follows:

1. Scientifically quantify the lake's root cause problems and identify the sources of those problems.
2. Use these data to formulate a comprehensive restoration strategy.
3. Obtain funding to implement the strategy.
4. Engage legislators, municipal leaders, and the community in the restoration process.
5. Make extensive use of social media to continuously engage and educate the community and maintain community and local government support.

Power to the people

While this formula is similar to that followed by many other lake communities, the outreach, engagement, and educational elements of the DLC's approach has proven critical to their success in overcoming LES. This began in 1982 with the preparation of a 314-funded Diagnostic Feasibility Study (Souza 1984), which served as the preliminary blueprint for the lake's restoration and management and the platform for accessing state and federal representatives. Through the plan, the DLC obtained United States Environmental Protection Agency (USEPA), NJDEP, and United States Army Corps of Engineers (USACOE) funding. Focus was placed initially on conducting in-lake projects that admittedly only addressed the symptoms of the lake's problems. However, this strategy enabled the DLC to gain the public and political support needed for larger-scale, watershed projects. The original plan was subsequently updated in 2009 (Souza 2010). The NJDEP approved Watershed Management Plan enabled the DLC to subsequently receive approximately $1.5 million in 319(h) funding and support the DLC's applications for over $1 million in USACOE funding. The ability to secure 319(h) funding was a major accomplishment, given that 319(h) funding is highly competitive with most of the money directed to the state's larger, recreational lakes.

Over the past ten years, the 319(h) monies have been used to implement various stormwater management projects that directly address the root-causes of the lake's water quality and use impairments. Due to the limited availability of public open lands, the DLC has installed both large and small subsurface manufactured treatment devices (MTDs) in lieu of the construction of conventional vegetated basins (Figure 1). The MTDs have proven to be very effective means of decreasing floatable, sediment, particulate pollutant, and nutrient loading. These are inspected and cleaned out seasonally by the Asbury Park DPW. The USACOE funds have been used to dredge sections of the lake and most recently to redesign and automate the lake's flume to protect properties from impacts caused by coastal and extreme-storm flooding events.

Where possible, the DLC has implemented various green infrastructure (GI) projects, such as shoreline restoration, rain gardens (Figure 2), curb-side tree boxes and floating wetland islands (FWIs) (Figure 3). Most of the projects included a significant public involvement element. Other hands-on ways that the DLC has engaged the community is by using volunteers to conduct spring/fall shoreline cleanups (Figure 4), participating in Monmouth University's Coastal Lakes Observing Network (CLONet) citizen science lake monitoring program, sponsoring and funding Canada goose control projects, and supporting a number of Eagle Scout projects. The latest MTD installations served as a "living classroom" opportunity for Asbury Park High School students (Figure 5).

The DLC actively stays involved at the municipal level by sponsoring breakfast stormwater workshops with municipal leaders and public works personnel (Figure 6) and providing technical review and comment on all new major developments occurring within the watershed. At the state level, the DLC has used meetings and field trips with legislators and NJDEP personnel to highlight project accomplishments and gain their support for future funding needs. The DLC is also the only urban lake that is part of the Public Lakes Alliance of New Jersey and NJ Coalition of Lake Associations. At the national level, the DLC is active in NALMS, participating in Lakes Appreciation Month and the NALMS Student Lake Poster contest. The DLC was the 2018 recipient of NALMS's Lake Management Success Stories Award.

Figure 1. Installation of the Comstock Avenue manufactured treatment device (MTD). Photo: S. Souza.

Figure 2. Volunteers planting rain garden at Asbury Park Municipal Building. Photo: D. Brockel.

As previously noted, public and legislative engagement is also accomplished by the DLC with social media. The DLC website is updated monthly with a wide range of lake management information. The DLC's monthly meetings are conducted via Zoom and include a public comment period. The DLC also keeps the community updated and informed through the extensive use of Twitter and Facebook.

To summarize

Urban lakes are special for several reasons. However, even though they serve a large community base, they are often overlooked, neglected, and treated as "throw-away" waterbodies. As a result, they fail to receive adequate restoration funding. Much of this has to do with LES, Legacy, Environmental, and Societal

Figure 4. Don Brockel, Chairman of DLC, and volunteers conducting semi-annual shoreline cleanup. Photo: D. Brockel.

Figure 3. Volunteers planting and deploying floating wetland islands. Photo: D. Brockel.

Figure 5. Asbury Park High School students observing installation of Main Street manufactured treatment device (MTD). Photo: D. Brockel.

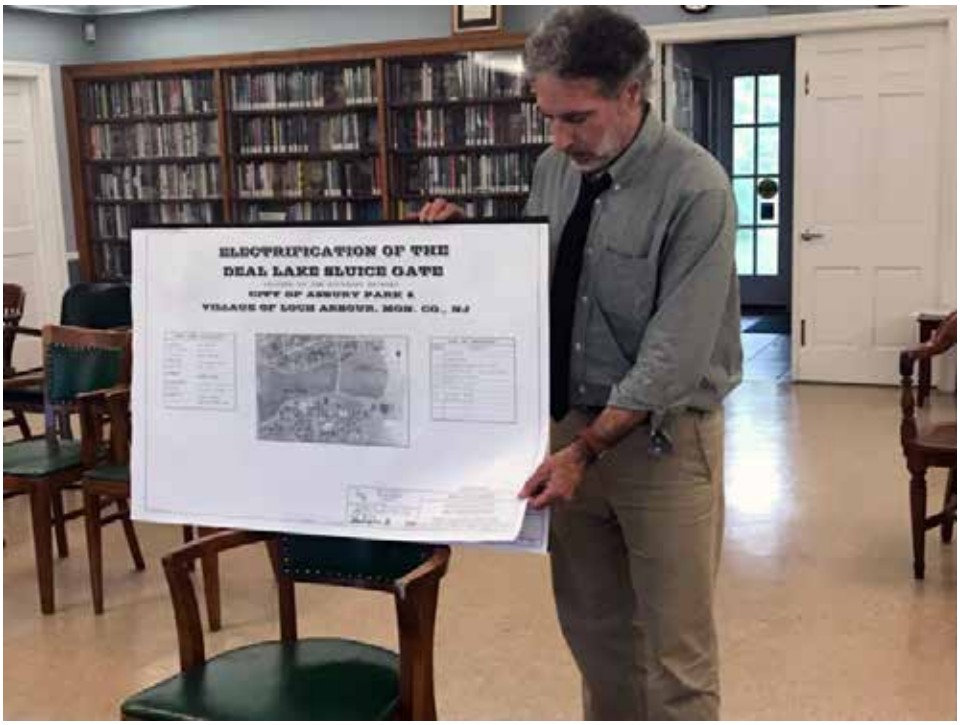

Figure 6. Peter Avakian, P.E., updates public and municipal officials on flume improvement project. Photo: D. Brockel.

barriers. LES adds to the challenges faced by urban lake managers and makes it difficult to achieve significant and sustainable water quality improvements. However, the Deal Lake Commission has found a way to do more even when faced with LES. Much of the DLC's success is a result of public engagement, education, and outreach. This has helped the DLC gain the local, state, and federal legislative support needed to secure the restoration funding they have used to implement both in-lake and watershed-based projects.

Acknowledgements

I want to first thank my co-authors. Over the past ten years Don Brockel has spearheaded the DLC's efforts and gets personally involved with everything from shoreline cleanups to operating the lake's flume during major storm events. Peter Avakian has served for over 40 years as the DLC's consulting engineer, his history with the lake and knowledge of lake is unmatched. Dr. Jack Szczepanski has managed the latest and most significant round of 319(h)-funded projects. Also, the success of the DLC would not be possible without the untiring efforts of each Commissioner and the numerous Deal Lake Community volunteers. I am deeply indebted to the support I have received over the past 40 years from the Deal Lake Commission in our collective endeavors to restore and manage Deal Lake.

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Steve Souza is the Owner of Clean Waters Consulting. He has served as the lake management consultant for the Deal Lake Commission since 1982, working with the DLC to secure lake funding as well as design, manage, and implement numerous lake restoration projects for the DLC. He is a past-president of NALMS and PALMS.

Don Brockel is the chair of the Deal Lake Commission and a life-time resident of Deal Lake. When not leading the DLC's lake management efforts he enjoys fishing, boating, and birding on Deal Lake.

Jack Szczepanski is a Senior Project Manager with Princeton Hydro. He is currently serving as the 319(h)-project manager overseeing the NJDEP funded restoration projects currently being conducted at Deal Lake.

Peter Avakian is the President of Leon S. Avakian. He has served as the professional engineer for the DLC since the late-1970s. He is responsible for the proper implementation of the dredging, stormwater management, and flume improvement projects conducted over the past 30+ years for the DLC.

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Tell us what you think of *LakeLine*.
We welcome your comments about specific articles and about the magazine in general.
What would you like to see in *LakeLine*?

Send comments by letter or e-mail
to editor Amy Smagula
(see page 2 for contact information).

Lake Winona: Urban Lake with a Long History of Disturbance, Rehabilitation, & Citizen Involvement

Neal D. Mundahl

Introduction

Lake Winona is a 129-hectare urban lake in southeastern Minnesota, located entirely within the City of Winona (Figure 1; 2019 population size = 26,854). The city began as a Native American village before being inhabited and platted by non-native white settlers in the 1850s. The lake originated as a side channel of the Mississippi River, but it has been modified extensively by humans during the past 170 years (Fremling and Heins 1986).

The lake has been dredged five times between 1913 and 2001 to remove eroded topsoil carried into the lake by a nearby stream, Gilmore Creek. Sediments removed during the initial dredging were used to create parkland by filling many of the lake's fringe wetlands, and to construct a dike/causeway that split the lake into two basins. The creek had been rerouted into the lake in 1885 to deliver oxygenated water to the lake, but was diverted away from the lake again in 1944 to eliminate the source of eroded soils that repeatedly entered the lake during severe floods. Today some creek water is still delivered to the lake via a county ditch, after first passing through an upstream sedimentation basin and flood storage reservoir. Another county ditch serves as a downstream outlet from the lake to the Mississippi River.

As Winona developed, storm sewers were engineered to carry stormwater runoff from the city into several local water bodies. Approximately 42 km of storm sewer collect runoff from 650 hectares of Winona and the adjoining City of Goodview, emptying through 53 stormwater outfalls and culverts either directly or indirectly into Lake Winona. This system delivers significant quantities of nutrients to the lake, producing a hypereutrophic system teeming with aquatic macrophytes and algae.

Figure 1. Google Earth image of the City of Winona, with the two basins of Lake Winona at the bottom and the Mississippi River at the top.

Into the mid-1960s, Lake Winona supported a fair gamefish community, but severe winters during 1964-65 and 1968-69 led to drastic oxygen depletion, eliminating most gamefish and leading to the invasion of rough fish like carp, buffalo, and shad from the Mississippi River. Winter kills continued and cleanups of 100,000 kg of dead fish became a common practice after spring ice-out. By 1973, aquatic macrophytes were gone, water transparency declined precipitously, and lack of oxygen at the lake bottom led to a rapidly expanding layer of organic ooze that eliminated aquatic insects.

Corrective measures

Concerned city residents worked with city, state, and federal authorities and university researchers to devise a plan to reclaim the lake as a sport fishery. Beginning in 1973, six aerators were installed, fish were killed by chemical treatment, an electric weir was installed on the lake outlet to prevent rough fish reinvasion, and gamefish were stocked. Local fundraising efforts supported the infrastructure improvements and government dollars funded fish management activities. The project's main goal was to provide a fishery for people of all ages who are unable to safely access the nearby Mississippi River.

Lake water clarity improved with rough fish removal, but the lake was completely overrun by invasive curlyleaf pondweed by 1976. After small-scale chemical control proved unsatisfactory, the city purchased a small weed cutter and several boat-mounted weed rakes. After a few years struggling with the labor-intensive system, a citizen's group raised funds to purchase a larger cutter-harvester (Figure 2) and shoreline loading system

Figure 2. Weed cutter-harvester operating in Lake Winona.

for the city in 1982. Under state permit, it was used primarily to control weeds in high-use areas, seldom removing more than three percent of the lake's total vegetation in any one year. The weed harvester remains in use to this day for special occasions like a local triathlon, but its age and frequent mechanical issues have greatly limited weed harvest as a control strategy.

A shifting fishery

During the early post-reclamation years, fishing was excellent on Lake Winona. Most anglers pursued bluegill, but trophy-size northern pike, large channel catfish, and walleye were caught regularly. To improve fishing access on Lake Winona, four fishing piers were installed to complement the three boat ramps already present on the lake. A 1980 creel survey estimated over 40,000 angler-hours were spent on Lake Winona during the May to September period.

Beginning in the mid-1980s, growth rates of bluegill and black crappie declined drastically, and fish became stunted. An over-abundance of spawning habitat, too much lake vegetation, too few predators, and not enough food produced skyrocketing populations of sunfish too small to satisfy most (any!) anglers. Continued stocking of more predatory fish, including the first intentional stocking of bowfin in the state of Minnesota (Mundahl et al. 1998), had no noticeable effect on sunfish populations.

During 1999 to 2001, a large portion of the lake's eastern basin was dredged, funded by a temporary local sales tax. By dredging shallow, weed-filled areas and creating more deep water, sunfish numbers were reduced and gamefish abundances and size structures improved (Mundahl and Hoisington 2020). This improved fishery has been sustained now for nearly two decades. However, carp and other rough fish entered the lake when the electric weir malfunctioned, and their numbers may now pose a threat to continued good angling.

Power of the people

Concerned citizens have been the driving force behind Lake Winona reclamation and management efforts for the past 50 years. A "Save Lake Winona Committee" was formed in 1972 to generate community support for lake rehabilitation. The group coordinated all aspects of the project, from public education and fundraising efforts to installing aerators and fish traps to picking up and disposing of dead fish. Hundreds of city residents contributed time, supplies, and money to what was truly a community effort. This is their lake, and they took pride in the successes that were achieved by their hard work and dedication. The Committee remained active through the 1999 to 2001 dredging project, but the deaths of several key Committee leaders over the next ten years led to a lull in community efforts directed toward the lake.

Interest in Lake Winona was rekindled in 2014 when the lake was added to Minnesota's 303(d) list of impaired waters (aquatic recreation: nutrients – phosphorus). Surrounded by city parkland and encircled by a multi-use paved trail, the lake is a major hub for outdoor activities, and citizens were concerned about lake water quality. A few remaining lake committee members were joined by a new generation of engaged citizens to form the citizens group "Healthy Lake Winona." Since inception, the group has worked to improve the health of Lake Winona by tapping into regional expertise and partnering with local governmental units to assist with grant applications and related activities.

Shoreline improvements, phosphorus, and carp

Healthy Lake Winona has targeted both large and small projects to improve the health of the lake. Citizens have worked with the city to fund rain gardens to reduce runoff, removed invasive buckthorn from infested shorelines, installed wave barriers to protect newly planted shoreline vegetation (Figure 3),

Figure 3. Local university students planting shoreline vegetation within an area protected by wave barriers created by cutting buckthorn from lake shorelines and wrapping in biodegradable coir matting.

planted new trees and shrubs along the lake, and converted nearshore turf to native plantings. While these efforts have improved the appearance of the shoreline (Figure 4) and involved many local residents and students from two local universities, they have not addressed the problem of too many nutrients entering the lake. These nutrients still support a dense community of native and non-native aquatic macrophytes, and produce algal blooms from late-June through autumn.

Major efforts are needed to manage phosphorus inputs into Lake Winona and hopefully get the lake removed from the impaired waters list. During the early 1990s, the city investigated the cost of intercepting all storm sewers that ran to Lake Winona, diverting flows into the Mississippi River to eliminate nutrient inputs into the lake from the city watershed. With a price tag exceeding $10 million, it was deemed too costly for the benefits accrued. A recent grant-funded study of the lake and its watershed estimated that storm sewers and related lake inflows account for >70 percent of the lake's annual phosphorus loading, with internal recirculation from sediments contributing 10 to 25 percent (Figure 5). Four phosphorus-reduction projects were recommended: creating a pond to treat all water entering the lake from the inflow ditch ($1.6 million), installing iron-enhanced sand filters at five problematic storm sewer outfalls ($2.5 million), managing the carp population ($500,000), and treating the lake with alum to bind up the phosphorus ($200,000). Cost-benefit analyses of these recommendations are ongoing.

The carp problem came as a surprise to many community members. Carp had re-entered Lake Winona in 1974 when the electric fish barrier failed temporarily. They migrated upstream out of the lake and spawned successfully in an upstream flood storage basin and an adjoining wetland, but the young carp were killed with a combination of an engineered winter kill and rotenone before they could migrate downstream into Lake Winona. Further spawning migrations by adult carp were prevented with a series of carp barriers within the lake inlet ditch. However, recent electrofishing surveys (Figure 6) revealed that carp populations

Figure 4. Area of Lake Winona shoreline converted from turf grass to native forbs and grasses.

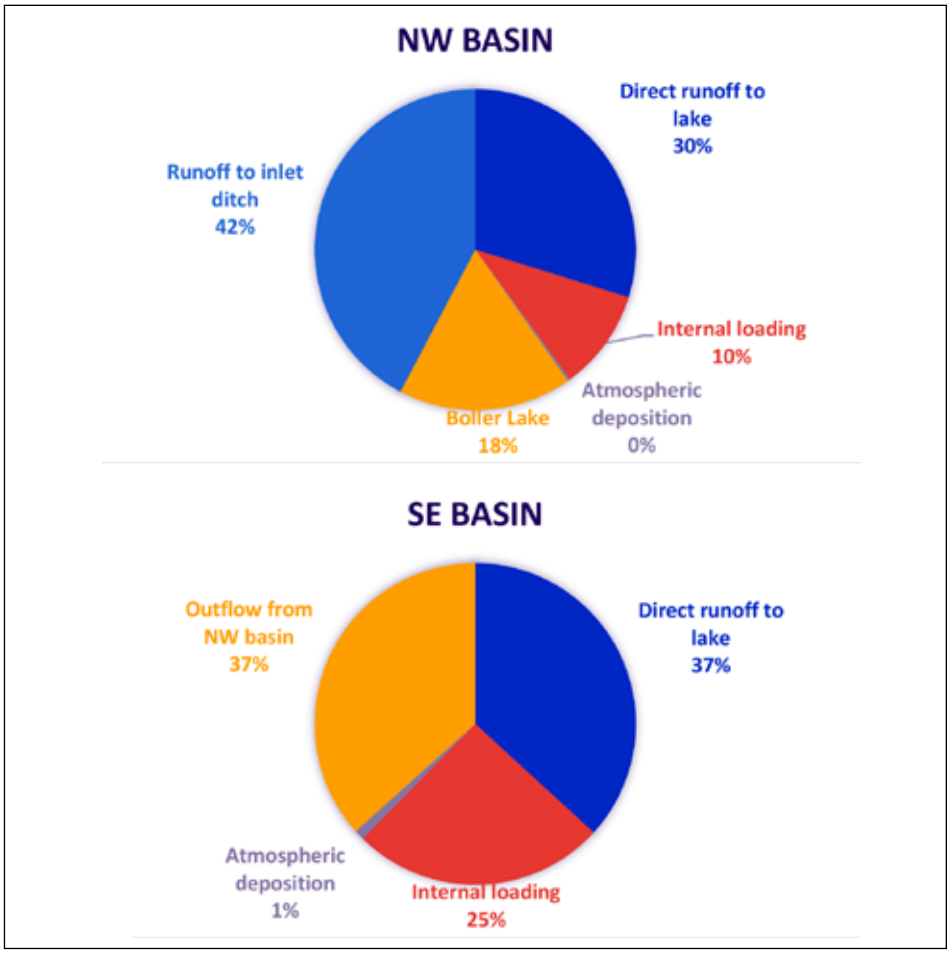

Figure 5. Sources of phosphorus for the two basins of Lake Winona.

Figure 6. Winona State University biology students with a large common carp captured in Lake Winona during recent shoreline electrofishing surveys.

in the western, upstream basin of Lake Winona had reached levels (>300 kg/hectare) potentially harmful to the lake ecosystem (Bajer 2017; Bajer et al. 2016). Apparently, carp spawning migrations had resumed after carp barriers were removed and not replaced, and a steady supply of young carp were entering Lake Winona from those upstream spawning habitats. Consequently, carp population reduction measures have been recommended to reduce carp numbers before treating the lake with alum to bind up phosphorus, as carp feeding likely would disturb accumulations of alum on the lake bottom meant to prevent release of phosphorus from the sediments.

Future undertakings and invasive species concerns at Lake Winona

While exploring options to reduce phosphorus inputs into Lake Winona, a new strategy is taking shape in the decades-long battle against unwanted aquatic plants in the lake. The city and the MN Department of Natural Resources are partnering to treat the shallow and weedy western basin of Lake Winona with herbicide for seven to eight years to target nonnative curlyleaf pondweed during its spring growing season. Suppression of the invasive pondweed would allow native plants access to nutrients when they begin growing during early summer, hopefully allowing for development of a more diverse community of aquatic vegetation. Eight years of herbicide treatment is estimated to cost the city less than $40,000, compared to $175,000 to purchase (plus additional costs to staff and maintain) a replacement weed harvester. Recent small-scale test applications of herbicides within the western basin and the lake outlet proved promising. Unfortunately, Eurasian watermilfoil is now common in the lake's summer plant assemblage, and it could provide a real barrier to an improved aquatic plant community if it becomes dominant as it has in many other Minnesota lakes.

Winona citizens also are concerned about the potential invasion of Lake Winona by zebra mussels. The invasive mussels have been in the Mississippi River less than one mile from the lake for 25+ years, but have not yet appeared in Lake Winona. Alarms have been raised numerous times whenever zebra mussel shells were found in the lake, but the city uses sand dredged from the river to sand streets during the winter. That sand is loaded with the shells of dead zebra mussels, which get washed into the lake via storm sewers during spring snowmelt. City, county, and agency staff remain vigilant so they can respond quickly if live zebra mussels are discovered in Lake Winona.

It is anticipated that new issues will continue to arise for Lake Winona, but local citizens likely will continue to contribute their time, effort, and dollars toward protecting the lake for the on-going enjoyment of the public. The city understands the community value of the lake and its surrounding parkland, and is willing to make the long-term investments needed to protect and maintain them.

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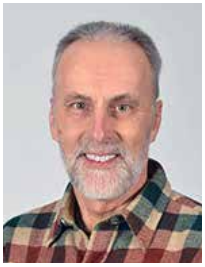

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Cumulative Impacts on Urban Lakes: A Shoreline Assessment Tool for Lake Health*

Bruce Mac Donald, Jason Schleppe, and Georgia Peck

Urban lake shorelines are experiencing unparalleled development pressures, resulting in reductions and impairments to shoreline habitat function, diversity, and aesthetic value. Developed in British Columbia, Foreshore Integrated Management Planning (FIMP), is a cumulative assessment tool that offers a solution for addressing these issues, one that is applicable to urban lakes across North America. In the following article we will provide background on FIMP, identify the problems around the current approach to shoreline impact assessments, discuss urban lake case studies while demonstrating how FIMP survey methods allow determination of rates of loss, and are therefore a suitable tool to identify cumulative impacts along a shoreline for lake management planning purposes.

Shorelines are the lifeline of a waterbody and often the focus of the human communities that are built up around them. Much of all lake and river life begins on shorelines. They connect aquatic areas with terrestrial habitat and provide food, nutrients, liveable space, and protection for invertebrates, insects, fish, reptiles, amphibians, birds, and mammals. Healthy shorelines act as filters, stabilizers, nurseries, and playgrounds for a multitude of species by maintaining water and habitats of high quality. On a global scale, healthy, functioning lake shorelines can help reduce flood-related impacts, and provide people with food and shelter. The critical importance of a healthy shoreline cannot be overstated, and yet the development pressures on lakes around the world continue. These pressures and their associated risks to shoreline and lake health are only expected to increase as more lakeside habitats urbanize, causing diminished ecological and economic value of the surrounding shoreline communities, while simultaneously impacting the survival of many different species. These development impacts are contributing to the greatest losses of biodiversity of our time. Globally, freshwater vertebrate populations have declined more than twice as steeply as terrestrial or marine populations (Tickner et al. 2020).

As a solution to this ever-growing problem, the Sensitive Habitat Inventory Mapping, or SHIM, protocol was first created in British Columbia by the Community Mapping Network in 2001. SHIM was adapted for lakes in 2006 to become Foreshore Inventory Mapping, or FIM. Subsequently, Living Lakes Canada, through its lake foreshore work in Canada, recognized a need to update and improve this lake foreshore tool. In 2020, through the support of a contribution agreement with Fisheries and Oceans Canada's Canada Nature Fund for Aquatic Species at Risk as well as other partners, Living Lakes Canada formalized the general approach and standardized the protocols for mapping, assessment, and guidance for small and large lakes in the Canadian Columbia River Basin. This lake survey methodology, renamed Foreshore Integrated Management Planning or FIMP (see Figure 1), helps agencies; non-profit organizations; local, provincial, and federal governments; and landowners understand lake foreshore habitat values and the prospective risks from proposed shore-altering activities. FIMP documents the foreshore condition of the entire lake and identifies, classifies, and provides an estimate of value for important habitats that should be protected or conserved from development, preferably in legally binding covenants or lakeshore management plans. The 2020 FIMP process follows three general steps:

1. Shoreline inventories following the Foreshore Inventory and Mapping (FIM) protocol are undertaken and mapped.
2. Shoreline habitat sensitivities are determined using a ranking index called the Foreshore Habitat Sensitivity Index (FHSI).
3. The Foreshore Development Guide (FDG) is prepared to identify risks posed by different shore altering activities to inform land use decisions on the lake foreshore.

The problem with today's shorelines

Lake foreshore development on British Columbia lakes has increased over the past 50 years because of increasing human development pressures and continued demand for recreational lakeshore properties. Traditional development preference has evolved from a recreational cabin nestled in the woods with a small wooden dock to large, executive-style homes with associated engineered docks, boathouses, outbuildings, and extensive horticultural landscaping (Figure 2). The regulatory review and approval process for lakeshore subdivision and lot development has involved federal, provincial, and municipal governments, and, more recently, First Nations (see Sam, page 7, this issue). Approvals are often focused on specific sites and do not typically consider – or only superficially consider – cumulative impacts on shorelines. For example, site assessments and common mitigation strategies for land and water tenures for dock installations, foreshore substrate alterations (e.g., beach grooming and rock groyne construction), vegetation removal, building construction, road

*Prepared for Living Lakes Canada

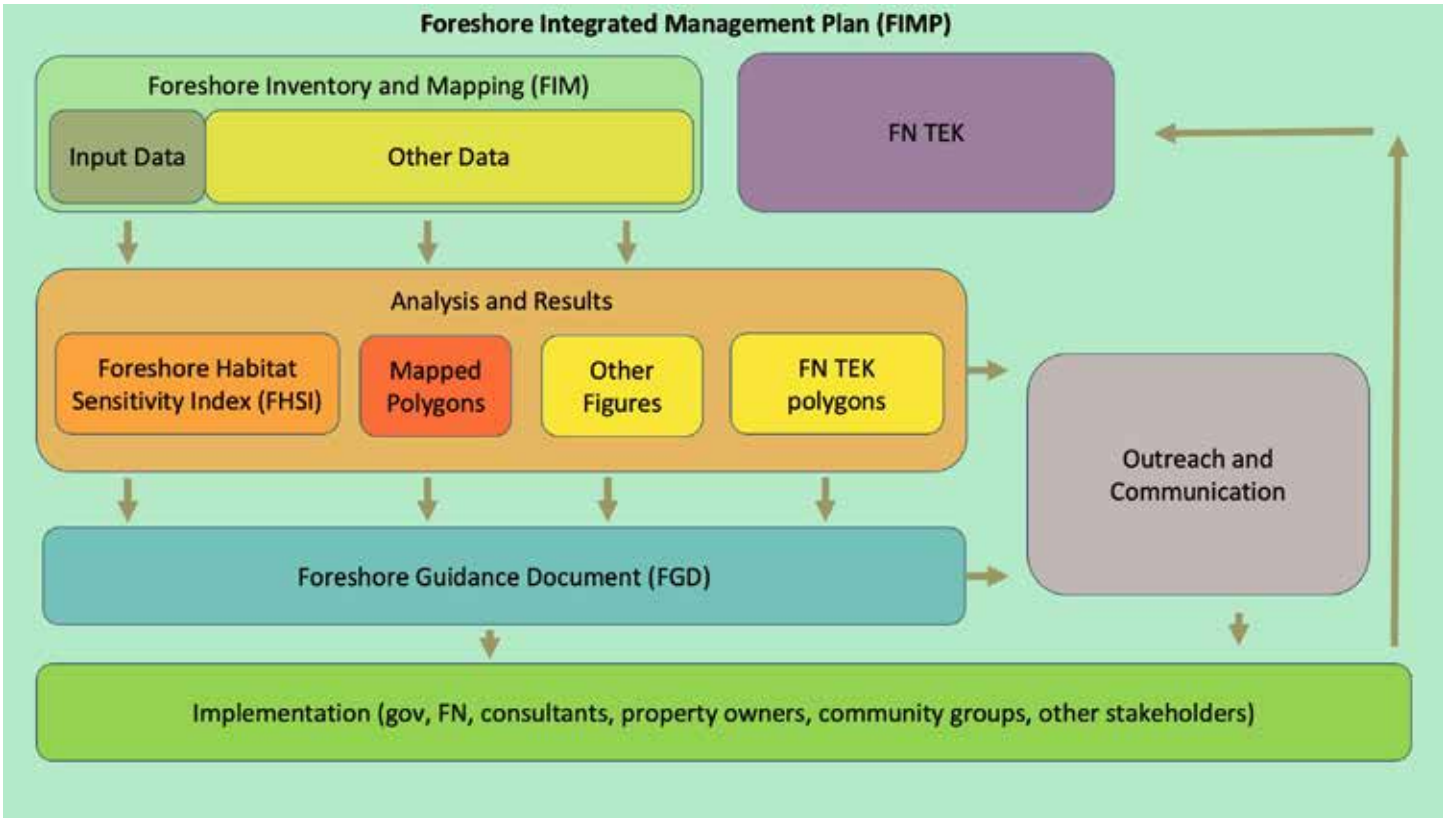

Figure 1. Foreshore Integrated Management Plan Process.

Figure 2. Examples of shoreline with a high level of impact.

access, etc., do not consider the full extent of impacts from ongoing cumulative losses along the shoreline as each adjacent lot builds out. It is not possible to identify cumulative impacts on a site-by-site basis since the cost of data acquisition exceeds the reasonable expectations of, for example, one single landowner who might desire to construct a dock. This site-specific development and approval process has resulted in an onerous workload for agency personnel, a reliance on voluntary compliance with guidelines or best management practices, and inadequate monitoring and enforcement of environmental legislation and regulations. The consequence has been the widespread, incremental loss and alteration of foreshore fish and wildlife habitats.

Until recently, foreshore development has been concentrated on municipal or privately held, easily accessible low gradient lands (e.g., alluvial fans, gravel beaches, floodplains, etc.) that did not require excessive costs for road access, or highly engineered lot development or building construction. Once the accessible areas are no longer available, and real estate values increase, development demands progress towards steeper slopes requiring highly engineered access, larger buildings with construction, and

subdivision of lots in more difficult terrain. With new technology and easier access to heavy equipment, sites that were historically undevelopable are now available to develop for the more affluent investors. This progression has increased the development of new lands and the associated pressure on lake foreshore areas that were not previously considered in potential cumulative impact assessments. Even wetlands are now altered to permit water access, boat mooring, and beach construction to property owners.

Today, we see lake foreshore fish and wildlife habitats suffering from a "death of a thousand cuts" because the impact of each lot buildout can be justified as minor. This is exacerbated by guidelines and best management practices within all local, regional, and provincial government agencies that, while well-intentioned, continue to allow and even facilitate ongoing "minor" impacts while compromising entire lake foreshore health. The current development and regulatory model perpetuates the incremental loss of important and, in some cases, critical fish and wildlife habitats. Many of the habitat losses would likely not have triggered a permitting or legislative process, even where regulatory review triggers are in place; compliance and enforcement actions are usually limited resulting in a similar outcome – incremental loss of habitats. In time, lake ecosystem level impacts should be expected, possibly to a point where certain at-risk species and/or their habitats become so degraded they can no longer support the species that rely upon them (i.e., entire population-level impacts).

A different approach to an old problem

Lake foreshore habitat surveys conducted using FIMP indicate that incremental loss of fish and wildlife habitats is occurring and will likely continue if approval agencies proceed with viewing lake foreshore development through the lens of single lot approvals versus cumulative impacts to the entire waterbody. Data collected from FIMP surveys on several large lakes in the British Columbia Interior indicate that as the level of urbanization increases to higher density, the quantity of available natural shoreline decreases. These data also suggest that as privately held parcels transition from a low-impact rural land use to a denser, higher-impact land use such as single, multi- family, commercial or, industrial, the level of shoreline disturbance will increase upwards of 50 percent. It is important to note that lakes surveyed occur across the Province of British Columbia and may have different local government regulations (e.g., City, Town, or Regional District/ County), and likely different provincial regulatory legislation. As an example, the provincial Riparian Areas Regulation does not apply throughout the province.

Figure 3. (A) FIMP on Lake Windermere. FIMP Project Director Bruce Mac Donald leads a calibration exercise on Lake Windermere in the East Kootenay region of the Canadian Columbia Basin using the updated FIMP methods. LLC Photo.

Living Lakes Canada has placed a focus on repeating FIMP surveys for priority lakes, allowing a rate of change or loss of natural shoreline capital to be estimated. Results from several BC Interior urban lakes that have been surveyed twice, including Lake Windermere, Lake Okanagan, and Kootenay Lake, provide unique insights (Figure 3). For example, the second survey of these three lakes identified rates of loss of natural shoreline of -0.18 percent, -0.2 percent, and -0.29 percent, respectively. The FIMP results demonstrate the rate of loss is very similar across all three lakes despite each lake falling under the jurisdiction of different local and provincial governments. The FIMP data support the conclusion that current shoreline management policies and/or regulations (i.e., mitigating site-specific development) do not necessarily address the underlying need for policy and zoning change that is required to support foreshore lake health.

Although it is recognized that attempts to reduce the impact of site-specific shoreline development will continue as site-specific environmental impact assessments by professionals; government agency approvals; monitoring and enforcement of legislation and regulations; landowner education; the use of best management practices and guidelines; and habitat restoration, FIMP as a cumulative impact assessment tool can enhance these practices. Through the identification and conservation of sensitive habitats at the lake level, development approval models can be shifted away from incremental site-specific approvals and impacts, to a holistic lake conservation model where key areas are identified and subsequently protected from the underlying mechanisms of change (e.g., subdivisions and changes in land use or density of use) (Figure 4). This management regime shift will require significant community and political discussion but will provide better protection of lake foreshore fish and wildlife habitats. This new approach has been successfully undertaken for Kootenay Lake in the BC Interior by local, regional, and First Nations governments and other stakeholders who formed the Kootenay Lake Partnership, a multi-agency initiative that supports healthy lake management approaches directed by the Foreshore Development Guide resulting from FIMP surveys.

Holistic lake management

At the community level, all stakeholders, governmental agencies, and non-profit organizations with a vested interest in lakeshore health, should begin to focus and place efforts on establishing processes that address the underlying mechanisms of change. For instance, lakeshore planning processes should start to consider how much land along a lake is set aside as Conservation Lands or Rural Reserves to ensure that some areas are permanently protected. Mechanisms to conserve private lands must be implemented. Consideration of watershed

3. (B) Lake foreshore habitat surveys conducted using Foreshore Integrated Management Planning or FIMP indicate whether or not incremental loss of fish and wildlife habitats is occurring, and allows a rate of change or loss of natural shoreline capital to be estimated when a lake is re-surveyed, as was the case with Lake Windermere in the East Kootenay region of the Canadian Columbia Basin (pictured here). LLC Photo.

3. (C) FIMP Project Manager Georgia Peck (right) discusses the FIMP framework with Carol Luttmer, the program manager for Living Lakes Canada's Columbia Basin Groundwater Monitoring Program, during the FIMP methods calibration exercise on Lake Windermere. LLC Photo.

level impacts and the development of watershed planning processes must begin. For lakes that span multiple jurisdictions, cooperation is paramount to success, as fish, wildlife, and ecosystems do not respond to arbitrary legal and administrative boundaries society has created. In some cases, legislative tools already exist, but have yet to be implemented. For instance, local government (regional or municipal) could incorporate FIMP results into regional growth strategies, bylaws, and official community plans. Provincial governments could help facilitate use of tools within the Water Sustainability Act (in BC) through plans such as a Water Sustainability Plan that can link land and water decision policy in a long-term watershed or ecosystem-based framework (Curran and Brandes 2019).

The need for this informed planning was felt in British Columbia in November 2021 when an atmospheric river created monumental storms, landslides, and unprecedented damage to infrastructure, homes, agricultural lands, and fish and wildlife habitats throughout the Lower Mainland and the southern interior of BC. With FIMP in place, pre-storm monitoring could have provided a baseline to allow assessments of the impacts of this catastrophic event, and the opportunity to develop more robust land use and foreshore policy to increase resilience to future similar events, as is the anticipated norm.

These lessons emphasize the importance of addressing shoreline industrialization in a more effective and multijurisdictional way. A change of lens is required to begin looking at urban lakes as a single, multifunctional entity, and not multiple opportunities for development or urbanization. FIMP provides replicable and scientifically robust methods to track changes in land use, impacts from development, environmental degradation, restoration activities, and climate change. The challenge will be to develop policies that can adapt to changes demonstrated by

Figure 4. Examples of shorelines with no- to low-level of impact.

FIMP that enable better community climate adaptation and ultimately protect healthy aquatic ecosystems.

Individuals and agencies interested in the FIMP model and helping expand its application are encouraged to contact Living Lakes Canada FIMP Program Manager Georgia Peck at georgia@livinglakescanada.ca.

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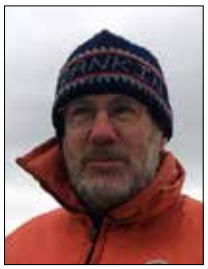
Jason Schleppe is a senior biologist and principal with Ecoscape Environmental Consultants Ltd. Jason has worked on a variety of different projects in terrestrial, lake and stream ecosystems. As a leader in British Columbia the province in the development of Foreshore Integrated Management Planning, Jason has become an expert in lake inventory and mapping projects.



Bruce Mac Donald is the retired Head of the Habitat Management Program in the Columbia River Basin for Fisheries and Oceans. He has 37 years of experience with impact assessment of land and water developments on fish habitat, initiated and led the implementation of FIM in the Columbia River Basin, and has directed 17 FIMP projects for lakes in BC, Alberta, and Manitoba.

Georgia Peck works with Living Lakes Canada as the Foreshore Integrated Management Planning Project Manager. Through this role, Georgia coordinates and oversees the current FIMP project in the Columbia Basin and is developing project expansions throughout BC and into other provinces. Her background is in conservation biology and lake stewardship.

Vinicius J. Taguchi

Student Corner

Who benefits from clean urban lakes?

The question of who benefits from clean urban lakes seems like it would have a simple enough answer. After all, the NALMS community works so diligently to manage, protect, and restore lake ecosystems, wildlife habitats, recreational pursuits, and community livelihoods (Figure 1). This is vital work in the face of ever-increasing land development and an ominous climate future. We dedicate our professional careers and, sometimes, even our free time to working with some of the most vulnerable water resources on the planet and serving the people who depend on and value them. But how can we make sure that the people we are trying to serve are able to reap the full benefits of our work?

Geographical context

In Minnesota, where I work, water is everywhere. And thankfully, we still have plenty of drops to drink. But both the availability and cleanliness of our drinking water are highly variable, spatially and socioeconomically. The unfortunate truth is that some of us live lives of relative water luxury, never having to think about where our next sip comes from, how good it will taste, or how potentially harmful it might be. For many others around the world, and even in wealthy countries like the United States, contaminated groundwater, mismanaged municipal water treatment (perhaps the most notorious in the U.S. being Flint, Michigan), and outdated infrastructure (like lead and copper pipes) are just a few of the reasons why entire communities are deprived of one of the most fundamental and essential human rights. So, is this the same for lakes?

Looking at a map of Minnesota's famous 10,000 lakes (actually closer to 14,000) and countless ponds, rivers, and streams, it sure seems like there is enough surface water for everyone. When we look at urban areas, the Twin Cities Metropolitan Area – composed of Minneapolis, St. Paul, and surrounding suburbs – is densely dotted with ponds, wetlands, and even a few medium-sized lakes. What makes these lakes different from those in less urban areas is their accessibility. Travel time, proximity to public transportation, presence of public property or easements on the waterfront, and the availability (and cost) of parking spaces all help shape who truly has access to urban lakes.

The quickest way to get an idea of who might interact with a lake is to see who lives closest to it. In many cities around the world, a strong correlation exists between income and proximity to desirable amenities. The opposite side of this trend often holds when considering negative attributes of urbanization, such as urban heat islands (higher temperatures in areas with paved surfaces). Often, urban heat islands are less severe near vegetation (green infrastructure) and sizeable surface water (urban lakes). An excellent visualization of this phenomenon is National Public Radio's (NPR) Heat and Income tool (Figure 2, Anderson and McMinn 2019), which includes maps for many cities around the U.S.

Figure 1. Recreation at Bde Maka Ska in Minneapolis, Minnesota. Photo: Vinicius Taguchi, 2018.

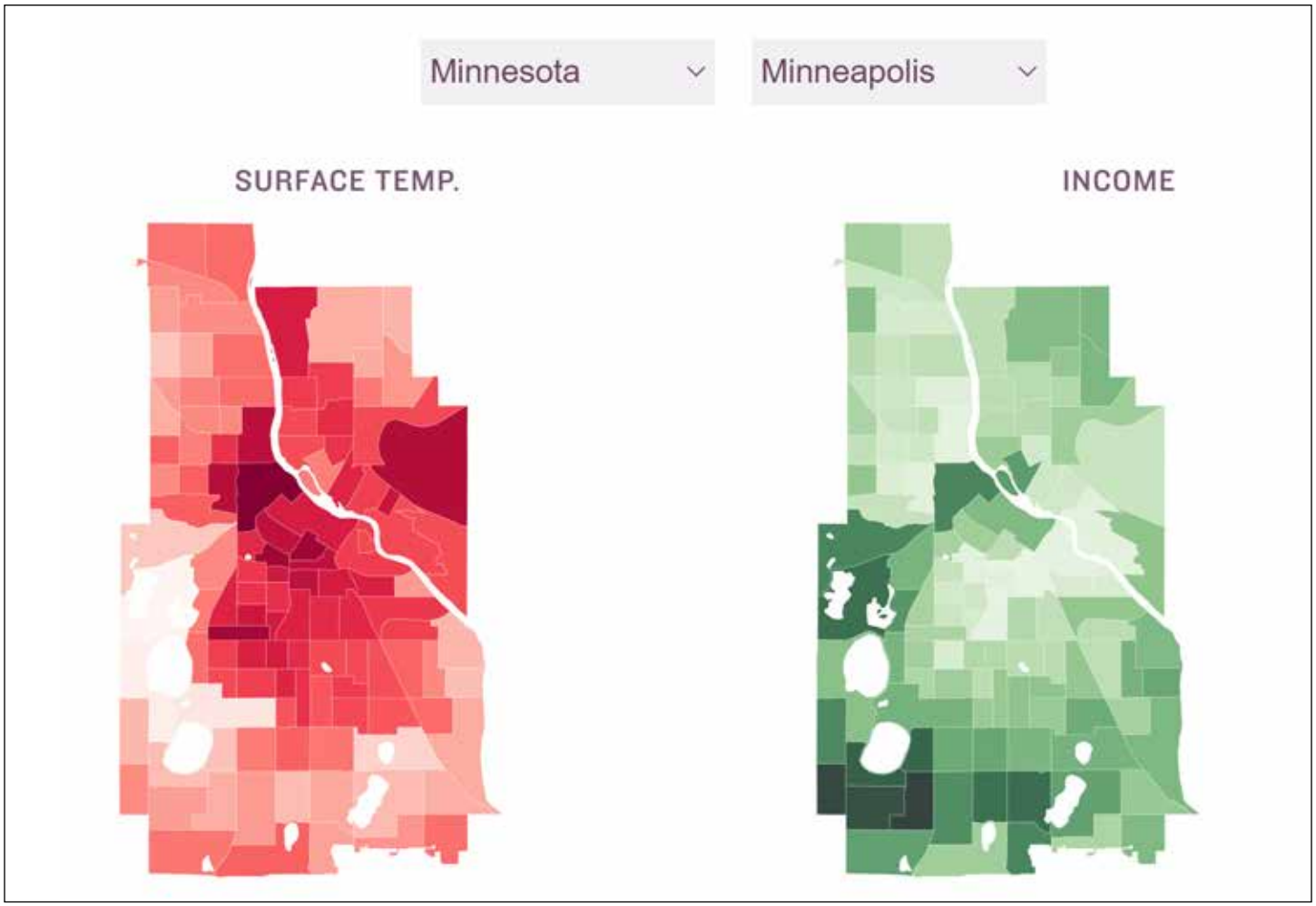


Figure 2. Heat and Income in Minneapolis, Minnesota according to NPR's Heat and Income tool (Anderson and McMinn, 2019). Light red indicates the lowest temperature and dark red indicates the highest temperature. Light green indicates the lowest income ($17k), and dark green indicates the highest income ($136k).

Historical context

What Figure 2 reveals about Minneapolis is that, unsurprisingly, surface temperatures are relatively lower, and incomes are relatively higher in areas adjacent to lakes, primarily located in the southwest of the city. Nicer places tend to be more expensive to live in because more people want to live there. The issue is that some people have been deliberately kept away from such opportunities. The New Deal-era Homeowners' Loan Act of 1933 categorically classified predominantly white neighborhoods as "desirable" and, therefore, good investments for mortgages, while non-white neighborhoods were classified as "less desirable" or even "hazardous" to investments (Robert et al. 2021). These practices, which were later termed "redlining," created stark racial disparities in addition to the economic disparities that already existed (rich neighborhoods became rich, white neighborhoods) that remain evident today (Figure 3, Stancil 1990).

Most of us are aware that the homes along the shores of beautiful, clean lakes are incredibly expensive and, therefore, inhabited by wealthy individuals who, in the U.S., are disproportionately white. And many of us are motivated by this knowledge to pursue grants and external funding to bring much-needed attention to long-neglected urban lakes in under-served communities. The issue is that even as altruistically minded groups attempt to rectify past wrongs through new investments and flashy restorations in the name of "environmental justice," some of these newly "revitalized" neighborhoods create additional economic pressures that lead to exclusivity.

Many studies have established that as a lake becomes cleaner and healthier, the adjacent property values increase. While a positive outcome to many, it's important to remember that the housing practices of the past made it disproportionately difficult for non-white individuals to get mortgages to purchase homes (Robert et al. 2021). Without the ability to own their homes, many people living in redlined areas were forced to rent. And just as the legacy of redlining defines lower-income and under-served communities today, so too does it define areas where most residents rent their homes rather than owning them. The result is that rising property values lead to rising rents, so those who can afford to pay the higher rents will move in to enjoy cleaner lakes and those who can't keep up with rising rents will be forced to relocate. This "green" gentrification is a paradox of the

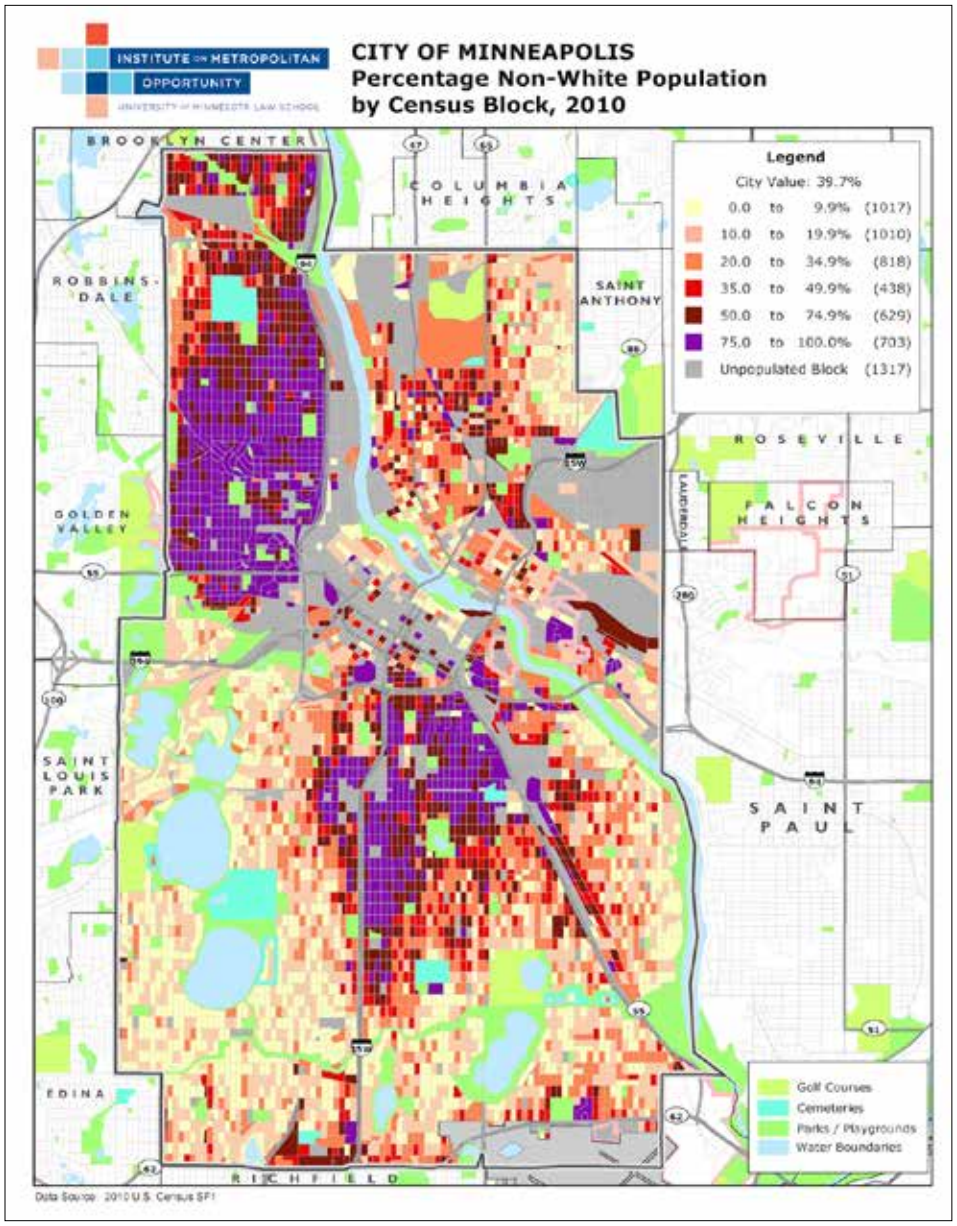


Figure 3. Map of the racial makeup of Minneapolis created by the Institute on Metropolitan Opportunity of the University of Minnesota Law School (Stancil 1990).

success of the environmental justice movement and a very real unintended consequence of some urban environmental restorations (Taguchi et al. 2020).

The unfortunate reality is that, regardless of our intentions or how successful we are at protecting and restoring water resources, the legacy of racial inequities from hundreds of years ago and codified in 1933 continue to greatly influence who benefits from our work. In the context of an unjust system, even objectively good work can result in unjust outcomes unless we prioritize community partnerships and welcoming diverse voices to the decision-making table (Taguchi et al. 2020). Included in those voices, we must also remember that most of these lakes and the land around them were stolen from the Indigenous communities that continue to be connected to this land. As we work to ensure access to urban lakes in contemporary U.S. cities, we must include Indigenous communities as inalienable stakeholders in lake management projects (Figure 4).

A path forward

One powerful tool for crafting a more diverse, equitable, inclusive, and just project process is the toolkit developed by the CREATE Initiative of the University of Minnesota, entitled *Sharing in the Benefits of a Greening City: A Policy Toolkit in Pursuit of Economic, Environmental, and Racial Justice* (Klein et al. 2020). This toolkit incorporates the knowledge and experience of community organizers, scholars, and Indigenous leaders from Minnesota, Georgia, and Florida. It also covers core concepts and terms related to gentrification in the contexts of environmental justice, affordable housing, urban planning, real estate speculation, and transit-oriented development. Additionally, the toolkit provides specific policy goals and actionable items that anyone in any role can work on toward a more just, equitable, diverse, and inclusive world. I hope you and all those in the NALMS community will consider utilizing this toolkit to maximize the benefits of your amazing work with lakes.

The only way to ensure that project outcomes are diverse, equitable, inclusive, and just is to ensure that every step from conception to execution is diverse, equitable, inclusive, and just. That means that all communities and stakeholders that could be impacted by a project must have meaningful involvement at every project stage (Taguchi et al. 2020). A single community listening session or town hall meeting halfway through a project is insufficient for this goal because fundamental aspects of the project will already have been defined by that point. Community members need to be at the table to weigh in on what a project should be, how it should be done, and even whether the project should occur at all. And at each stage of the project, they should be able to reevaluate and reassess how things are going. Such a rigorous and detailed approach may initially seem tedious, but it is actually to the benefit of project managers for multiple reasons. The more diverse minds you have at the table, the earlier issues will be identified, and the more unintended consequences can be avoided. The design will be more robust, and the result will be more favorable for the people you're trying to serve.

Acknowledgements

I respectfully acknowledge that the lands on which this work occurred are the original homelands of the Dakota and

Figure 4. Protest street art reading "STOLEN LAND" located on the 3rd Avenue Bridge over the Mississippi River in Minneapolis, Minnesota (artist unknown). Photo: Vinicius Taguchi, 2020.

Ojibwe Nations. And I aspire to honor and respect the Indigenous peoples who were forcibly removed from and are still connected to this territory by owning my part in their continued displacement. I would also like to thank Micaela Taguchi and Mark Rosenkranz for contributing substantially to the editing and reorganization of this article.

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"Lakespert" on Urban Lakes

Steve Lundt, CLM

Urban lakes are overused and under-appreciated. Do something about it.

There are urbanized lakes (Lake Washington and Lake Mendota) and then there are urban lakes (small, sometimes nameless lakes in city parks). Any "lakespert" will tell you that lakes in populated areas are important to the community and at the same time are neglected and underappreciated.

Urban lakes dotting our cities and towns are typically small, shallow, murky, afterthoughts that are lined with seawalls, choked with overfertilized lawns, and lost to city politics and departments. My local urban lake near downtown Denver doesn't even allow canoeing! These waterbodies have so much potential but are typically over utilized or completely forfeited by the community. Here's a list of pressures and expectations that urban lakes run into:

1. **Storm water** (treatment, trash collection, and flood control)
2. **Aesthetics** (high natural lake expectations plus a fountain)
3. **Fishing** (recreational and subsistence)
4. **Boating** (dragon boat races to water skiing)
5. **Wildlife habitat** (connectivity to wildlife corridor and birding)
6. **Therapeutic relief from daily stresses** (think outdoor yoga or a place to picnic)
7. **Water quality standards** (Clean Water Act)
8. **Safe place for people experiencing homelessness** (sanitation issues)
9. **Economic driver** (local businesses, real estate, and tourism)
10. **Commons** (farmer markets, charity runs, fireworks, and open-air concerts)
11. **Backdrop for outdoor exercising** (jogging, biking, and walking)
12. **Outdoor classrooms and summer camps** (some kids never get out of the city)

A popular urban lake in Denver, CO. How many lake issues can you find in this photo? Photo: Steven Lundt.

Now imagine your local urban lake and how it is trying to meet all these competing needs. It's no wonder there are more residential geese than actual residents enjoying the lake. In my "lakespert" opinion, I recommend three action items that would improve any urban lake:

1. *Allow appropriate boating* – get people on the water,
2. *Stock heavily with appropriate, catchable fish* – get kids excited about lake fishing, and
3. *Organize an annual Lakes Appreciation event in July* – educate the community about what an urban lake is and can do.

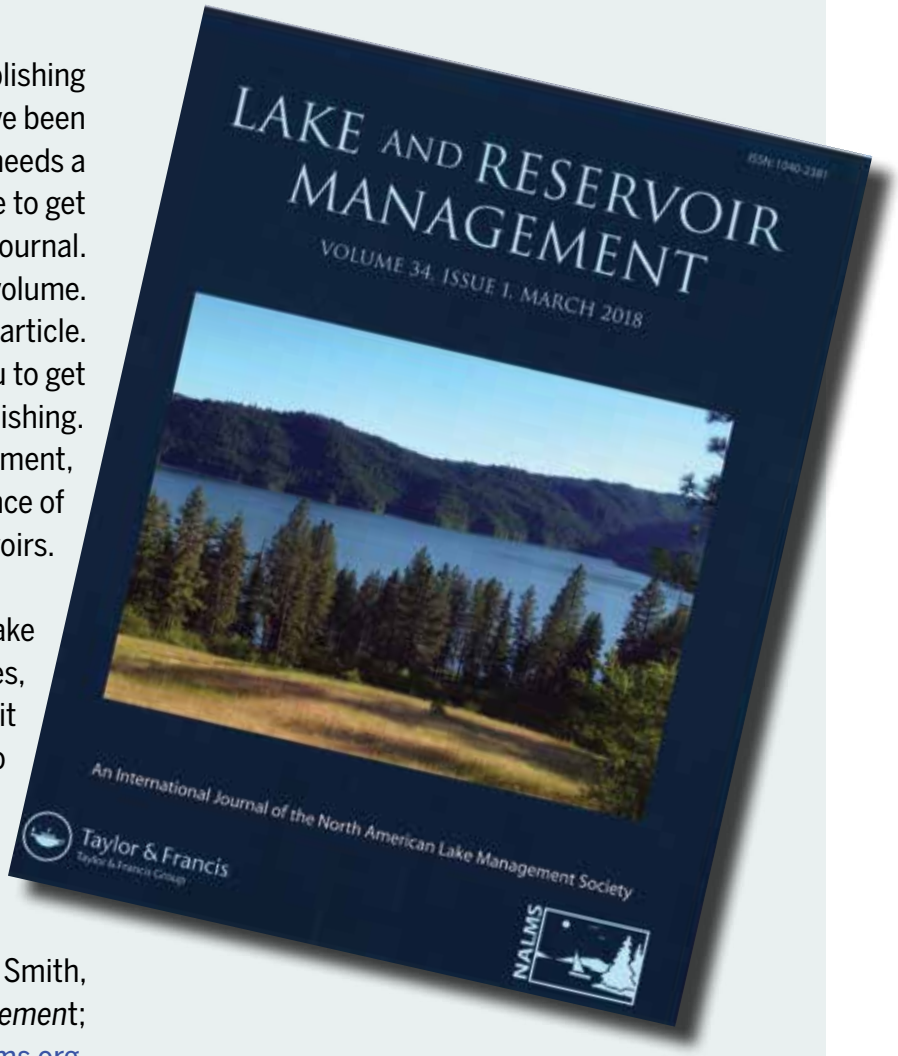
If those three items can happen successfully, then most other lake related topics and issues will be addressed along the way.

Ever wonder why we have so many urbanized and urban lakes around the world? People are drawn to water for safety, food, excitement, comfort, and relaxation. Urban lakes need a better chance to fulfill these core desires. Do something about it. Start planning your Lakes Appreciation celebration now.

Steve Lundt, Certified Lake Manager, has monitored and worked to improve water quality at Barr Lake (Denver, Colorado) for the past 19 years. Steve is active with the Colorado Lake & Reservoir Management Association and is a past Region 8 director for NALMS and an active member since 1998.

LAKE and RESERVOIR MANAGEMENT

A scientific publication of NALMS published up to four times per year solicits articles of a scientific nature, including case studies.



If you have been thinking about publishing the results of a recent study, or you have been hanging on to an old manuscript that just needs a little more polishing, now is the time to get those articles into your journal. There is room for your article in the next volume. Don't delay sending your draft article. Let the editorial staff work with you to get your article ready for publishing. You will have a great feeling of achievement, and you will be contributing to the science of managing our precious lakes and reservoirs.

Anyone who has made or plans to make presentations at any of the NALMS conferences, consider writing your talk and submitting it to the journal. It is much easier to do when it is fresh in your mind.

Send those articles or, if you have any questions at all, contact: Andrew Paterson and Andrea Smith, Co-Editors, *Lake and Reservoir Management*; lrmeditor@nalms.org.

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