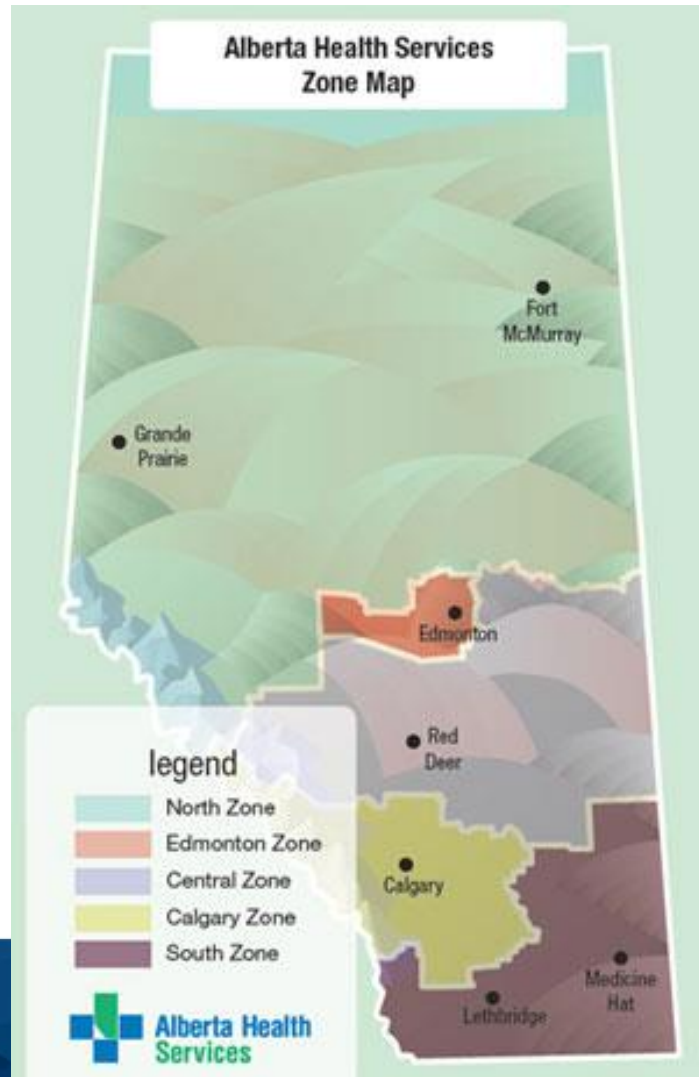


Alberta Safe Beach Protocol

Debra Mooney and Jennifer Graydon

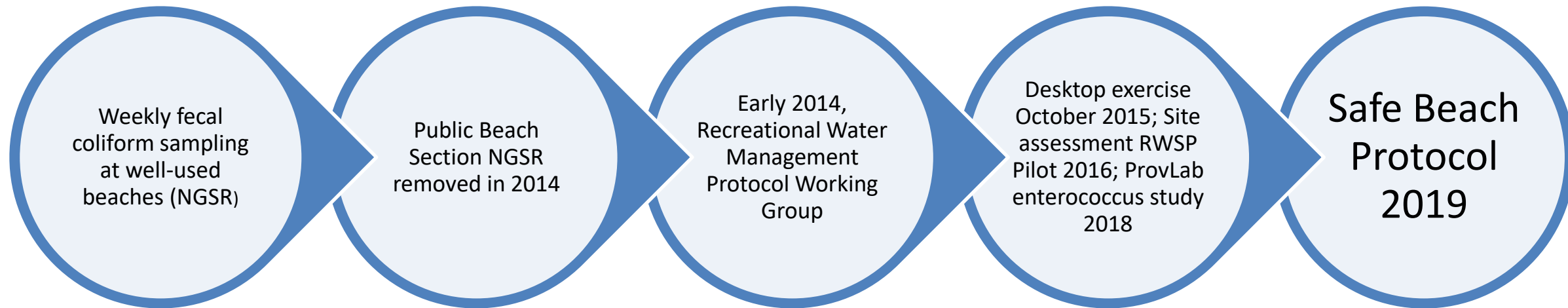
Health Protection Branch, Alberta Health

History of Public Health Monitoring of Cyanobacterial Blooms



- Prior to formation of AHS there were different procedures for responding to cyanobacterial blooms in different health regions.
- Around 2011, AHS developed standardized processes that apply across zones and help achieve consistency in bloom response and advisory procedures.
- Between 2012 and 2017, AHS summer students collected water samples at high-use recreational beaches during the recreational water season.
- Bloom monitoring of priority sites transitioned to operators under implementation of the Safe Beach Protocol in 2019.
- Public Health Inspectors also investigate referrals (complaints) about blooms from the public and other sources.

History of Monitoring of Fecal Contamination



Goals of *Safe Beach Protocol*

Establish scope of the program:
defining
'recreational water site';
Primary use only

Identify priority beaches :
effectively use
laboratory
resources

Establish acceptable water quality targets:
enterococcus,
cyanobacteria
microcystin
(relevant,
representative
water quality
targets)

Operator-led sampling

Monitoring of enterococcus cyanobacterial blooms/toxin at priority sites

Introduce site assessment and management strategies

Parameters Used To Define 2019 Priority Beaches

Parameter	Measure	Rationale
Level of Beach Usage	High/medium/low	Indicator of exposure
Number of fecal coliform advisories in the past three years	Number of advisories	This indicates the confirmation of unacceptable water quality.
Percentage of samples with higher levels of fecal coliforms	% >400 cfu % 200-399 cfu % <200 cfu	Indicates deteriorating water quality
Percentage of samples with high levels of Enterococcus	>6400 cce 1280-6400 cce <1280 cce	Indicates deteriorating water quality
Confirmation of Bacteroides markers (human/ruminants)	Presence/absence	Confirms presence of human sources of sewage
Number of cyanobacterial advisories in the past three years	Number of advisories	Indication of significant and confirmed blooms
Percentage with unsatisfactory cell counts	Percent of samples with high cell counts	Deteriorating water quality
Percentage with unsatisfactory microcystin concentration	Percent of samples with high microcystin concentration	Deteriorating water quality
Trophic State of Lake	Oligotrophic/mesotrophic/eutrophic/hypereutrophic	Degree of eutrophication
Reports of animal illness or death	Number of reports	Toxic levels of cyanobacteria

Bloom Monitoring Priority Site Tool

	A	B	C	D	E	F	G	K	L	M	N	O	P	V	W	X	Y	ED
1	Access Number [Source: AHS Master list] "assigned by ProvLab"	Waterbody Code [Source: AHS Master list]	WaterBody Name [Source: AHS Master list]	Beach Name [Source: AHS Master list]	OC_NAME (PARKS) [Source: Jenny's GIS file]	Beach ID [Source: AHS Master list]	Zone [Source: AHS Master list]	Designated Beach 1=yes 0=no (assume yes until confirmed) [Source: AHS]	Screen In? 1=yes 0=no (based on Designated Beach status)	GOA Park 1=yes 0=no [Source: AEP Alta Parks Beaches or if 'Prov']	GOA Park 1=yes 0=no [Source: Jenny's GIS file; red needs to be]	Level of Beach Usage (High=3 0) [Source: AHS Beach Use Info &]	Operator sampling? 1=yes 0=no (default is no)	# of Cyanobacterial Advisories (2016) [Source: AHS Rec Water Adv's]	# of Cyanobacterial Advisories (2017) [Source: AHS Rec Water Adv's]	# of Cyanobacterial Advisories (2018) [Source: AHS Rec Water Adv's]	Total # of Cyanobacterial Advisories (total 2016-2018)	PRIORITY SCORE CYANOBACTERIA
2	9180123	W165	Pigeon Lake	Pigeon Lake Provincial Park	Pigeon Lake Prov'l Park	343	Central	1	1	1	1	30	1	1	1		2	16.3
3	9180135	W165	Pigeon Lake	Zeiner Park	Pigeon Lake Prov'l Park	345	Edmonton	1	1	0	1	30	1	1	1		2	14.4
4	9380005	W105	Lac La Nonne	Camp Encounter	N/A	221	North	1	1	0	0		1	1	1	1	3	14.0
5	9010225	W26	Calling Lake	McFarlane Beach	N/A	540	North	1	1	0	0		1	1	1	1	3	13.6
6	9601214	W228	Wizard Lake	Jubilee Park	N/A	468	Edmonton	1	1	0	0	30	0	1	1		2	13.4
7	9301207	W167	Pine Lake	Scotty's Family Resort	N/A	357	Central	1	1	0	0		1	1	1		2	13.3
8	9050014	W193	Steele (Cross) Lake	Cross Lake Provincial Park	Cross Lake Prov'l Park	412	North	1	1	1	1		1	1	1	1	3	13.3
9	9050004	W26	Calling Lake	Calling Lake Provincial	Calling Lake Prov'l Park	65	North	1	1	1	1		0	1	1	1	3	12.7
10	9010033	W91	Hutch Lake	Hutch Lake Campground and Day Use	N/A	186	North	1	1	0	0	30	1		1		1	12.6
11	9621462	W104	Lac La Biche	Sir Winston Churchill Provincial Park - Day Use Beach	Sir Winston Churchill Prov'l Park	217	North	1	1	1	1		1	1	1	1	3	12.5
12	9720021	W167	Pine Lake	Pine Lake Day Use	N/A	354	Central	1	1	0	0		1	1	1		2	12.4
13	8801574	W205	Travers Reservoir	Little Bow Provincial Park Beach	Little Bow Prov'l Park	430	Calgary	1	1	1	1	30	1		1		1	12.3
14	9601524	W18	Bonnie Lake	Bonnie Lake Campground	N/A	46	North	1	1	0	0		1	1	1	1	3	12.3
15	N/A	W113	Isle Lake	Camp Koinonia	N/A	237	North	1	1	0	0		1	1	1	1	3	12.0
16	9411695	W104	Lac La Biche	McArthur Beach	N/A	496	North	1	1	0	0		1	1	1	1	3	12.0
17	9010017	W218	Wapasu Lake	Wapasu Lake	N/A	503	Central	1	1	0	0		1	1	1	1	3	12.0
18	8823573	W166	Pine Coulee Reservoir	Pine Coulee SE Beach	N/A	350	Calgary	1	1	0	0		0	1	1	1	3	11.7
19	9621608	W165	Pigeon Lake	Ma-Me-O / 6th Street	N/A	341	Central	1	1	0	0		0	1	1		2	11.6
20	9011520	W239	Heritage Pond	Heritage Pond	N/A	193	Edmonton	1	1	0	0		1		1	1	2	10.4
21	9622402	W98	Kehiwin Lake	Kehiwin Provincial Recreation Area	Kehiwin Prov Rec Area	202	North	1	1	1	1		1		1	1	2	10.3
22	9622236	W148	Moose Lake	Moose Lake East (Vezeau)	N/A	309	North	1	1	0	0		1	1	1	1	3	10.3
23	9410415	W7	Baptiste Lake	Baptiste Lake South	N/A	15	North	1	1	0	0		0	1	1		2	10.1
24	9300163	W3	Alix Lake	Alix Lake Recreation Area	N/A	2	Central	1	1	0	0		1	1	1	1	3	10.0
25	9010190	W82	Hastings Lake	Hastings Lake Bible Camp Beach	N/A	171	Edmonton	1	1	0	0		1	1	1		2	10.0
26	9622238	W148	Moose Lake	Franchere Bay Provincial Park	Franchere Bay Prov Rec Area	302	North	1	1	1	1		1	1	1	1	3	10.0

Ranking	Waterbody Name	Beach Name	Zone
1	Pigeon Lake	Pigeon Lake Provincial Park	Central
2	Pigeon Lake	Zeiner Park	Edmonton
3	Lac La Nonne	Camp Encounter	North
4	Calling Lake	McFarlane Beach	North
5	Wizard Lake	Jubilee Park	Edmonton
6	Pine Lake	Scotty's Family Resort	Central
7	Steele (Cross) Lake	Cross Lake Provincial Park	North
8	Calling Lake	Calling Lake Provincial Park	North
9	Hutch Lake	Hutch Lake Campground and Day Use	North
10	Lac La Biche	Sir Winston Churchill Provincial Park - Day Use Beach	North
11	Pine Lake	Pine Lake Day Use	Central
12	Travers Reservoir	Little Bow Provincial Park Beach	Calgary
13	Bonnie Lake	Bonnie Lake Campground	North
14	Isle Lake	Camp Koinonia	North
15	Lac La Biche	McArthur Beach	North
16	Wapasu Lake	Wapasu Lake	Central
17	Pine Coulee Reservoir	Pine Coulee SE Beach	Calgary
18	Pigeon Lake	Ma-Me-O / 6th Street	Central
19	Heritage Pond	Heritage Pond	Edmonton
20	Kehiwin Lake	Kehiwin Provincial Recreation Area	North
21	Moose Lake	Moose Lake East (Vezeau)	North
22	Baptiste Lake	Baptiste Lake South	North
23	Alix Lake	Alix Lake Recreation Area	Central
24	Hastings Lake	Hastings Lake Bible Camp Beach	Edmonton
25	Moose Lake	Franchere Bay Provincial Park	North

Enterococcus Priority Site Breakdown

Site Category	Rationale	Total
Priority (Sample in 2019)	High use and / or unsatisfactory water results (score of 30 or over)	79
Non-priority (no sampling in 2019)	Low use and unsatisfactory water results in 1 or 2 of the past 3 years (score of 20 or 10)	74
Non-priority (no sampling in 2019)	Low use and no sampling info for the past 3 years (score of 0)	90
Non-priority (no sampling in 2019)	Low use and satisfactory water results for the past 3 years (score of 0)	59
Not designated as a beach (no sampling in 2019)	Not used as a beach	112

Protocol: Water Quality Indicators

Replace Fecal coliforms with *Enterococcus* and Microbial Source Tracking

Previous	Current
<p>a) the geometric mean of bacteriological counts from not fewer than 5 samples of water from the swimming or bathing area taken over a 30-day period does not exceed 200 <u>fecal coliforms</u> per 100 ml of water,</p> <p>b) No two consecutive samples of water from the swimming or bathing area have a bacteriological count in excess of 400 <u>fecal coliforms</u> per 100 ml of water.</p>	<ul style="list-style-type: none">• When open for the season, every priority recreational water site should sample weekly for <i>Enterococcus</i>.• Operator led sampling at priority sites• Grab and Composite samples• The water quality results shared with operators in a timely manner.• Assessment of <i>Bacteroides</i> human and ruminant markers to determine possible sources.

Interpretation of qPCR *Enterococcus*

Indicator	Interpretation	Action	Follow-up
Single Threshold Value			
>6400 cce	Unsatisfactory Regardless of source, risk to human health is high 10X the EPA Beach Action Value	Issue advisory	Under advisory until results are <6400
>1280 and <6400 cce	Cautionary advisory Elevated levels may be due to birds/human/cattle/other mammals	Risk assessment including Microbial Source Tracking Bacteroides human and ruminant species	If positive for ruminant or human, proceed to advisory
<1280 cce	Satisfactory Low risk to humans	No action needed	Continue routine monitoring
Geometric Mean			
> 300 cce	Unsatisfactory Beach GM should be > 300 cce in any 30 day period	Risk assessment and possible advisory.	

Cyanobacterial Bloom Indicators (Health Canada, 2012)

Total microcystins: 20 µg/L
Total cyanobacteria: 100,000 cells/mL

Total cyanobacteria guideline has the effect of protecting against other possible toxins present and skin irritation effects

Health Canada guidance recommends that both total cyanobacterial cell densities and total microcystin concentrations be monitored as part of a risk management strategy for cyanobacteria and their toxins in Canadian recreational waters.

Managed recreational water areas should be monitored visually for cyanobacterial growth

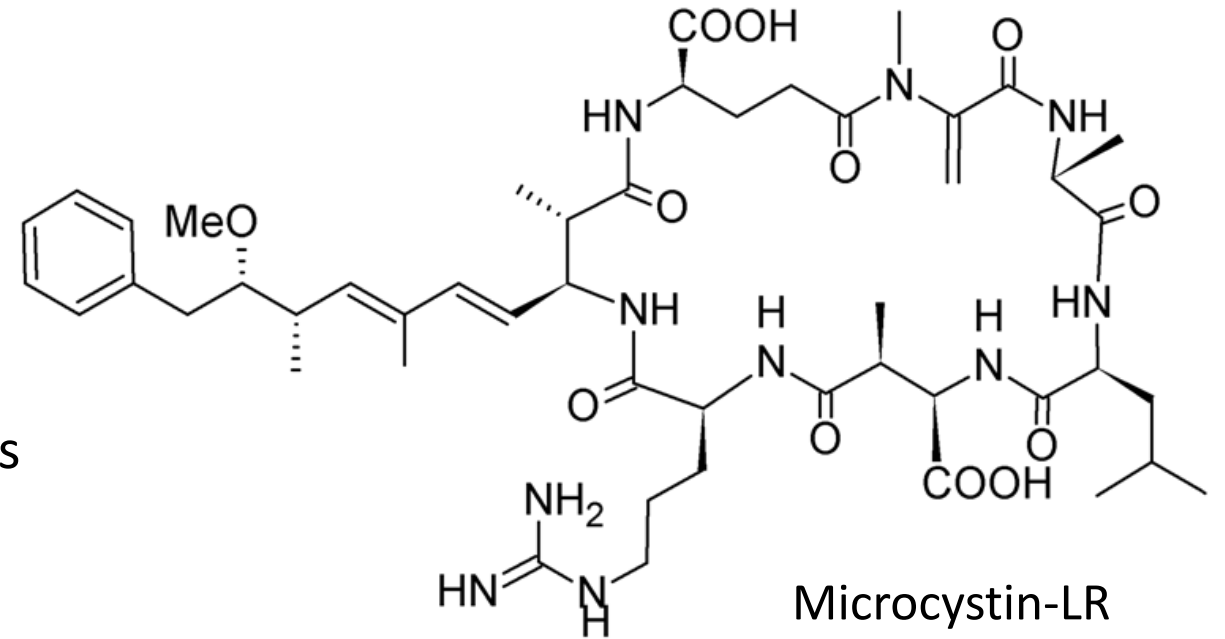
Microcystins

Class of toxins produced by certain cyanobacteria (e.g., Microcystis, Planktothrix, Anabaena, Nostoc)

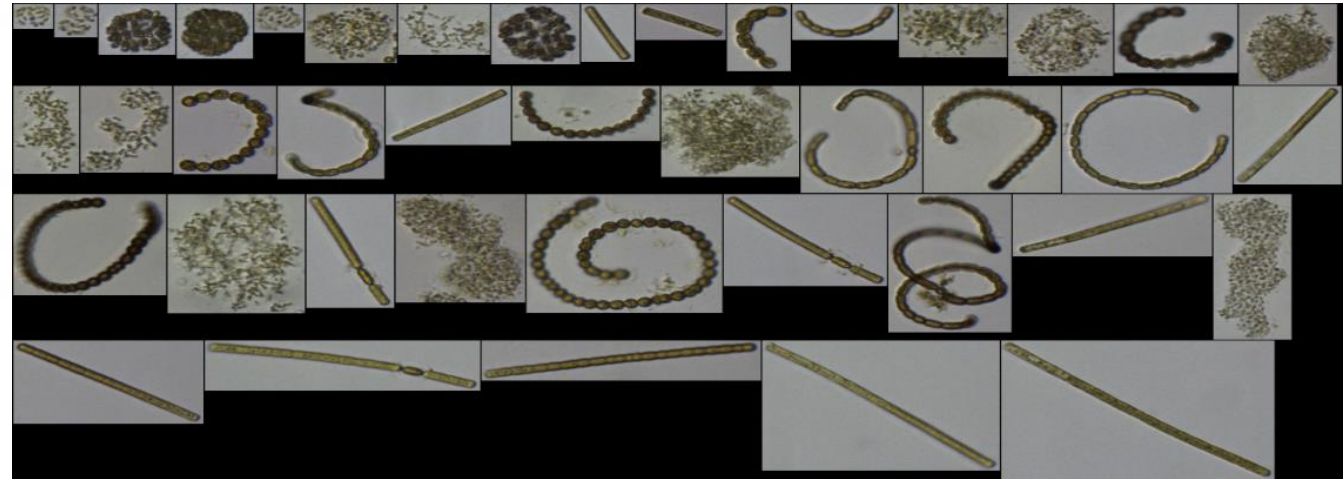
Monocyclic heptapeptides

Hepatotoxic, inhibit protein phosphatases

Over 80 known variants with very different toxicities



FlowCAM-Based Cyanobacterial Cell Counts



Beach Management:

Previous	Current
Site Assessment No requirement Reviewed during desktop and pilot study	Site assessment at all priority sites in 2 years (every 3-5 thereafter) Template provided/ AHS support Site information could inform priority status. Non-priority sites may conduct assessment to determine if the site should be a priority.
Recreational Water Safety Plan No requirement Reviewed during desktop	Option for operators to use risk assessment tool to respond to identified impacts on the beach. For example, work with municipality to reduce storm sewer outfall.

2019 Season:

Enterococcus Sampling at Priority Beaches

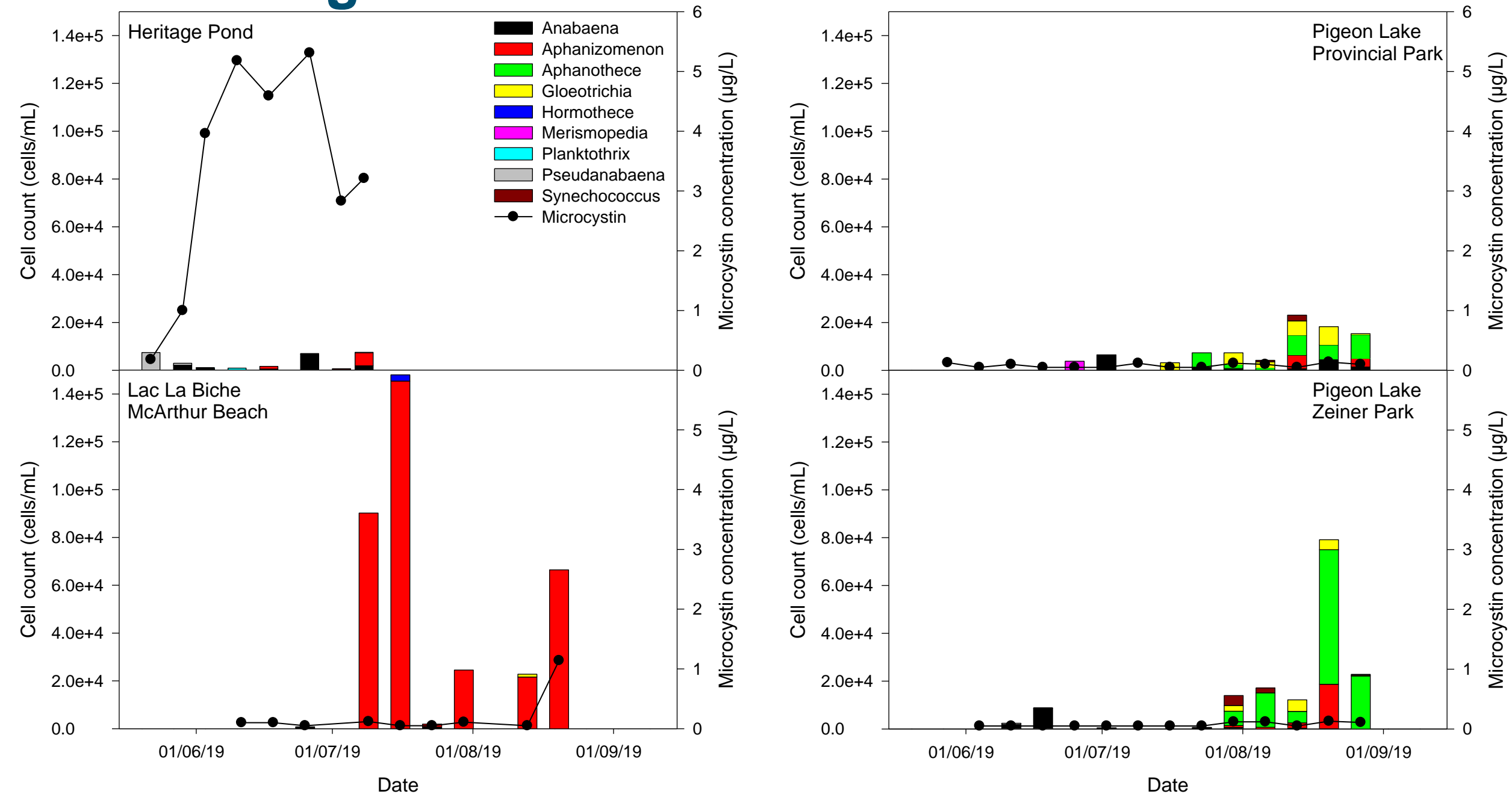
- 80/414 sites considered priority based on high use and/or history of unsatisfactory water results
- 68/80 previously operator sampled
- 54/80 sites sampled in 2019 season



Monitoring Results - Enterococcus

	Results	Locations
Total Number of Samples in 2019 (as of Sept 13, 2019)	2076	54 beaches/80 priority beaches
Number of samples < 1280	1834 (88%)	
Number of Samples >1280-6400	94 (4.5%)	
Number of Sites with Bacteroides Human Marker	9 (9.5% of 94)	Chestermere Lake-Anniversary Park Beach (1) Elbow River Beach-Stanley Park (4) Kinisoo-Beach (4)
Number of Sites with Bacteroides Ruminant Marker	0	None
Number of Samples (no MST) ➤ 6400	64 (3%)	
Range of Sample Results	Non-detect - 2,868,023 cce	

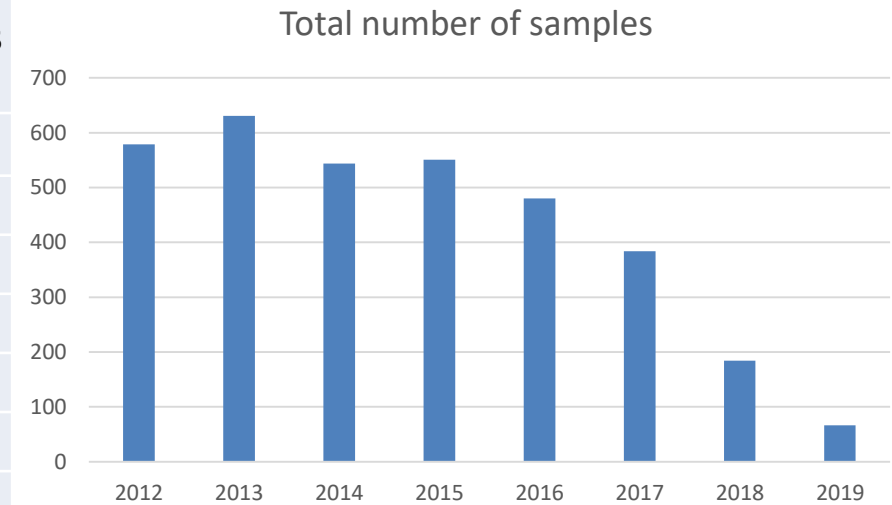
Monitoring Results - Blooms



Water Quality Advisories - Blooms

Year	Monitored Lakes	Monitored Beaches	Cyanobacterial Bloom Advisories (Total)	Cyanobacterial Bloom Advisories (Monitored Lakes)	Cyanobacterial Bloom Advisories (Referrals)
2012	36	57	17	5	12
2013	37	55	35	13	22
2014	33	48	30	14	16
2015	32	47	25	9	16
2016	38	48	32	21	11
2017	22	31	45	10	35
2018	7	10	35	2	33
2019	4	4	20	1	19

*to September 15, 2019



Water Quality Advisories – Fecal Contamination

2019: 8* fecal contamination advisories based on enterococcus

Type of Advisory	Total # Advisories 2010-18	2010-13	2014	2015	2016	2017	2018	2019
Fecal coliform	33	6	5	8	7	3	4	8*

Next steps and Discussion

- **Evaluate 2019 season – laboratory, operators, AHS and AEP Parks staff**
 - Determine barriers and challenges of operator-led sampling
- **Consider options for 2020 to increase number of beaches routinely sampled for both cyanobacteria and enterococcus:**
 - Lake Stewardship groups
 - Dr. Patrick Hanington: community based monitoring with portable test kit for qPCR enterococcus and cyanobacteria
 - Enhanced communication
 - Synergy with other lake projects e.g., phosphorus loading at Moose Lake

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