## Mersivity 2023 August meetup

Tue., Aug. 15, at Michael Hough Beach, Ontario Place, just West of the Cinesphere

# **Humans**

## Technology



Water

### TRANSP60

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Water - Human



Summer Mersivity Symposium speakers schedule

Tue. Aug. 15, 10am, Michael Hough Beach, Ontario Place, West Island:

• 10am Olivia Chow to arrive by paddleboard, weather-permitting, to give intro.



 10:05am Mike Schreiner, Party leader of the Green Party of Ontario. "Protecting outdoor public spaces, safeguarding equitable access to water and freshwater preservation public trust."



(Wikipedia)

• 10:15am Charles Rishor, Yachting Director, Boulevard Yacht Club.



• Keith Rich, "I Love You" (first public release of original musical composition)



 1pm Chloe-Marie Brown, "Transforming spaces into cutting-edge research and education centers dedicated to climate change. ⅔ ... innovative #wetlab at Ontario Place for protecting the #greatlakes ♀ ... implementing #Scientists-in-

#### Residence programs 🏠 🔆 "



- 1:30-145pm Ed Hore and Niv Froehlich will arrive together by kayak:
- 1:30-1:45pm Ed Hore, founder, Waterfront for All



• 1:30-145pm Niv Froehlich, Director of Paddle Canada Stand Up Paddleboard & Kayak Programs. "Creating a Paddle-Friendly City"



• Time TBD David Shellnutt, "The Biking Lawyer".



• Time TBD Ryan Janzen, founder, Transpod



- Time TBD Leea Puntanen, "Open water community at Ontario Place"
  Time TBD Anne (Anya), "Call on Canada Green Building Council (CAGBC)..."

## Hydraulikos: 12 years of Ontario-Placemaking<sup>TM</sup> and $U_oOP$ = University of Ontario Place

Steve Mann, Ed Hore, Charles Rishor, Ryan Janzen, Keith Rich, Mike Schreiner, and Perry Toone, Tuesday, August 15, 2023, TeachBeach<sup>™</sup> outdoor classroom, Michael Hough Beach, West Island, Ontario Place DOI: 10.5281/zenodo.10447759

Pictured below is what we argue is the world's most important island and beach in regards to freshwater stewardship:



This beach was created in the 1970s using pebbles rather than sand, to provide water that is free of grit, grime, and dirt, creating unique scientific and artistic possibilities like acoustic studies and underwater music videos [1].

#### Crystal-clear water in the heart of the downtown core of Canada's most populous city



City of Toronto map annotated in red, showing location of the beach in the Downtown Toronto core.

Sand-free water makes for great underwater music videos, and is kind to camera equipment, as well as to prosthetic devices (used by those with disabilities) that are easily damaged by just a few grains of gritty abrasive sand.



This makes the beach accessible to many people who are unable to tolerate sand. Although large flat rocks could also provide such access, the nicely-sized pebbles provide safer traction than slippery wet rocks, especially for year-round (including winter) swimmers. The pebbles also provide a barefoot "reflexology trail" like those found in many parks where pebbles are brought in for barefoot walking.

The water quality here often tests with contaminants at less than 1.0 e. coli/100mL, which is the lowest (i.e. cleanest) of any of the beaches in the entire city.

Additionally the extremely clear water serves important scientific purposes such as research on wave-propagation, hydraulics, and hydraulophonics [1,2], thus giving rise to the Teachbeach<sup>TM</sup> outdoor classroom and research lab built by the swimming community at this beach and used for research, labs, and lectures nearly every day year-round:



#### Why Ontario Place West island is at the world's epicenter of freshwater-stewardship.

Let us explain why Ontario Place West island, and Michael Hough Beach in particular, is at the world's epicenter of freshwater stewardship:

- 1. Ontario has been called the freshwater capital of the world. It is home of the world's largest (by area) freshwater lake, Lake Superior, having  $31,700 \text{ mi}^2 = 82,100 \text{ km}^2$ . It is the largest, coldest, deepest (406m = 1,1332 feet), and healthiest of the Great Lakes.
- 2. The Great Lakes contain 84% of North America's surface freshwater.
- 3. The Great Lakes are the world's largest freshwater system and hold about 21% of the world's surface freshwater supply.
- 4. The Great Lakes are the world's largest group of freshwater lakes by combined area.
- 5. The Great Lakes are predominently in the Canadian province of Ontario, whereas in the United States there is no single state that predominates.
- 6. Toronto is the largest city on the Great Lakes.
- 7. Toronto is Canada's most populous city, and is the capital of Ontario, as well as home of Canada's largest (in terms of enrollment as well as annual research budget) university, the University of Toronto [2].
- 8. Toronto is home of Ontario Place, a public park on 3 islands connected to the mainland by pedestrian bridges.
- 9. Of these 3 islands, West island is the island with the beach designed by landscape architect Michael Hough.
- 10. Unlike other beaches, which are sand-based, Hough created Toronto's first and only pebble beach. This pebble beach facilitates pebble-walking (barefoot walking on pebbles for therepeutic effect), and is a popular location for year-round swimming with thousands of members of SwimOP (Swim at Ontario Place), Swim Drink Fish, and Lake Ontario Waterkeeper. The swimming water quality is tested regularly year-round by Swim Drink Fish, and is the site for a wide range of educational and research activities including Teachbeach<sup>TM</sup> research lab and outdoor classroom.
- 11. This beach has a unique freshwater ecosystem of particular scientific and research interest in close proximity to University of Toronto.
- 12. It is also the only beach within the downtown Toronto core. This makes it unique in terms of recreation, research, visibility, and ease-of-access to large numbers of daily swimmers, sunbathers, birdwatchers, etc.
- 13. The unique landscape, designed by Michael Hough, isolates the beach both visually and acoustically, as well as chemically (e. coli, etc.) from the hustle and bustle of the city. This creates an idyllic feeling of being surrounded by wilderness, forest, and wildlife.
- 14. At present, this beach, and the entire West island, is under threat of commercialization and the commercial development would see the removal of more than 850 mature trees, and destruction of much of the natural fish habitats around the island. This damage would have a potential negative impact on the natural ecosystems and on the Toronto's cleanest beach.
- 15. Most notably, a private foreign commercial business would assume a 95-year lease on this island and be put in charge of redeveloping and maintaining the beach and other public space around the perimeter of the island, while building an artificial bathing facility (waterpark, spa, pools, etc.) on most of the island.
- 16. The proposed facility would use the beach only as a visual backdrop, but not for customers to enjoy during their visit, i.e. not in the healthy way that would encourage more people to use the lake by warming up in a sauna or the like, jumping in the lake for a swim, going back to the sauna to warm up, etc..
- 17. There is an inherent conflict-of-interest in privatizing the island for a corporation to manage the public space, especially as the public space beach amenity competes with the sale of pool passes to swim in the private facility.
- 18. The severity of this situation extends well beyond the public versus private property of Ontario Place, as it affects the ecosystems and freshwater supply of Lake Ontario which is of national, and in fact international (United States and Canada) importance.
- 19. About 3/4 of Earth's surface is covered in water, but most of it is not drinkable. Freshwater is precious and hard to find; it is "the new oil". Past wars fought over oil will be fought over water, akin to the opening scene of Kubrick's "2001: A Space Odyssey" where hominids fighting over a water hole lead to the invenion of the first weapons and the dawn of human civilization.

#### **Spa + Science Centre + Classroom + University Research Lab at Ontario Place**

The idea of a spa facility at Ontario Place is not itself new. Stephanie Mann envisioned a research lab + science centre + spa + waterpark + university at Ontario Place that would help people connect with Lake Ontario, as follows:



In the basement, an underwater window looks out at the fish. In the main floor, an indoor waterslide goes out into the lake after warming up in a sauna or hot tub. A door also leads to a lake-level dock + deck, to enter or exit Lake Ontario. There is also an outdoor hot tub to go fishing while sitting in the tub. The tub lowers from the second floor when the lake is calm, otherwise it stows up high to protect it from rough water. On the rooftop there a greenhouse with 6 hydraulophones and an outdoor deck with diving platform and waterslide going into the lake. The concept was presented as Hydraulikos 2011, November 22:



### A spa could save the lake by encouraging people to swim in it, or poison the lake by discouraging people from swimming in it.

The best way to protect our freshwater ecosystem is to swim in it. Fish have no rights but humans do. The "NO SWIMMING" signs are what makes pollution tolerated. If we look at other great cities like San Francisco, in the busy harbour shipping port, there are bather entrances into the ocean every 400m along the Embarcadero. There is the Dolphin Club and South End Rowing Club where swimmers jump into the frigid waters of the San Francisco Bay and warm up in the sauna afterwards. As a result, many of the wealthy Silicon Valley executives join these social clubs and swim regularly. The rich, the famous, and the influencers swim there. And others follow their example. Silion Valley California is based on a love of nature. Trees are seldom cut down there, as they are greatly valued, and you can see many examples where the road or sidewalk goes around a tree rather than cutting it down. The city Palo Alto gets its name from a more than a thousand-year-old famous redwood tree, "El Palo Alto", Spanish for "The tall tree". In 1894 the city was incorporated and the name of the city was derived from its most famous inhabitant, the redwood tree. Many residents of Palo Alto display their wealth not with fancy houses, but with very nice trees, maintained by some of the world's best arborists. One will see many a humble abode surrounded by an orchard of citrus trees, and a love of nature in general.

This balance between nature and technology is what characterizes mersivity, the idea that if technology can (im)merse us, we should be able to (im/sub)merse the technology, i.e. mersivity implies reciprocity in 'mersion.

A facility, such as a spa, that discourages people from swimming in the natural water would set a bad precedent, and bad example, as a technology that 'merses us but isn't itself 'mersive. The proposed design at Ontario Place suffers from this problem of scale, as a proposal to clear-cut 850 mature trees and build a fully enclosed facility that does not connect with the lake, could serve to poison the lake.

Let us explain the reasoning here. The spa being proposed now for Ontario Place would see Michael Hough Beach destroyed and a new beach created on the West side of the island, next to the heavy traffic of Lake Shore Boulevard, a major arterial road, and not far from the Gardiner Expressway, and right beside the CSO (Combined Sewer Outfall). The public realm, including the beach, would be managed by the private company that runs the spa.

The problem here is one of potential conflict-of-interest, i.e. because spa patrons do not use the lake as part of its offering, there is little incentive for the beach to be maintained in an attractive state as it competes with, rather than compliments their business offering.

Thoughts from Celina Caesar-Chavannes: Ontario Place can be a well being destination that thousands can enjoy; however, that is not what is included in the current proposal from Therme Canada. While it looks inviting and promising, if privatized Ontario Place will remain inaccessible, especially for those who need well being spaces the most.

Ontario Place is primarily a waterfront place that should serve as the world's example of Mersivity, i.e. a place that allows us to immerse/submerse in nature, including the surrounding waters.

In this way even the Walter Kehm's recently renovated Trillium Park (at the Ontario Place East island) falls short of Mersivity as the large boulders on the shoreline are far from inviting to safe and easy water access. One only has to look across to Toronto Island surrounded on nearly all of its perimeter with beautiful beaches, i.e. good water access all the way around the island, not just in one or two designed swim areas.

Water-related activities on the waterfront should connect to the water! Waterfront property is precious and limited, so we should make full use of it for water access. We envision a completely accessible waterfront where anyone can easily swim, launch a paddleboard, or Mersivity ball, or exercise in the water.

![](_page_10_Picture_0.jpeg)

Figure 1. Mersivity Ball is a simple technology that helps us connect with nature. Arrays of sensors provide feedback on a fitness training regimen of balance and Integral Kinesiology. The ball is a good example of a vessel that has a clearly defined interior ("Invironment") and exteriour ("Environment"), the boundary therebetween denoted as "Vironment".

#### 1. Hydraulikos activities at Ontario Place, 2011 to present

This connection, specifically, using technology to connect us with the world around us, was the original goal of the Hydraulikos project (presented in public, November 2011) to explore and envision Ontario Place as a combination of a university, research lab, science centre, and spa. Not just any spa, but a spa that helps connect people to the water!

At our 2023 meetup, we reviewed some of this work over the past 12 years, providing context for using technology to connect us with our environment, i.e. to connect us to the earth, to water, our natural world, and to each other. Here are some pictures showing examples of our explorations of these ideas.

Our Summer Symposium (August Meetup) began with an opening by Keith Rich who performed an original song "I Love You" introduced to the world for the first time at this August 15th meetup.

We also had the Mersivity ball available as an example of a technology which, in one aspect may appear to isolate us completely from nature (it is a completely sealed airtight and watertight vessel), but in fact helps us connect to nature, to the ebb-and-flow of the lake, and to be intimately aware of every little ripple upon the water's surface. See Fig 1.

Fig 2 shows the Architouch<sup>™</sup> laminar water-arch, presented as a series of art installations in and around the lake to teach concepts of laminar versus turbulent flow, hydraulic head (gamified as "Head Games<sup>™</sup>"),

![](_page_10_Picture_8.jpeg)

Figure 2. Architouch is a water-based art installation that teaches mathematics, physics, and measurement, as we plot the parabolic trajectory of the water through space, as well as understand laminar flow, and hydraulic head. The ultraclean (sandless) beach facilitates easy access to clean water, such as the submersible pump, with no worry about it being clogged with sand.

and the parabolic trajectory of the water jet under the influence of gravity. The location of these experiments and art installations, Michael Hough Beach, is a place of unique scientific and artistic significance. As Toronto's only sandless (sand-free) beach, it provides access to ultraclean water, so that, for example, a water pump can be tossed into the water, and sit right on the bottom, on the lake bed, and not be clogged with sand or grit or grime or dirt.

Much of the Hydraulikos work involves us interacting with technology and the physical world, e.g. being in the water, embodied, to touch and be touched by water, and partake in a spa-like experience. Accordingly we also created a variety of experiences, as art installations and the like, to connect us to the water. Among these installations, we created a series of bathing experiences, such as a lakeside sauna (Fig 3) enabling members of the public to experience, free of any cost or any advance registration, a renewed connection to nature. The sauna attracted large numbers of visitors to try cold-water swimming for the first time. The ability to warm up made it possible for many people to overcome their fear of cold water, and thus introduced them to the health benefits of winter swimming. In this way the sauna is interventional. Many continued to do cold-water swimming even without the sauna, once introduced to cold-water swimming with the help of the sauna. Helping visitors overcome these barriers opens them up to new possibilities.

The pebble beach provided many other unique possibilities to experience connections to nature. In many places around the world, one can go to a pebble spa to walk barefoot on variously-sized pebbles. See for example Fig 4. What is remarkable is that we have an excellent barefoot pebble-walking spa right in the heart of downtown Toronto at Michael Hough Beach which we've used for a variety of artistic interventions and scientific explorations including "Rock Band", a lithophonic musical instrument made of one or more rubber bands moving pieces of rock around to a striking mechanism to sequentially play musical notes from the pebbles. Another variant of the pebble-based sound is "Walking Rock Music" made by walking on pebbles and frequency-shifting the natural pebble sounds to musical notes. See (and hear) videos of YouTube user Hydraulist.

The Ancient Greeks discovered sand-bathing by way of being buried in hot sand. This treatment is called "psammotherapy" from Ancient Greek " $\psi \dot{\alpha} \mu$ - $\mu o \varsigma$ " (psámmos) which means "pertaining to sand".

We improved upon this ancient therapy by using pebbles, resulting in a similar experience but without the grit and grime. We name it "vótsalotherapy" or "chalíkitherapy" from Greek " $\beta \delta \tau \sigma \alpha \lambda \sigma$ " ("vótsalo") or " $\chi \alpha \lambda (\pi \iota$ " ("chalíki") meaning "pebble". See Fig 5.

We also organized a number of concerts and musical performances around the hydraulophone (underwater pipe organ), as part of a series of meetups and gatherings associated with the Hydraulikos effort (Fig. 6).

#### 2. Headgames

This year we continued our tradition of Headgames<sup>TM</sup>as a gamification of the teaching of hydraulic head, i.e. to make hydraulic head fun [3]. We designed a series of games that are simple for anyone of modest (or no) means to reproduce. Much of the activities can be done with a bucket, a rope, and some driftwood. Buckets can be found at the roadside on garbage day because many products come in plastic buckets and when the product is used up, the buckets are disposed of. A hole is drilled into the bottom of the bucket, and it is filled with water and suspended from a tripod made from 3 pieces of driftwood or tree branches. A large-print ruler can be purchased at modest cost or made by hand. See Fig 7.

#### 3. Waves

The beach is an ideal place to learn about waves, wave propagation, oscillations, resonance, and the like. Thus we continued with our tradition of teaching about waves from fundamentals, such as a simple mass-spring system. We affixed a pebble to a spring hanging from the same tripod that we created for Headgames. See Fig 8.

Here we teach a very simple relationship between spring elongation and the period of oscillation, T (i.e. how long it takes for the mass to go down and back up again), in a way that requires no measurement equipment other than a ruler and a timer such as a wristwatch. Our method of teaching does not require knowledge of the mass of the pebble, nor does it require knowledge of the spring's constant. We shall show a very simple result leading to a very simple equation, perfect for teaching purposes with minimal means.

Forces are equal and opposite:  $f = kx = -ma = -m\ddot{x}$ , where *a* here is the acceleration due to gravity which is about 9.806  $m/s^2$  in the Toronto area, *m* is the mass of the pebble, and *k* is the spring constant. Thus:

 $kx = -m\ddot{x}(Eq.1)$ , and let

 $x=Acos(\omega t+\phi)$  (Eq. 2) be a general solution so that

$$\dot{x} = -A\omega sin(\omega t + \phi)$$
, and:

 $\ddot{x} = -A\omega^2 cos(\omega t + \phi)$  (Eq. 3), and substitute Eq. 2 and 3 into Eq. 1:

 $kAcos() = mA\omega^2 cos()$ , so that:  $k = m\omega^2$ , i.e.  $\omega^2 =$ 

![](_page_12_Picture_0.jpeg)

Figure 3. Sauna as a way to increase our connection to the lake and cold-watear swimming.

k/m, so that  $\omega = \pm \sqrt{(k/m)}$ , and the frequency, f of oscillation is:  $f = \pm \frac{1}{2\pi} \sqrt{k/m}$ , and the period, T = 1/f, so that:  $T = \pm 2\pi \sqrt{m/k}$ .

Let l be the length/meter extension when mass/kg, m is added to the spring, e.g. l = -x, the position of the spring when it hangs elongated.

Recall f = kx = -ma (Eq. 1) where  $a = g = 9.806/(m/s^2)$ , so kl = mgk = ma/l $T = 2\pi \sqrt{\frac{m}{mg/l}} = 2\pi \sqrt{l/g}$ , which is a constant times  $\sqrt{l}$ , i.e.  $T = \frac{2\pi}{\sqrt{g}}\sqrt{l}$ , i.e. a constant  $2\pi/\sqrt{9.806}$  times the square root of how much longer the spring got:  $T \approx = 2.0065\sqrt{l}$ , where T is the period per sec and l is the elongation per meter.

An often close enough approximation is:

$$T = 2\sqrt{l}.$$

Very simple indeed! Again, no need to know the mass, m, or the spring constant k. We simply measure how much longer the spring became when the mass was added, take the square root of that length, and double it, and we have calculated the period

![](_page_13_Picture_0.jpeg)

Figure 4. Pebble spa in Seoul, South Korea, for barefoot walking on variously sized pebbles.

![](_page_13_Picture_2.jpeg)

Figure 5. A cleaner variation of the Ancient Greek psammotherapy (sand bath) treatment using pebbles rather than sand. No grit or grime, and improved muscle and nerve stimulation from the texture of the pebbles.

which we can measure to confirm the experimental accuracy.

Interestingly the period only depends on how much longer the spring gets when pulled down, not on how long the spring itself is, and thus the top end of the spring's position does not matter.

This ultra simplicity makes the exercise perfect for the beach!

#### 4. Conclusions

We have envisioned and adapted Ontario Place as a combination university (UoOP = University of Ontario Place), research lab, science centre, and spa, in fulfillment of our public presentation as such in November 2011.

No trees or animals were harmed in the process, and we maintained the principle of Mersivity, i.e. technology to connect us to the world around us ... Sustainable Technology Society.

#### References

- [1] Steve Mann, Mark Mattson, Steve Hulford, Seung min Park, Fadel Adib, Chris Houser, Stephen Diamond, Pierre Lafontaine, Florian Mueller, et al. WaterHCI: Exploring the intersection between water, humans, and technology. Proceedings of the 24th annual Water-Human-Computer Interface Deconference, Ontario Place TeachBeach, Toronto, Ontario, Canada, pages 5–22, 2022. 6, 7
- [2] Steve Mann, Mark Mattson, Steve Hulford, Mark Fox, et al. Water-human-computerinterface (waterhci): Crossing the borders of computation, clothes, skin, and surface. PRO-CEEDINGS OF THE 23RD ANNUAL WATER-HCI DECONFERENCE, VOLUME 23, DE-CEMBER 9, 2021, DOI (Digital Object Identi-

![](_page_14_Picture_0.jpeg)

Figure 6. Hydraulophone (underwater pipe organ) played by Josh Matlow. Bottom picture courtesy of photographer Steven Evans.

![](_page_15_Picture_0.jpeg)

Figure 7. "Headgames": Gamification of the teaching of the concept of hydraulic head.

![](_page_16_Picture_0.jpeg)

Figure 8. Waves and waveforms: Oscillations in a mass (pebble) and spring system.

*fier*) = 10.5281/zenodo.5769045, pages 6–35. 7, 8

[3] Steve Mann. Hydraulikos: Nature and technology and the centre for cyborg-environment interaction (CEI). In *Proceedings of the Sixth International Conference on Tangible, Embedded and Embodied Interaction*, pages 29–32. ACM, 2012. 12