

Enteric bacteria and microbial source tracking in Alberta lakes

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Our recreational waters are valuable

ECONOMIC BENEFITS OF RECREATION SITES ON IRRIGATION RESERVOIRS IN SOUTHERN ALBERTA

Rod B. McNaughton

Published online: 23 Jan 2013.

- In 1992, recreationists using Alberta lakes spent an average of \$44.44 +/- \$3.70 per day at a lake
- >\$1 million per spring/summer for well-developed site

2014

Economic Impact Assessment of Sylvan Lake Tourism

- In 2014 the average tourist visiting Sylvan Lake spent \$35.17 per stay
- The total economic impact (aggregate of employment, GDP, labour income) was ~\$75 million

- US survey on Recreation and Environment finds that >61% of the US population over 16 use natural water bodies
- >4 billion surface water recreation event occur annually
- Recreational beaches contribute >\$320 billion annually to the US economy

Recreational water in Alberta faces numerous threats

Banff lake may be drained to stop spread of deadly whirling disease in fish

Parks Canada considers extreme measures to halt spread of deadly parasite

CBC News Posted: Nov 08, 2016 6:51 PM MT | Last Updated: Nov 11, 2016 5:44 AM MT

ENVIRONMENT October 9, 2015 3:39 pm Updated: October 9, 2015 4:08 pm

Zebra mussels cost Canadians billions each year; cost to Manitobans still unknown



By **Brittany Greenslade**
Reporter/Anchor Global News

Swimmer's itch a pain for Edmonton family hitting the beach

'She is covered head to toe, like everything is covered'

CBC News Posted: Jul 05, 2016 7:00 AM MT | Last Updated: Jul 05, 2016 7:00 AM MT

Blue-green algae takes over many Alberta lakes as hot weather returns this week: 'It smells like sewage'



By **Caley Gibson** · Global News
Posted August 30, 2022 10:59 am · Updated August 30, 2022 3:59 pm

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Public beach in Bonfield closed due to goose poop

Posted: Jul 29, 2015 5:19 PM ET



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Fecal bacteria leads to advisories at multiple Alberta lakes, including Wabamun and Pigeon



By **Allison Bench** · Global News
Posted August 1, 2020 4:22 pm · Updated August 2, 2020 7:10 pm

Poop problem: AHS advises against swimming in Chestermere Lake



These threats impact recreational activity and local economies

>4 billion surface water recreation events occur annually

Swimming accounts for the largest use of recreational water (~48%)

~90 million estimated illnesses annually

Majority of illness is acute gastrointestinal infections

Between 333 and 1696 hospitalizations and 16-67 deaths occur annually due to rec water illnesses

Estimated cost of \$2.2 – 3.7 billion annually (~10% of value)

NEEAR Studies

The National Epidemiologic and Environmental Assessment of Recreational Water

Rapidly Measured Indicators of Recreational Water Quality Are Predictive of Swimming-Associated Gastrointestinal Illness

Timothy J. Wade,¹ Rebecca L. Calderon,¹ Elizabeth Sams,¹ Michael Beach,² Kristen P. Brenner,³ Ann H. Williams,¹ and Alfred P. Dufour³

¹National Health and Environmental Effects Research Laboratory, Human Studies Division, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, USA; ²Parasitic Diseases, Centers for Disease Control and Prevention, Atlanta, Georgia, USA;

³National Exposure Research Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio, USA

- Resulting from litigation in the 2000s, the US EPA ran a series of epidemiological studies at beaches with known point sources of pollution – usually waste-water treatment plant discharges or storm water discharges
- The Beaches Environmental Assessment and Coastal Health Act (BEACH Act) was developed
- The NEEAR studies changes the definition of illness
 - 1986 – a highly credible gastrointestinal illness included any one of the following within 8-10 days of contact
 - Vomiting
 - Diarrhea (with fever)
 - Stomach ache (with fever)
 - In 2012 – NEEAR gastrointestinal illness (NGI)
 - 10-12 days all the above but without the requirement for fever

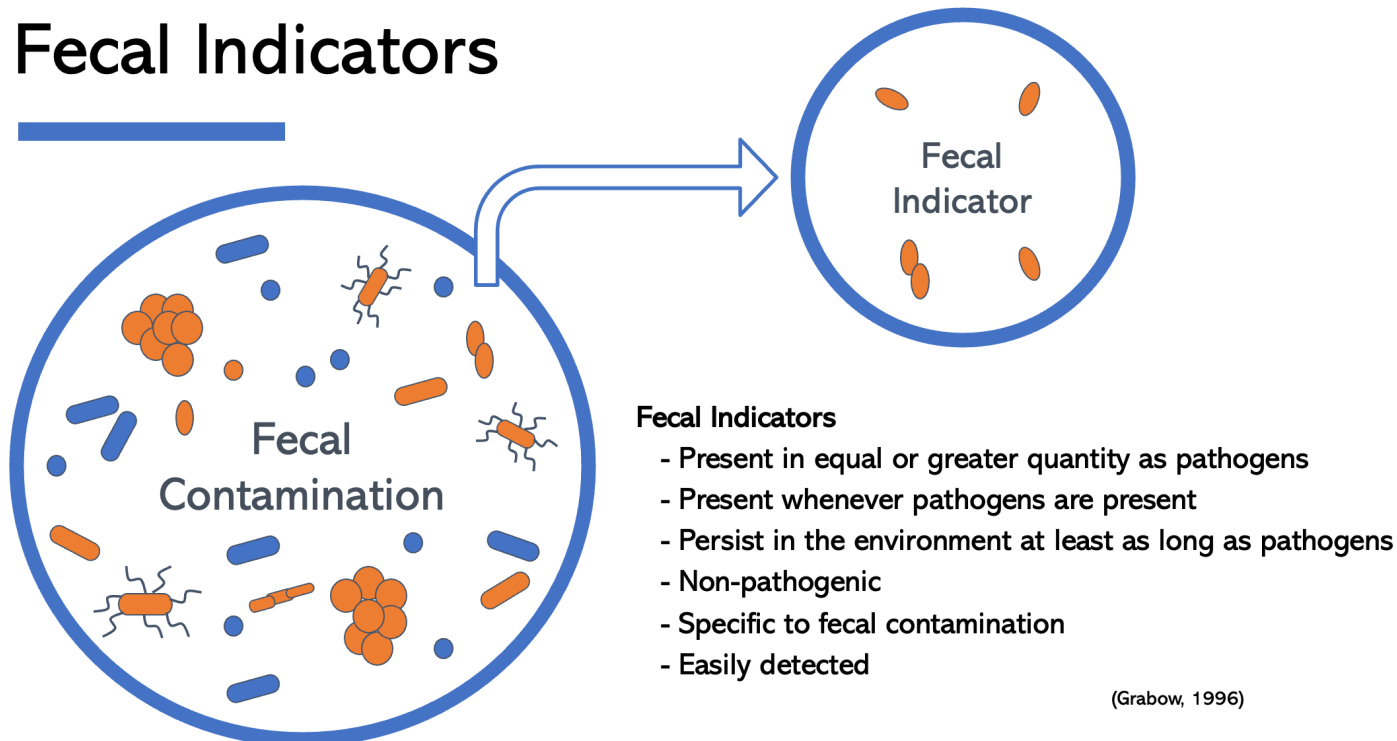
NEEAR implications

Comparing 1986 data to 2012 data suggested a conversion factor of 4.5

Using historical highly credible gastrointestinal illness report data (7-8 HCGI/1000 swimmers) = 32-36/1000 swimmers

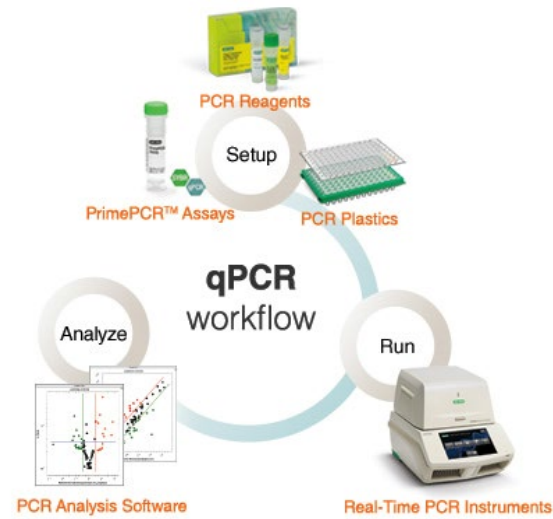
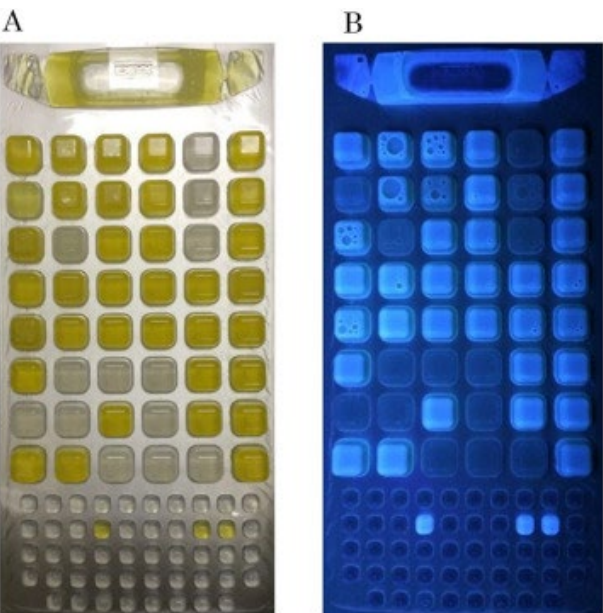
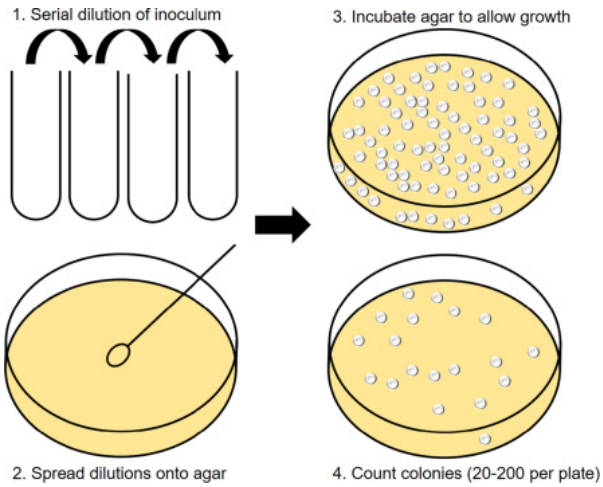
Which test for the presence of fecal bacteria works the best to predict risk of developing GI?

Fecal Indicators

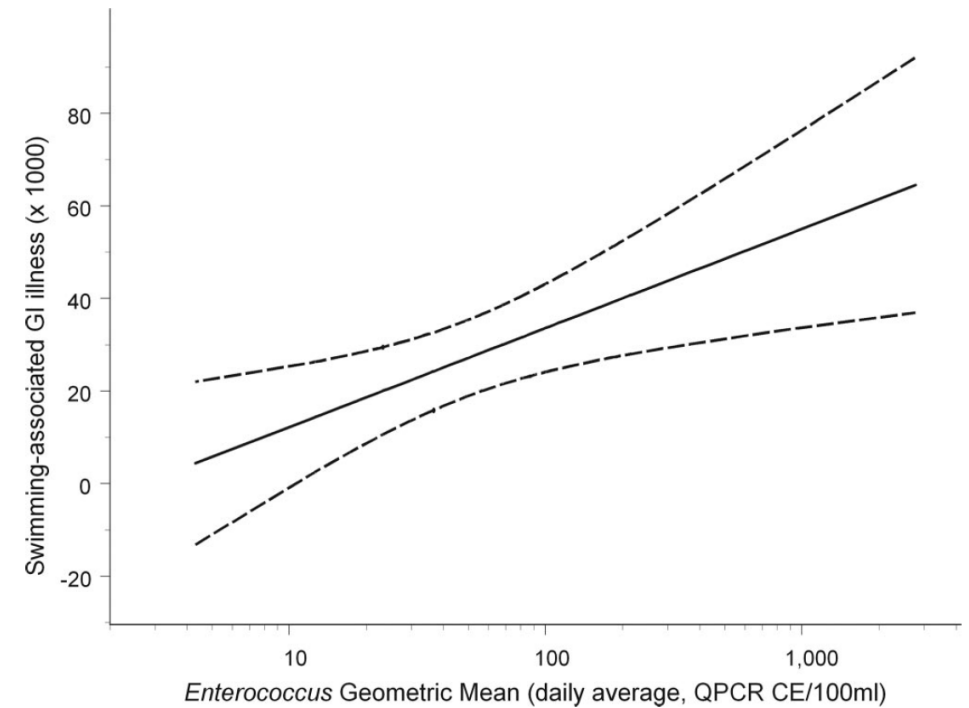


Water body type	Indicator	Correlation coefficient
Freshwater	Fecal coliforms	-0.08
	<i>E. coli</i>	0.80
	<i>Enterococci</i>	0.74
Marine	Fecal coliforms	-0.01
	<i>E. coli</i>	0.52
	<i>Enterococci</i>	0.75

Recreational water testing focused on *Enterococcus*

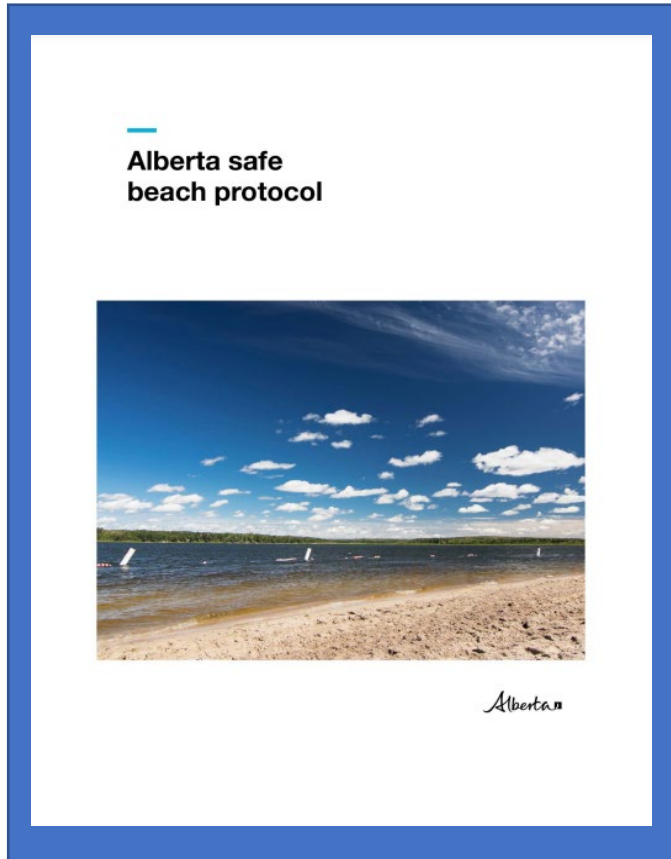


	OR (NGI)	OR (Diarrhea)	OR (Respiratory)
<i>Enterococcus</i> (CFU)	1.16	1.22	1.11
<i>Enterococcus</i> (qPCR)	2.56	4.42	1.88



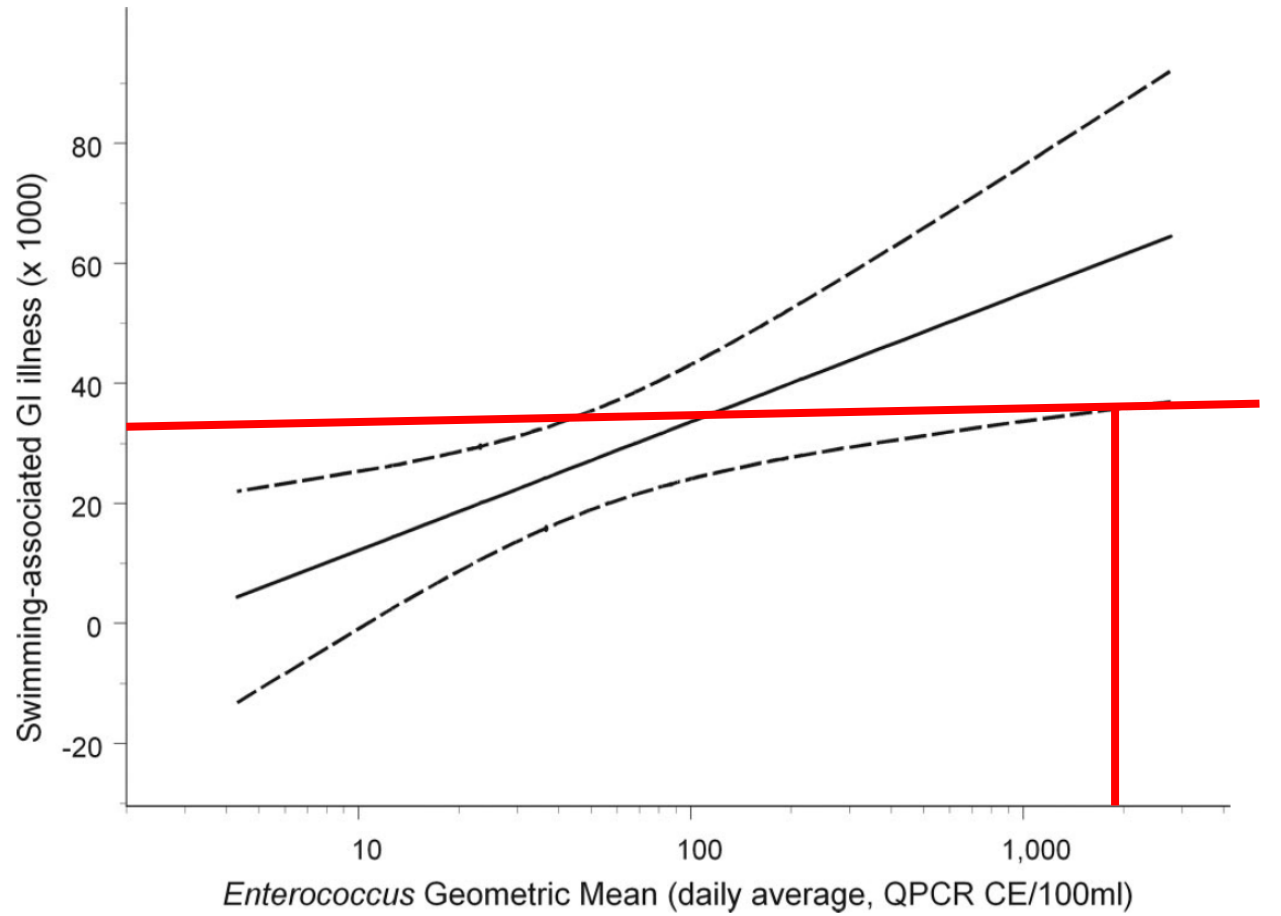
Enterococcus testing in Alberta

qPCR enterococcus testing adopted in Alberta in 2019



Alberta Safe Beach Protocol cover. Alberta Health, 2021. Retrieved from : <https://open.alberta.ca/publications/9781460145395>

32/1000



1280 CCE/100ml

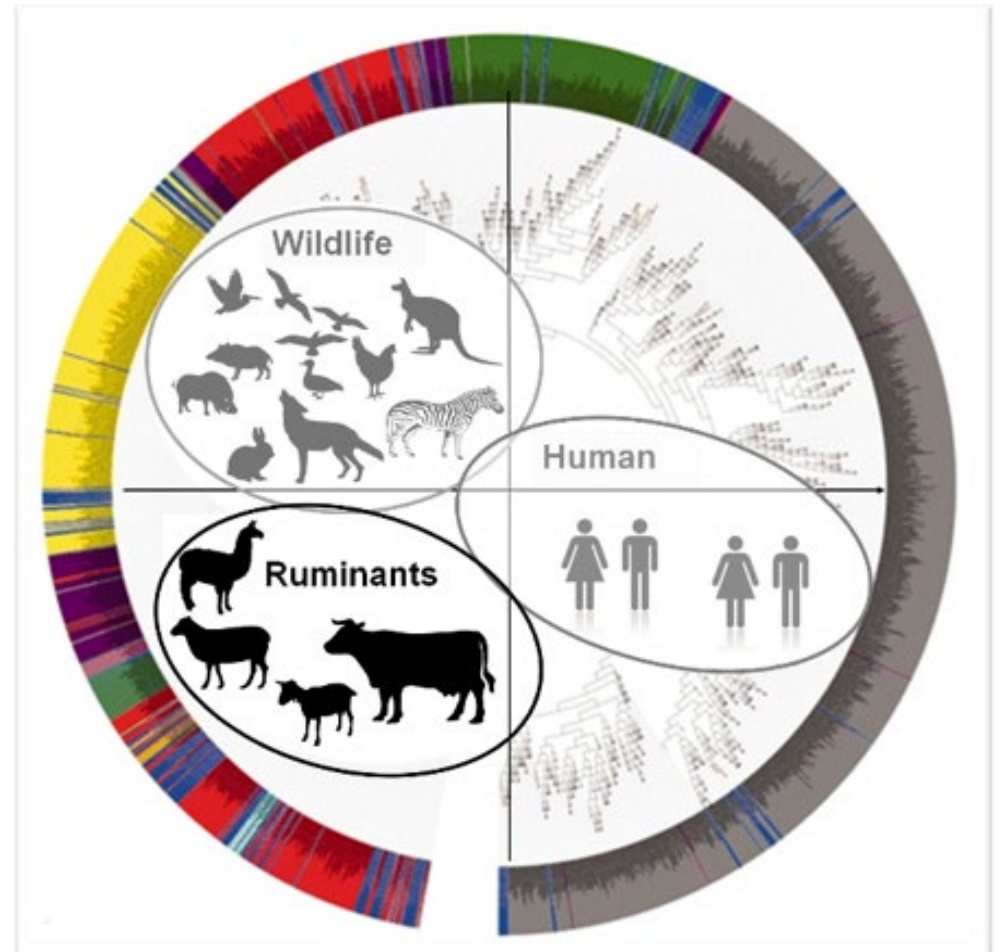
Advantages and disadvantages of qPCR

Culture-based methods: *E. coli* and enterococcus

- Good for recreational water monitoring due to only detecting live bacteria.

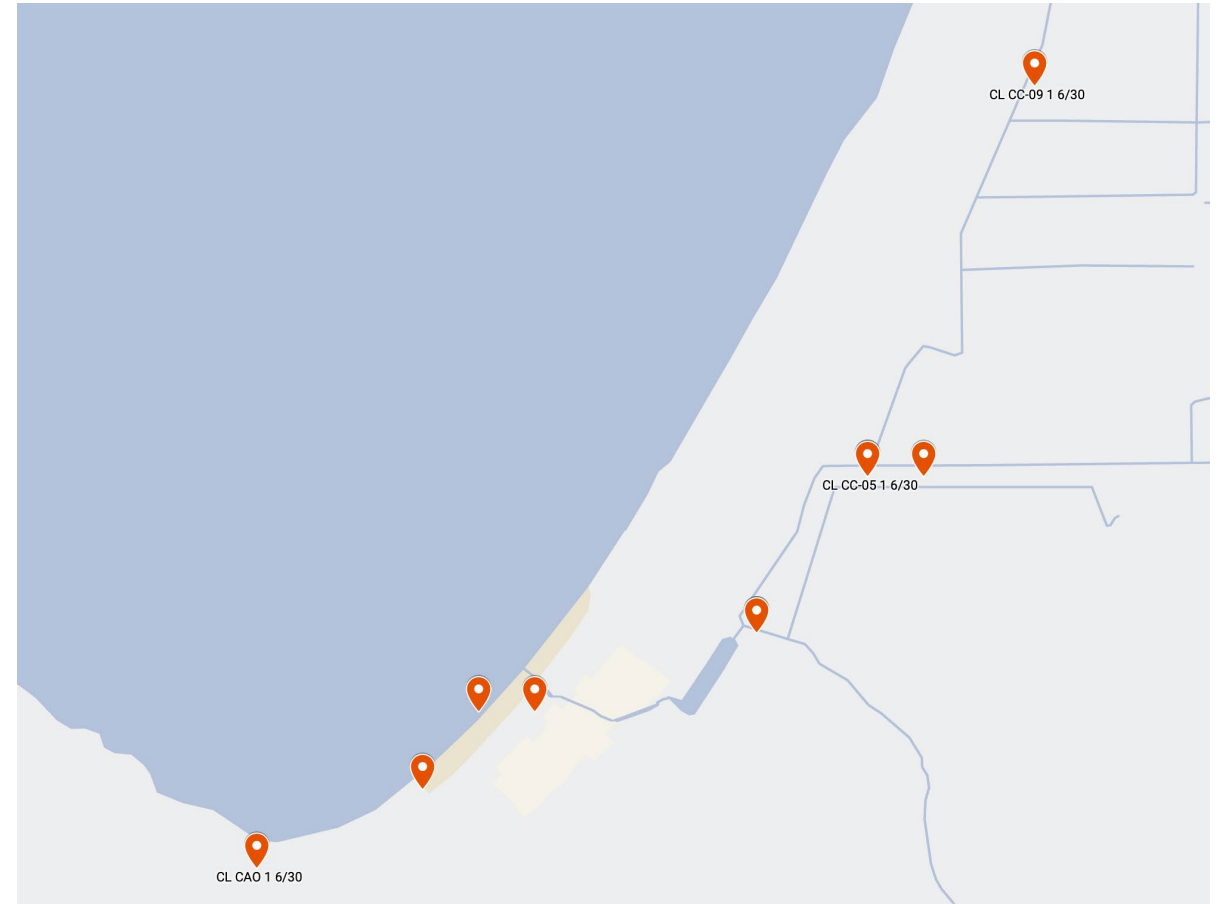
qPCR: Enterococcus

- Faster
- Higher sensitivity and specificity
- **Microbial Source Tracking is only done via qPCR**

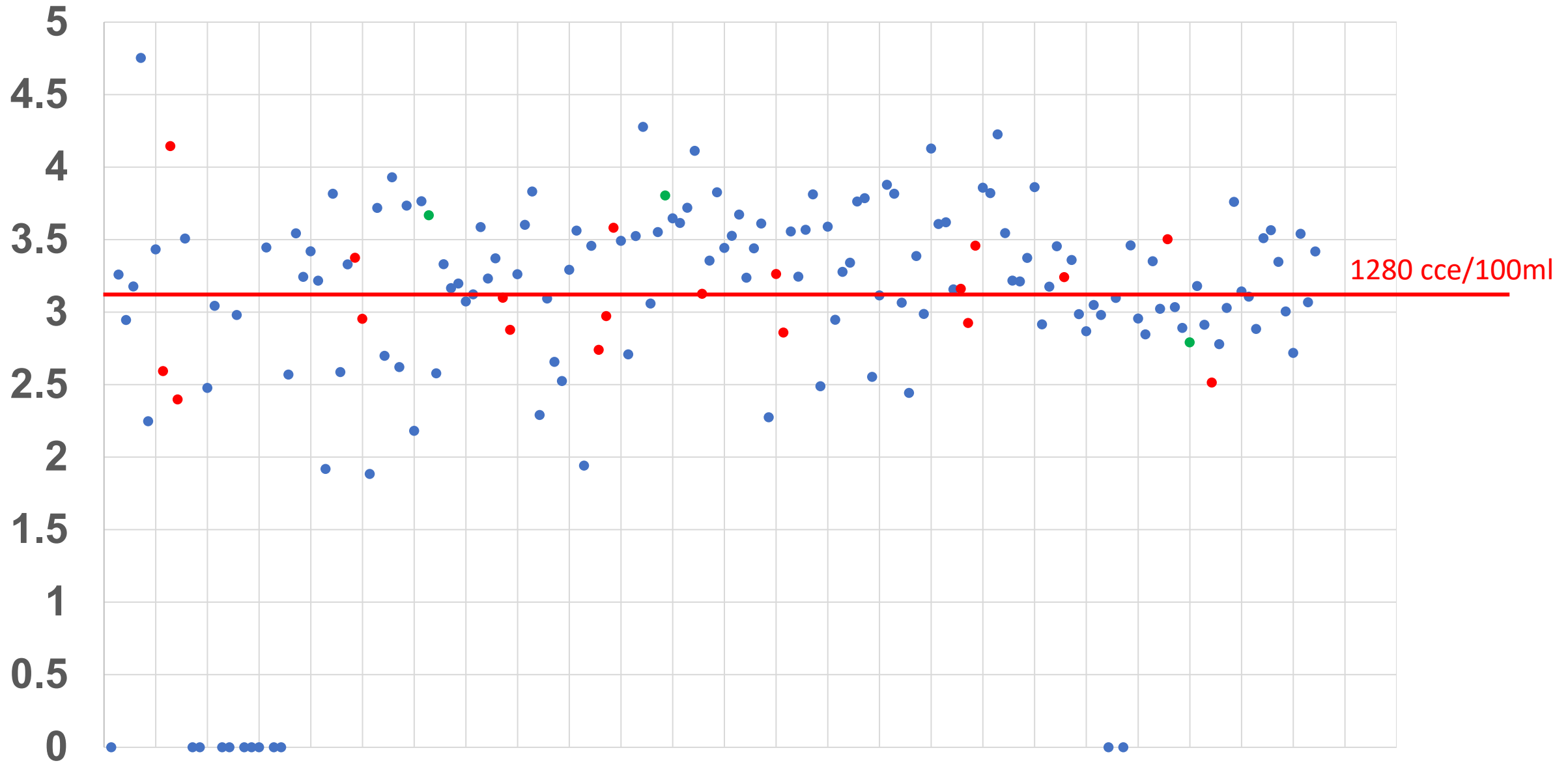


Microbial Source Tracking (MST) – still an indicator

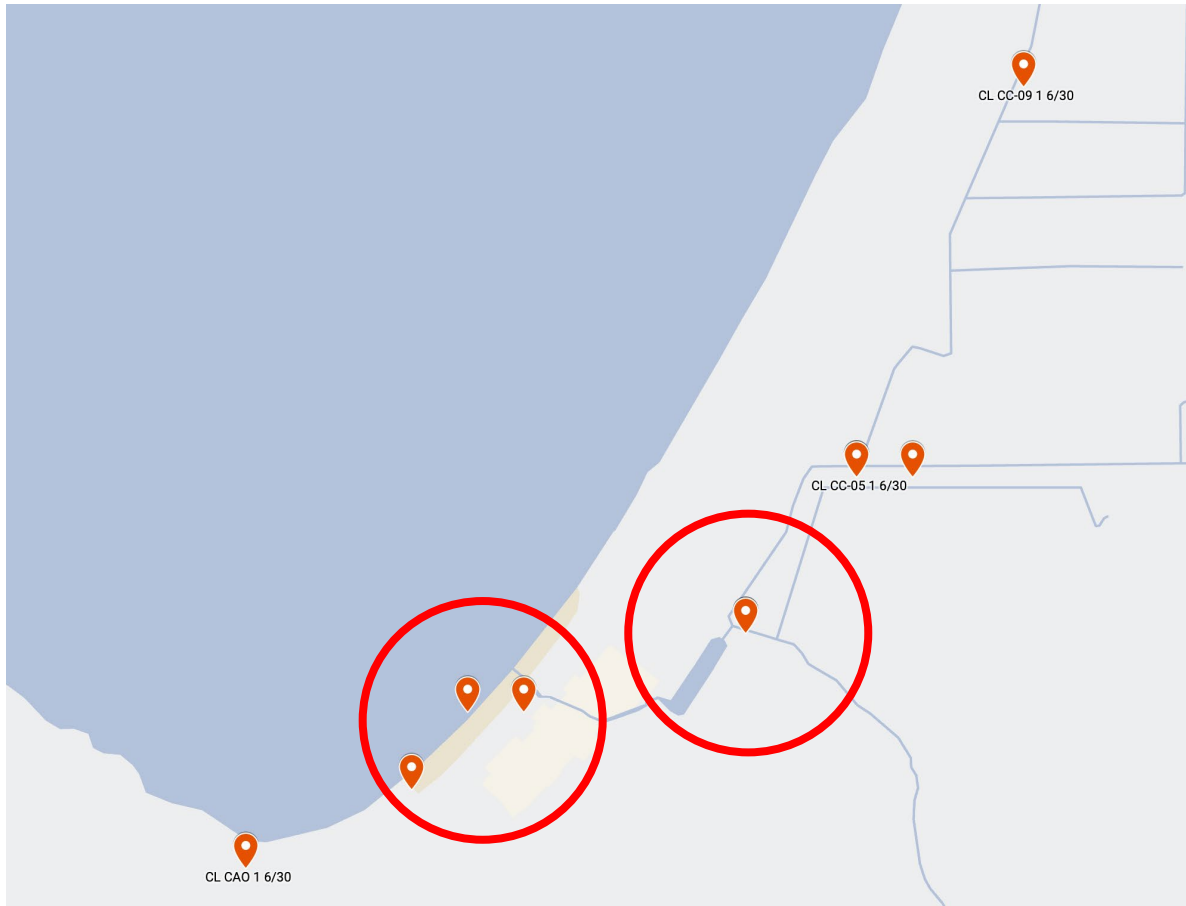
- Understanding fecal sources can be useful when determining risk and designing mitigation strategies
- Knowing the source can serve as another indicator of risk, just as the abundance of *Enterococcus* does
- Human fecal pollution poses more potential risk than does bird fecal pollution



Microbial Source Tracking

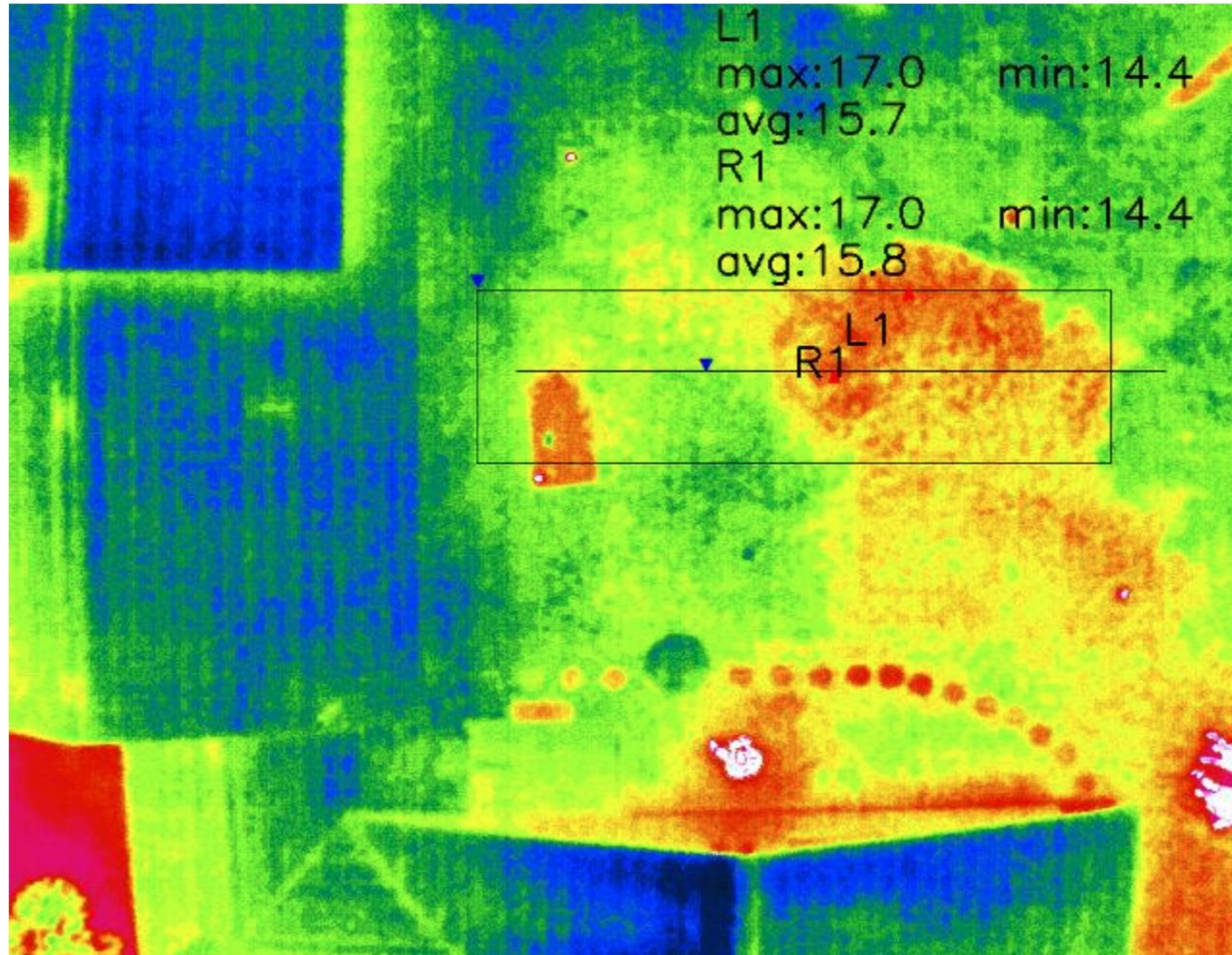


Microbial Source Tracking



- Storm pond associated with the rural municipality drains to the public beach area (red circle)
- All sites on the public beach are impacted by human fecal pollution
- Bird fecal pollution is uncommon
- Numerous sites are well above the recreational water quality guideline that we use in Alberta

Microbial Source Tracking





Fecal pollution sources in Alberta

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Assessing Pathogen Risk to Swimmers at Non-Sewage Impacted Recreational Beaches

Mary E. Schoen* and Nicholas J. Ashbolt

View Author Information ▾

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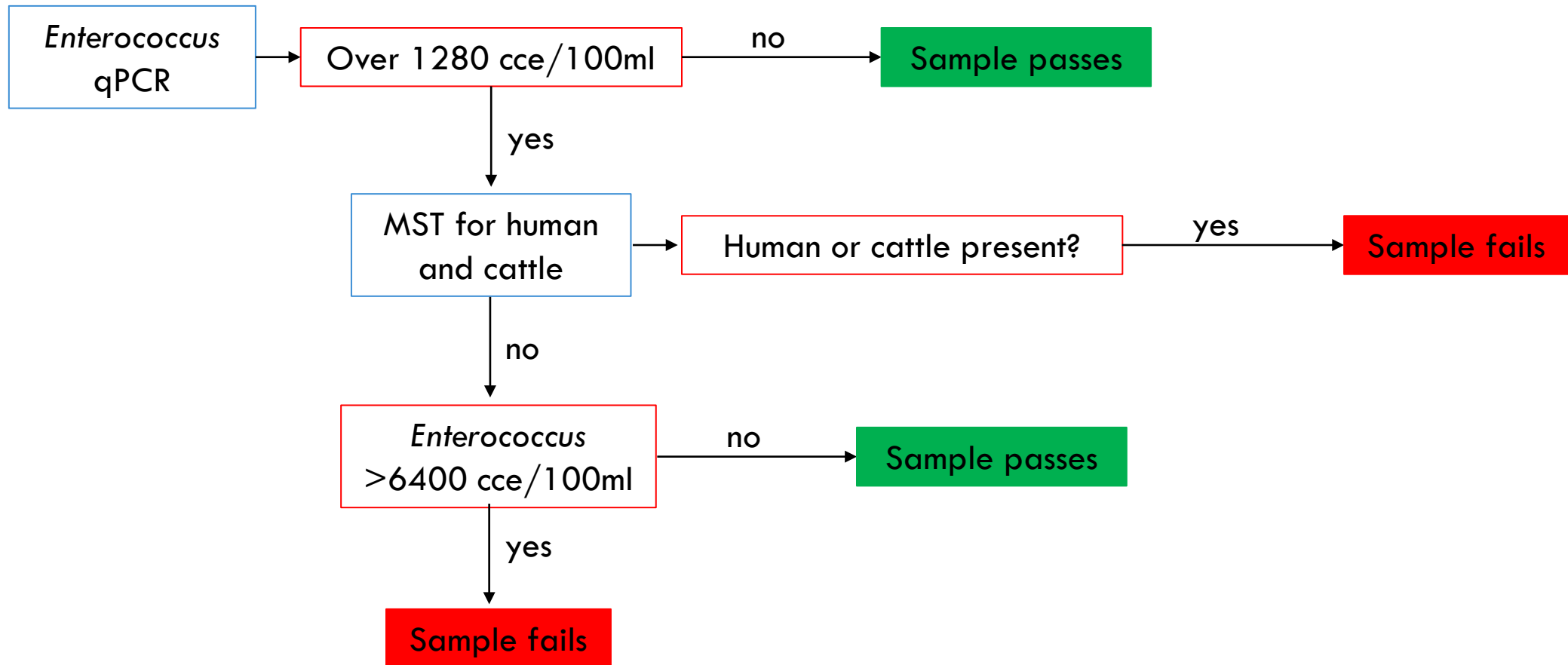


Human health risk implications of multiple sources of faecal indicator bacteria in a recreational waterbody ☆

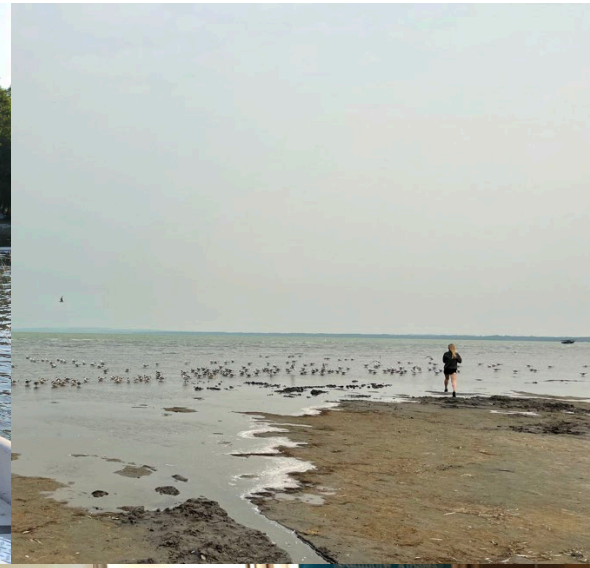
Jeffrey A. Soller ^a✉, Mary E. Schoen ^a, Arun Varghese ^b, Audrey M. Ichida ^b, Alexandria B. Boehm ^c, Sorina Eftim ^b, Nicholas J. Ashbolt ^{d,1}, John E. Ravenscroft ^e

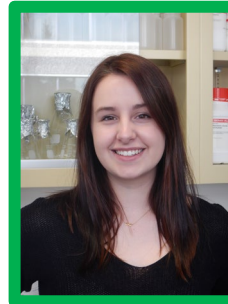
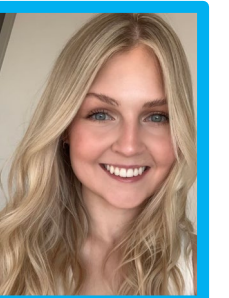
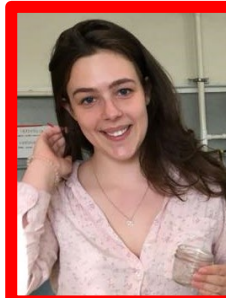
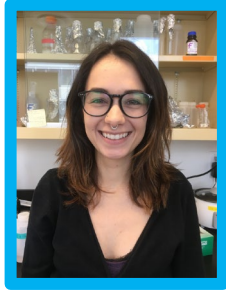
- Bird fecal contamination represents between 55 and 100 times lower risk to swimmers than human fecal pollution
- How can we weave MST into assessment of beach safety for recreational activity?

Incorporating MST into beach monitoring



Beyond beach monitoring: answering community questions about lakes





Baptiste/Island Lake (BAILS): Dennis Irving, Dave Beecroft, Curtis Schoepp, Jim Montague. Pigeon Lake: Robert Gibbs, Amanda Koot, Carson Hvenegaard. Moose Lake: Kellie Nichiporik. Swimdrinkfish: Jacquie Pallard. Glen Lake: Joe Blondia, Dale DeJager, Andy DuPont, Cecelia Denton, Evan Fink, Ed Gergosian, Rob Karner, Bill Meserve, Shelley Walter, Holly Wright. South Lake Leelanau: Dan Harkness, Thad Popa. North Lake Leelanau: Jeff Green, Brian Price, Jim Wysor. Walloon Lake: Connor Dennis, Betony Braddock, Jac Talcott, John Marklewitz, Russel Kittleson, Mary Pat Goldich. ALMS: Bradley Peter, Caleb Sinn, Robert Xu, Sarah Klimchuck, Tina McLean. FWS staff and students: Chris Froelich, Daniel Clyde. NMC staff and students in the Freshwater Studies Program