CreekWatch
Urban Stormwater Monitoring

2017
Alberta CreekWatch

A Report Card on Urban Creek Water Quality

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ALBERTA CREEKWATCH

A Report Card on Urban Creek Water Quality, 2017

RANK	CREEK	SCORE	LOCATION	NUMBER OF STORMWATER OUTFALLS
1	Jumpingpound Creek	77%	Cochrane	3
2	Fish Creek	63%	Calgary	14
3	Wedgewood Creek	62%	Edmonton	1
4	Pine Creek	58%	Calgary	2
5	Waskasoo Creek	57%	Red Deer	99
6	West Nose Creek	53%	Calgary	15
7	Blackmud Creek	47%	Edmonton	11
8	Sturgeon River	45%	Lac Ste. Anne	–
9	Whitemud Creek	44%	Edmonton	16
10	Fulton Creek	42%	Edmonton	7
11	Oldman Creek	40%	Strathcona County	1
12	Gold Bar Creek	39%	Edmonton	6
12	Confederation Creek	39%	Calgary	17
14	Mill Creek	32%	Edmonton	46
15	Nose Creek	30%	Calgary	65

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Summary

How healthy are Alberta's urban stormwater creeks?

The 2017 CreekWatch monitoring program suggests that Alberta has a range of water quality exemplified in their stormwater creeks, perhaps reflective of the number and loading of contributing stormwater outfalls.

This report provides baseline water quality data for the 2017 open-water season and can be used going forward to compare differences in water quality over the years.

While each study creek had a different source area, this report ranked creeks against each other as the easiest method of comparison. Of special note:

- This year's data was collected from fifteen Alberta urban creeks.
- Ranking scores ranged from 77% down to 30%.
- Six creeks scored above 50% and nine creeks scored below.
- The monitored creeks all had some amount of stormwater input.
- Jumpingpound Creek in Cochrane had the best and highest ranked water quality.
- The top ranked creek, Cochrane's Jumpingpound Creek, receives minimal urban input as it travels from the western foothills before entering the Bow River in Cochrane.
- The second-ranked creek, Calgary's Fish Creek, contains multiple constructed wetlands that collect stormwater runoff from the streets of the surrounding communities. These networks of engineered wetlands function to allow sediment to settle and pollutants to be removed before water moves downstream.
- The two lowest ranking creeks – Calgary's Nose Creek and Edmonton's Mill Creek – had some of the highest numbers of stormwater outfalls entering their catchment area.
- Nose Creek in Calgary had the lowest ranked water quality.
- The lowest ranked creek (Nose Creek, Calgary) also receives stormwater discharges from the Town of Crossfield and City of Airdrie before even entering the City of Calgary.
- The two lowest ranked creeks, Edmonton's Mill Creek and Calgary's Nose Creek, drain significant urban land areas without sufficient wetlands to settle out the runoff. A significant portion of Mill Creek is also partially diverted into underground pipes, preventing ecosystem functions as the water travels underground.
- Red Deer's Waskasoo Creek, while not ranking high or low, has nearly 100 stormwater outfalls whose impacts are mitigated with headwater wetlands.

Introduction

This third annual CreekWatch Report Card examines the state of urban creeks in Alberta based on water quality data collected with the assistance of community-based environmental monitoring groups, water quality technicians and lab analysis. This 2017 CreekWatch Report and the accompanying Data Appendices are available at www.creekwatch.ca.

CreekWatch is a program of the RiverWatch Institute of Alberta, a non-profit organization specializing in community-based environmental monitoring and award-winning science education for more than twenty-three years. This 2017 Report shares our findings with the public, governments, and water quality professionals to collaboratively work towards the base-line monitoring and improvement of our urban creeks in Alberta.

Unlike wastewater and drinking water management that are long-established in our towns and cities, stormwater management is an emergent and evolving discipline that is also designing for tomorrow. While today's cities make plans and take action over time to address better stormwater management, it is important to begin measuring where we're at in order to judge if we have gone anywhere in the future. This is the role of CreekWatch.

The primary goal of CreekWatch is to support a community-based environmental monitoring network able to collect useable, cost-effective and publicly available baseline water quality data on urban stormwater creeks in Alberta. Urban stormwater tributaries face unique stressors that already make them some of the most highly impacted local waterways, and consequently, they are of interest and importance to communities and watershed managers.

Urban creeks function as receiving waterbodies for stormwater runoff and surface contaminants draining our city pavements. Increased impermeability or surface-hardening in created urban environments quickly sheds more run-off water than is characteristic of pre-development environments, and this has burdened our receiving creeks with sudden flow changes, accelerated erosion and scouring, deteriorating water quality and increased levels of bacteria. The historical presence and abundance of fish in some creeks has been lost, along with fondly remembered local swimming holes.

CreekWatch has undertaken the monitoring of nutrient, physical and biological indicators of water quality at the mouths of stormwater creeks. This data then becomes a report card on how well we're doing with stormwater management in the upslope catchment area draining to a creek.

In Table 1, the top creek rankings denote greater overall water quality, while lower rankings signify lesser overall water quality. This year's data indicates that Jumpingpound Creek in Cochrane had the best and highest ranked water quality; Nose Creek in Calgary had the lowest.

Table 1 A Report Card on Alberta Urban Creek Water Quality, 2017

Rank 2017	Creek	Score	Location	Number of Stormwater Outfalls
1	Jumpingpound Creek	77%	Cochrane	3
2	Fish Creek	63%	Calgary	14
3	Wedgewood Creek	62%	Edmonton	1
4	Pine Creek	58%	Calgary	2
5	Waskasoo Creek	57%	Red Deer	99
6	West Nose Creek	53%	Calgary	15
7	Blackmud Creek	47%	Edmonton	11
8	Sturgeon River	45%	Lac Ste. Anne	—
9	Whitemud Creek	44%	Edmonton	16
10	Fulton Creek	42%	Edmonton	7
11	Oldman Creek	40%	Strathcona County	1
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Urban creeks function as receiving waterbodies for stormwater runoff and surface contaminants draining our city pavements. Pre-development run-off was much less than it is today – the majority of meltwater and stormwater either evaporated, transpired from vegetation or soaked into topsoil. Post-development run-off is greatly increased nowadays in built urban environments, and this new water source is rapidly shed from impermeable roofs, roadways, parking lots and driveways. (See Photos 1 and 2).

Photo 1
Pavement and stormwater drain

Photo 2
Dump no pollutants, drains to river

With increasing residential and industrial development, many urban surfaces are now impermeable, allowing increased snowmelt and rainwater volumes that no longer soak into the soil. Along the surface, stormwater run-off journey, stormwater collects various contaminants from vehicles, roadway maintenance, industries, pet waste and neighborhood yards that ultimately discharges into creeks via stormwater outfalls that impact river ecology and urban sustainability. See Table 2 for total stormwater outfalls and drainage area per monitored creek.

Table 2 Total Drainage Area and Urban Stormwater Outfalls on monitored Alberta Creeks

	Calgary & Area						Edmonton & Area								Red Deer
	Fish Creek	Nose Creek	West Nose Creek	Pine Creek	Confederation Creek	Jumpingpound Creek	Whitemud Creek	Blackmud Creek	Mill Creek	Fulton Creek	Oldman Creek	Gold Bar Creek	Wedgewood Creek	Sturgeon River	Waskasoo Creek
Total Outfalls	14	65	15	2	17	3	16	11	46	7	1	6	1	—	99*
Drainage Area (km²)	444	976	590	231	17	604	372	694	89	31	131	30	169	3301	700

*Waskasoo Creek has 73 outfalls, and is joined by Piper Creek which has an additional 26 outfalls.
Source: City of Calgary Water Resources, 2018; City of Edmonton Drainage Services, 2018, City of Red Deer Environmental Services, 2017.

Increasingly, we expect a lot of our stormwater ponds, wetlands and creeks. The first stormwater ponds were constructed in the 1970's to retain large sediments, attenuate peak flows and minimize downstream flood risks. These original assets only provided basic services and are now in waning condition.

Nowadays, not only must stormwater be collected and control-released into our creeks and rivers, but we also expect stormwater not to impair the triple bottom-line of economics, environment an society. Stormwater management must address public safety, affordability, social values, aesthetics, recreational opportunities, water treatment, environmental function, and asset maintenance and lifecycle considerations.

Looking to the future, we envision that low impact development, green infrastructure, climate change, water license closures, community collaborations, stormwater re-use, government legislation and overland flood mitigation are additional considerations for stormwater management.

CreekWatch
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Site Information

Sampling sites were identified on urban tributaries of the North Saskatchewan River in Edmonton, the Sturgeon River in Lac Ste. Anne, the Red Deer River in Red Deer, and the Bow River in Cochrane and Calgary. Sites were selected based on the consideration of accessibility, perceived value of tributary importance, the extent of our resources to collect data, and the advice and suggestions from water quality professionals. Samples were collected at the mouth of each selected tributary. (See the supporting document Data Appendices 6 for individual creek sampling locations and description.)

Study Design

The first three years of CreekWatch (2015 – 2017) have established a framework and tools for incorporating community-based environmental monitoring to address existing issues and research gaps in stormwater monitoring, including:

- the number and frequency of stormwater creeks being monitored
- baseline data for stormwater quality
- reliability of volunteer citizen science data
- the cost-efficiency of monitoring programs
- the public availability of online data
- and the engagement of a public able to understand and contribute to the management of rivers and streams.

The 2017 CreekWatch program collected data on eleven parameters: dissolved oxygen, pH, turbidity, chloride, ammonia-nitrogen, nitrate-nitrogen, water temperature, conductivity, salinity, and fecal coliforms.

Three levels of data collection—manual equipment used by volunteers; digital probes used by technicians; and lab analysis—continued in 2017 as means to involve volunteers, increase the number of sampling events, and to provide quality assurance and control.

Photo 3
Volunteers creekside performing Level One water quality tests

Photo 4
Level One Hach monitoring lab

Level One Data was obtained through trained volunteers using manual equipment. (See Photo 3). This method involved the use of Hach testing kits housed in wheeled coolers (portable labs) for ease of transport and access (See Photo 4). Expectations were that each volunteer would collect data on their own free time at least 2 – 4 times, the end result being that teams of volunteers could combine efforts and complete almost weekly monitoring throughout the open-water season. The 2017 season had 81 total volunteers with 38 volunteers in Edmonton area, 7 volunteers in Red Deer, and 36 volunteers in the Calgary area. Water sampling occurred during the eight months of March – October 2017.

Photo 5
CreekWatch Technician using Level Two equipment

Photo 6
Level Two Electronic monitoring equipment

Level Two Data was collected by CreekWatch Technicians on a weekly basis between March – October. This involved the use of a YSI Professional Plus instrument capable of measuring a wide range of parameters. Also included in the equipment were two separate LaMotte 1200 Colorimeters, one for nitrate-nitrogen and one for phosphorus. See Photo 5 and 6.

The collection of **Level Three Data** happened once in 2017, and this involved the submission of water samples to Exova for laboratory-based testing. On that day, all three levels of data were collected at the same time, allowing for a unique comparison between the three different data levels to verify accuracy and consistency.

All volunteers and technicians were provided a unique PIN to access the data entry portion of the CreekWatch website, and once submitted, it was available for public viewing in real-time. For all sampling events, see Table 3. (Please see the supporting document Data Appendices for a description of the data viewing and entry platform.)

Once data was submitted, it becomes publicly available on our website. Anyone who visits **www.creekwatch.ca** is able to create a data graph and view data.

In 2017, during the eight months of March – October, there were:

- 81 trained volunteers and two science technicians in Edmonton, Lac Ste. Anne, Red Deer, Cochrane and Calgary
- a combined 410 total sampling events
- over 4,300 collected water sample data points
- an estimated 450 hours total time spent on fifteen urban creeks
- 14 portable water monitoring labs distributed
- 22 sampling locations monitored across urban creeks in Alberta

Table 3 Total Sampling Events per Creek in 2017

	Calgary & Area						Edmonton & Area								Red Deer	
	Fish Creek	Nose Creek	West Nose Creek	Pine Creek	Confederation Creek	Jumpingpound Creek	Whitemud Creek	Blackmud Creek	Mill Creek	Fulton Creek	Oldman Creek	Gold Bar Creek	Wedgewood Creek	Sturgeon River	Waskasoo Creek	Total Events
Level One	4	4	5	33	38	22	5	4	2	2	—	1	1	18	12	151
Level Two	20	28	18	24	9	3	22	25	23	2	27	26	26	1	—	254
Level Three	1	1	1	1	1	—	—	—	—	—	—	—	—	—	—	5
Total Events	25	33	24	58	48	25	27	29	25	4	27	27	27	19	12	410

Stewardship Action

In September 2017, a stewardship project was coordinated along a section of Whitemud Creek as it enters the North Saskatchewan River in Edmonton. This project was coordinated with the help of the City of Edmonton and volunteers with Dream Developments and Invistec spent an afternoon removing invasive plants from selected areas. The target plant for the day was Common tansy (*Tanacetum vulgare*). Listed as a noxious weed in Alberta, this plant grows in dense 1.5m tall stands with yellow button-like flowers. As seen in the photos 7 and 8 below, our volunteers made a worthwhile contribution removing 50 large garbage bags of this plant and look forward to more events in 2018.

Photo 7
Before. Common Tansy (*Tanacetum vulgare*) at the confluence of Whitemud Creek

Photo 8
After. Volunteers were equipped with shovels and gloves to properly remove the entire plant

January 2017 saw the wrap-up of a project dealing with a significant industrial release of plastic pellets discovered littering the shorelines of the Bow River in Calgary. In September 2016, the pellets were traced back to a stormwater outfall in the Ogden industrial area and detected at other sampling sites up to 50 km downriver from the outfall. Most of the pellets were concentrated in rocks and gravels at various high water marks and in river back-eddies but were also seen trapped atop mats of recent aquatic plant growth. (See Photos 9 and 11). The Calgary pellet release into the Bow River was a first-time event in Alberta and with no previous cleanup history. The pellet discovery was reported in September 2016 to the provincial Energy & Environmental Response 24-Hour Hotline.

By November 1st, 2016, and realizing that time was running out due to approaching winter weather, we submitted a proposal to Alberta Environment and Parks to conduct the cleanup ourselves. This became an opportunity for CreekWatch and RiverWatch to become involved in a hands-on cleanup project along the Bow River. Five RiverWatch staff worked twelve November cleanup days to remove 841kg of collected material along 1,419m of shoreline. It is estimated that over 490,000 pellets were removed from the Bow River shoreline during this time. (See Photos 10 and 12 below).

Photo 9
The plastic pellets first discovered along the Bow River shoreline

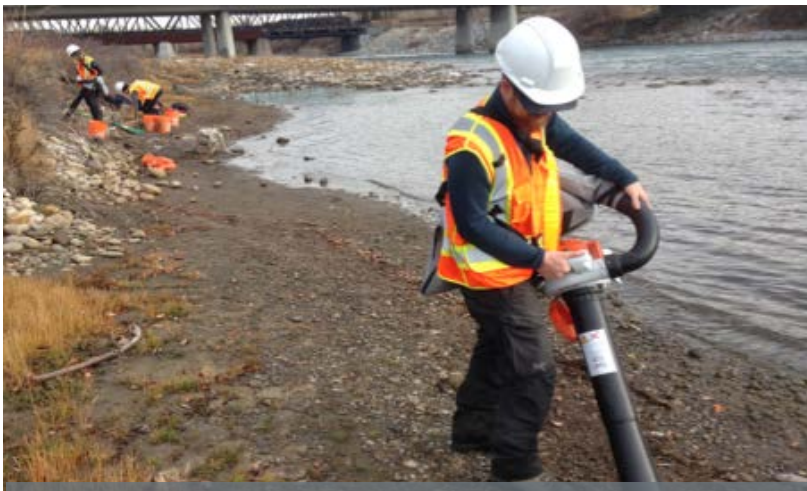


Photo 10
Gas-powered leaf vacuums were used to specifically target the lightweight plastic pellets

Photo 11
Quantification of the spill that was measured at stormwater outfall locations downstream of the release

Photo 12
Our cleanup crew sorting through shoreline debris to target the plastic pellets

Analysis

This third year of CreekWatch March – October 2017 established an effective framework and tools for incorporating community-based environmental monitoring as a tool for tracking stormwater management over time.

Three key successful strategies were again applied to address quality assurance and quality control during CreekWatch Year Three:

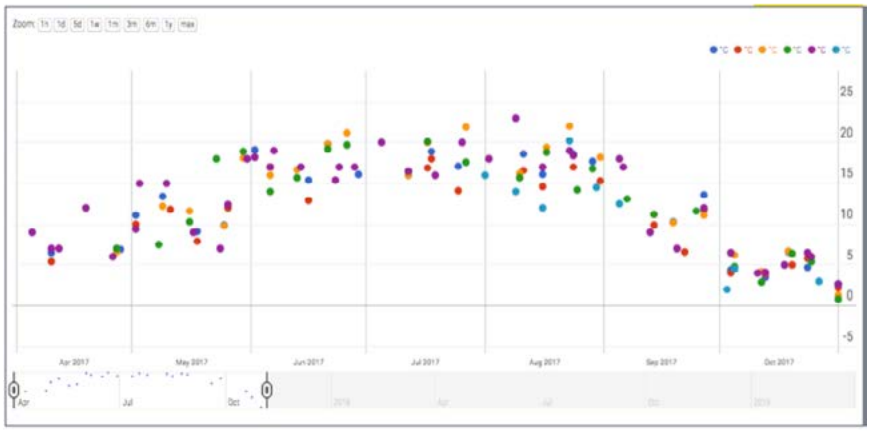
1. Monitoring equipment required constant kit maintenance, upkeep, and the replacing of consumables throughout the season for both Level One and Level Two equipment.
2. Data accuracy was evaluated again this year by collecting three levels of data on the same day to compare our equipment results against lab results.
3. The engagement of volunteers was ongoing throughout the season with frequent program updates, friendly reminders, and technical support for equipment and online data entry.

Looking back at the weather of 2017, it was a year of extremes that may have affected stormwater and stormwater creeks.

- Record-breaking temperatures and extremely low rainfalls were widespread across much of the province from May to August.
- Several Alberta counties declared states of agricultural disaster due to extreme drought.
- Forest fires were burning across Western Canada at rates well above normal forcing governments to impose fire bans.

With future climate change considerations in mind, it is interesting to track temperatures in urban creeks that may be impacted by changes to dissolved oxygen concentrations and fish survivability. The 2017 CreekWatch data showed Calgary creeks to approach or exceeded 20°C on 19 occasions between late-May and late-August; Edmonton creeks 46 times and beginning earlier in May. (See Photos 13 and 14 below))

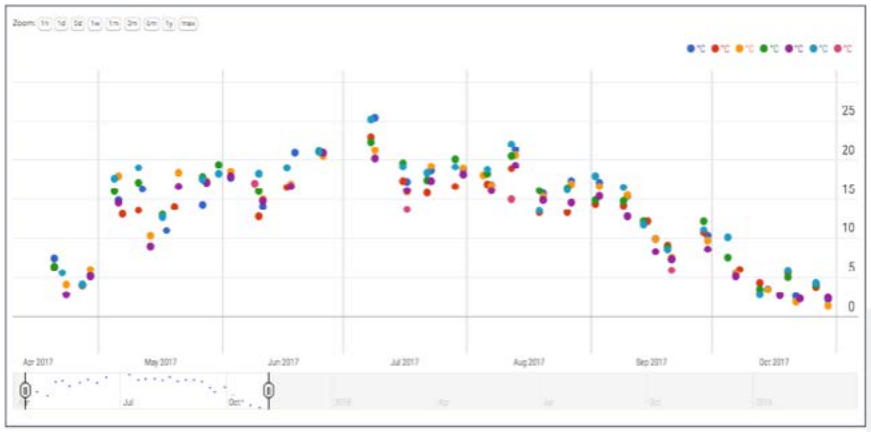
Temperature - Calgary and Area Creeks 2017



	Bow River Basin: Nose Creek at mouth - Water Temperature (°C)	Bow River Basin: West Nose Creek - Water Temperature (°C)	Bow River Basin: Fish Creek - Water Temperature (°C)	Bow River Basin: Pine Creek at mouth - Water Temperature (°C)	Bow River Basin: Confederation Creek - Water Temperature (°C)	Bow River Basin: Jumpingpound Mainstem - Water Temperature (°C)
Median	13.6	11.8	16	14.1	9	12.5

Photo 13 Screen capture of the data-graphing platform showing temperature for six urban creeks

Temperature - Edmonton and Area Creeks 2017

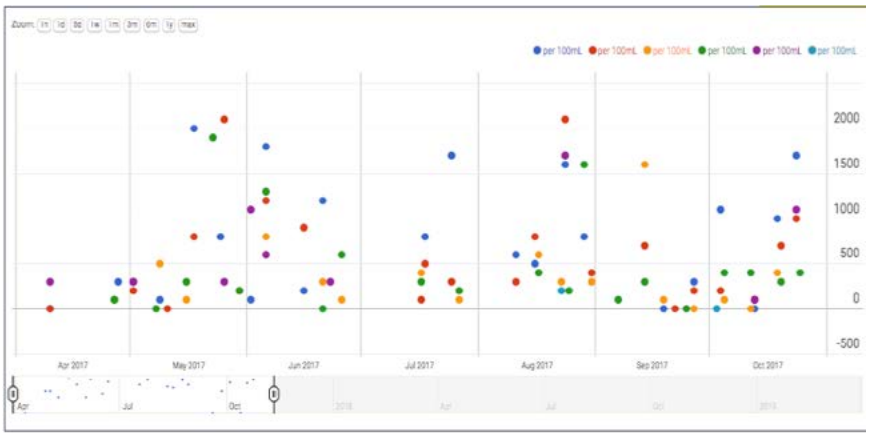


	North Saskatchewan River Basin: Whitemud Creek at mouth - Water Temperature (°C)	North Saskatchewan River Basin: Mill Creek at Mill Creek Swimming Pool - Water Temperature (°C)	North Saskatchewan River Basin: Blackmud Creek - Water Temperature (°C)	North Saskatchewan River Basin: Oldman Creek - Water Temperature (°C)	North Saskatchewan River Basin: Wedgewood Creek - Water Temperature (°C)	North Saskatchewan River Basin: Gold Bar Creek - Water Temperature (°C)	North Saskatchewan River Basin: Fulton Creek - Water Temperature (°C)
Median	15.15	13.3	16.25	16	14.8	17.5	14.35

Photo 14 Screen capture of the data-graphing platform showing temperature for seven urban creeks

The 2017 CreekWatch data showed stormwater creeks contained significant levels of *E. coli* bacteria of indeterminate origin and likely of some note to recreational users. Calgary and area creek *E. coli* concentrations were generally at or below 1000 CFU/100mL; Edmonton and area creek *E. coli* concentrations were generally lower, at or below 400 CFU/100mL. Some recreational standards are set at 200 CFU/100mL. (See Photos 15 and 16 below.)

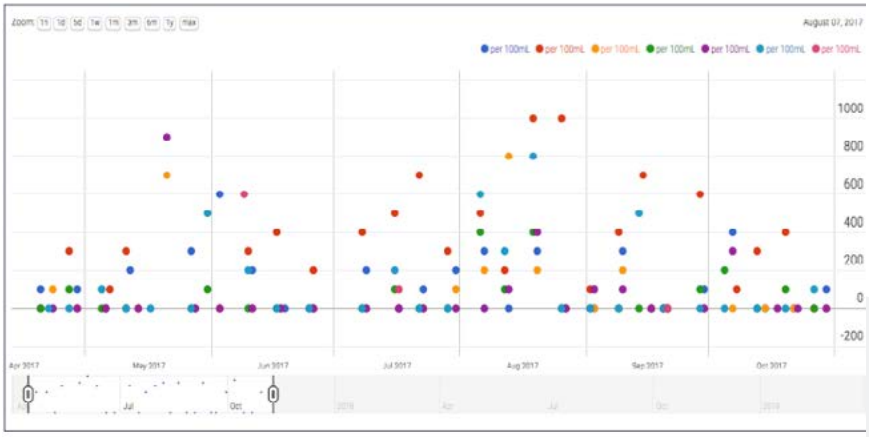
E. coli - Calgary and Area Creeks 2017



	Bow River Basin: Nose Creek at mouth - E. coli (per 100mL)	Bow River Basin: West Nose Creek - E. coli (per 100mL)	Bow River Basin: Fish Creek - E. coli (per 100mL)	Bow River Basin: Pine Creek at mouth - E. coli (per 100mL)	Bow River Basin: Confederation Creek - E. coli (per 100mL)	Bow River Basin: Jumpingpound Mainstem - E. coli (per 100mL)
Median	700	400	250	300	300	100

Photo 15 Screen capture of the data-graphing platform showing *E. coli* for six urban creeks

E. coli - Edmonton and Area Creeks 2017



	North Saskatchewan River Basin: Whitemud Creek at mouth - E. coli (per 100mL)	North Saskatchewan River Basin: Mill Creek at Mill Creek Swimming Pool - E. coli (per 100mL)	North Saskatchewan River Basin: Blackmud Creek - E. coli (per 100mL)	North Saskatchewan River Basin: Oldman Creek - E. coli (per 100mL)	North Saskatchewan River Basin: Wedgewood Creek - E. coli (per 100mL)	North Saskatchewan River Basin: Gold Bar Creek - E. coli (per 100mL)	North Saskatchewan River Basin: Fulton Creek - E. coli (per 100mL)
Median	100	300	0	0	0	0	100

Photo 16 Screen capture of the data-graphing platform showing *E. coli* for six urban creeks

Next Steps

Looking ahead to the 2018 season, CreekWatch will take steps to expand the project scope to allow:

- The addition of more volunteers to complement the current volunteer base established in 2015 – 2017 through collaboration with other corporate and community groups.
- Early season monitoring of the spring freshet with experienced volunteers.
- The addition of flow calculations on each creek.
- Data analysis for the total area of all combined outfalls for each creek.
- The purchasing of additional equipment for additional groups of volunteers.
- Consider contributions to Low Impact Development projects and awareness.

There would be future merit in correlating the water quality ranking of urban creeks with the number of their stormwater outfalls; the stormwater nutrient and sediment loading; the stormwater volume and rate of flow rate; the upslope residential, commercial and industrial development characteristics; and the best management practices employed on each creek.

Conclusion & Recommendations

The key CreekWatch objective is to provide credible and affordable community-based environmental monitoring to support informed decisions on urban stormwater management, and to make this data readily available in a timely manner to watershed managers and the public. An annual report card on the water quality of urban stormwater creeks is one method to accomplish this objective.

How healthy are Alberta's urban stormwater creeks? The CreekWatch monitoring program suggests that Alberta has a range of water quality exemplified in its stormwater creeks. (See Report Card Page 1).

Photo 17
Cochrane's Jumpingpound Creek, ranked highest overall water quality

Photo 18
Calgary's Nose Creek, ranked lowest overall water quality

To achieve improved urban creek water quality in the future, it is recommended that agencies, governments and the public:

- increase public and industry education, making everyone aware that a.) stormwater runoff from our streets, homes, businesses, and parking lots travels through storm drains largely untreated into our waterways, and b.) low impact development and stewardship actions can make a positive difference;
- consider stormwater impacts in any new snow removal planning or the spraying of anti-icing agents;
- uncover (daylight) and remove pipes and culverts from partially buried creeks to reinstate open-air ecosystem functions;
- continue addressing sediment loading generated by stormwater through the implementation of erosion controls in construction areas; settling in stormwater ponds; use of bioengineering along creeks; and installation of oil and grit separators;
- increase the use of Low Impact Development (LID) green infrastructure techniques such as constructed/engineered wetlands, rain gardens, green roofs and permeable pavements as a means to reduce and treat stormwater;
- investigate and initiate stormwater reuse technology to divert stormwater from oversubscribed drainages;
- continue identifying and correcting sewage and stormwater cross-connections;
- create municipal budgeting for stormwater asset maintenance, repair and expansion;
- support new and entrepreneurial stormwater technologies;
- take measures to control invasive species;
- consider provincial changes to water licensing to address stormwater runoff as a source of new water.

Photo 19
The future of urban stormwater management is dependent on a reconsideration of hard, impermeable surfaces

Acknowledgements

CreekWatch was made possible through HSBC funding and HSBC volunteers in a collaborative effort with the RiverWatch Institute of Alberta. Additional funding support was received from Dream Development, Invistec Consulting Ltd. and Raywalt Construction Co. Ltd.

The enthusiasm and time donated by citizen science volunteers is amazing. Eighty-one trained volunteers used a loan-pool of monitoring equipment to collect data from their local creeks in Edmonton, Red Deer, Cochrane and Calgary. Volunteers were recruited from the following organizations:

HSBC Bank Canada
Dream Developments
Invistec Consulting Ltd.
Lac Ste. Anne Community Group
Friends of Confederation Creek
Cochrane Neighborhood Community
Ann and Sandy Cross Conservation Area
EPCOR
Waskasoo Neighborhood Community

Advice and support was received from organizations and professionals across Alberta to help plan, develop, manage, display and analyze CreekWatch data collection, and include the following:

Alberta Environment & Parks
City of Calgary Water Resources
City of Red Deer Environmental Services
Bow River Basin Council
North Saskatchewan Watershed Alliance
EPCOR
Web3 Marketing
Web Heroes
Exova
Salmo Consulting
Victoria Hansen

Thank you everyone.

Data Appendices are published separately at www.creekwatch.ca