

Impact to Cootes Paradise Marsh associated with Chedoke Creek spill of 2014-2018



Chedoke Creek below Hwy 403 box culvert - Tys Theijsmeijer, July 3, 2018



Tys Theijsmeijer
Natural Lands Department
Royal Botanical Gardens
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Please forward any questions about the report to:
Head of Natural Lands
Royal Botanical Gardens
P.O. Box 399
Hamilton, ON L8N 3H8
Canada

Executive Summary

This report is a summary of information available to Royal Botanical Gardens (RBG) through various sources, including Hamilton Harbour Remedial Action Plan (HHRAP) meetings, joint monitoring programs and internal efforts to communicate issues related to water quality flowing into Cootes Paradise from Chedoke Creek, to the public and HHRAP stakeholders. The HHRAP is a public process led by three levels of government. It is intended to be a transparent and shared process in order to facilitate the shared goal of all stakeholders in recovering the health of the local environment in the Hamilton Harbour/Burlington Bay basin of Lake Ontario. The principle underlying issue being addressed in the HHRAP is the capture and treatment of sewage associated with the cities of Hamilton and Burlington.

This report has been created to summarize information shared with stakeholders as it pertains to the Chedoke Creek sewage spill and its impacts, along with combined sewer overflows within Hamilton in 2018. This report follows a rapid response by RBG in the summer of 2018, to share extensive environmental monitoring information with the City of Hamilton in support of their creation of a summary report outlining the effects of the sewage spill. Two RBG staff were also interviewed by the Ontario Ministry of the Environment, Conservation and Parks (MECP) investigator in September 2018 as part of the spill investigation. The full volume and nature of the spill incident remained unknown to Royal Botanical Gardens until the information appeared in the *Hamilton Spectator* in November 2019. All employees of Royal Botanical Gardens remain deeply concerned over the lack of information available to them.

The impacts to Royal Botanical Gardens were diverse and extensive as Cootes Paradise Nature Sanctuary is the largest and central property of RBG property. Effects range from ecological damage and contamination of the bed of the marsh, loss of planted emergent plants associated with decades of intensive marsh restoration work, public access management, as well as revenue-loss associated with lack of access and RBG programming. The ecological damage was driven by a doubling of phosphorus concentrations throughout much of the marsh in 2018. This resulted in intense algae blooms that smothered aquatic life and left the water depleted of oxygen. These effects are illustrated in the pictures and graphs included in this document that summarize monitoring work undertaken in support of marsh restoration. The effects are notable starting in 2014, but there was a general collapse of the marsh aquatic plant community that occurred in summer 2016. Similar impacts are noted at the water quality monitoring station at the mouth of nearby Grindstone Marsh in 2018 but are not included in this report. The spill effects are also clearly visible in the aerial photos obtained for July 2015 & 2018 (Figure 18, Figure 19).

Chedoke Creek has been a primary source of sewage to the southeast corner of Cootes Paradise Marsh since the middle 1800s. Over this time, and particularly in the past 25 years, several substantial remediation projects have been undertaken to improve water quality in this creek. Several more substantial projects will be required to recover creek water quality to federal and provincial guidelines. At no time in the history of water quality sampling in lower Chedoke Creek could the water be considered anything better than an open sewer. Monitoring information obtained in 2018 indicated that water quality in Chedoke Creek was dramatically worse than in all previous years. This condition was apparent by the end of May 2018, with massive algae blooms present within the creek's delta. This condition was conveyed to City of Hamilton staff by the end of May 2018 and was confirmed through a review of the Hamilton Conservation Authority's lower Chedoke Creek monitoring results at the time. In 2018, Hamilton Conservation Authority was involved with HHRAP partners in an intensive monitoring program to better determine the location of long-standing water quality issues. The full nature of the issue in the Chedoke inlet was ultimately investigated by Tys Theijmeijer in early July, undertaking a site

visit into the inlet by boat via Cootes Paradise late in the day July 3rd. The resulting pictures and conditions were conveyed to the relevant stakeholders and local Ward councillor the following day. An RBG volunteer, John Boddy, reported this to the MECP spills hotline. An RBG internal communications process was launched at this time to protect the health and wellbeing of staff and visitors.

The primary public access point for visitors to Cootes Paradise is Princess Point and the adjacent Desjardins Trail, located beside the lower Chedoke Creek. The primary RBG program location is located on the opposite north shore far from the source of the spill. RBG employees most affected by the spill were those working at the Cootes Paradise Fishway, and those undertaking environmental monitoring programs.

HHRAP partners include Environment & Climate Change Canada, Department of Fisheries and Oceans, Ministry of Natural Resources and Forestry, Ontario Ministry of Environment, Conservation and Parks, Hamilton Conservation Authority, Conservation Halton, Arcelor-Mittal, Steelco, Hamilton Port Authority, Hamilton Waterfront Trust, Royal Botanical Gardens, Green Venture, McMaster University and Bay Area Restoration Council.

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Introduction

Much of Cootes Paradise was established as a Royal Botanical Gardens Property in 1941 with the creation of the RBG Act. The Cootes Paradise property at that time included the remnants of the Dundas Marsh Crown Game Preserve of 1927. Currently almost the entire marsh and shoreline is owned by the Garden's. The recovery of Cootes Paradise Marsh has been an objective of the Royal Botanical Gardens since the 1950s with the marsh subject of study and recommendations in the 1940s in partnership with McMaster University. Recovery efforts focused on the marsh figure prominently in RBGs early annual reports and highlight water quality issues and invasive Common Carp as the causes of decline. However, carp management efforts were futile, and beyond upgrades to the Dundas Wastewater Plan in the 1970s and 1980s, little progress was made until the establishment of the Great Lakes Water Quality Agreement. Implementation of a number of watershed and onsite projects. These were triggered by the creation of the Great Lakes water quality agreement and the establishment of localized efforts at highly degraded sites (Areas of Concern) around the great lakes in 1985 in the Hamilton Area the Hamilton Harbour Remedial Action Plan was initiated. In addition, implementation of guidelines and requirements were established as part of the Ontario Water Resources Act in 1994.

Tremendous forward progress on the restoration of aquatic and emergent marsh plant communities had been made following a combination of improvements during 2012 and 2013. These improvements included the replacement of the sand filters at the Dundas Wastewater Plant, the establishment of the McMaster Combined Sewer Overflow tank, and low Lake Ontario levels that allowed for the elimination of virtually all large carp. By 2014 aquatic plants were dominating many areas of Cootes Paradise Marsh, with the notable exception of the Chedoke Bay area.

Water Quality Wetland Recovery Goal = Mesotrophic Marsh Environment

Initial reports of water quality impacts on plant community were reported by RBG in summer 2016 and resulted in a media story in the Hamilton Spectator that fall. (*Dry summer wiped out fish and plants in Cootes Paradise Oct 12*)

Water quality monitoring of Chedoke Creek was transferred from RBG to Hamilton Conservation Authority to begin 2014. Water Quality at no time had achieved a status of unimpaired during its history of monitoring but had shown improvements as a result of the implementation of the Main King CSO tank (1996), and the Royal CSO tank (2008). In 2014 Chedoke Creek was reported as worse by Hamilton Conservation Authority during 2014 relative to past years at the HHRAP research and monitoring workshop of February 2015. The difference was quantifiable but not a significant percentage poor overall as measured by total phosphorus concentration (~15%). The results remained consistently poor through 2017. In 2018 spring results for both lower Chedoke Creek and downstream in Cootes Paradise were strikingly poorer.

Cootes Paradise Marsh Hydrological Characteristics

Total water volume:

- High water = ~4 billion litres
- Average water level = ~2 billion litres
- Low water = ~0.5 billion litres
- Chedoke Inlet Area Water Volume: Average water levels = ~50 million litres (50,000m³)

Total watershed area: 270 km²

- Main tributary: Spencer Creek
- Total tributaries/surface water sources: 16 separate watersheds and Dundas Wastewater Plant
- Water residence time (hydrological models created in support of the HHRAP)
- Spring floods: 3-6 hours
- Typical tributary flows: 4-6 days
- Summer low flows/droughts: 40-60 days

Combined Sewer Overflows and Tanks

1. Main/King CSO **Tank** – Chedoke Creek
2. Royal/Stroud CSO **Tank** – Chedoke Creek
3. Aberdeen CSO – Chedoke Creek
4. Tope CSO – Chedoke Creek
5. Glen Rd CSO – Chedoke Creek
6. McMaster/Ewen CSO **Tank** – Ancaster Creek
7. Sterling Street Under Road Pipe sill – Westdale Creek
8. Dundas WWTP Diversion **Tank** – Desjardins Canal



Figure 1. Map of Royal Botanical Gardens Cootes Paradise Property and the area of Chedoke Inlet adjacent to Princess Point Bay

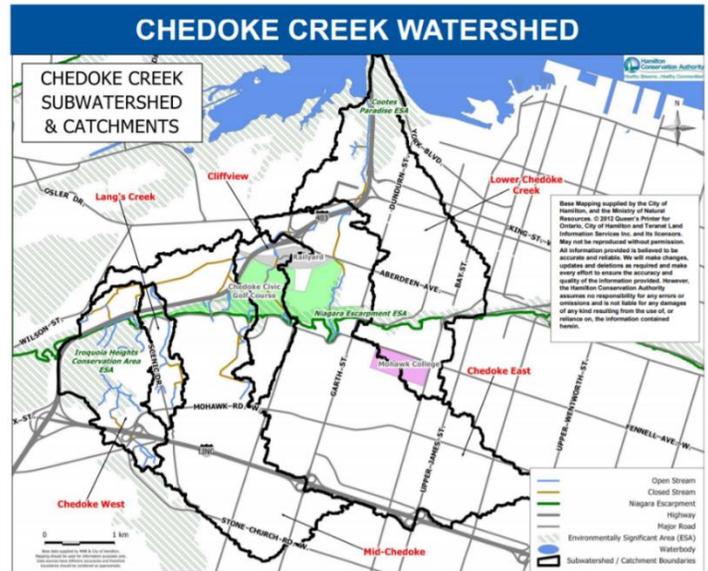
Chedoke Creek Watershed/Sewers

Hamilton Conservation Authority reports the natural watershed is 25km². The creek enters Cootes Paradise in the southwest corner of the marsh. Much of the marsh in this inlet has been infilled and includes Kay Drage landfill and Hwy 403. The watershed also receives waters via the Hamilton sewer system from the areas of:

- Ancaster
- Dundas
- Waterdown

These waters can spill from the sewage line at various overflow locations within the Chedoke Watershed.

Map courtesy Hamilton Conservation Authority, online 2018 Stewardship Factsheet regarding Chedoke Creek.



Cootes Paradise Combined Sewer Overflow (CSO) Spill Summary

The Hamilton Wastewater Masterplan contains the following two objectives for the Combined Sewer System discharging to Cootes Paradise Marsh:

- CSO policy for Cootes Paradise is =<1 spill per discharge point/year.
- CSO objective is set to a 5-year storm event (2006 City of Hamilton information).

The spill information noted below was provided by the City of Hamilton in December 2019. Reporting this information is an annual requirement under the Ministry of Environment, Conservation and Parks pollution control plant operational requirements (PPCP).

Main-King CSO tank spills due to operational failure (2014-2018)

- ~2.9 billion litres -Dry Weather Flow (DWF = raw sewage - 2018 only)
- ~21.1 billion litres –2014-2018 due to tank operational failure (lower holding gate open)

Overall 2018 CSO information provided by City of Hamilton

Main-King (general tank bypass due to operational failure)

- ~3 billion litres - Wet Weather CSO
- ~2.9 billion litres - Dry Weather (raw sewage)

Chedoke Other (Aberdeen*, Tope*, Glen*, Royal)

- 168 hrs, ~16,010,000 litres, 45 events

Westdale (Sterling*)

- 89 hrs, ~11,129,000 litres, 34 events

West Cootes (Dundas, Ewen)

- 0 hrs

*Flow Model estimated

ECCC Weather Stations (total precip)	2018 RBG	2018 Airport
> 25mm	4	6
>20mm	6	11
>15mm	15	25
Total days Precipitation	134	150

Impact to Cootes Paradise Marsh - Google Air photos July 2015 and 2018



Figure 2. July 10, 2015 Google Earth aerial photo (Photo used in RBG Wetlands Restoration Plan, 2016-2021). Marsh clear and with aquatic plants (other than algae bloom in waters downstream of Chedoke Creek).



Figure 3. July 7, 2018 Google Earth aerial photo – all Cootes Paradise is an algae bloom as water mixes; unmixed Chedoke inflow is notable by Princess Point.

Chedoke Creek Water Quality Monitoring Results

Data Sources

- Water sampling undertaken by Ontario Ministry of the Environment (MOE) in 1970-1980s
- Water sampling by McMaster in 1994
- Water sampling by RBG in partnership with others from 1999-2012
- Water sampling by MOE in 2013
- By Hamilton Conservation Authority in partnership with others from 2014-2019
- Monitoring results have been shared between HHRAP partners annually through agreements since 1996.

Lower Chedoke Creek Water Quality Monitoring Highlights

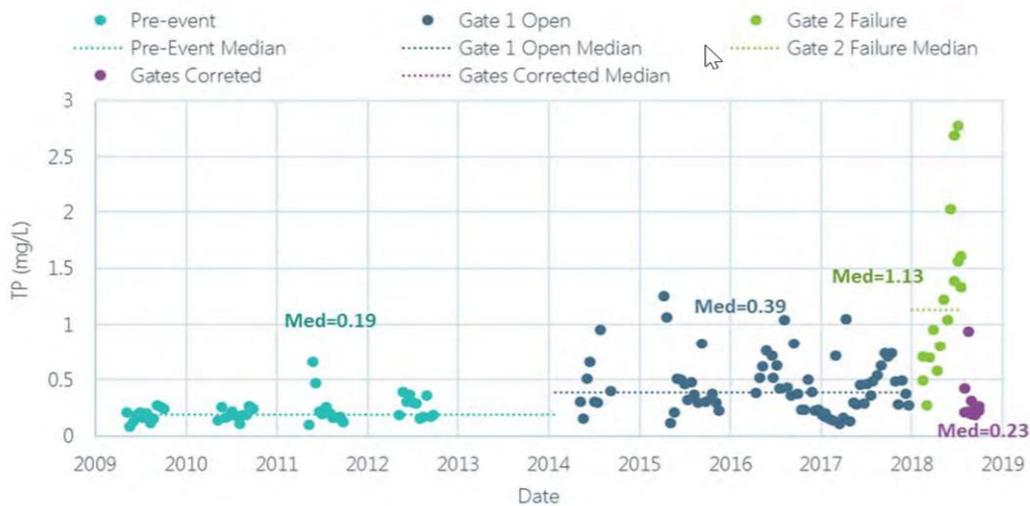


Figure 4-12: CP-11 TP Scatterplot with Medians for Event Time Periods

Figure 4. Lower Chedoke Creek Inlet of Cootes Paradise Marsh total phosphorus result. Results pre-2009 are reflective of all other years of monitoring data, with previous summary in RBG 2012 Water Quality trends report. All samples are substantially poorer than Provincial and Federal Water Quality Guidelines for Aquatic Life with 2018 essentially raw sewage.

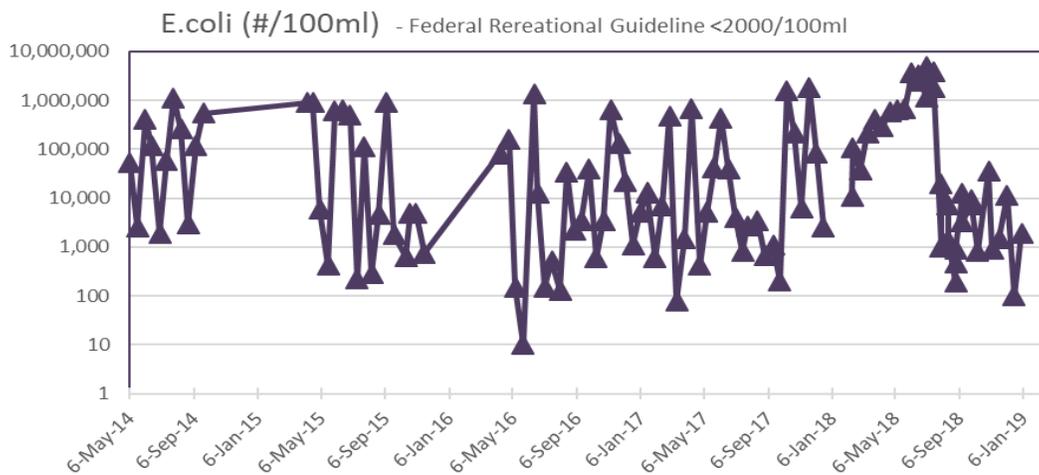
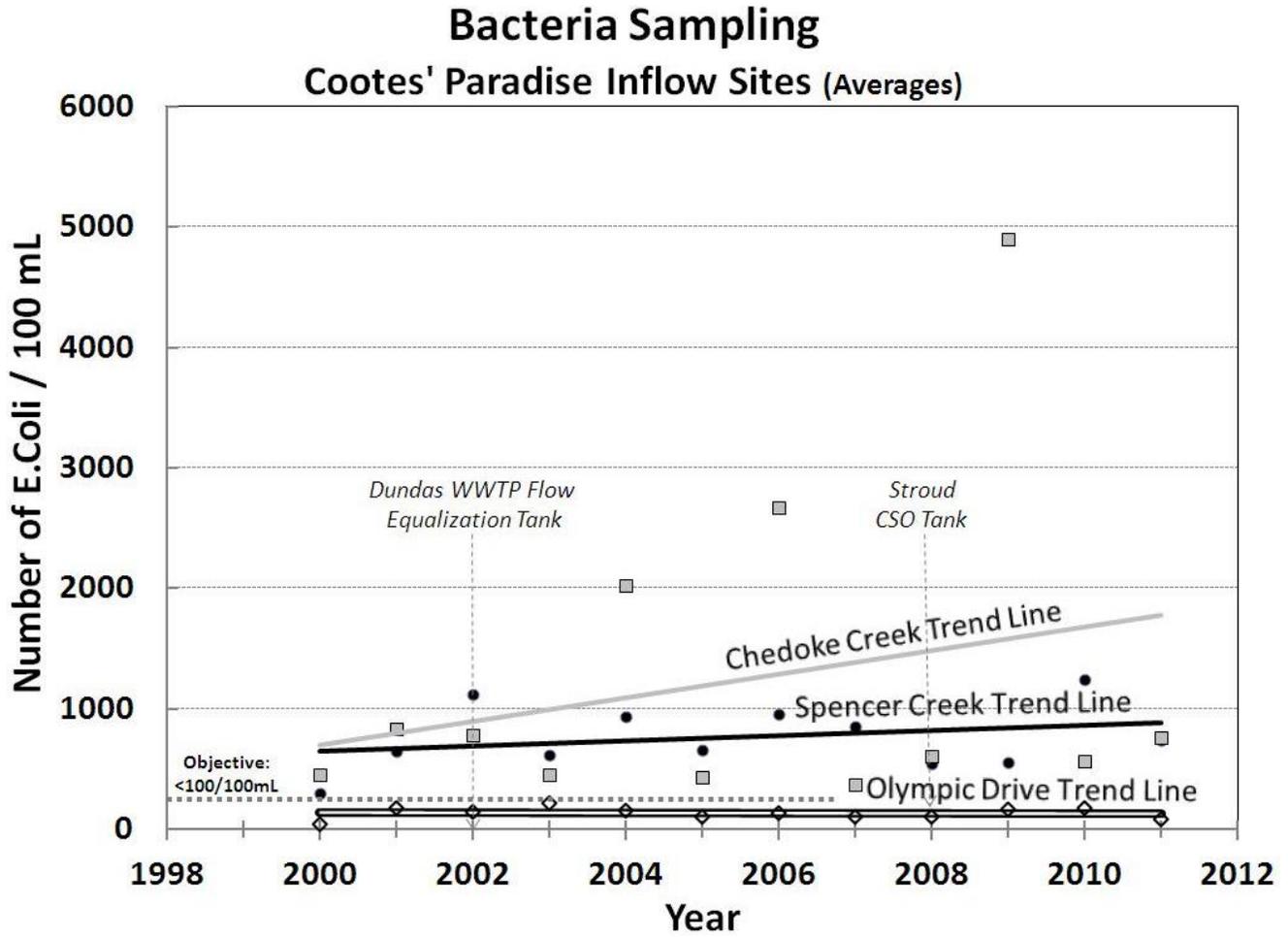


Figure 5. HCA monitoring data, lower Chedoke Creek inlet at Kay Drage bridge crossing. Information courtesy Hamilton Conservation Authority through the HHRAP partnership and Cootes Paradise Water Quality Committee.



Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Minimum	40	10	96	30	60	10	50	50	20	50	60	20
Average	449	837	786	449	2,027	427	2669	369	605	4,899	570	762
Maximum	4,000	70,000	150,000	26,200	260,000	13,000	210,000	200,000	35,900	190,000	6,700	560,000

Figure 6. Lower Chedoke Creek Water Quality highlights, Royal Botanical Gardens 2012 Water Quality report (available online within the RBG website).

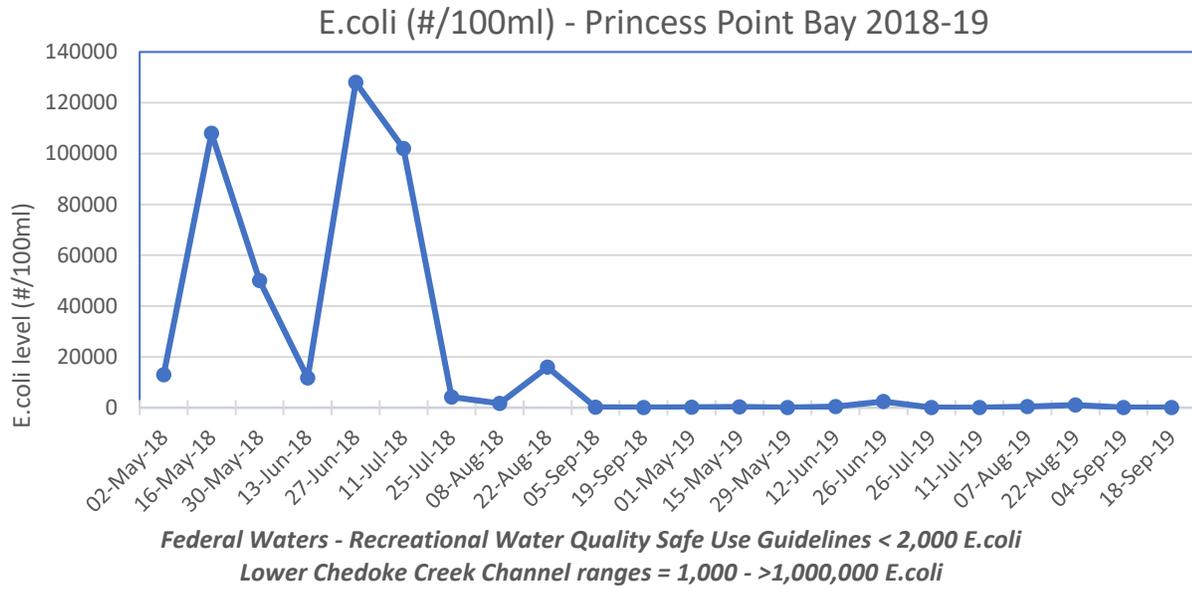


Figure 7. E.coli Monitoring Results 2018-2019 Princess Point Bay. Sampling is a project associated with a Chedoke waters diversion berm assessment, with the first section of berm installed in February 2018. The waters are reflective of conditions at the adjacent RBG public canoe launch. Since Sept 2018 all samples have tested below 2000 E.coli/100ml.



Figure 8. Christmas tree berm in the delta of Chedoke Creek, Cootes Paradise Marsh as interim deflector of the creek water

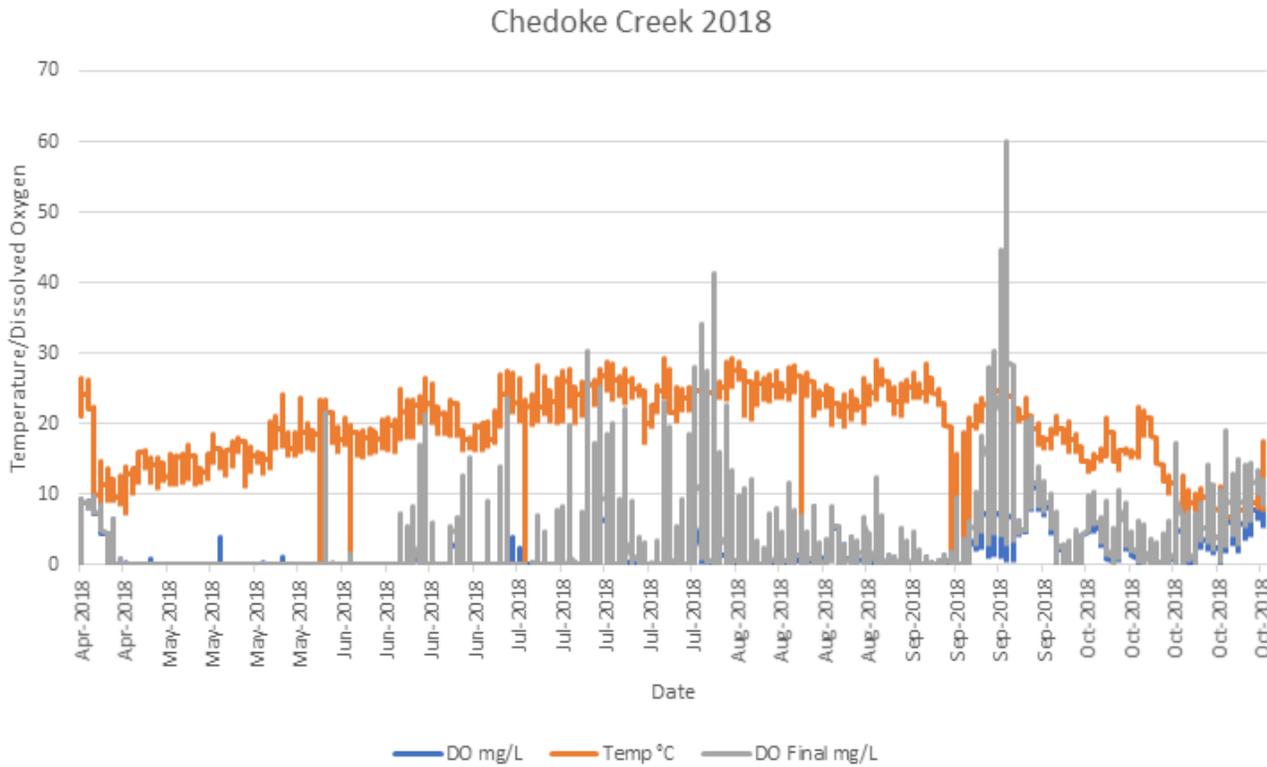


Figure 9. 2018 Dissolved Oxygen profile for Chedoke Inlet of Cootes Paradise Marsh illustrating anoxic conditions

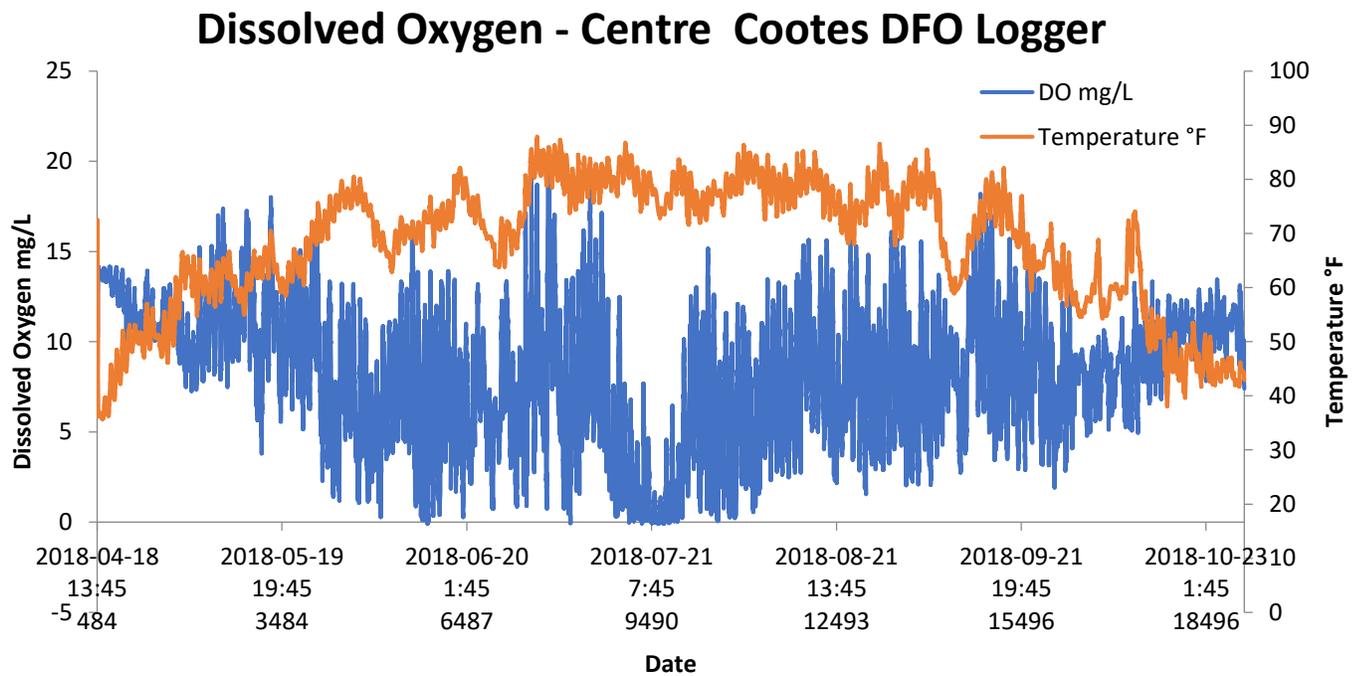


Figure 10. 2018 Dissolved Oxygen profile at the centre station of Cootes Paradise Marsh illustrating near anoxic conditions

Long Term Trends, Cootes Paradise Marsh

Water Quality monitoring occurs biweekly May to September. Lab analysis completed by City of Hamilton Environment Lab, and work sponsored by MECP for much of the monitoring period.

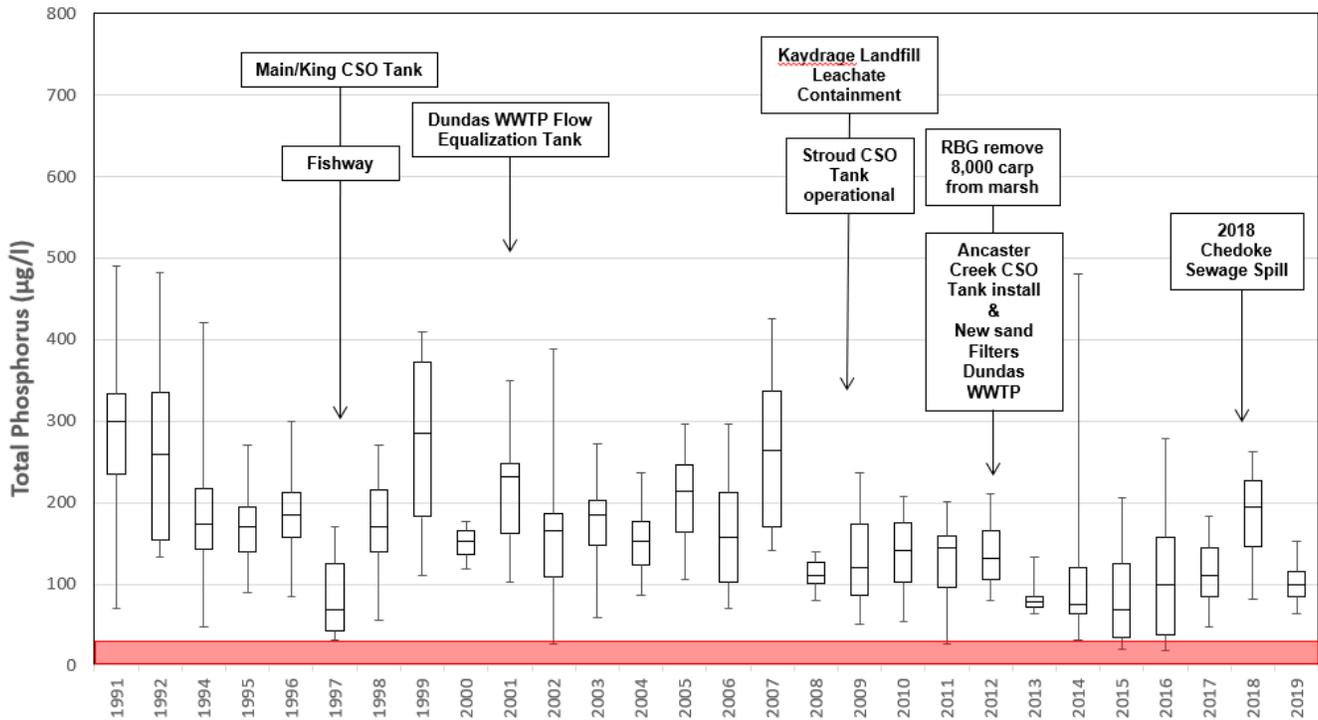


Figure 11. Total Phosphorus trend at the centre of the marsh. The centre station serves as the HHRAP target index station, illustrating the effect of the spill in circulating within main water area of the marsh. Chedoke Spill 2014-18.

Water Clarity - Centre Cootes Index Station

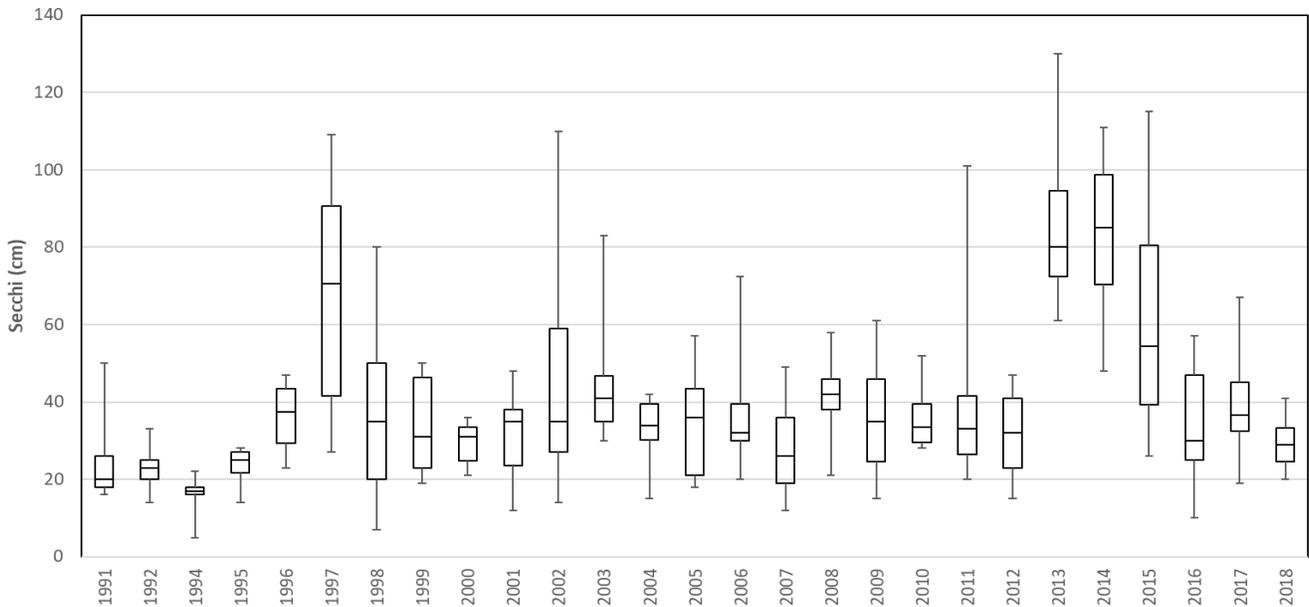


Figure 12. Water Clarity long term trend at the centre of the marsh. Chedoke Spill 2014-18.

Cootes Paradise Marsh Vegetation Changes - Target 240ha

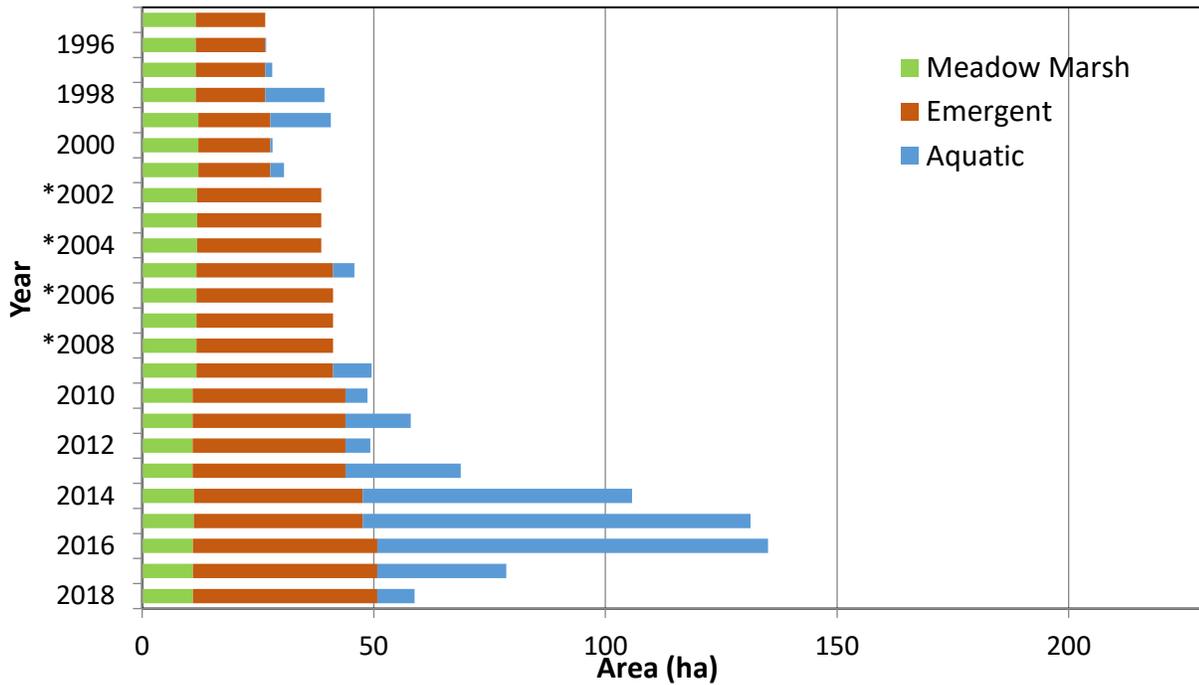


Figure 13. Aquatic Vegetation Coverage Trends in Cootes Paradise 1996-2018.

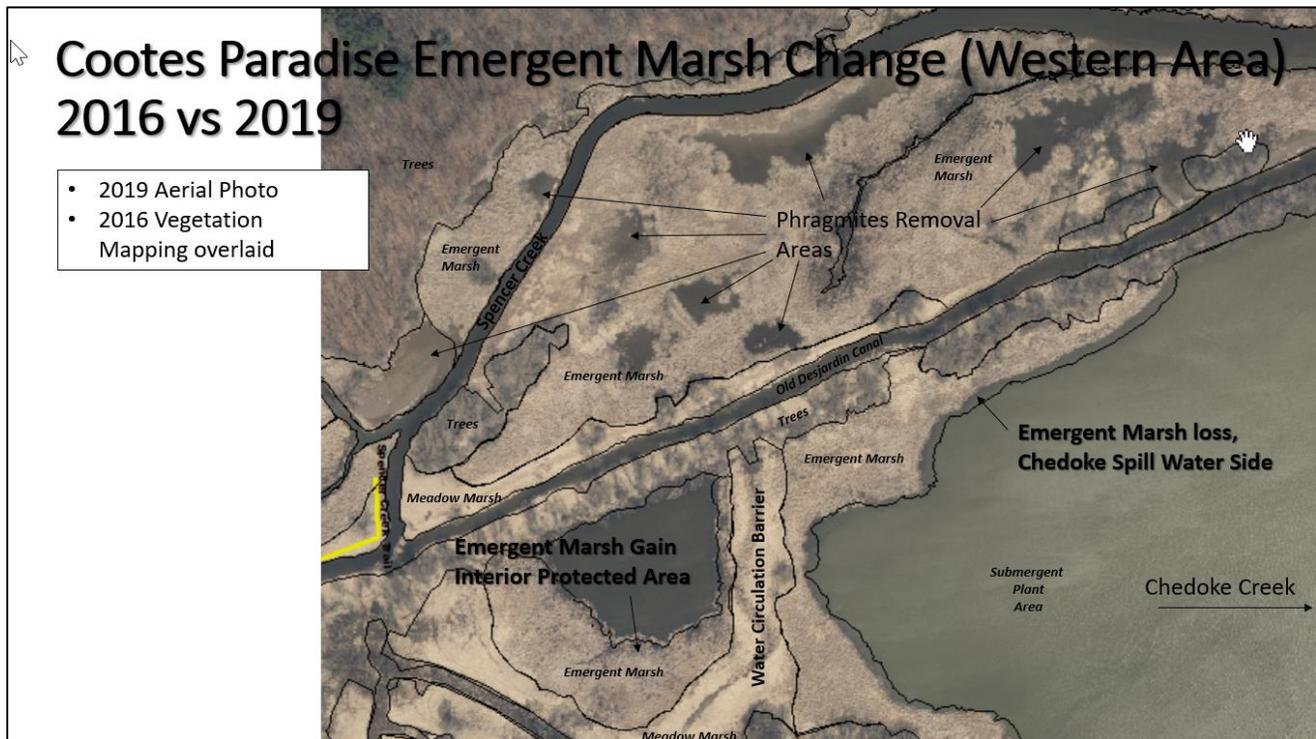


Figure 14. Emergent Marsh Mapping - 2016 Mapping overlaid on 2019 Aerial Photo showing loss of cattails

Impacts to Royal Botanical Gardens

The impacts to Royal Botanical Gardens were diverse and extensive as Cootes Paradise Nature Reserve is the largest and central property of Royal Botanical Gardens. Effects range from ecological damage and contamination of the bed of the marsh, loss of plants associated with decades of wetland restoration work, public access management, as well as revenue loss associated with access and RBG programming. These effects are illustrated in the associated pictures and graphs that summarize monitoring work associated with the restoration. Figure 11 demonstrates the extent of hypereutrophic waters, extending into the full water circulation area and doubling the seasonal average Total Phosphorus concentration. Similar impacts are noted in the mouth of nearby Grindstone Marsh but not included in this report. The spill effects are also clearly visible in the aerial photos of July 2015 & 2018 (Figure 18, Figure 19). In 2018 the spill effects expanded from the Chedoke Creek inlet area of Cootes Paradise, to all of Cootes Paradise, with the exception of the upstream Spencer Creek Inlet.

Princess Point and Fishway 2018

Following the Hamilton Public Health Order of July 7, 2018, Royal Botanical Gardens undertook several measures to protect both staff and public safety as it pertains to contact with the water. The primary focus was the public access point at RBG's Princess Point location that includes a boat launch, but also the Cootes Paradise Fishway. In addition, RBG coordinated work with City of Hamilton Parks staff for the Desjardins Trail along the waterfront (owned by RBG, managed by City of Hamilton).

- Temporary closure signage and supplies - (largely staff time)
- Boat dock removals and reinstallation - (staff time/equipment)
- Fishway supplies and employee protection - (largely staff time)
- Public communications (staff time)

Environmental Restoration Program

The wetland restoration program approach during the period of the spill is outlined in the Wetland Restoration Plan 2016-2021. Most of the efforts and progress during this period were destroyed by the spill. This included multiple projects including Spencer Delta reestablishment, Shoreline Collapse Bioengineering, Water lily and wild Rice reintroduction projects. In addition, the time invested in excluding carp via the Cootes Paradise Fishway were destroyed as the extensive naturally regenerated aquatic plant community was smothered by algae. The spill effect was exacerbated by extreme high-water levels during 2017 allowing the poor water quality to penetrate further west into Cootes Paradise.

Wetland Restoration Plantings Lost during the HHRAP habitat restoration program

The RBG work undertaken to recover the wetland plant community has been ongoing for decades and where significantly impacted, as a result of the smothering algae that resulted from the spill. Work most impacted is focused to the 2016-18 timeframe as starting in 2016 RBG initiated an aggressive replanting program in Cootes Paradise Marsh (excluding the Chedoke Creek delta/inlet) to overcome water level regulation challenges of Lake Ontario, as per the 2016-2021 RBG Wetland Restoration Plan. This complemented the associated program of carp exclusion to allow plant regeneration (whether planted or naturally regenerating). Many of the projects were focused on stabilizing eroding shorelines, with the remainder associated with the Spencer Creek delta area. Multiple financial sponsors were obtained to assist with this program including U.S. Fish and Wildlife Foundation, Environment Canada's Great Lakes Sustainability and Protection Initiative Funds, Loblaw's, Mclean Foundation, S.C. Johnson, and the Patrick J McNally Foundation. All these efforts were lost during 2017 and

again in 2018 as plants were smothered by algae blooms. In 2017 high waters surrounded the plantings of 2016 and circulated poor quality water over them. This again was the case in 2018 with both 2017 and 2018 planting attempts lost. No planting work was undertaken in the Chedoke Creek delta area due to pre-existing knowledge of the poor water quality that prevents plant survival.

Wetland Planting Details

- 65,700 planted emergent plants lost.
- 360 planted White Waterlilies lost.
- 1.5km of plant protection fencing were managed/relocated/repaired/constructed in associated with the 2016-2018 planting strategy.
- Wild Rice eliminated from the main water area of Cootes Paradise Marsh.
 - *Note: Some Wild Rice remains in the RBG propagation facility and in the southwest corner in a sheltered separate interior area marsh area known as President's Pond.*
- 2017 & 2018 vehicle rental to support restoration efforts.
- Communication – staff time regarding planting losses. 2016 media article regarding water quality issues and plant loss - <https://www.bramptonguardian.com/news-story/6905767-dry-summer-wiped-out-fish-and-plants-in-cootes-paradise/>

Note: includes 2 RBG staff and intern and a summer student, between July and August with addition repair and inspection work in remaining months. Assumes 2 months full time for staff and intern and 2 months with summer student.

Carp Exclusion Cost estimate (Fishway operation)

Carp exclusion is fundamental to the ability to grow plants in Cootes Paradise Marsh with carp management efforts in Cootes Paradise through Royal Botanical Gardens dating back to 1951. The current carp management program is associated with the broader Hamilton Harbour Remedial Action Plan.

- Annual operation of carp barrier – March to November
- Capital upgrade expenses associated with higher water level and updated Lake Ontario water level plan implementation starting January 2017 were not included

Note: includes 2 RBG staff and intern and a summer student, part time between March and November with addition inspection work in remaining months. Assumes 5 months full time for staff and intern and 2 months with summer student.

Water Monitoring and Remediation History

Chedoke Creek is a subset of overall Cootes Paradise Water Quality Monitoring and Remediation history initiated by Royal Botanical Gardens in the early 1950s.

1972 - One-year monitoring project Initiated in 1972 by Ontario Ministry of Environment (MOE) at the request of Royal Botanical Gardens, to summarize water quality impairments to Cootes Paradise.

1975 -One-year monitoring report repeated in support of overall Cootes Paradise water quality improvements; work through RBG Board and led by MOE.

1986 – follow-up monitoring report by MOE following various sewage capture projects, particularly upgrades to the Dundas Wastewater Treatment Plant to tertiary sand filter treatment.

1994–As a HHRAP partner, McMaster uptakes lower Chedoke Creek monitoring, while tributary monitoring is generally discontinued across the province by MOE. Agreements for a subset of higher priority tributaries are made with Conservation Authorities to continue some of the program. Program called the Provincial Water Quality Monitoring Program.

1999 – RBG uptakes seasonal Water Quality Monitoring Program, continuing the program initiated in 1994-95 with site-specific locations added to assess conditions/success of various projects. Supported by Encana & MOE.

2001 – RBG completes an updated Water Quality Status Report for Cootes Paradise Marsh; Chedoke Creek is highlighted as a serious issue although improved with the addition of the Main King CSO tank.

2008 – RBG completes a water quality study of the main tributaries entering the RBG property. Chedoke Creek is highlighted as having significantly more water pollution issues than all other tributaries, although better than the Dundas WWTP at the time.

2012 – Redeemer College initiates Chedoke Creek water quality study of tributaries at waterfalls as a class project.

2013 – Chedoke issues directed to MOEE for special study of watershed pollution sources.

2014 – Responsibility for lower Chedoke Index monitoring program station shifted from RBG to Hamilton Conservation Authority

Recent History

2012 – RBG publishes report on 20-year water quality trends, highlighting dramatic improvements in Cootes Paradise overall, but also highlighting that Chedoke Creek water quality is not improved and requires further attention.

2013 – MOEE initiates detailed Chedoke Creek Water Quality monitoring concerns after concerns are repeatedly brought forward by RBG at various HHRAP committees (i.e. Beaches, Technical Teams, BAIT).

2014 – RBG learns that an additional uncontrolled CSO remains on Chedoke Creek, called the Aberdeen CSO.

2016 – RBG publishes updated 5-year strategy for Cootes Paradise Marsh restoration, including a section noting which tributaries are the source of which type of water quality issues, for partners to focus efforts.

2016 –RBG cohosts public open house with partners in March, on the status and history of Chedoke Creek

2016 – In partnership with Department of Fisheries and Oceans and McMaster University, RBG initiates a detailed dissolved oxygen study of the HHRAP area including RBG marsh areas.

2018 –RBG initiates development of a protection berm in Princess Point Bay in January, to divert polluted waters away from Princess Point public access point, as per the RBG 2016-2021 Restoration Plan (with funding support from Environment and Climate Change Canada).

2018 – RBG with HHRAP partners undertake a joint inventory/monitoring project in the Chedoke Creek Watershed. No report completed due to withdrawal of MECP funds, but information forwarded to City of Hamilton.

2019 –RBG continues to develop protection berm in Princess Point Bay to divert polluted waters away from Princess Point public access point, as per the RBG 2016-2021 Restoration Plan.

2019 – In March, RBG and partners cohost a second public open house on Chedoke Creek.

2019 – From May to September, RBG undertakes water quality monitoring program to assess the effectiveness of the berm at diverting Chedoke Creek water past the Princess Point Bay.

Project/Timelines by under the F-5-5 Provincial regulation (1994 Water Resources Act)

Projects to improve sewage capture and treatment for waters flowing to surface waters such as Cootes Paradise Marsh undertaken by the City of Hamilton.

1997 - Main King CSO (Combined Sewer Overflow) Tank Operational - Chedoke Creek

2002 - Dundas WWTP Flow Equalization Tank Operational

2005 - CSO Initial Mitigation for Westdale Creek

2008 – Royal/Stroud CSO Tank Operational for Chedoke Creek

2008 – Kay Drage Landfill Leachate Containment Part 1 for Chedoke Creek Operational

2009 - CSO Outfall Rebuilt for Westdale Creek

2012 – Sand filters replaced at Dundas Wastewater Plant

2012 – CSO tank for lower Ancaster Creek becomes operational

2014-2018 – Homeowner Sewer Cross-connection repair program

2017 – Kay Drage Landfill Leachate Containment Part 2 for Chedoke Creek Operational

2019 – Rain gardens installed in Churchill Park to reduce rainwater runoffs to the Combined Sewer system

Other Combined Sewer Overflow Locations

2014 – RBG learns of the presence of the unmitigated Aberdeen CSO associated with Chedoke Creek, from City staff

2019 – RBG learns of the presence of two addition unmitigated CSO points entering Chedoke, via City reports

2019 – RBG learns that Sterling CSO mitigation measures associated with Westdale Creek are not achieving desired results (with 34 spill events estimated by City of Hamilton for 2019 alone)

Outstanding Water Quality Issues

An incomplete list of sources of untreated sewage to Cootes Paradise:

- Aberdeen Rd CSO – Chedoke Creek
- Tope Rd CSO
- Glen Road CSO
- Sterling CSO
- Pump system improvements to reduce CSO main trunk line volumes at spill points (Real Time Control)
- Storm Drains & potential cross connection associated with Main St at McMaster and a separate pipe
- Cross Connections – Dundas
- Cross Connections – West Mountain/Ancaster
- Septic Systems – various, particularly Hickory Brook watershed.
- Existing combined sewer overflow tanks during growing numbers of larger rain events

Images Summarizing Environmental Effects



Figure 16. April 20th Algae accumulation issue at the Fishway (like most years prior to 2018 at the Fishway).



Figure 17. Pictures of Stewards of Cootes Volunteers clean-up efforts from August work along the flooded Desjardins Trail and children fishing at Princess Point by the warning sign.

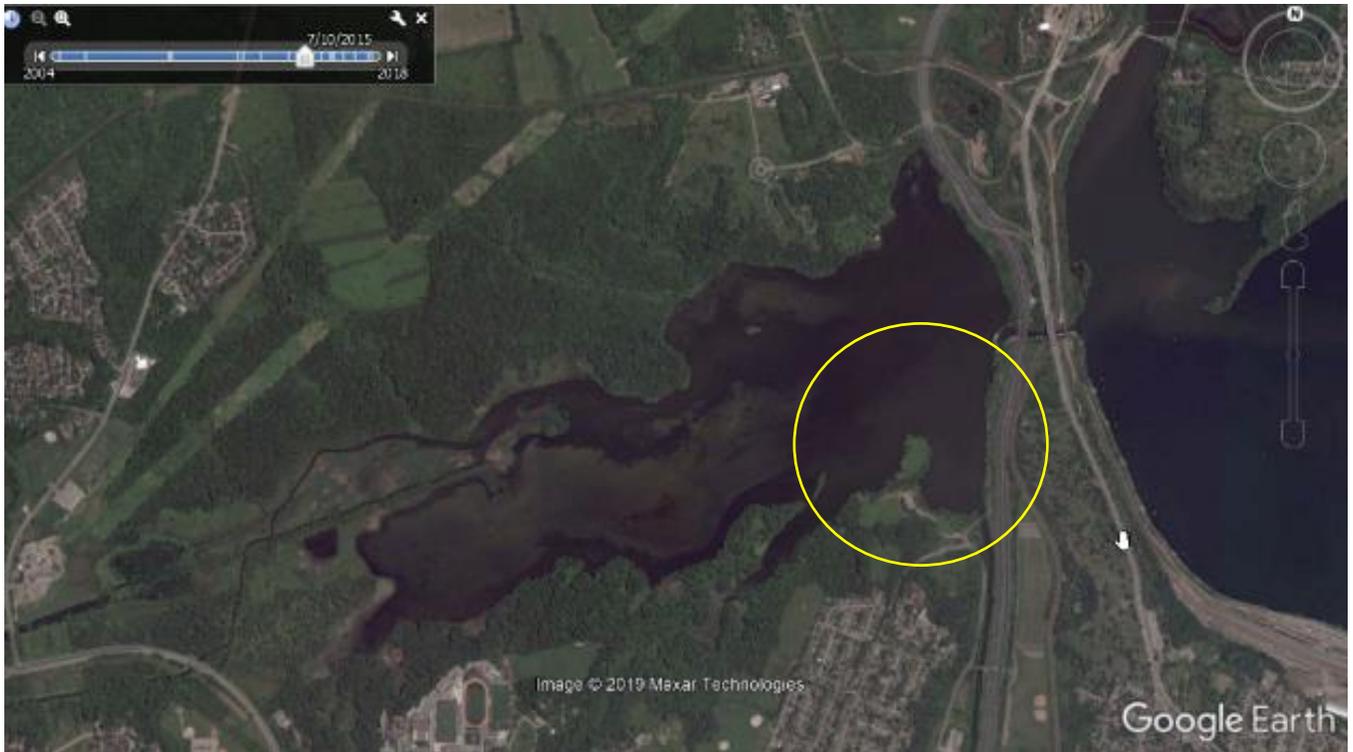


Figure 18. July 10, 2015 Google Earth aerial photo (Photo used in RBG Wetlands Restoration Plan, 2016-2021). Marsh clear and with aquatic plants (other than algae bloom in waters downstream of Chedoke Creek).



Figure 19. July 7, 2018 Google Earth aerial photo – all Cootes Paradise is an algae bloom as water mixes; unmixed Chedoke inflow is notable by Princess Point.

Summer 2014 – Westdale Inlet Aquatic Plant Community



Summer 2018 – Westdale Inlet Aquatic Plant Community



Figure 20. Pictures illustrating plant community decimated in Westdale Inlet area of Cootes Paradise



Figure 21. Example area where emergent vegetation (bur-reed & cattails) was lost to algae and high water near the RBG Boathouse at Cootes Paradise. October 2017 photo following a water level decline of ~90cm.



Figure 22. Water lilies attempting to grow through the early algae blooms in May 2018.

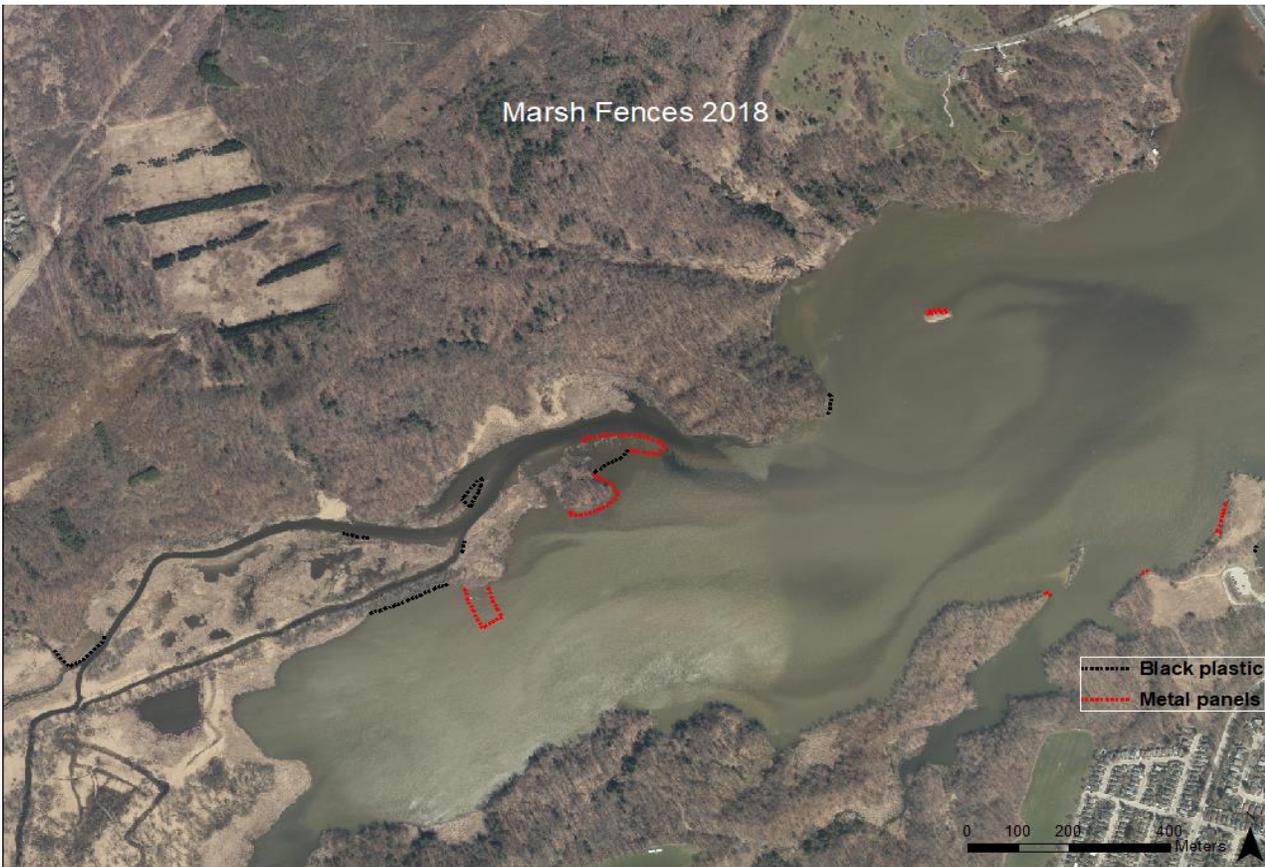


Figure 23. Cootes Paradise Marsh Planting Herbivory/wave protection fence locations in 2018. Total length 1.5km

References

Reddick D. & Theysmejer T. 2012. 20 Year Trends in Water Quality, Cootes Paradise and Grindstone Marsh. Royal Botanical Gardens. Burlington, Ontario.

Hamilton Conservation Authority. 2008. Hamilton Conservation Authority Subwatershed Stewardship Action Plan.

Hamilton Conservation Authority. 2018. 2017/2018 Tributary Monitoring for Cootes Paradise, a Hamilton Conservation Authority Water Quality Report for the HHRAP.

Hamilton Conservation Authority. Chedoke Creek Factsheet 2018

Appendix 1 Hamilton Wastewater Masterplan Background

- MECP procedures require municipalities with CSOs to prepare Pollution Prevention and Control Plans (PPCP) that outline the nature, cause and extent of pollution problems, examine CSO control alternatives and propose remedial measures. Municipalities must then recommend an implementation program including costs and schedules.
- 1991 - Hamilton's original PPCP was completed (Dundas and its waste treatment plant were not a part of the City of Hamilton in 1991).
- 2003 and 2009, PPCP was updated as part of the City of Hamilton's new Integrated Wastewater Servicing Masterplan.
- 2019 – initiation of installation of the remaining components of CSO Control Program, highlighted by the Real Time Control (RTC) system to optimize the operation of the Combined Sewer System and maximize the volume of CSOs conveyed to the Woodward Wastewater Plant.
- CSO policy for Cootes Paradise is ≤ 1 spill per discharge point/year.
- CSO objective set to a 5-year storm event (2006 information).
- RBG was not a stakeholder during these processes.
- Dundas Wastewater Plan has not been assessed through the Environmental Assessment process.

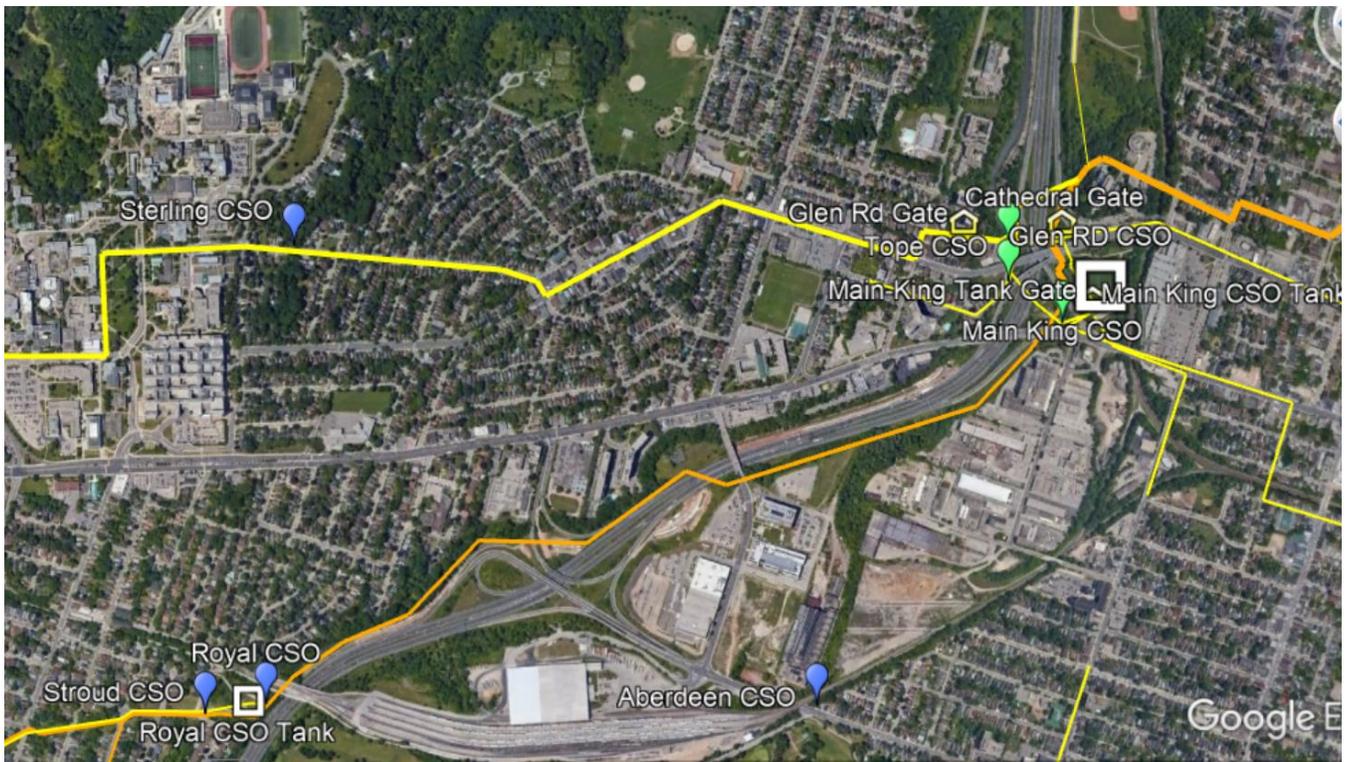


Figure 24. Main King Sewer Control System Area as transposed from the Hamilton online maps portal.

The City of Hamilton provides the locations and direction of flow of the sanitary and stormwater sewer system, with information found on the **Hamilton Maps website** under the Water and Wastewater theme map

A web of sewer lines comes through the Chedoke Watershed area. They concentrate at the lowest point, at the mouth of Chedoke Creek at the Main St West crossing, creating a bottleneck. These sanitary sewer and

combined sewer lines use the Main King CSO tank as storage in case of overflows during heavy rain events. The Main-King CSO tank holds approximately 77,000 m³.

Beyond the Chedoke watershed, sewage from Waterdown, as well as overflows from Dundas, have 4 candidate locations to overflow into Cootes Paradise while on route to Woodward Wastewater Treatment Plant

1. Dundas Diversion Tank (this has never occurred to date)
2. Westdale – Sterling CSO point
3. Glen Road CSO point
4. Main King CSO point

In addition, a diversion point from on top of the escarpment in Ancaster to one of the sewer lines following down Chedoke Creek's west branch, diverts excess flow in the escarpment trunk sewer lines to the Main-King CSO tank.

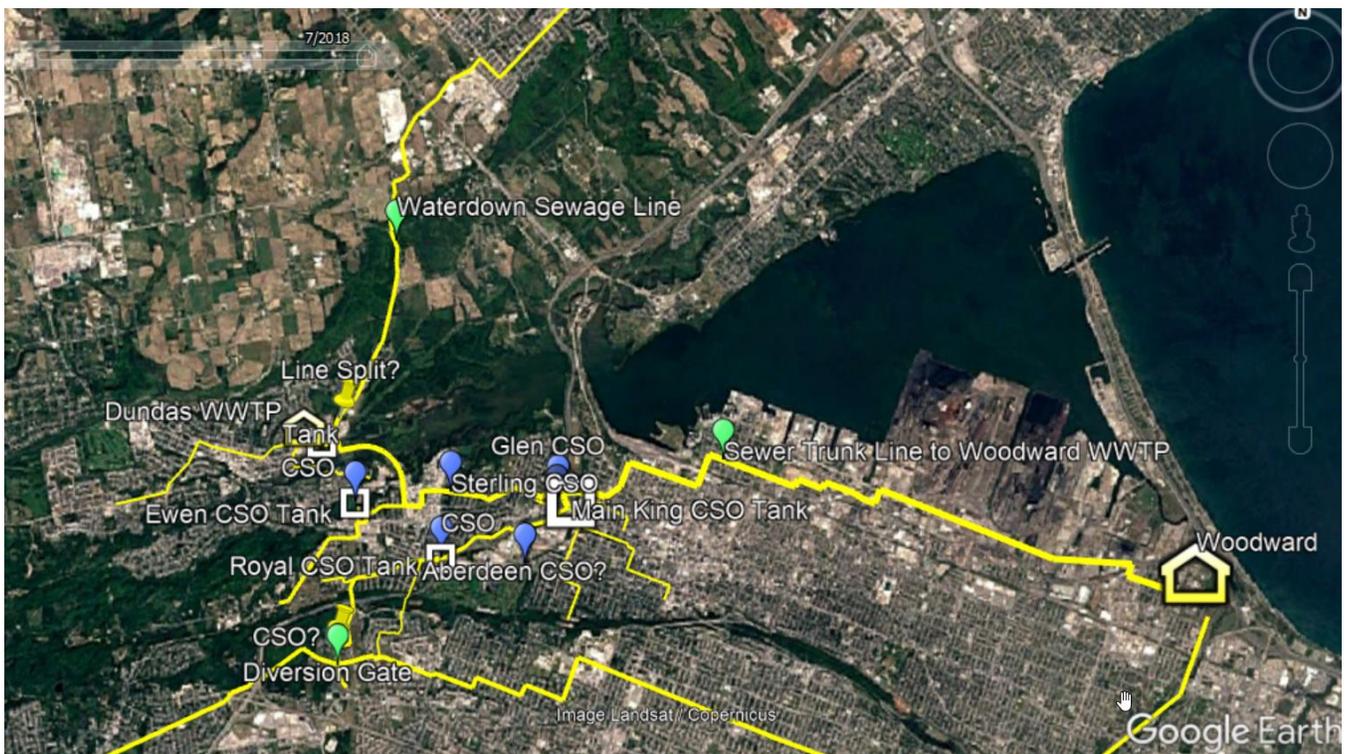


Figure 25. Basic Layout of the Sewage Control System as transposed from Hamilton online maps portal.

Appendix 2. Quantifiable Financial Record Impacts to Royal Botanical Gardens

EXPENDITURES	2016	2017	2018	TOTAL
WETLAND PLANTING COSTS	\$140,745	\$110,134	\$111,932	\$362,811
CARP EXCLUSION COSTS	\$80,917	\$83,144	\$86,499	\$250,560
DIRECT SPILL SITE MANAGEMENT			\$5,680	\$5,680
COMMUNICATIONS – STAFF TIME			\$6,600	\$6,600
TOTAL EXPENDITURES	\$221,662	\$193,278	\$210,711	\$619,051
OVERHEAD (20%)	\$44,332	\$38,656	\$42,142	\$125,130
LOST REVENUE				
PRINCESS POINT PARKING REVENUE			\$2,655	\$2,655
SUMMER CAMP AND CANOE PROGRAM REVENUE			\$4,431	\$4,431
TOTAL LOST REVENUE			\$7,086	\$7,086
TOTAL FINANCIAL IMPACT	\$265,995	\$231,934	\$259,939	\$751,267

Notes:

1. Wetland planting costs as implemented as part of the 2016-2021 RBG Wetland Restoration Plan Document and involve the planting program and the carp exclusion program
2. Carp Exclusion Costs as implemented as part of the 2016-2021 RBG Wetland Restoration Plan Document
3. Princess Point Parking Revenue - 2018 revenue estimated to be approximately \$8K as only includes the credit card revenue component registered at the meter as coin revenue is pooled for all meters.
4. Summer Camp and Canoe Program Revenue -Assumes Canoe programs have historically been filled 90%.
5. Direct Spill Mitigation Costs - salary/expense cost pertaining to Public Health at Princess Point water access and Cootes Paradise Fishway
6. Wetland planting costs includes 2 RBG staff and intern and a summer student, between July and August with addition repair and inspection work in remaining months. Assumes 2 months full time for staff and intern and 2 months with summer student.
7. Fishway operation includes 2 RBG staff and intern and a summer student, part time between March and November with addition inspection work in remaining months. Assumes 5 months full time for staff and intern and 2 months with summer student.