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Item No. 11.1.4
Halifax Regional Council
September 29, 2020

TO: Mayor Savage and Members of Halifax Regional Council

SUBMITTED BY: Original Signed by
Jacques Dubé, Chief Administrative Officer

DATE: August 6, 2020

SUBJECT: **Pollution Control at Lake Banook and Lake Micmac**

ORIGIN

On February 27, 2018, the following motion of Regional Council was put and passed:

That Halifax Regional Council include $150,000 for a Pollution Control Study of Lake Banook and Lake Micmac in Planning and Development's 2018/19 operating budget.

On February 24, 2015, the following motion of Regional Council was put and passed:

That Halifax Regional Council direct staff to:

1. *Seek approval from the Province to manage the weeds in Lakes Banook and MicMac;*

2. *Implement the short-term control of weed management on Lake Banook and Lake MicMac through contracted mechanical harvesting services;*

3. *Prepare recommendations for long-term options for weed control on Lake Banook and Lake MicMac; and*

4. *Pending provincial approval, to include contracted mechanical weed control in Lakes Banook and MicMac as a new service in the 2015/16 Operating Budget and directing staff to prepare the 2015/16 Planning and Development Budget and Business Plan incorporating the direction from Council and the applicable costs associated with the program as outlined in the December 17, 2014 staff report estimated at $182,000.*

RECOMMENDATIONS ON PAGE 2

LEGISLATIVE AUTHORITY

Halifax Regional Municipality Charter

7A The purposes of the Municipality are to

(a) provide good government;

(b) provide services, facilities and other things that, in the opinion of the Council, are necessary or desirable for all or part of the Municipality; and

(c) develop and maintain safe and viable communities.

…

79A(1) Subject to subsections (2) to (4), the Municipality may only spend money for municipal purposes if

(a) the expenditure is included in the Municipality's operating budget or capital budget or is otherwise authorized by the Municipality;

(b) the expenditure is in respect of an emergency under the Emergency Management Act; or

(c) the expenditure is legally required to be paid.

RECOMMENDATIONS

It is recommended that Halifax Regional Council:

1. Suspend the rules of procedure under Schedule 5, the Environment and Sustainability Standing Committee Terms of Reference, of Administrative Order One, the *Procedures of the Council Administrative Order*.

2. Direct the Chief Administrative Officer to:

   (a) Implement the short-term actions to mitigate phosphorous and bacteria loading into Lake Banook and Lake Micmac as identified within Table 4, and

   (b) Prepare cost estimates for future actions to mitigate loading of phosphorous, bacteria, and other pollutants to be considered in the 2021-2022 budget cycle, as identified within Table 4.

BACKGROUND

Birch Cove Beach is a popular municipally-owned beach located on the western shoreline of Lake Banook, Dartmouth. During the summer of 2017, the beach was closed for 33 days out of a 62-day beach season due to high fecal coliform (*E. coli*) bacteria counts. This number of closures was higher than in all previous years and appeared to be part of an upward trend at this location. This beach was closed for 28 days in 2018, 2 in 2019, and 29 days in 2020 as of August 6, due to the combined effect of harmful algae bloom risk advisories (2018 and 2020 only) and elevated *E. coli* counts.

Lake Banook is a culturally significant lake to the Municipality, providing opportunities for swimming in the urban core and serving as a major hub for the canoe, kayak, rowing, dragon boat, and paddleboard communities, among other users. The race course installed at Lake Banook supports the lake's use for training and competitions for local clubs through to international boating events.

Lake Micmac flows directly into Lake Banook at the latter's northern end through a channel underneath Highway 111 and is also heavily used by the boating community as an extension of Lake Banook, such that

they form a single functional unit. They are also part of the larger Shubenacadie Lakes system due to the Deep Cut of the Shubenacadie Canal, connecting Lake Micmac to Lake Charles immediately upstream. The Shubenacadie Lakes system is also an important system of cultural, recreational, and environmental significance in its own right.

Like swimming, boating activities depend on adequate water quality, with contaminant levels low enough to avoid impacts on human health. The unknown origin of elevated bacteria counts prompted concerns about the potential for degrading environmental conditions in Lake Banook and Lake Micmac and the viability of their future value as recreational spaces.

To assess the origin of bacterial contamination and possible solutions, Halifax Regional Council approved funding of $150,000 to conduct a pollution control study on Lake Banook and Lake Micmac. Awarded to Stantec Consulting Ltd., the study scope addressed the bacteria concerns through three inter-related parts:

i. Conduct a bacteria-loading analysis to determine total *E. coli* loading, the principal locations from which loads originate, and the timing of loading;
ii. Using microbial source tracking techniques, determine the principal sources of *E. coli*, and discriminate among non-contributing bacteria through microbial source tracking, and
iii. Develop recommendations to manage bacteria loads to reduce future beach closures and enable safe ongoing use of the lakes.

Lake Banook and Lake Micmac are currently subject to nuisance aquatic weed growth affecting recreational and competitive boating activities and have been since prior to the onset of elevated beach closures. Although a municipal weed harvesting project initiated in 2015 has limited the impact of these weeds, it has not addressed the cause of the weed growth – believed to be nutrient enrichment of lake sediments through non-point source sediment loading to the lake. More recently, research published by Dalhousie University on behalf of Halifax Water has indicated that local lakes appear to be recovering from sulfate deposition, with increases in dissolved organic carbon, pH, colour, alkalinity, and calcium concentrations. They concluded that lake recovery processes are widely occurring in Nova Scotia Lakes and that overall, lakes are expected to yield greater productivity (of plants, algae, or both).

Consequently, the project, as awarded, extended the original project scope to include phosphorus loading analysis and recommendations to manage phosphorus to enable the safe ongoing use of lakes.

Phosphorous is an essential nutrient required for the growth of plants, algae, and bacteria that, when abundant, may contribute to increases in plant or algae growth, algae blooms, ecosystem changes, and negative impacts on established recreational activities dependent upon relatively unvegetated (“open”) waters. The phosphorus study was similar and complementary to that of bacteria loading – to determine the geographic sources and relative loading rates of phosphorus to the lakes and to develop practical recommendations that could achieve successful long-term weed control – ideally, the absence of any weed issues on the lakes. This phosphorus assessment responds to Halifax Regional Council’s direction to staff, in February 2015, to prepare recommendations for long-term options for weed control on Lake Banook and Lake Micmac.

For both bacteria and phosphorus loading, Stantec was required to recommend, at a minimum, mitigation options addressing land use, stormwater management infrastructure, and public education.

Study Findings and Recommendations

Stantec conducted field work for the Pollution Source Control Study in summer 2018 and conducted subsequent data analysis, modelling, assessment and report development over the next several months. Halifax received Stantec’s final project report in 2019 (see Attachment A).

Results

The study confirmed that the lakes, situated in a highly urbanized watershed, are experiencing challenges to their water quality as a result of the surrounding land uses. Land use within the Lake Banook watershed is primarily residential, with 78% of the land use attributed to low, medium, and high-density residential areas and associated roadways. Lake Micmac watershed lands are predominantly commercial in nature, with 58% of the watershed covered by commercial developments (42%) and roadways (16%).

Commercial land uses contributed the majority of bacteria (*E. coli*) loading to Lake Micmac (72%), whereas residential land uses contributed the majority of bacteria loading to Lake Banook (76%). An analysis of discrepancies between modeled and measured bacteria loading yielded the recommendation that assumptions regarding *E. coli* concentrations in the watershed should be made using measured data only.

Commercial and roadway land uses, collectively, were found to be responsible for the majority of annual phosphorous loading in both watersheds, although commercial lands were more dominant contributors in the Lake Micmac watershed (58%) and roadway land uses contributed the majority in the Lake Banook watershed (66%). Although the study successfully determined the origin of phosphorous for both watersheds, it also determined that both lakes were at relatively low trophic states [1](Micmac = mesotrophic, Banook = oligotrophic).

Bacteria (microbial) source tracking (MST) techniques were also deployed to trace fecal contamination to specific hosts of origin, focusing on human, dog, ruminant (e.g., deer), and bird genetic markers. Elevated occurrence of each marker was found at specific lake locations in association with *E. coli* concentrations exceeding guideline levels for recreational activities (Table 1). A map of corresponding monitoring locations is provided in Attachment B).

Table 1. Potential Contributing Sources to elevated *E. coli* concentrations at Sample Location (adapted from Stantec's report, Table 13)

Host Species	Lake Banook	Lake Micmac
Dog	n/a	• Watercourse 6 (west of off-leash dog park)
Bird	• Nearshore 2 (Graham's Grove Beach); • Waterfowl 1 (Hwy 111 Bridge); • Watercourse 1	• Watercourse 6 (west of off-leash dog park)
Ruminant	n/a	• Watercourse 2 (Grassy Brook); • Watercourse 5 (Shubenacadie Canal)
Human	• Nearshore 2 (Graham's Grove Beach); • Outfall 8 (Brookdale Beach); • Watercourse 1 (Downstream of Lake Banook Dam)	• Watercourse 2 (Grassy Brook)

Consultant Recommendations

Stantec developed recommendations to mitigate loading of both *E. coli* and phosphorous and the associated risks of elevated pollutant levels through a combination of approaches including maintenance activities, infrastructure assessments and installations, land use changes, and public education. These recommendations are summarized below (Table 2).

[1] Trophic states describe the amount of biological productivity in an ecosystem, measured principally by the mass of aquatic plants and algae. Oligotrophic lakes are the least productive, as a class, and mesotrophic lakes are the second-least productive.

In addition to the Municipality's focus on *E. coli* and Phosphorous, Stantec noted that copper and chloride concentrations in both lakes exceeded CCME guideline values for freshwater aquatic life. Consequently, they also recommended the adoption of mitigation techniques to address these pollutants – road salt reduction for chloride, and stormwater Best Management Practices (BMPs), applicable to both elements.

Stantec also recommended that Halifax conduct, in future, a suite of on-going monitoring activities to assess changes to pollutant loading rates and associated concentrations over time. The purpose of these monitoring activities is to enable the Municipality and community to determine if applied pollutant mitigation actions are achieving the desired effect and, if not, to flag the need to consider more or different actions.

Table 2. Summary of Stantec's Recommendations to Mitigate Bacteria and Phosphorous Pollutant Loading and Select Unwanted Effects

Recommendation	Mitigation Target[a]	Mitigation Form[b]	Ongoing Monitoring
1. Implement street maintenance programs to remove sediment-associated phosphorous from roadways prior to it being carried to the lake systems via stormwater runoff. Street sweeping and catch basin cleanout are required routine maintenance for urban street systems to minimize sediment transport to downstream receptors.	P	IW	
2. Promote green space creation or reclamation within highly urbanized watersheds.	P	LUC	
3. Implement source-based and end-of-pipe phosphorous removal stormwater design best management practices (BMPs). May use infiltration or settling (LID) techniques. Treatment should primarily focus on mitigating stormwater loading to watercourses within the watershed, which should be a requirement of new developments in the area.	P	LUC	
4. Continue to harvest vegetation (i.e., aquatic plants or weeds) in Lake Banook.	P	AWH	
5. Monitor in-lake phosphorous concentration at deep lake locations through the vegetation die-off period (i.e., fall), to capture data to document whether there is any increase in concentrations and associated trophic status caused by a release of phosphorous from vegetation decay. If continued after seasonal lake turnover, may also capture increase in phosphorous concentration from lake anoxic zone.	P		x
6. Continue profiling (depth, temperature, pH) and surface and lake bottom sampling at deep-water lake locations.	P		x
7. Continue flow monitoring and grab sampling at select monitoring locations to track loading reductions resulting from mitigation measures. Monitoring locations should include watercourses where SW treatment BMPs are implemented or headwalls where roadway maintenance implemented.	P		x
8. Conduct and complete wastewater collection system inspections to pinpoint the source of human waste, with a focus on systems near outfall 8, watercourses 2 and 6.	B	IW	x

9. Install bird deterrents on the NS Hwy 111 bridge located at the outlet of Lake Micmac.	B	IW	
10. Increase public education on the need to pick up droppings from domestic dogs.	B	PE	
11. Increase public education of the risk of swimming in areas where wildlife congregates (i.e., birds and deer).	B	PE	
12. Continue public education respecting public beach closures.	B	PE	
13. Complete MST sampling at headwall locations during storm events.	B		x
14. Monitor concentrations of chloride (Cl) and copper (Cu) to track changes in concentrations over time that may be affected through road salt reduction strategies (Cl) and stormwater treatment BMPs (Cu).	O		x

a) (B)acteria; (P)hosphorus; (O)ther
b) Land Use Changes (LUC); Infrastructure Work (IW); Public Education (PE); Aquatic Weed Harvesting (AWH)

DISCUSSION

The study has effectively concluded the origin of the principal pollutants of concern – bacteria and phosphorous - to Lake Banook and Lake Micmac and recommended several actions that may be taken to mitigate against further pollutant loading. Several of its findings were cause for significant concern, including the apparent finding of human-sourced *E. coli* bacteria at three locations within the lake system.

These concerns prompted the organization of a post-study meeting between staff of the Municipality, Halifax Water, Stantec, and Dalhousie University on August 1, 2019. Dalhousie participated as it had performed the MST analyses on behalf of Stantec throughout the study. The questions asked and answers shared during that meeting are presented below in Table 3.

Table 3. Summary of Discussions Held with Stantec Post-Study

Question	Conclusion
1. Is it possible that human gene marker findings were misleading or overestimated the content of human-source *E. coli*?	No. The human marker used in MST analysis is very well established and well validated. This means that, when they are observed in environmental samples, the findings are reliable and there was in fact fecal matter of human origin at that location at the time of sample collection.
2. The report found evidence of deer gene markers at two locations within Shubie Park but no associated recommendations. Why not?	Recommendations were focused on things that could be readily controlled, rather than things that could not, such as deer feces.
3. High bacteria events associated with a high number of human gene markers of *E. coli* were found at Watercourse 2 (Grassy Brook). Could this have originated from Halifax Water's wastewater infrastructure upstream of this area?	No. Although there is wastewater infrastructure in the area upstream of the watercourse within the study boundaries, the layout of the pipe network makes it unlikely to be a source of human waste to this watercourse. Areas further upstream of the public wastewater infrastructure are exclusively serviced by private septic systems. For these reasons, it was concluded that it is not worthwhile to consider this location any further.
4. There was one high bacteria event at Watercourse 6 (June 19) in the presence of human genetic markers.	Yes, it does, as human fecal sources are expected to pose a greater risk to human health and locations identified to have these markers should be prioritized for remediation. Canine and avian sources have also been detected in association with elevated *E. coli* concentrations. It should be noted that, like

Does this warrant concern?	Grassy Brook, Watercourse 6 also drains a large area upstream outside of the geographic scope of the study area.

Additional Findings

Despite significant assessment, Halifax Water was unable to find any evidence of cross-connections between the wastewater and stormwater systems in the sewershed surrounding Lake Banook.

On July 18, 2018, following the study's conclusion, Dalhousie University re-sampled monitoring stations 8 and 8b, where human markers had been found in association with elevated *E. coli* levels. *E. coli* concentrations were 2,500 and 500 CFU respectively, and human gene markers were also detected at both stations.

There is a very high likelihood that untreated wastewater is being unintentionally released from wastewater system infrastructure and finding its way into nearby stormwater systems, groundwater, or the lakes themselves - a phenomenon is known as sewage exfiltration. If true, this would explain, in part, findings of *E. coli* and human genetic markers finding their way into the lake. Bacteria concentration data generated by Halifax Water pursuant to the study prior to the meeting provides sufficient rationale to further consider sewage exfiltration or other forms of leakage from the wastewater system, especially upon finding any new evidence of wastewater in Lake Banook. Any subsequent sampling events, for bacteria or phosphorous, should include measurements of both (parameter) concentrations and flow volumes so that the assessment of results may focus on loadings.

Subsequent Activities

1. Halifax Water committed to perform dye-testing in the trunk sewer adjacent to Outfall 8 (the North Dartmouth Trunk Sewer). This testing was completed on August 15, 2019 with no evidence of a cross-connection observed.
2. Halifax Water and Dalhousie University committed to collaborate to conduct a paired *E. coli* / MST sampling event upstream of Outfalls 8 and 8b within 48h of a wet weather event. This event was conducted on October 2, 2019. The two organizations observed similar *E. coli* results, and Dalhousie also observed human markers of *E. coli* origin, although their prevalence was lower than July 2019 and the overall average from summer 2018.
3. Halifax Water committed to investigate various customer locations upstream of Outfall 8, for possible *E. coli* contamination sources. This investigation was completed in August and September 2019 and found no evidence of stormwater sewer contamination with wastewater.

Additional Avian Pollution – Canada Geese

After the design, award, and initiation of the pollution control study, in summer 2020, municipal staff, among others, observed that a small but persistent flock of Canada geese (*Branta canadensis*) had taken up residence on grassed lawns, including but not limited to municipal parkland, on the shoreline of Lake Banook. Their presence is noteworthy in the context of this study because Canada geese are known to produce significant volumes of feces in the areas where they feed. Goose feces is both a physical nuisance and a potent pollutant, as it contains high volumes of both *E. coli* and phosphorous, left over from its plant-based diet. Unfortunately, due to the timing of their arrival, detailed study of the geese and the associated development of mitigation options was outside of the project scope.

To deter the geese from feeding and defecating at Birch Cove Park and the associated beach, Parks and Recreation staff installed flashing (strobe) lights at the end of the wharf at Birch Cove Beach, among other locations. Although geese were initially deterred, they quickly learned that the lights did not pose a threat and resumed their prior park occupation and habits.

Since that time, staff have consulted with lake management professionals and municipal staff in other jurisdictions across Canada and the United States to find out what has worked elsewhere. While some jurisdictions have found success with specially trained dogs, these are typically used to protect a single location, such as a golf course, from nuisance geese. This is anticipated to be an unsatisfactory solution in Dartmouth as the geese may readily choose from among several other local lakes commonly used for

recreational purposes. Other options include the use of live predatory birds (raptors), broadcasting pre-recorded bird calls (predator cries, prey alarms, distress and anxiety), culling or oiling eggs, entrapment and relocation, growing long grasses along lake shorelines, allowing adjacent parkland grasses to grow taller, and habitat alteration. Staff will continue to monitor the situation, assess options and return to council for direction as needed.

Assessment of Stantec Recommendations

1. *Implement street maintenance programs (street sweeping and catch basin cleanout).*

   The intended result of this recommendation – preventing the mobilization of phosphorous from roads and right-of-ways to lakes – is appropriate, as are the proposed means - but this pollutant would be better addressed via a multi-barrier approach.

   The first barrier to establish is addressing phosphorous at its source and limiting its transport off-site. This can be done by controlling, for example, stormwater runoff from construction sites and keeping fertilizer and vegetation (leaves, grass, etc.) off paved and other hard surfaces from which they may flow into the storm sewer system and waterways. Construction site run-off is being addressed by the Grade Alteration and Stormwater Management By-law (see Recommendation 3 for more details).
   Rainfall events also move phosphorous to lakes by overland runoff directly from lakeshore properties. These sources may be addressed through appropriate source controls, such as but not limited to riparian buffers.

   The second barrier to phosphorous loading is to remove what gets left on paved areas by sweeping streets more frequently as well as cleaning paved surfaces within the watersheds other than municipal streets – such as private commercial, retail, and multi-residential properties.

   The Municipality conducts street sweeping operations in Dartmouth and other areas, whereas Halifax Water and NS TIR are responsible for cleaning out catch basins on roadways within the watershed. Staff will develop cost estimates for the current level of service in the Lake Banook and Lake Micmac watershed and will project costs for two higher level-of-service scenarios – once weekly and once monthly - for consideration during the 2021-2022 budget and business planning process.

   The third barrier to phosphorous loading from paved surfaces is a catch basin cleanout maintenance program. In the Lake Banook and Lake Micmac watersheds, a majority of catch basins are owned by Halifax Water and the Nova Scotia Department of Transportation and Infrastructure Renewal (NS TIR). Halifax Water already has a catch basin cleanout program in place, and staff will engage with Halifax Water and NS TIR to consider if more frequent maintenance is required. However, additional cleaning should only be considered in concert with the above noted source controls.

2. *Promote green space creation or reclamation within highly urbanized watersheds*

   See Recommendation 3

3. *Implement source-based and end-of pipe stormwater best management practices (BMPs: treatments &/or technologies) to remove phosphorous loading to watercourses through stormwater*

   Recommendation 3 must be implemented along with and in support of Recommendation 1. Staff in Transportation and Public Works have agreed with both recommendations 2 and 3 in principal and have incorporated additional greenspace in the completed detailed redesign of the Prince Albert Road, which will be tendered later in 2020. Staff are also considering opportunities to

incorporate future BMPs within the ROWs, although there is currently no clear mandate or budget to do so.

HRM and Halifax Water have also jointly developed Stormwater Management Standards for work on private property, which promotes the use of BMPs, green infrastructure, and low impact development to remove phosphorous from stormwater before it enters watercourses. All such infrastructure – public and private alike - must be designed to allow for ease of maintenance, including adequate access. A new Grade Alteration and Stormwater Management By-law and revised Stormwater Management Standards are scheduled to receive Second Reading by Regional Council on September 22.

In January 2019, Halifax Regional Council approved a report which provides direction to staff to undertake naturalization initiatives in parks and right of ways. The mitigation of stormwater runoff is one of the benefits that naturalization may provide. Pursuant to Regional Council's direction, staff will return with an assessment of the naturation initatives and their impacts after a 2-year period, towards a consideration of a future naturalization policy.

4. *Harvest aquatic vegetation in Lake Banook*

   The Municipality has contracted Stantec Consultants Ltd. to develop a long-term aquatic vegetation control study for Lake Banook and Lake Micmac, pursuant to the conclusion of the 5-year pilot project of aquatic harvesting in 2019. That project will be completed during summer 2020 and a subsequent recommendation report will be presented to Regional Council later in fiscal 2020-21.

5. *Monitor in-lake phosphorous concentrations year-round to determine potential additional sources of phosphorous loading*

   See Recommendation 7

6. *Continue profiling (collecting temperature and pH data at 1m increments throughout the water column) and collecting phosphorous samples for analysis at the top and bottom of the water column at deep-water lake stations in Lake Banook and Lake Micmac*

   See Recommendation 7

7. *Continue flow monitoring and grab sampling at select monitoring locations to track loading reductions resulting from mitigation measures, including where stormwater BMPs are installed or where new or enhanced road maintenance is conducted)*

   The Municipality has contracted AECOM Canada Ltd. to develop recommendations for municipal water quality monitoring, including the basis for developing lake-specific management plans. This project will be completed during summer 2020 and a subsequent recommendation report will be presented to Regional Council later in fiscal 2020-21. Staff anticipates recommending the development of a stand-alone lake management plan for Lake Banook and Lake Micmac on the basis of the findings of the pollution source control study and associated challenges, such as the recurring harmful algae blooms observed since 2017. Staff supports all of Stantec's recommendations regarding water quality and quantity monitoring (#s 5-7 above) and will pursue their implementation in future.

8 *Conduct and complete wastewater collection system inspections to pinpoint the source of human waste, especially near outfall 8, watercourse 2 and watercourse 6*

   As noted above (Table 3):
   Re Outfall 8: Despite persistent findings of elevated *E. coli* results and human markers of that *E. coli*, Halifax Water (HW) has found no evidence of contributions from its wastewater infrastructure,

despite conducting an extensive investigation at that location and within its catchment. Their investigations included dye testing on the North Dartmouth Trunk Sewer (August 2019) and the private properties upstream.

Halifax Water has noted that on-site (septic) systems have previously been located within the service boundary in Dartmouth in the past. It is possible that one or more properties located within the Outfall 8 catchment area has an on-site system contributing to these observations. Staff will engage NS Environment and other parties as needed to determine if this is the case and to proceed accordingly if so.

Re Watercourse 2 (Grassy Brook): Although human markers were found in this watercourse, Stantec agreed with Halifax Water that, based on the layout of their upstream wastewater infrastructure, it was very unlikely to be responsible for the elevated *E. coli* counts or human markers observed here. Further, they agreed that such observations are more likely associated with privately owned and operated septic systems located further upstream within the Lake Micmac watershed. Since the Municipality cannot readily or directly assess bacteria loading from private septic systems, the Municipality and Stantec agreed that there is no value to further assessing the possibility of wastewater system contributions to the observations at this watercourse.

Re Watercourse 6: Elevated *E. coli* concentrations were found here in association with human, canine, and bird markers. Despite draining a large area upstream of the geographic scope of the study area, locations bearing human markers should be prioritized for remediation. Municipal staff will develop options to further assess human contributions to this watercourse in consultation with Parks staff, the Shubenacadie Canal Commission, and local residents.

Municipal staff will engage NS Environment and other parties as needed to assess the possibility of septic system contributions to each of these three locations and to follow up as appropriate.

9 Install bird deterrents on NS Highway 111 bridge at outlet of Lake Micmac

Dozens if not hundreds of pigeons roost underneath the Highway 111 bridge marking the separation of Lake Micmac from Lake Banook. Halifax began investigating options for suitable bird deterrents – i.e., netting or spikes - in summer 2019 and has contracted a qualified firm to design the installation of hardware underneath the bridge in cooperation with NS TIR. This work will be tendered in 2021/22 subject to budget approval.

10 Increase public education on the need to pick up droppings from domestic dogs

Halifax initiated the development of a public education campaign in May 2019 by taking and mapping a detailed inventory of poop bag stations and garbage cans in association with parks, beaches, and off-leash areas and trails used by dog owners and their pets.

The campaign, developed by Energy & Environment in consultation with Corporate Communications, was branded “Canines for Clean Water” and conveyed three key messages, as follows:

i. Pet waste, which may contain harmful bacteria and parasites, can be hazardous to human health and to our waterways. Uncollected, it may contribute to beach closures
ii. Properly dispose of pet waste in garbage bags – it is neither organic waste nor a safe natural fertilizer
iii. Keep pets on leashes near waterways and sensitive areas

The Canines for Clean Water campaign was launched at the Good Bones Loonie Carnival, held at Kiwanis Graham’s Cove Park on August 10, 2019. Staff had a table with bandanas and stickers

with the Canines for Clean Water logo available to the public and requested dog owners to sign a pledge to help keep our lakes clean by picking up after their pets. Subsequently, three additional pop-ups took place at Lake Banook (August 24th) and Shubie Park (September 19th and 29th). Pledges were collected at the information booth as well as online. A total of 56 pledges were collected.

Halifax renewed campaign promotions on Earth Day, April 22, 2020, by tweeting to remind residents of the importance of continuing to pick up pet waste. A volunteer event planned for April ("April Stools Day") was cancelled due to COVID-19. Messaging for Canines for Clean Water is planned to take place throughout the summer and fall of 2020. Plans may involve pop-ups and volunteer events, new signage, and additional bag dispensers, depending on public health protocols related to the pandemic over the next few months.

The current campaign is focussed on activities within public lands. Staff will consider expanding the current campaign, or developing a new campaign, to address stormwater management on private residential properties as part of the annual budget and business planning process.

11 *Increase public education of the risk of swimming in areas where wildlife (i.e., birds and deer) congregates*

Staff will develop new content for the Municipality's website (Halifax.ca) to identify and explain this risk, and will consider, in consultation with Corporate Communications and Public Health, additional means to provide this education (e.g., posted signage, social media, etc.)

12 *Continue public education respecting public beach closures*

Planning & Development, Parks and Recreation, Corporate Communications, and NS Environment (Environmental Health division) collaborate to develop, deliver, and improve public beach closure messages each summer.

13 *Complete microbial source tracking at headwall locations during storm events*

Staff will develop a plan to complete the recommended microbial source tracking program, and to assess the results to identify any conclusions and appropriate next steps.

14 *Monitor concentrations of chloride and copper to identify and assess changes in concentrations over time that may be affected through road salt reduction strategies (Chloride) and stormwater treatment BMPs (Copper)*

There are no current plans to implement new road salt reduction strategies in the vicinity of Lake Banook or Lake Micmac. As new strategies are developed or current ones are enhanced, staff proposes to develop a monitoring strategy to identify and assess changes, and to find funding to develop and implement the strategy as a performance measure for the use reduction strategy.

Currently, staff intends to tender the redesign of Prince Albert Road, with construction estimated to begin in 2021, depending on the priority for this capital project and availability of capital resources. Energy & Environment staff will consult with TPW staff to assess the likely impact on copper loading and will propose a monitoring program as part of the annual budget and business planning process. Ideally this proposed program will leverage a broader monitoring program to reduce the marginal costs of monitoring activities.

Table 4. Summary of Proposed Actions

Pollution Source	Short Term (2020 – 2021)		Long-Term (2021-2022 and Beyond)	
	Bacteria	**Phosphorus**	**Bacteria**	**Phosphorus**
Source Agnostic	• Develop recommendations for a lake management plan, encompassing both Lake Banook and Lake Micmac • Consider developing a public education campaign for stormwater management on private residential properties • Consider expanding the scope of the approved Park Naturalization Strategy to mitigate stormwater runoff		• Seek Council direction to fund and implement the proposed lake management plan • Contingent upon approval, develop and implement public education campaign for stormwater management on private residential properties	
Source Agnostic	• Develop and consider options to further assess human contributions to Watercourse 6 (Lake Micmac) • Develop a plan to conduct microbial source tracking at headwall locations during storm events (with Dalhousie University and potential follow-up by Halifax Water)	• Consider enhanced watershed street sweeping LOS scenarios during 21-22 business planning processes • In addition to implementing source control measures, engage Halifax Water & NS TIR to encourage more frequent catch basin maintenance • Recommend adoption of phosphorus loading mitigation measures in Regional Planning review process • Recommend adoption of a long-term aquatic weed control strategy for the lakes as part of 21-22 business planning processes • Issue tender for redesign of Prince Albert Road, to incorporate green space reclamation • Recommend adoption of a municipal water quality monitoring policy and programming framework, including provision for lake-specific management plans	• Conduct further assessment of human contributions to Watercourse 6; develop recommendations to mitigate if necessary • Execute approved plan for microbial source tracking of headwalls and develop additional recommendations based on results	• Consider additional opportunities for the design, installation, and performance monitoring of additional BMPs throughout the lake watersheds

Pollution Source	Short Term (2020 – 2021)		Long-Term (2021-2022 and Beyond)	
	Bacteria	**Phosphorus**	**Bacteria**	**Phosphorus**
Humans	• Engage NS Environment to assess the potential for septic system contributions to outfall 8 (Lake Banook) and Watercourses 2 and 6 (Lake Micmac)		• Consider the inclusion of environmental impacts beyond the immediate Park area in future review of AO 2017-013-OP, Off Leash Dog Areas Within Parks	
Birds	• Investigate options to address Canada Geese; develop recommendations for implementation 2021 • Develop and deploy public education materials regarding the risk of swimming in areas where wildlife (birds & deer) congregate		• Install bird netting on underside of Highway 111 bridge to deter pigeon roosting • Implement approved goose control approach(es)	
Dogs	• Implement limited version of Canines for Clean Water public education campaign • Develop recommendations for more robust future public education programming and evaluation		• Implement expanded public education programming as developed in 20-21	

FINANCIAL IMPLICATIONS

The proposed short-term actions (first and second columns) in Table 4 above can be accomplished within the 20/21 operating budget with existing resources. Actions proposed for consideration in the 2021-22 budget (third and fourth columns) will be fully costed and any funding requirements will be subject to the approval of Regional Council during the 21/22 operating budgeting process.

RISK CONSIDERATION

The Pollution Source Control Study has demonstrated the negative impacts of water pollution by fecal bacteria, excess phosphorus, and other elements, due to that land development, stormwater management, and land use practices. This report presents options by which these risks may be reduced, in the near and long terms, whereby more significant and expensive options will be subject to greater assessment and risk consideration through future Council reports.

COMMUNITY ENGAGEMENT

No community engagement was undertaken for the development of this report.

ENVIRONMENTAL IMPLICATIONS

This report presents the recommendations of staff and a hired consultant to address several sources and locations of priority pollutants in Lake Banook and Lake Micmac – fecal bacteria and excess phosphorous.

These recommendations are intended to reduce pollutant loading to the lakes and thereby to improve the aquatic environment such that it may continue to reliably serve as a vital regional recreational and cultural asset to the Municipality and its residents.

ALTERNATIVES

Council may choose to reject one or more of the proposed short-term options. This alternative is not recommended for reasons identified within the body of the report.

ATTACHMENTS

Attachment A - Pollution Source Control Study Final Report (Executive Summary)
Attachment B - Map of Sampling and Monitoring Locations used in Pollution Source Control Study
Attachment C - Map of Lake Banook and Lake Micmac watersheds

A copy of this report can be obtained online at halifax.ca or by contacting the Office of the Municipal Clerk at 902.490.4210.

Report Prepared by: Cameron Deacoff, Water Resources Specialist, 902.476.0363

Attachment A

Stantec

Pollution Source Control Study for Lake Banook & Lake Micmac

Final Report

April 11, 2019

Prepared for:

Halifax Regional Municipality
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Prepared by:

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Sign-off Sheet

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Prepared by **Original signed** _____

(signature)

Janeen McGuigan, M.A.Sc., E.I.T.

Reviewed by **Original signed** _____

(signature)

Igor Iskra, P.Eng., Ph.D.

Approved by **Original signed** _____

(signature)

Marc Skinner, C.D., Ph.D.

Executive Summary

The focus of this study is on sourcing and quantifying pollutant loadings of phosphorous (P) and *E.coli* to the studied lakes and recommending mitigation measures to counter the effects of these pollutants on recreational use of the lakes. Lake Micmac and Lake Banook are important recreational waterbodies located in Dartmouth, Nova Scotia. The watersheds contributing to both lakes are considered highly developed or urbanized (Figure 1). Land use within Lake Banook contributing watershed is primarily residential, with 78% of the land use attributed to high, medium and low-density residential areas and associated roadways. The Lake Micmac watershed land use is primarily commercial, with commercial developments and associated roadways covering 58% of the watershed.

Pollutant models were developed to assess P and *E.coli* loading from surrounding watershed land-uses on an annual and rain-event basis. Additionally, for P, a lake systems P model was used to estimate in-lake P concentrations using a method balancing P loading inputs and outputs. A field study was undertaken to capture water quality and flow data at select locations including near-shore, in-lake, watercourse and storm outfall inputs and lake outlets. The captured data was used as a comparison tool for pollutant models, as well as a measure of lake water quality.

Results from the in-lake P modeling showed predicted in-lake P concentrations which differed from measured data. Predicted P concentration for Lake Micmac was estimated to be 0.057 mg/L and predicted P concentration for Lake Banook was estimated to be 0.049 mg/L. Both predicted P concentrations are associated with a eutrophic status, meaning highly-productive in terms of vegetation growth. Measured in-lake P concentrations, however, did not correspond to modeled results. Lake Micmac was classified as oligotrophic, or low vegetative productivity, and Lake Banook as mesotrophic based on measured concentrations. It is possible that vegetation harvesting efforts in Lake Banook have contributed to a reduction in overall P concentration. The extension of the sampling program through the colder months has been recommended to extend lake concentrations capture results during the non-growth period.

Within Lake Micmac, 95% of the annual P loading comes from commercial developments and roadways. These land uses account for 84% of the P loading to Lake Banook (Figure 2). Commercial developments within Lake Micmac account for 73% of the annual bacteria loading, whereas residential developments account for the majority of bacteria loading to Lake Banook, at 76% (Figure 3). Rain-event models were completed for both lakes to provide both an estimate of typical pollutant removal requirements during a standard 25 mm design storm, as well as to allow for comparison of modeled vs. measured loading results. Rain-event model results were as expected when comparing to measured P loading data from the lake watersheds and select sub-watersheds; however, *E.coli* model results were higher than measured data. Variability in land use-based loading values for bacteria were noted in the literature, and likely contributed to poor comparison between modeled and measured loading for this parameter. It is recommended that assumptions regarding *E.coli* concentrations in the watershed be made using measured data.

An additional method of study was used to ascertain bacterial loading data from the lake watershed, which proved useful. Microbial Source Tracking (MST) was completed at select surface water locations

within both lake systems. MST uses genetic marker detection to trace *E.coli* to a specific host-of origin. This study focused on human, canine, ruminant (deer) and avian genetic markers, with results showing high occurrence of each marker at specific lake locations. For example, high instances of avian genetic markers were found to be associated with high *E.coli* concentration events near a bridge separating the two lakes. Human genetic markers were detected at several locations discharging to the lake systems.

Recommendations have been made to mitigate pollutant loading and associated risk from the studied parameters through a varied combination of maintenance undertakings, infrastructure assessment, stormwater treatment implementation, land use changes, public consultation and continuation of existing mitigation activities in the form of submerged aquatic vegetation harvesting programs.

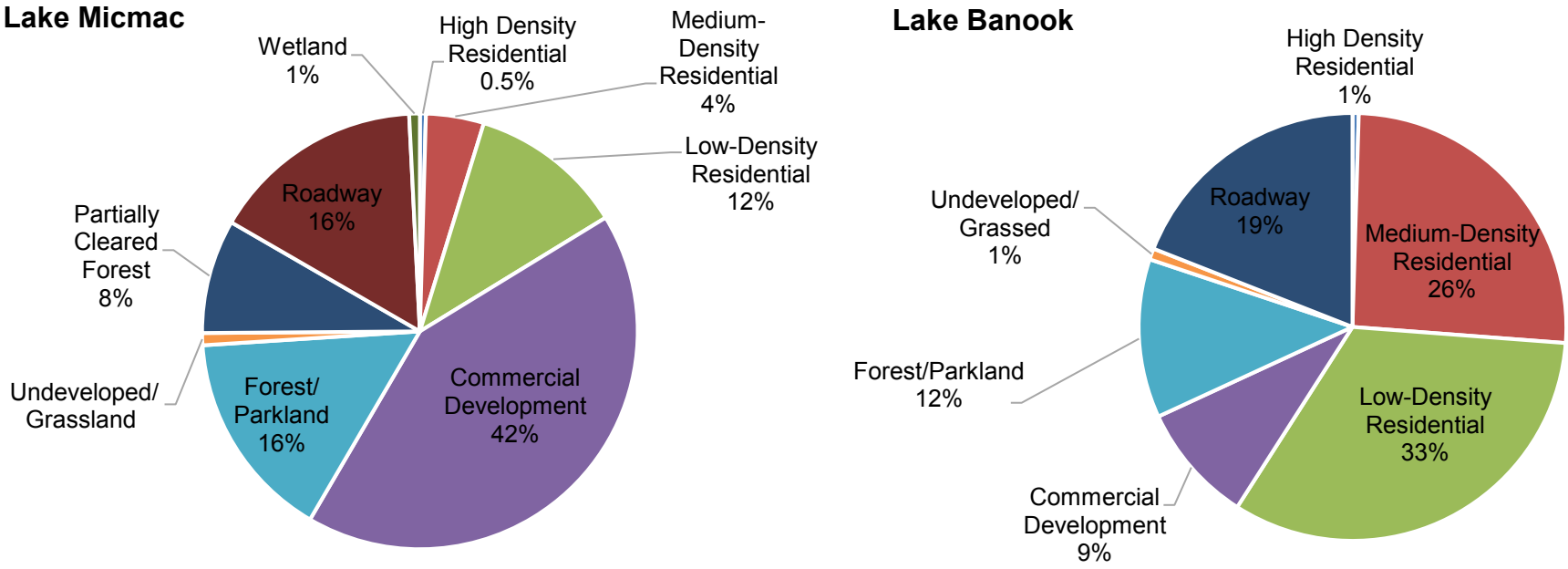

Figure 1 Land Use Breakdown of Lake Watersheds

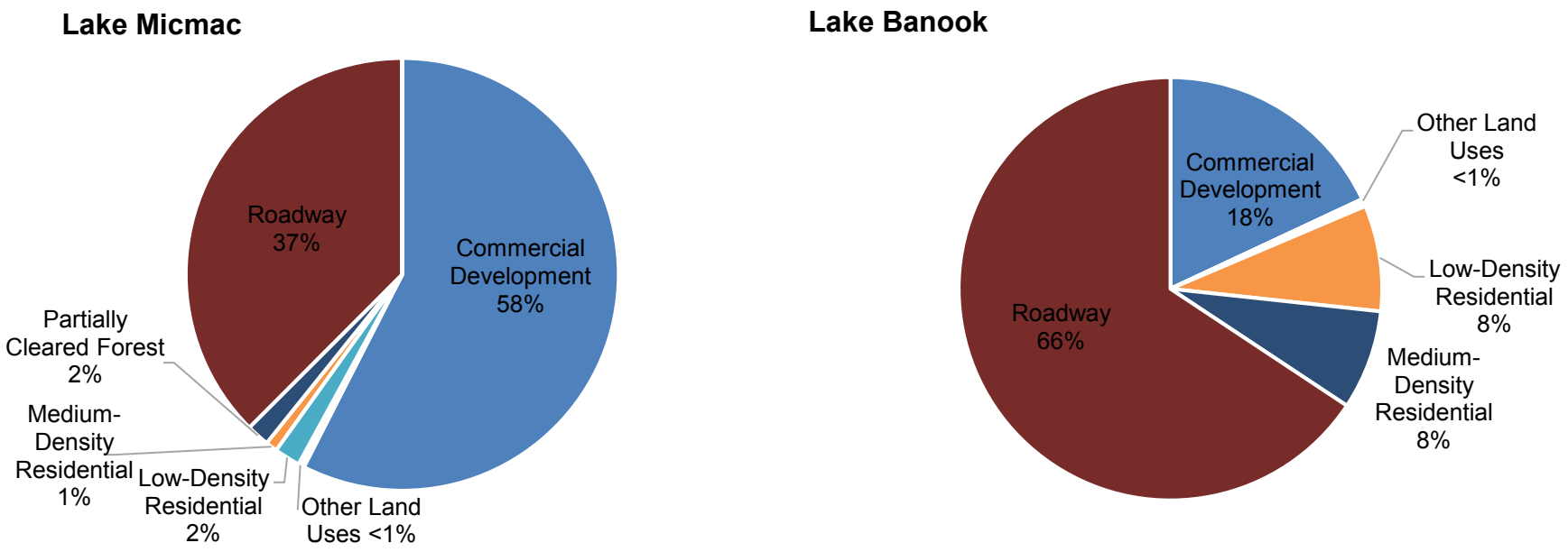

Figure 2 Phosphorous Loading Breakdown by Land Use

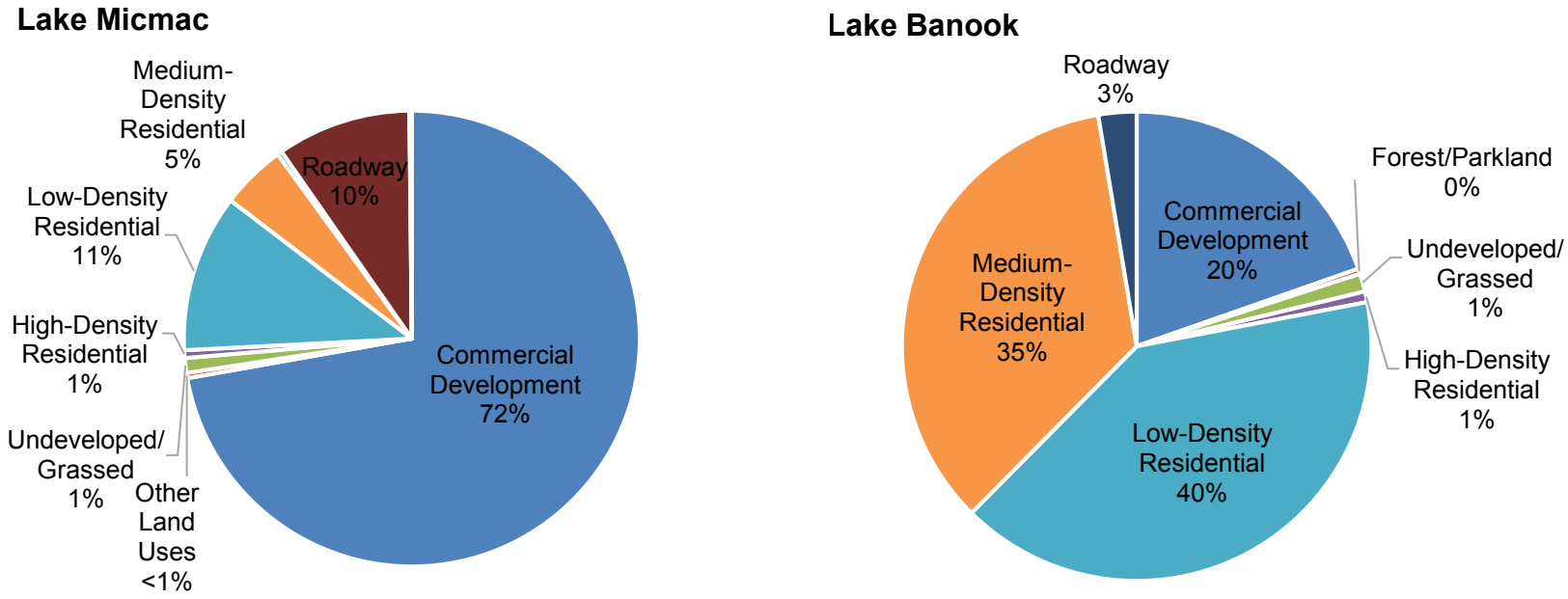

Figure 3 ***E.coli*** **Loading Breakdown by Land Use**

Attachment B

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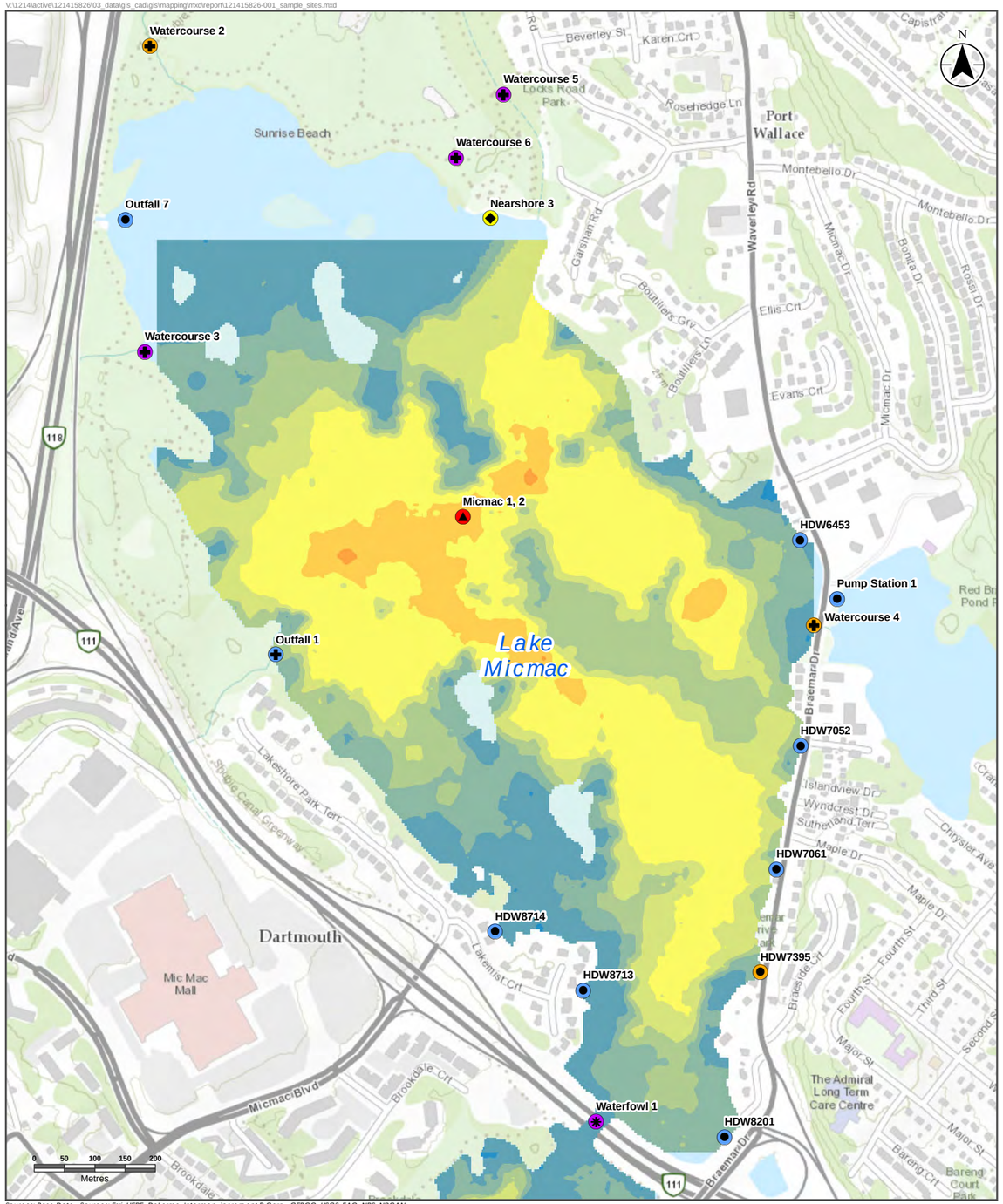

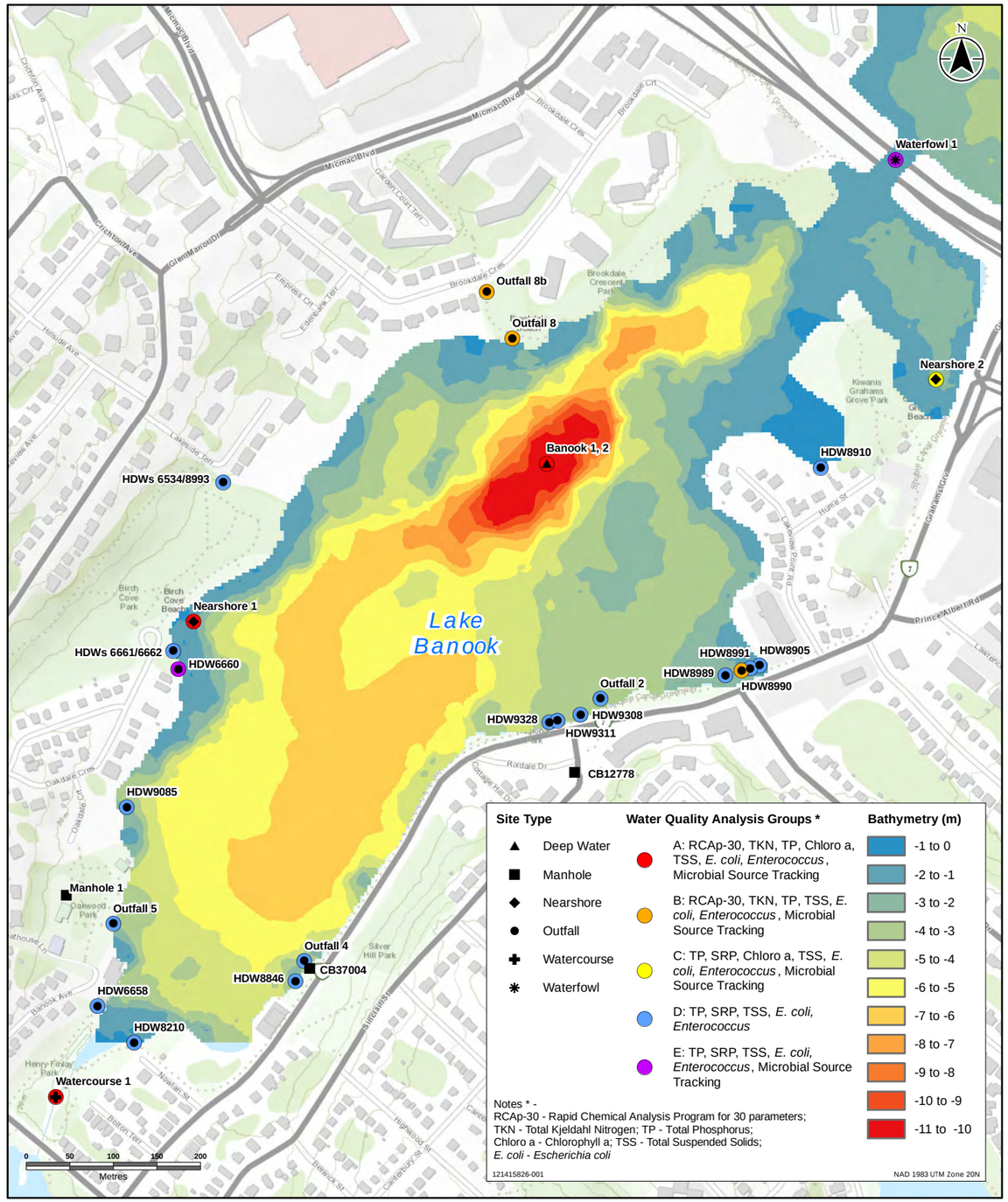

Site Type

- Deep Water
- Manhole
- Nearshore
- Outfall
- Watercourse
- Waterfowl

Water Quality Analysis Groups *

- A: RCAp-30, TKN, TP, Chloro a, TSS, *E. coli, Enterococcus*, Microbial Source Tracking
- B: RCAp-30, TKN, TP, TSS, *E. coli, Enterococcus*, Microbial Source Tracking
- C: TP, SRP, Chloro a, TSS, *E. coli, Enterococcus*, Microbial Source Tracking
- D: TP, SRP, TSS, *E. coli, Enterococcus*
- E: TP, SRP, TSS, *E. coli, Enterococcus*, Microbial Source Tracking

Bathymetry (m)

-1 to 0
-2 to -1
-3 to -2
-4 to -3
-5 to -4
-6 to -5
-7 to -6
-8 to -7
-9 to -8
-10 to -9
-11 to -10

Notes * -
RCAp-30 - Rapid Chemical Analysis Program for 30 parameters;
TKN - Total Kjeldahl Nitrogen; TP - Total Phosphorus;
Chloro a - Chlorophyll a; TSS - Total Suspended Solids;
E. coli - Escherichia coli

121415826-001

NAD 1983 UTM Zone 20N

Sources: Base Data - Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, Mapmyindia, © OpenStreetMap contributors, and the GIS User Community

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Identified Sampling and Monitoring Locations - Lake Micmac

Identified Sampling and Monitoring Locations - Lake Banook

Pollution Source Control Study for Lake Banook & Lake Micmac,
Halifax Regional Municipality

Figure A-1

Attachment C

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Sources: Infrastructure provided by Halifax Water

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Delineated Watersheds for Lake Micmac and Lake Banook

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POLLUTION SOURCE CONTROL STUDY FOR LAKE BANOOK & LAKE MICMAC,
HALIFAX REGIONAL MUNICIPALITY

Figure A-2