



2019 - 2020

IMPACT REPORT

Machine learning & transforming
citizen science for water monitoring

Ontario
Trillium
Foundation

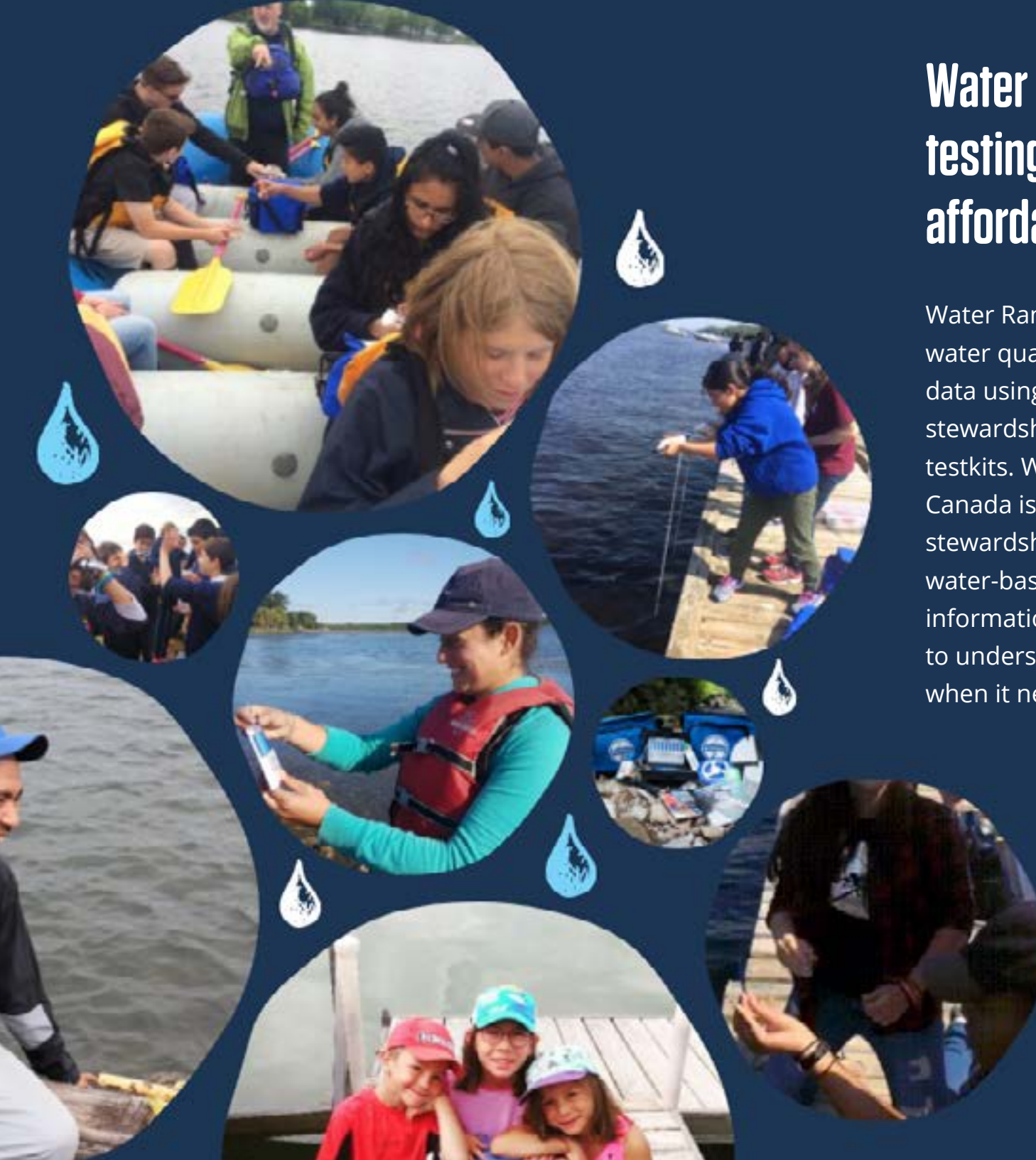


Fondation
Trillium
de l'Ontario

An agency of the Government of Ontario
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Water Rangers wants water testing to be accessible, affordable, and accurate.

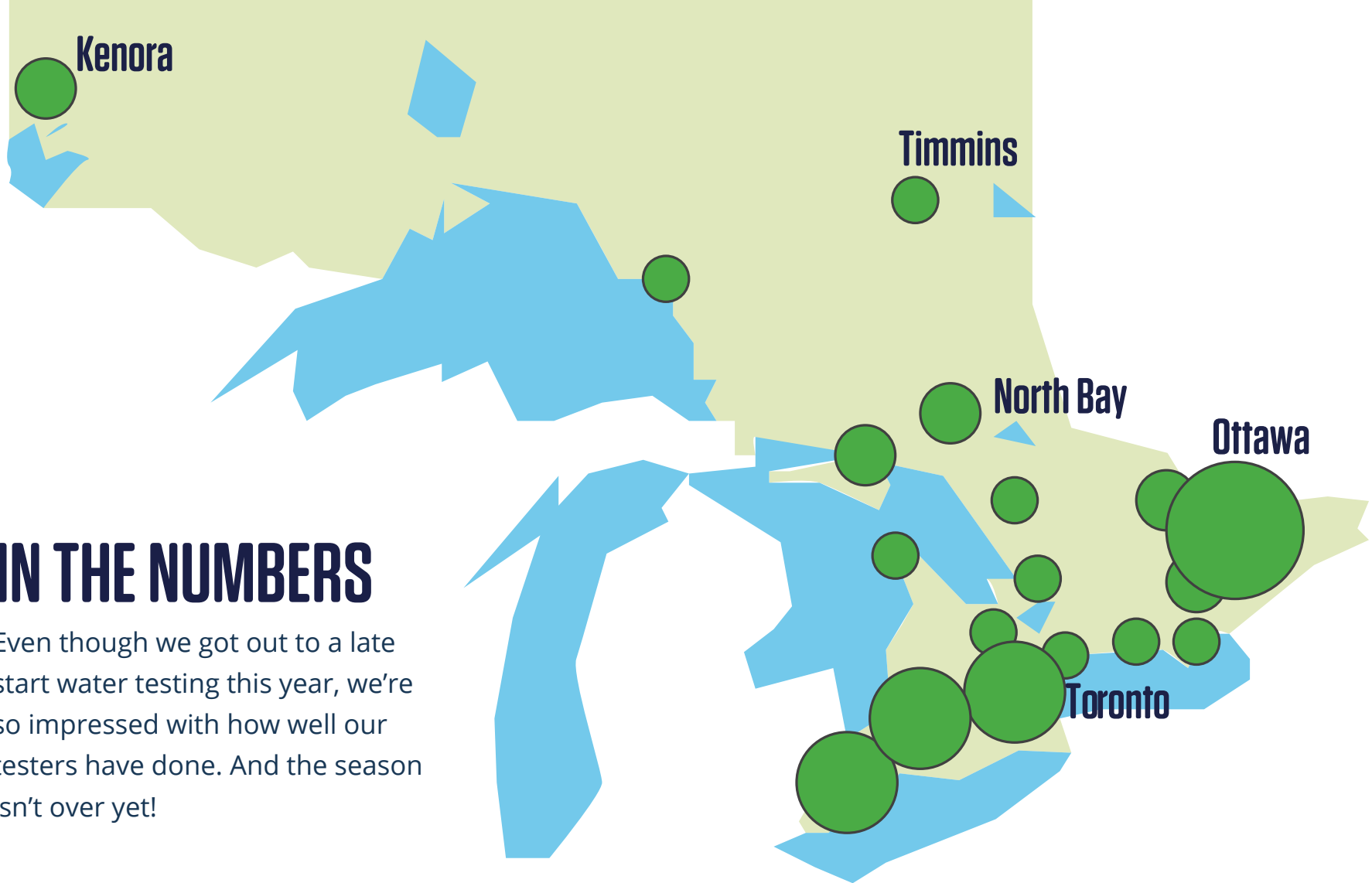
Water Rangers empowers citizens to collect water quality observations and view open data using our web platform, app, water stewardship training, and water quality testkits. We envision a future where Canada is a world leader in environmental stewardship through innovation, and where water-based research and crowdsourced information make it easy for all Canadians to understand when water is healthy and when it needs help.



ABOUT THIS PROJECT

How can we inspire more people to test waterways? Water Rangers researched how machine learning, user experience design and academic research can validate and expand meaningful water testing for citizen scientists! We found out that inexpensive water testing equipment, when combined with technology that reads and interprets results, can produce high quality data. Through this, we confirmed that making water testing affordable, accurate and meaningful empowers more citizens to participate in conservation efforts. This project discovered ways to create more legitimacy, usefulness and effectiveness in citizen science water monitoring.





IN THE NUMBERS

Even though we got out to a late start water testing this year, we're so impressed with how well our testers have done. And the season isn't over yet!

324

Water testers

364

Waterbodies

935

Observations... so far!



657

People trained in water testing

“The kids loved it! It was neat to see the same water every week for a series of weeks as well as for the kids to learn about the qualities of water. I called it the Science lesson of the week. Having been out of school since March it was nice to have some hands on activities with limited screen involvement. Thank you!”

- Kelly Pickett

A photograph of a light-colored dog with a black collar and leash sitting on a grassy bank. In the background, there is a large body of water and a cloudy sky. A blue bag and some papers are scattered on the grass to the left of the dog.

REACH

We were able to reach many Ontarians through social media and through our partners.

30,880

Facebook Reach

2,570

Information website visits

DEVELOPING A MACHINE LEARNING ALGORITHM



WARNING: Technical language here! Only for those who want to know :) Thank you to Farid Omarzadeh, for all your hard work in developing this incredible technology!

Farid says: In this project, we used a deep learning model and convolutional neural networks to detect different parts of the test strip images. On a given photo, the app detects 5 regions. The first is a grey dot on the reference card. The other 4 regions correspond to the 4 pads on the test strip that measure chlorine, pH, alkalinity, and hardness. The grey dot is used as a reference for white balancing the image. This allows us to get closer RGB values of ROIs in photos. Using photos of the test strips taken in a lab to know the exact values of each parameter, we obtained an average RGB value for each pad at specific value. New images are passed through the network, the white balancing algorithm is applied, its RGB values are calculated, and based on the Euclidian Distance we find the closest cluster representing its testing value. This project has been implemented in Python and TensorFlow library, the generated H5 model was then wrapped in a Django REST app and was deployed on AWS EC2 instance using NGINX, Celery, Redis, GUNICORN.



1,316

Machine learning photos collected (so far!)

As our testers continue to take photos on the reference card, the machine algorithm will continue to get more and more accurate! The hard work in building the initial model is done, and our volunteers have helped us build something incredible.

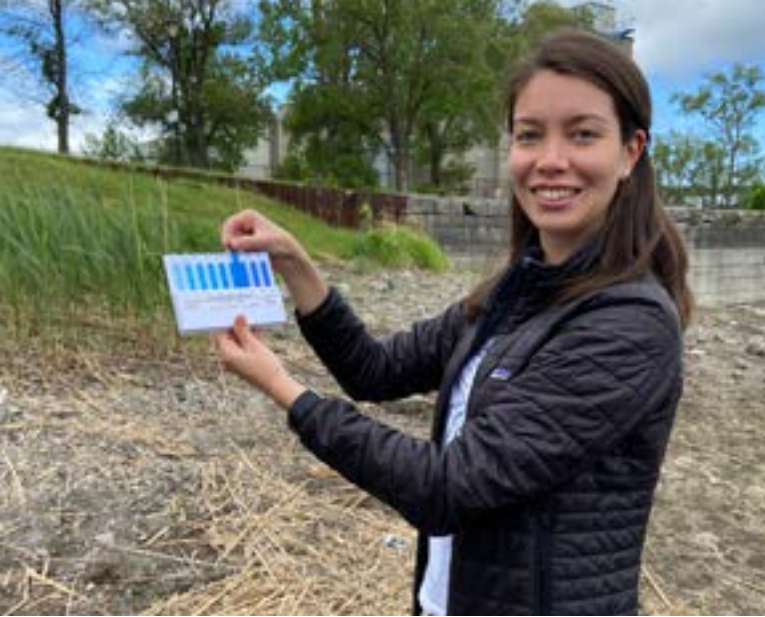


17%

Had trouble using the app and helped us by reporting issues

An app is never finished!

Technology projects can always be improved, and we've made some discoveries throughout this process. Thanks to all our users who have told us when the app has crashed or didn't work as expected. We're working hard to make sure that the experience is as smooth as possible going forward.



Our researcher, Laura Gilbert!

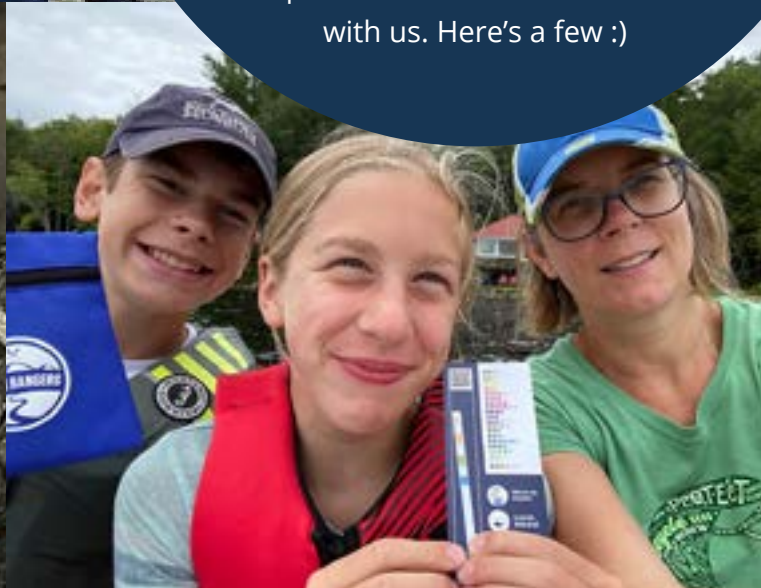
Laura is completing this research as part of her PhD in Natural Resource Sciences. Thanks to Mitacs for contributing to this opportunity!

Water and the environment have always been important to me. I believe our actions make a difference and I want people to feel the same way. An important part of that is having access to the knowledge and tools to create change. That's why I was so excited to partner with Water Rangers to find out how to keep people engaged and help them test their new machine learning algorithm. Life often gets in the way of our best intentions so it's important to create easy to use tools, keep people engaged and be available to them to make sure that they feel supported to continue testing the water. Through this project, I heard all the reasons why people wanted to test: to teach their kids the importance of protecting the environment, to learn more about the place where they live, to spend time outside, to contribute to a knowledge base, etc. Even with the added difficulties created by COVID-19, our participants are committed to testing the water and using this opportunity to spend time outdoors. A few participants are saving the kits for the fall, to share with partner schools or youth programs or to use for homeschooling with their own kids. We've found that by highlighting the accomplishments of what we call Champion Water testers, it motivates people to do their water tests. We've been rewarding these Champion testers with more testing equipment and they've all continued to test with their new equipment. Engaging the testers just a bit, through social media or emails, goes a long way. I've found that personally reaching out to people to see how they're doing makes them feel supported. They're more likely to ask questions and share their water testing stories. It's helped me feel connected to a large community of water stewards in a time when making connections is difficult.



So many Action shots!

Thanks to all our participants for sharing their photos of their water adventures with us. Here's a few :)

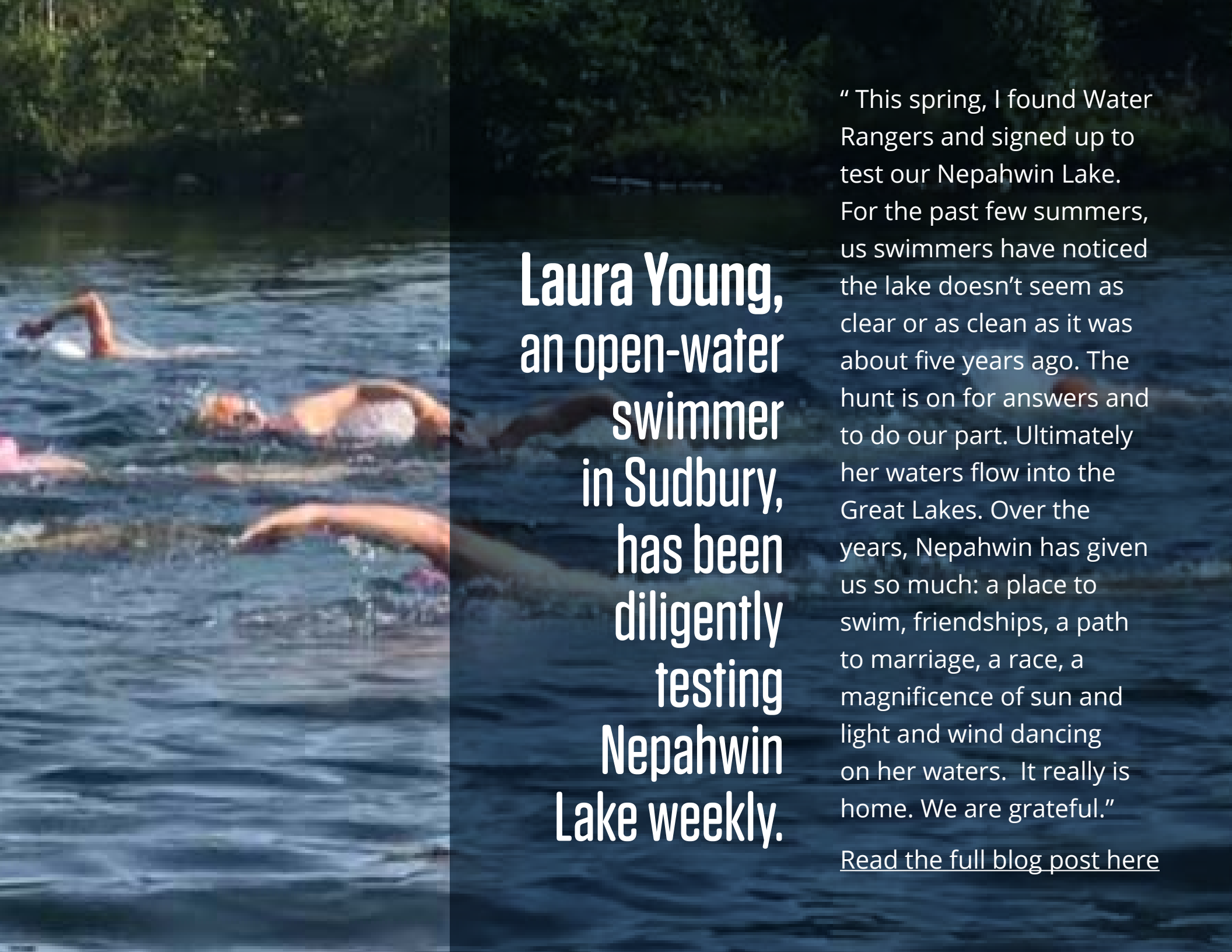




Nature discoveries

Our participants shared so many beautiful photos of animals and landscapes across Ontario



A photograph of several people swimming in a lake. The water is dark blue and rippled. In the background, there is a dense line of green trees. The text is overlaid on the right side of the image.

**Laura Young,
an open-water
swimmer
in Sudbury,
has been
diligently
testing
Nepahwin
Lake weekly.**

“ This spring, I found Water Rangers and signed up to test our Nepahwin Lake. For the past few summers, us swimmers have noticed the lake doesn’t seem as clear or as clean as it was about five years ago. The hunt is on for answers and to do our part. Ultimately her waters flow into the Great Lakes. Over the years, Nepahwin has given us so much: a place to swim, friendships, a path to marriage, a race, a magnificence of sun and light and wind dancing on her waters. It really is home. We are grateful.”

[Read the full blog post here](#)



Noticing more

Many of our participants enjoyed seeing
how waterways changed over time

"I enjoyed noticing the differences or lack of differences between observations from week to week. I enjoyed getting my kids excited about doing these experiments and we enjoyed helping out with a water testing study. We enjoyed having a goal and something that we had to do and schedule it on our calendar. We learned that different bodies of water or different parts of the same body of water could be different temps especially since we were surprised that the deeper water was always warmer than the more shallow water. That even if the air temp was super warm the water temp was not. We enjoyed doing the water testing and playing a role in this study."

- Melissa Petit-Clerc



88%

believe their actions make a difference in helping conserve the natural environment

“As Lake Steward for Little Silver and Rainbow Lakes I have been sharing the data with the Lake Association Board and intend to provide all the residents with a summary at the end of the year together with the other information which is collected by RVCA, which provides a different set of parameters. There is a great deal of interest from residents around the lakes in their water quality, and any trends that may be of concern; and we will be very interested in whatever comes out of the Water Rangers program.
- Andrew Kendrick (Lake Steward for Little Silver Rainbow Lakes)



One of our
priorities was
to support
Indigenous
water testing.

“Our youth group are all from various First Nations and we hope to share with them how precious the water is at their home communities. (...) We are testing the water where several young people died, in fact that is why we started this project at Dennis Franklin Cromarty High School. (...) We have just shared a mini test kit with the science teacher at our partner location Dennis Franklin Cromarty High School, which will increase our reach.”

- Gillian Leitch from AlterEden



169
Indigenous
participants



We interrupt this report to share this amazing snake photo, posted by one of our participants. Because it's awesome.



95%

say it's important to them to do what they can to preserve the natural environment

94%

say their relationship to nature is an important part of who they are



89%

always think about how their actions affect the environment





COVID

Like many organizations, the virus held up some of our work. Once we were allowed to visit parks again, we were so impressed with our participants, who were looking for a way to get outside and give back to the environment. Thank you for your perseverance!

Thank you to all the participants for their enthusiasm. We had way too many photos to put them all in here. Thanks, too, to Ontario Trillium foundation for supporting our research! We couldn't have done this without your help! Questions? research@waterrangers.ca

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THANKS!

