REPORT

TECHNICAL APPENDIX C 2024 ANNUAL FISHERIES REPORT OF THE MILL CREEK COORDINATED MONITORING REPORT

Submitted to:

DUFFERIN AGGREGATES, A CRH COMPANY

Submitted by:

WSP Canada Inc.

582 Lancaster St. West, Kitchener Ontario N2K1M3 Canada

+1 519 904 1717

CA0019938.6257

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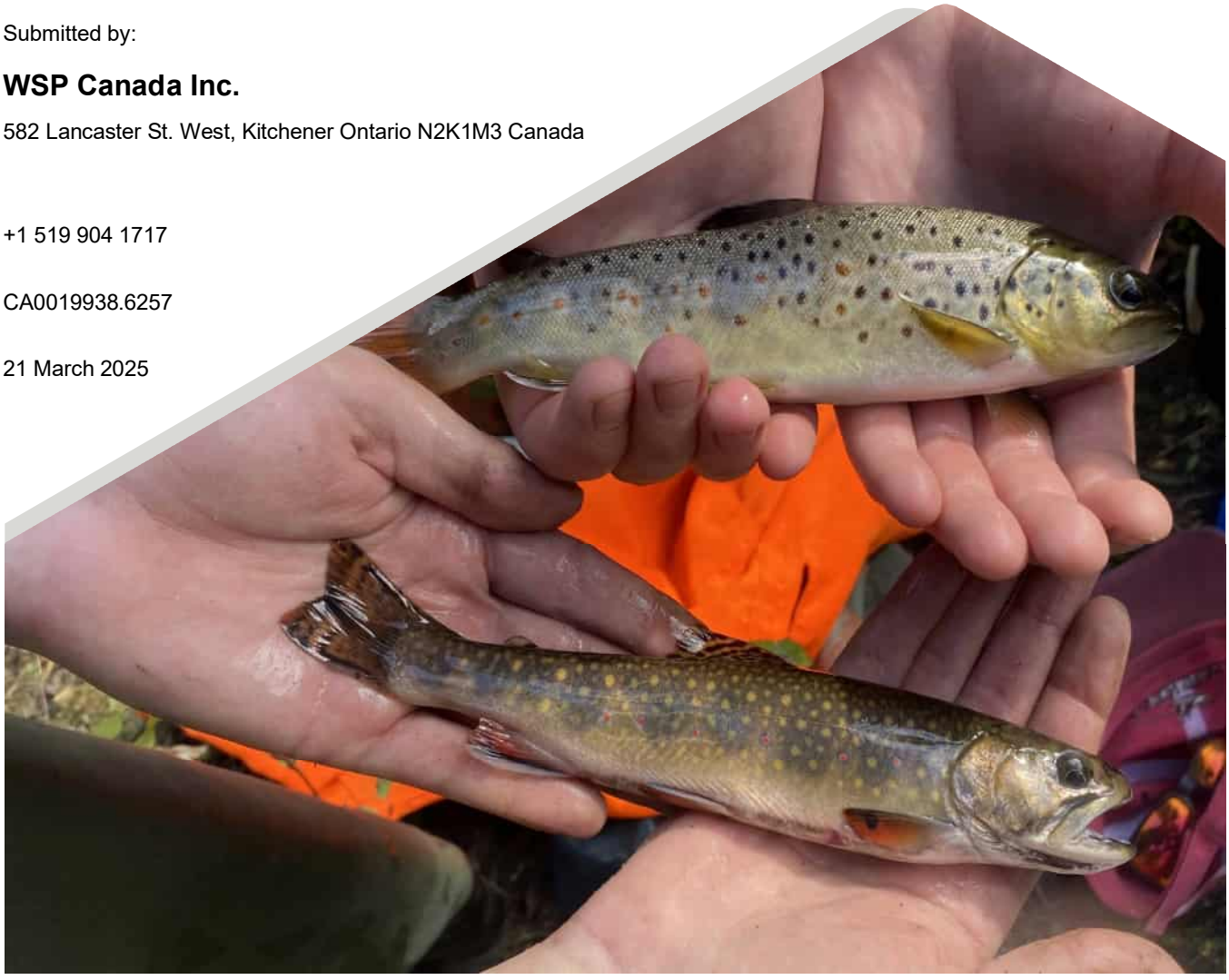

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1.0 INTRODUCTION

1.1 Project Background

Dufferin Aggregates, a CRH Company (Dufferin) initially retained WSP Canada Inc. (WSP) in 2020 to undertake the fisheries monitoring for the Mill Creek operation as required by the Ontario Ministry of Natural Resources (MNR) **Aggregate Licence Number 5738**. WSP had already been completing a number of separate requirements for the permit licence including surface water and hydrogeology. Prior to 2020, the fisheries assessment portion of the licence was completed by LRG Environmental (LRG). As of the 2021 field season, WSP was solely responsible for the monitoring of the fisheries assessment portion under Licence Number 5738.

Detailed environmental monitoring is a condition of the aggregate licence, in particular condition #23, which states:

> *"Pit operation shall not result in a net loss of the productive capacity of fish habitat in Mill Creek or its tributaries."*

The purpose of this Technical Appendix is to integrate the 2024 spawning results and community indices with data from previous years. A detailed environmental monitoring plan for the Mill Creek operation was originally developed in 1993 (Planning Initiatives, 1993) and received final approval by the MNR and the Department of Fisheries and Oceans (DFO) in October 1993. The monitoring program includes the preparation of a technical appendix for each discipline:

- Technical Appendix A – Surface Water Hydrology
- Technical Appendix B – Hydrogeology
- Technical Appendix C – Fisheries

After evaluation of the ecological monitoring results, changes to the program were proposed and accepted by MNR in 2012 and implemented in 2013. One of the changes was to reduce the trout population electrofishing survey to once every two years instead of annually. As a result, there was no population electrofishing survey completed in 2014, 2016, 2018, 2021, or 2023.

In January 2019 a fuel spill occurred on Highway 401 and a significant quantity of *Jet Fuel A* entered Mill Creek within the Hanlon Reach. MNR agreed to postpone the electrofishing survey from 2019 to 2020 due to concerns regarding worker safety and possible disturbance of residual fuel in the sediments. More details regarding the jet fuel spill can be found in the 2019 Report (*Coordinated Monitoring Report* 2019). Mill Creek was given a year to recover from the restoration works associated with the jet fuel spill, with population surveys commencing in 2020, and then every other year after including 2022 and 2024. The sampling program for 2024, as outlined in this report, included the Brown Trout (*Salmo trutta*) spawning surveys conducted in the fall and trout population surveys. A *Coordinated Monitoring Report* that summarizes and integrates information from each of the monitoring programs is submitted to MNR by March 31 each year.

Limited gravel extraction at the site began in 1994 and extraction below the water table commenced in the spring of 1995 in the south end of Phase 1. Therefore, the fisheries data collected up to and including 1994 represent the pre-operational baseline conditions and hence forth identified through the report as the pre-operational period (1983 to 1994). Further details on the operation are provided in the Coordinated Report.

1.2 Study Area

To undertake the fisheries monitoring for the operations, reaches within Mill Creek represent the Study Area. Mill Creek is a permanently flowing watercourse, which originates on the Galt Moraine about 3.2 km northeast of the Village of Aberfoyle. The creek drains about 5,972 square ha of largely rural land before it enters the Grand River near Shades Mill in the City of Cambridge.

Some earlier reports refer to Mill Creek as Galt Creek. However, in the current nomenclature, Galt Creek is one of two small tributaries that enter Mill Creek from the north. Pond Creek is the other coldwater tributary that enters Mill Creek about 260 m downstream of Galt Creek (Figure 1).

For this 2024 report, the Study Area is divided into two reaches that are referred to as the Hanlon By-pass station (Highway 401 downstream to Galt Creek – 610 m) and the University of Guelph station (Galt Creek downstream to the western property boundary – 660 m). The former name is attributed to the section that was diverted around the Highway 401/Hanlon Expressway interchange during construction in 1974.

There is a third reach known as the Bond Tract (43.4131178, -80.2268119), which is located approximately 6 km downstream of the University of Guelph station. This is a downstream reach of Mill Creek situated in the Bond Tract Trail which is a managed forest owned and maintained by the Grand River Conservation Authority (GRCA).The original purpose of the Bond Tract reach was to provide reference data for the Study Area, however redd surveys (spawning) are not conducted at the Bond Tract Station due to absence of suitable spawning habitat.

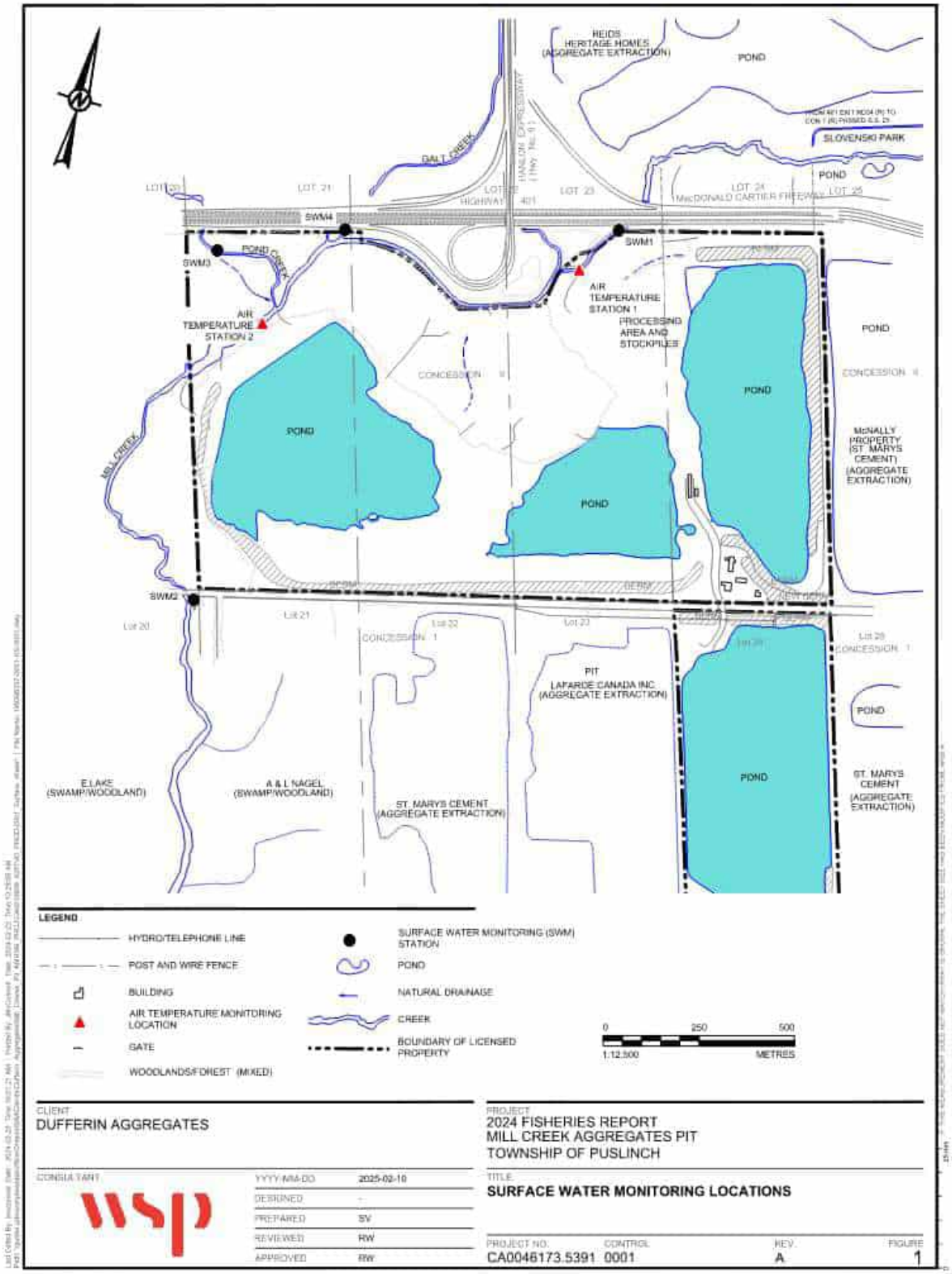

Figure 1: Location of Surface Water Monitoring Stations in Mill Creek

1.3 Background Fisheries Information

1.3.1 Trout in Mill Creek

A historical perspective of the background fisheries information was summarized in the 1995 Coordinated Monitoring Report (ESP *et al.* 1995). Mill Creek was a native Brook trout (*Salvelinus fontinalis*) stream that gradually deteriorated as a result of watershed development including agriculture, land clearing, and the construction of the Highway 401 and the Hanlon Expressway. Brown trout were first stocked in the watershed in the 1940's and stocking continued in the 1950's and 1960's. Replacement of native Brook trout by Brown trout is common in North America in locations where temperatures become too warm for Brook trout (Nyman 1970; Jonsson *et al.* 2001). Other factors that may account for Brown trout's ability to out-compete Brook trout include greater aggressiveness in foraging and use of spawning sites, faster growth rate, survival to a larger size, and greater resistance to predators (Fausch and White 1981; Waters 1983). In addition, Brown trout stocking programs provided an additional advantage for Brown trout over Brook trout. There is also evidence of redd superimposition by the later spawning and larger Brown trout over Brook trout spawning locations (Witzel and MacCrimmon 1983; Sorensen *et al.* 1995). In Mill Creek, Brown trout is now the dominant salmonid species in the main channel, with Brook trout found primarily in the small coldwater tributaries (Galt Creek and Pond Creek). Other studies have confirmed that the salmonid population in Mill Creek above Highway 401 is almost exclusively Brown trout (Dance Environmental Inc. 2000).

1.3.2 Trout Habitat

Within the Study Area speckled alder (*Alnus incana*), dogwood (*Cornus sp*.), white cedar (*Thuja occidentalis*), willow (*Salix sp.)* and white birch *(Betula papyrifera*) provide riparian stream cover. The forest canopy is sparse in the eastern section of the Mill Creek property, through which the channelized section (lower section of the Hanlon By-pass) of the creek flows. However, the University of Guelph section and Pond Creek are shaded by dense forest canopy.

A habitat assessment conducted by MNR in the early 1980's indicated that Mill Creek was suffering from high temperatures and nutrient enrichment originated upstream of Highway 401 and high sand and silt bed load in the downstream end of the Hanlon By-pass station. Rehabilitation projects within the Study Area conducted by the GRCA, the MNR, and local fishing enthusiasts during the mid-1980's resulted in increased Brown trout biomass and spawning activity. The number of redds per kilometre of stream doubled between 1983 and 1987 and fish biomass increased almost six-fold between 1984 and 1994. The key Habitat Suitability Index (HSI) variables for Brown trout (Raleigh *et al.* 1983) were calculated for both sections of the stream. Historically, the HSI scores in the University reach for adult and young trout were 0.6 and 0.42, respectively. The HSI scores in the Hanlon reach were 0.3 and 0.2, respectively, indicating poorer quality salmonid habitat in the Hanlon reach compared with the University reach.

Beavers have inhabited the study area since at least 2014. The felling of trees and building of dams has interfered with water flow and fish movement. Five large beavers were trapped and removed in the fall of 2018. Beaver dam removal was recommended to agencies for summer 2019; however, this was postponed due to the jet fuel spill in 2019 and the COVID-19 pandemic lasting from 2020 to 2022. Since WSP has taken over the monitoring of the Brown trout in Mill Creek, fluctuations in beaver activity continue to be observed, with dams built and then blown out by flows each year. In 2024, no beaver dams were observed within the University, Hanlon or Bond reaches, and no visual beaver activity along the riparian shoreline was recorded.

Since 2001, the Friends of Mill Creek (FOMC), the MNR, and GRCA have conducted a summer stream temperature survey generally between Highway 401 and Brock Road. The FOMC is a unique partnership

between the local industry, private residents, and various levels of government including Puslinch Township, GRCA, MNR, and Wellington County with Dufferin Aggregates as a supporter. One of the primary objectives of the FOMC is to protect and restore fish habitat in Mill Creek. From 2003 to 2018, habitat restoration projects were carried out by the Mill Creek Rangers with funding from the FOMC. No work has been undertaken in the Study Area since the 2019 jet fuel spill, and works were postponed between 2020 and 2022 due to COVID-19 safety measures in place. The Mill Creek Stewardship Rangers and Friends of Mill Creek completed a Site tour with Dufferin in August 2023, where they completed benthic monitoring. A second visit was conducted on August 2, 2024; however, no channel work had been undertaken this year.

2.0 METHODS

Monitoring conducted and reported in this fisheries report includes:

- Mill Creek water chemistry;
- Mill Creek surface water temperature;
- Mark-recapture population surveys for Brown trout; and
- Brown trout spawning (redd) survey results for the University and Hanlon reaches.

2.1 Water Quality

Water quality results for the period from 1993 to 2024 are found in **Sub-Appendix A** of this report. Historical surface water quality data (pre-1993) are available in ESP *et. al*. (1995) Technical Appendix C. Groundwater chemistry is analyzed as part of the groundwater monitoring program (Technical Appendix B).

For this report, water samples were collected by WSP on November 21, 2024, at the four surface water sampling stations (SWM1, SWM2, SWM3, and SWM4). A blind duplicate sample was collected at SWM1 and submitted to the laboratory as SWM5. Station locations are shown on Figure 1. Water samples were submitted to Bureau Veritas in Waterloo and analyzed for the following parameters:

- pH, conductivity
- total alkalinity
- nitrate, nitrite, ammonia
- total phosphorus, orthophosphate
- total organic carbon
- total suspended solids
- chloride
- fecal coliform bacteria, Total coliforms and *Escherichia coliforms* (E. coli)
- biochemical oxygen demand, chemical oxygen demand

In addition to the field duplicate, the laboratory conducts its own internal QA/QC program which includes routine duplicate analysis, spiked matrix samples, spiked blanks, and method blank samples.

2.2 Surface Water Temperature

Water temperature is recorded hourly at all four monitoring stations shown on Figure 1 as part of the surface water monitoring program (Technical Appendix B). Water temperatures are discussed in this report as it relates to available trout habitat. Prior to 1997, water temperatures were measured manually, not necessarily daily, and usually only once per day. Prior to 1993, water temperatures were measured by the GRCA and Faunaquatics.

2.3 Trout Population Surveys

In 2024, the electrofishing field survey was conducted on September 5th, 6th, and 11th for the Mark Run, and September 12th and 13th and 19th for the Recapture Run. A summary of survey methods and timing for the trout population surveys is provided in Table 1. As previously discussed, population surveys are currently conducted every two years with exceptions in recent years discussed in detail in Section 1.1 above.

Surveys were not conducted in 2002 and 2012 due to extremely low precipitation levels and high temperatures experienced throughout southern Ontario in the summer and early fall. The Guelph District MNR agreed that such a survey would pose unnecessary stress on fish that were already subject to in-stream conditions that were less than optimal, with low water levels (reduced available habitat) and elevated stream temperatures resulting from the drought conditions. The fisheries survey was not conducted in 2008, with the acceptance from the MNR, due to high precipitation levels in the summer of 2008. The Guelph District MNR acknowledged that the unusually high flows in Mill Creek could present a safety issue for the survey crew and increase the difficulty of capturing fish which would reduce the potential to obtain a reliable population estimate. In addition, the MNR agreed that, with the high-water levels, it was less likely that the extraction of material at the Mill Creek site could have a negative impact on the trout population in Mill Creek.

Although the names of the companies have changed, the same core personnel were involved in the electrofishing program from 1993 to 2017. Although in 2020 the electrofishing program was completed by WSP staff, LRG staff were also present on site during the first mark run to ensure consistency in methods carried out for the surveys. In 2024, the program was completed by core personnel at WSP familiar with the previous survey methods.

The basic survey approach has not changed since the studies began, although the equipment use has changed. In all cases, the basic method is a single pass electrofishing assessment without blocking of the stream at either end for each of the mark and recapture runs, and for each reach surveyed. This method is considered appropriate to estimate trout populations in Southern Ontario streams (Jones and Stockwell 1995). Mark and recapture runs were generally separated by a one-week period. The time to conduct the mark run has been approximately 5-6 hours for each reach and the recapture run has been approximately 4-5 hours each. The shorter time for the recapture run is due to the quicker processing time for fish (only counting clipped versus unclipped fish).

Since 1998 the survey team has consistently used two back-pack electrofishing units, and therefore two anodes, in tandem to provide simultaneous coverage of the stream. Each shocking unit was accompanied by a minimum of one netter (two to three netters in total) who pass the fish to other staff for processing. A minimum of 6 people were involved in all electrofishing surveys. The actual number of electrofishing seconds was not recorded during the early survey years but the time to conduct the surveys (level of effort) has been similar in recent years.

Table 1: Summary of Electrofishing Methods in Mill Creek

Year	Lead Group	Equipment	Mark Dates			Recapture Dates			Number of Reaches
			U of G	Hanlon	Bond	U of G	Hanlon	Bond	
1989	GRCA	Punt Electrofisher	Aug. 22	Aug. 23	Aug. 21	Aug. 30	Aug. 29	Aug. 31	3
1990	GRCA	Punt Electrofisher	Aug. 27	Aug. 21	Aug. 22	N/A	N/A	N/A	3
1991	GRCA	Punt Electrofisher	Aug. 19	Aug. 16	Aug. 16	Aug. 23	Aug. 20	Aug. 20	3
1992	GRCA	Punt Electrofisher	N/A	N/A	Aug. 18	N/A	N/A	N/A	3
1993	GRCA	Punt Electrofisher	Sep. 9	Sep. 20	Sep. 8	Sep. 17	Sep. 23	Sep. 6	3
1994	GRCA	Punt Electrofisher	Aug. 30	Sep. 1	Aug. 29	Sep. 7	Sep. 23	Sep. 6	3
1995	GRCA	Punt Electrofisher	Sep. 27	Sep. 21	Sep. 19	Oct. 3	Sep. 26	Sep. 25	3
1996	No Survey								
1997	GRCA	Punt Electrofisher	N/A	N/A	No Survey	N/A	N/A	No Survey	2
1998	ESG	Back-pack Units	Aug. 27	Aug. 28	No Survey	Sep. 3	Sep. 4	No Survey	2
1999	ESG	Back-pack Units	Sep. 1	Sep. 2	No Survey	Sep. 8	Sep. 10	No Survey	2
2000	ESG	Back-pack Units	Sep. 6	Sep. 7	Sep. 8	Sep. 13	Sep. 14	Sep. 19	3
2001	ESG	Back-pack Units	Sep. 5	Sep. 6	Sep. 7	Sep. 11	Sep. 12	Sep. 13	3
2002	No Survey								
2003	CWA	Back-pack Units	Aug. 26	Aug. 27	Aug. 28	Sep. 2	Sep. 3	Sep. 4	3
2004	CWA	Back-pack Units	Sep. 8	Sep. 10	Sep. 7	Sep. 15	Sep. 16	Sep. 14	3
2005	CWA	Back-pack Units	Aug. 29	Aug. 30	Sep. 6	Sep. 7	Sep. 8	Sep. 14	3
2006	GLL	Back-pack Units	Aug. 28	Aug. 30	Aug. 31	Sep. 5	Sep. 6	Sep. 7	3
2007	GLL	Back-pack Units	Aug. 28	Aug. 29	Aug. 30	Sep. 4	Sep. 5	Sep. 6	3
2008	No survey								
2009	AECOM	Back-pack Units	Aug. 24	Aug. 25	Aug. 26	Sep. 1	Sep. 2	Sep. 3	3
2010	LRG	Back-pack Units	Aug. 31	Sep. 1	Sep. 2	Sep. 7	Sep. 8	Sep. 9	3
2011	LRG	Back-pack Units	Aug. 30	Aug. 31	Sep. 1	Sep. 6	Sep. 7	Sep. 8	3
2012	No survey								
2013	LRG	Back-pack Units	Aug. 19	Aug. 20	Aug. 21	Aug. 27	Aug. 28	Aug. 29	3

Year	Lead Group	Equipment	Mark Dates			Recapture Dates			Number of Reaches
			U of G	Hanlon	Bond	U of G	Hanlon	Bond	
2014	No survey								
2015	LRG	Back-pack Units	Aug. 25	Aug. 26	Aug. 27	Sep. 1	Sep. 2	Sep. 3	3
2016	No survey								
2017	LRG	Back-pack Units	Aug. 29	Aug. 30	Aug. 31	Sep. 6	Sep. 7	Sep. 8	3
2018	No survey								
2019	No survey[1]								
2020	WSP	Back-pack Units	Sep. 3	Sep. 4	No Survey[2]	Sep. 9	Sep. 10	No Survey[2]	2
2021	No survey								
2022	WSP	Back-pack Units	Sep. 6	Sep. 8	Oct. 4	Sep. 14	Sep. 15	Oct. 13	3
2024	WSP	Back-pack Units	Sep. 5	Sep. 6	Sep 11	Sep. 12	Sep. 13	Sep. 19	3

N/A = Not Available
[1] No survey was completed in 2019 due to the jet fuel spill.
[2] No survey was completed at Bond Tract during the 2020 survey because of permission to access the lands from the GRCA was not granted due to COVID-19 concerns.

Brown trout populations are expressed as fish density (number of fish per hectare) and are calculated using the Petersen Population Estimate (mark/recapture). The population estimates are a reliable method to determine the relative abundance of fish in the survey area. However, the estimates are influenced by various factors including different water levels between mark and recapture runs, experience of the field crew, and proportion of recaptured fish on the second run.

The formula to calculate the fish population estimate is: $N = MC/R$

Where:

N = estimate of population size

M = the number of fish marked during the first survey run

C = the number of fish captured on the second run including both marked and non-marked fish

R = the number of marked fish that are recaptured

This formula is widely used and is based on several assumptions including (from Everhart *et al* 1975):

- That marked fish, during the period between release and recapture suffer no greater mortality than unmarked fish;
- That marked fish do not emigrate further than unmarked fish;
- That no marks are lost or overlooked during recapture;
- Marked and unmarked fish are caught at the same rate;
- That marked fish are randomly distributed; and

- There have been no additions to the population between the mark and recapture run.

Since the number of marked fish that are recaptured (R) is the denominator, as the number of marked fish that are recaptured increases, the population estimate actually decreases. The effect of varying recapture rates on the population estimate is explored further in the results section.

Results of the electrofishing survey, population estimate calculations, and historical data are included in **Sub-Appendix B** of this report.

2.4 Redd Survey

Trout redds have been counted in the study area since 1983. Although the staff have changed over the years, the redd surveys have continued to be conducted by experienced fisheries ecologists who are familiar with the Study Area as well as the specific habitat requirements for trout spawning.

The redds were recorded on WSP owned spawning survey field sheets and compared to historical data. A trout redd is an obvious nest or disturbance in the substrate. WSP takes the assessment a step further, providing more detail in regard to the spawning evidence. A *confirmed redd* is a disturbance in the substrate and a fish visually observed in the general vicinity; a *probable redd* has substrate disturbance but no fish visually observed; and a *scrape* is a less defined or small clearing of disturbed substrate with no fish visually observed. Brown trout redds are typically elongated scars in the streambed, characterized by a scour or hole in the substrate followed by a mound of gravel at the downstream end. Multiple redds have several scars and mounds created by more than one spawning pair. Brook trout redds are smaller, rounder, and less obvious than Brown trout redds.

3.0 RESULTS

3.1 Water Quality

The water quality monitoring program provides a snapshot of existing water quality conditions. Data for 2024 is provided in Table 2. The entirety of the data from 1993 to 2024 for water chemistry is provided in Appendix A of this report. Overall, the results indicate that water quality is similar within the Study Area, but the data does suggest possible influences from road salt and agricultural practices.

Table 2: Mill Creek Water Quality November 21, 2024

	SWM1 Hwy 401	SMW2 (Boundary)	SWM3 Pond Creek	SMW4 Galt Creek	PWQO[1]	RDL[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.29	8.34	8.34	8.30	**6.5-8.5**	**N/A**
Conductivity (mS/cm)	0.73	0.79	0.7	0.87	**-**	**0.001**
Alkalinity (Total mg/L as Ca CO_3)	270	270	270	270	**-**	**1.0**
Chloride	56	72	37	86	**-**	**1.0**
Nitrate (mg/L)	0.49	0.91	4.13	2.70	**See[3]**	**0.10**
Nitrite (mg/L)	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	**<0.1[4]**	**0.010**
Total Ammonia-N	<0.050	<0.050	<0.050	<0.050	**1.20**	**0.050**
Orthophosphate	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	**-**	**0.010**

	SWM1 Hwy 401	SMW2 (Boundary)	SWM3 Pond Creek	SMW4 Galt Creek	PWQO[1]	RDL[2]
Total Phosphorus	<0.020/ND	<0.020/ND	<0.020/ND	0.020	**0.030**	**0.020**
Total Organic Carbon	6.7	6.9	6.6	7.4	-	**0.40**
Total BOD	<2/ND	<2/ND	<2/ND	<2/ND	-	**2**
Total Chemical Oxygen Demand	26	27	29	30	-	**4.0**
Total Suspended Solids	<10/ND	<10/ND	17	<10/ND	-	**10**
Fecal Coliforms (CFU/100mL)	20	270	60	100	**100**	**10**
Total Coliforms (CFU/100mL)	640	490	910	270	-	**10**
Escherichia coli	60	250	10	50	-	**10**

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] RDL = Reportable Detection Limit
[3] concentrations that stimulate prolific weed growth should be avoided.
[4] federal guidelines (CCREM)
N/A = Not Applicable ND = Not Detected

In 2024, the fecal coliform count ranged from 60 to 270 CFU/100 mL with one result exceeding the Provincial Water Quality Objective (PWQO) of 100 CFU/100mL. The fecal coliform count reported a decrease from 2022 to 2023, however sampling in 2024 indicated an increase among all samples. Specifically, the 2024 sampling has shown the highest concentrations ever recorded with 270 CFU/100 mL at the SWM2 station, located downstream of the University and Hanlon reaches. High fecal coliform reports are usually associated with sewage or animal waste contamination. The sampling site is located at the Concession 2 road crossing, downstream of a residential property and upstream of an agricultural field. It is possible that the increased fecal coliform levels are a result of contamination from one of these three sources (road spill, failure or residential sewage storage, or use of manure on agricultural fields).

For nitrate, there is no PWQO for the protection of freshwater biota, as it is relatively non-toxic to fish. There is a federal (Environment Canada) water quality guideline for nitrate of 12 mg/L and the Ontario Drinking Water Standard for nitrate is 10 mg/L. The concentrations of most of the water quality parameters are similar between the upstream (SWM1) and downstream (SWM2) limits of the Mill Creek property and follow concentration trends from previous years. The presence of nitrate in the two tributaries can be attributed to agricultural runoff in the watershed. In 2024, the highest nitrate level was observed at SWM3 (Pond Creek) with a value of 4.13mg/L, which was lower than recent years (4.35 mg/L in 2021 and 5.02 mg/L in 2022) and is well below federal and provincial guidelines. In 2022 SWM4 noted an elevated level of nitrate at 4.72 mg/L, however in 2024 levels have decreased to 2.70 mg/L, which is similar to 2021 and 2023 values.

Like previous years, nitrite was not detected in 2024 (<0.010 mg/L).

Phosphorus levels in Mill Creek have varied historically from less than the analytical detection limits to exceeding the PWQO in different years. Total phosphorus was below detection limits (0.020 mg/L) at all sampling stations in 2024, remaining below PWQO limits (0.030 mg/L for streams).

The Canadian water quality guidelines for chloride for the protection of freshwater life are 640 mg/L (short term exposure of < 96 hrs) and 120 mg/L for long term or indefinite exposure (CCME, 2012). Chloride and conductivity were higher in Galt Creek (SWM4) relative to the other three stations which is consistent with previous years. The

2024 results show chloride concentrations for the four sampling stations in Mill Creek ranged from 37 mg/L to 86 mg/L. Therefore, salt concentrations measured in Mill Creek are well below levels expected to impact fisheries.

The basic water chemistry of Mill Creek appears relatively unchanged over the past 30+ years, however, chloride and conductivity levels in Mill Creek appear to have gradually increased during the past two decades (Figure 2). Prior to 1999, chloride levels in Mill Creek were consistently below 40 mg/L but are now routinely above 50 mg/L, with some recent values above 80 mg/L. Sampling has been conducted in November and December in recent years. It is likely that road salt has already been applied by this time and these changes are likely due to the influence of road salts applied within the watershed and entering the water system. Therefore, stream chloride and conductivity values could be influenced by seasonal conditions and time of sampling.

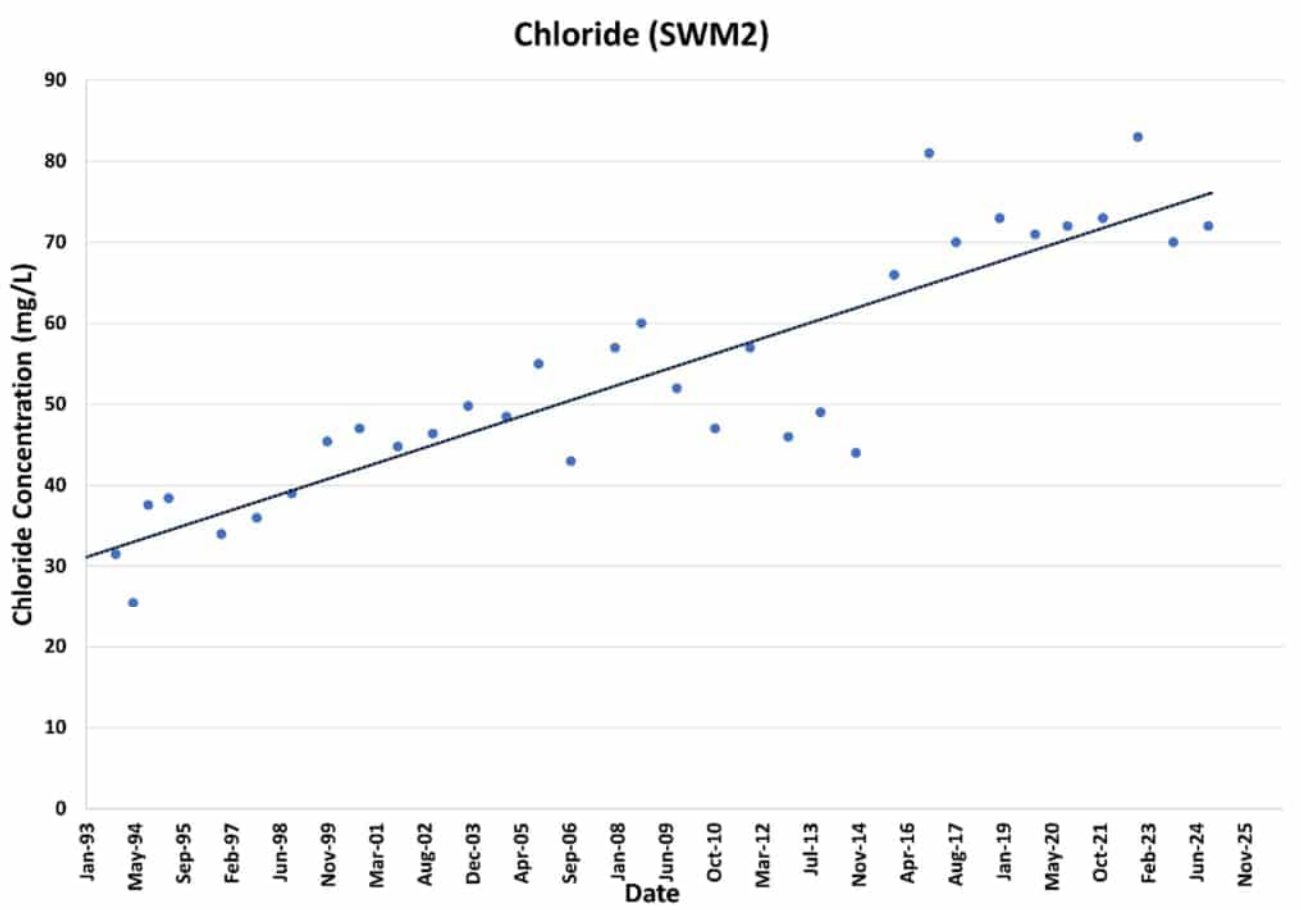

Figure 2: Historical Chloride Values in Mill Creek at SWM2 (1993-2024)

Conductivity values (Figure 3) in Mill Creek are relatively high (typically greater than 0.65 mS/cm) for a surface stream indicating the high proportion of groundwater in the system. The higher conductivity in Galt Creek (SWM4) further emphasizes the strong groundwater influence on this small tributary.

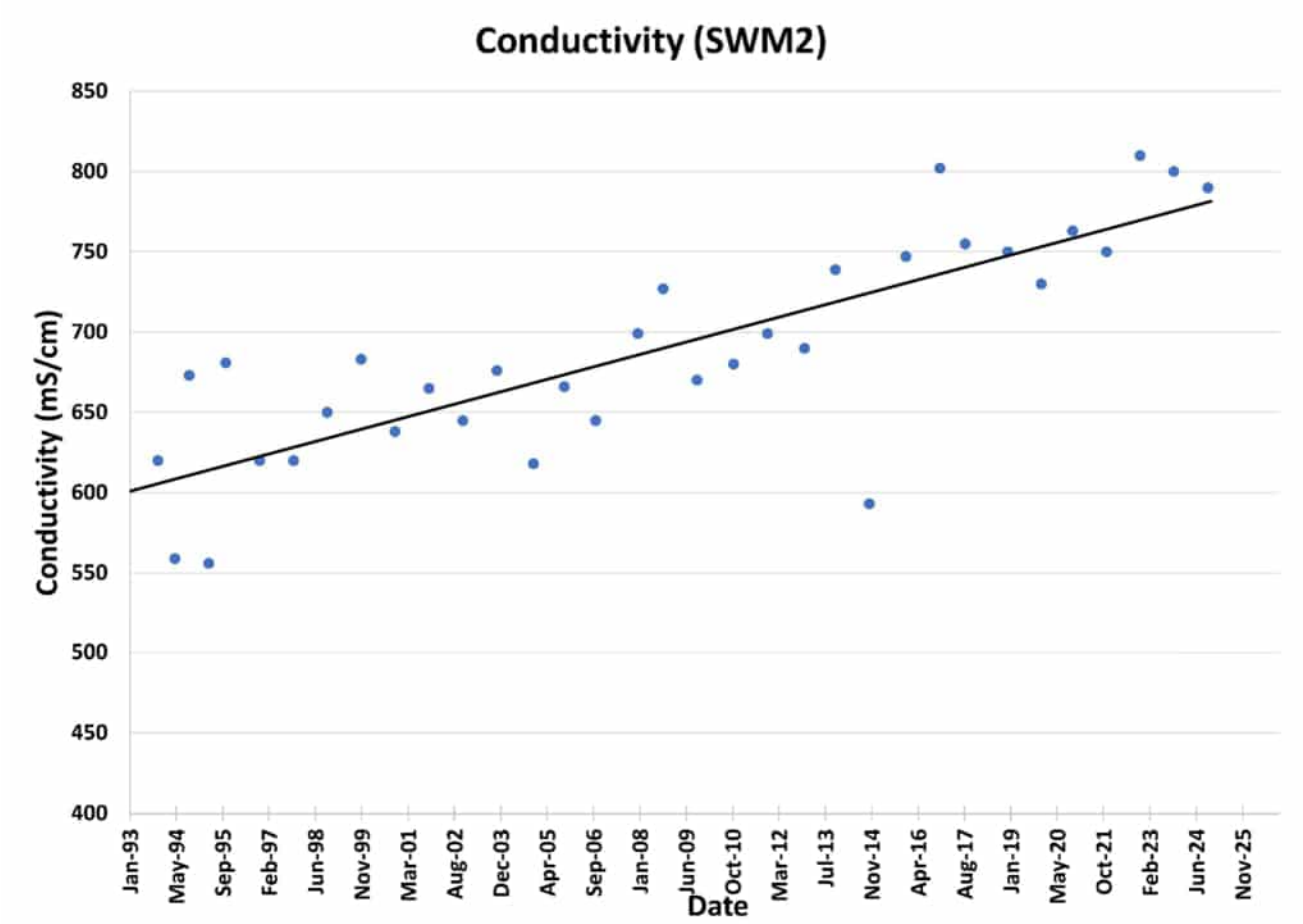

Figure 3: Historical Conductivity Values in Mill Creek at SWM2 (1993-2024):

3.2 Surface Water Temperature

Water temperatures in the main channel of Mill Creek (SWM1 and SWM2) for the summer of 2024 are shown in Figure 4 along with critical trout temperatures. The maximum recommended tolerable temperature for Brown trout is considered to be 26.8°C (Raleigh et al, 1986).

The maximum summer water temperature recorded in Mill Creek at the monitoring stations in 2024 was 24.35°C at SWM1 on June 19 at 17:00 hours (Figure 4). The maximum surface water temperature in 2024 occurred during a six-day (June 18 to June 23, 2024) heat wave where maximum air temperatures exceeded 30°C and peaked at 36°C on June 20, 2024. As a comparison, the highest water temperature ever recorded in the Study Area was 27.9°C in 2002. Water temperatures relative to air temperatures are discussed in further detail in Technical Appendix A. The main branch of Mill Creek within the study area did not exceed the upper tolerable temperature for Brown trout (26.8°C) in 2024 (Raleigh 1982). However, the maximum temperature which Brook trout can tolerate is 24°C (Raleigh 1982) and this was exceeded on June 19 at SWM1 and was very close to being matched on June 19 at SWM2 (Figure 4).

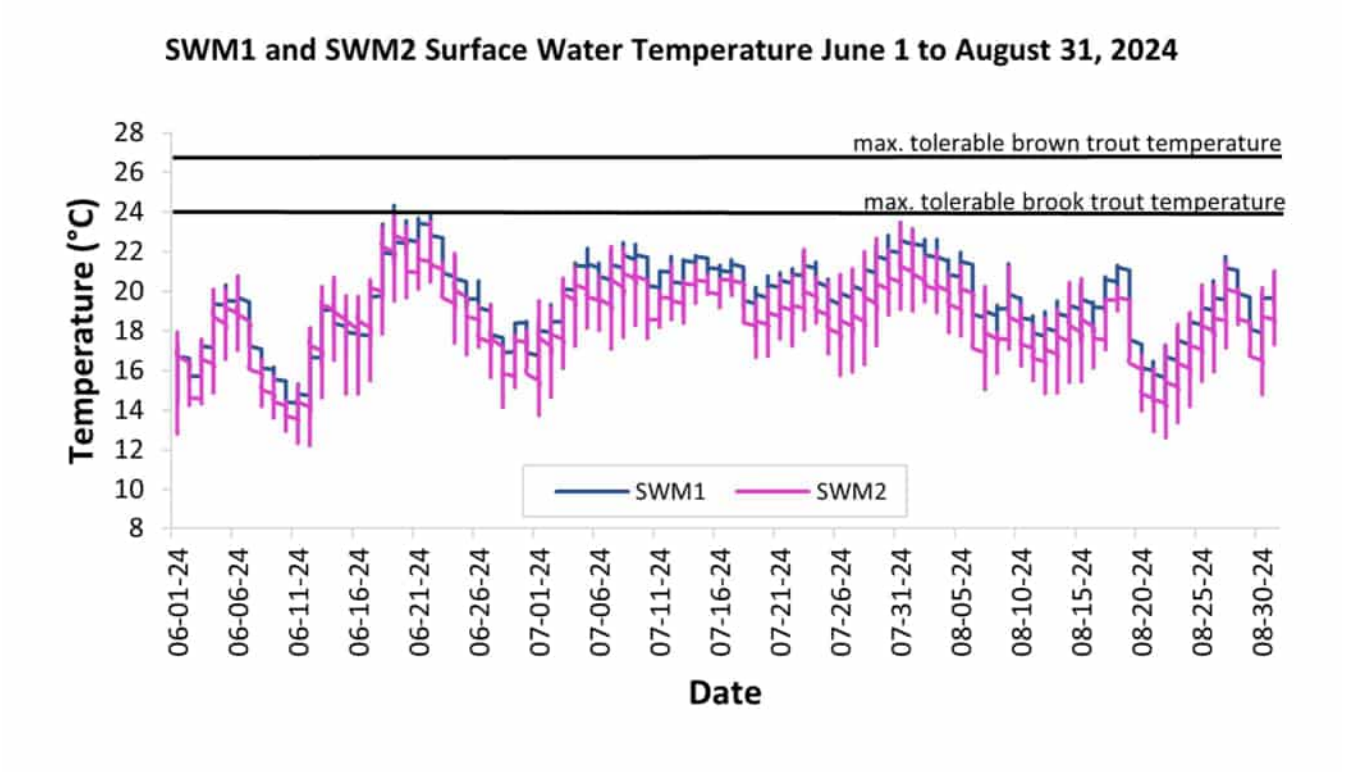

Figure 4: Thermographs from SWM1 and SWM2, for June 1 to August 31, 2024

Stream water temperatures have traditionally been cooler at the downstream SWM2 station compared with SWM1 and this trend continued in 2024. When the maximum water temperature occurred at SWM1 (24.35°C: June 19, 17:00), the temperature at SWM2 was 0.82°C lower (Figure 5). The maximum summer temperature at SWM2 in 2024 was 23.85°C, on June 19, at 20:00. The greatest temperature difference between SWM1 and SWM2 during the summer of 2024 occurred on June 12 at 12:00 when SWM2 was 2.29°C cooler than SWM1. Surface water temperatures are recorded as cooler at SWM2 than SWM1 due to groundwater input, inflow of the two coldwater tributaries, and good shade from riparian vegetation within the University of Guelph reach down to Concession Road 2.

The maximum summer temperatures in the two small tributaries were only 20.05 °C (SWM3) and 19.12 °C (SWM4). Thus, through the conveyance from the coldwater tributaries, this reach of Mill Creek continues to protect and enhance the coldwater attributes of the stream and provides good habitat for Brown trout and Brook trout.

The continuous temperature recorders also illustrate the effect of diurnal solar warming on Mill Creek as the water temperatures gradually rise during the day and cool off at night (Figure 5 and 6). At SWM1 the temperature fluctuation was 2.54°C between June 19 and June 20, following the maximum temperature (Table 3). At SWM2 the temperature fluctuation was 4.11°C. At SWM3, the temperature fluctuation was 1.54°C on July 16 and July 17, while SWM4 temperature fluctuation was 1.92°C on July 17 to July 18 (Figure 6). The smaller temperature fluctuations in SWM3 and SWM4 compared to larger fluctuations in SWM1 and SMW 2, support the conclusion that the temperatures at SWM3 and SWM4 are mainly controlled by groundwater inputs.

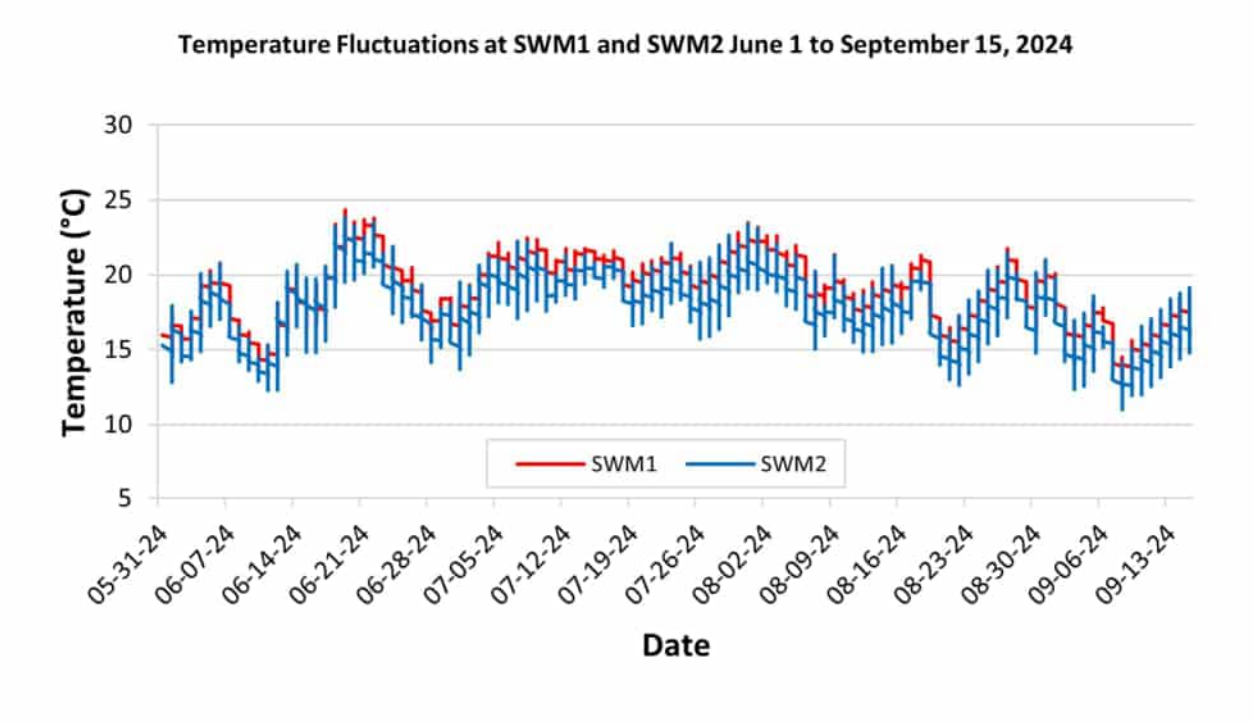

Figure 5: Diurnal Temperature Fluctuations from June 1 to September 15, 2024, at SWM1 and SWM2

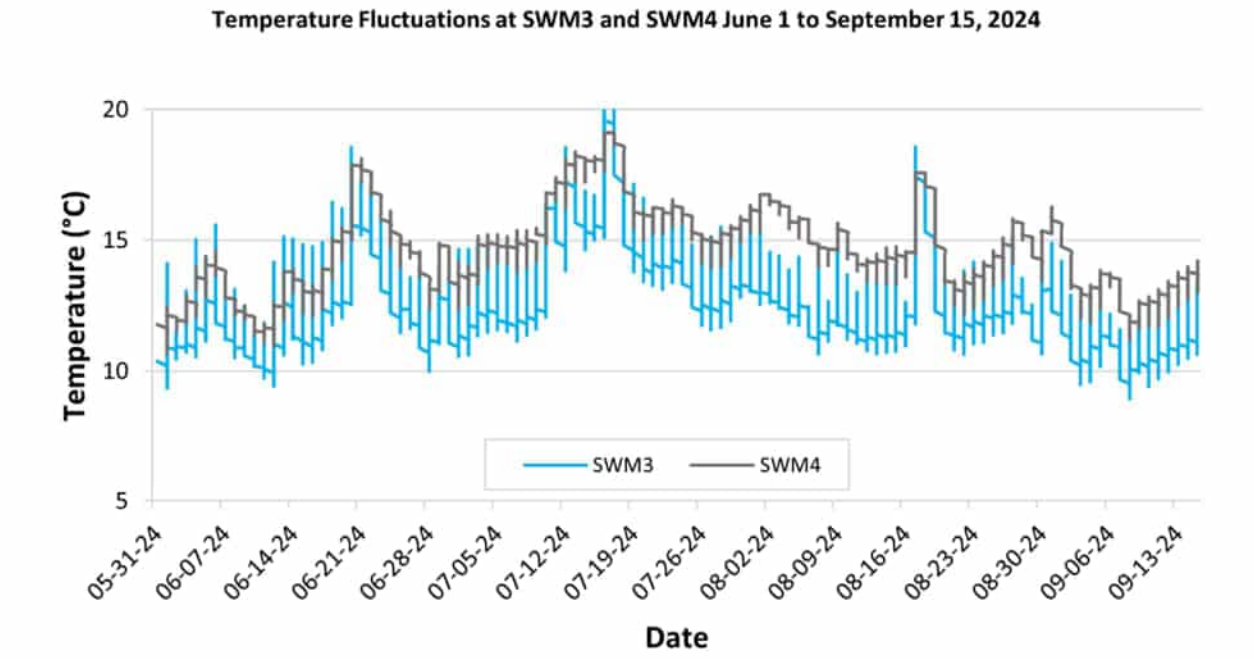

Figure 6: Diurnal Temperature Fluctuations from June 1 to September 15, 2024, at SWM3 and SWM4

Table 3: Diurnal Temperature Difference Following Maximum Recorded Temperature at Each Surface Water Monitoring Station in 2024

Station	Summer Maximum			Post-Maximum Low			Fluctuation[a] (°C)
	Temp. (°C)	Date	Time	Temp. (°C)	Date	Time	
SWM1	24.35	June 19	17:00	21.81	June 20	8:00	2.54
SWM2	23.85	June 19	19:00	19.74	June 20	9:00	4.11
SWM3	20.05	July 16	16:00	18.51	July 15	9:00	1.54
SWM4	19.12	July 17	19:00	17.20	July 15	13:00	1.92

[a] Difference between summer maximum and minimum temperature the following day

The maximum surface water temperatures recorded at all four monitoring locations within Mill Creek since 1983 are illustrated in Figures 7 and 8, respectively. Surface water data were collected manually prior to 1997, and true maximum temperatures may not be represented by the dataset, since data were not recorded on a continual basis (sampling events were selected according to weather conditions). In addition, temperatures were typically recorded manually between noon and 15:00, but maximum temperatures can now be observed after 16:00. Therefore, while water temperatures appear higher since 1998, maximum temperatures prior to 1997 may actually have been greater than those presented in Figures 7 and 8.

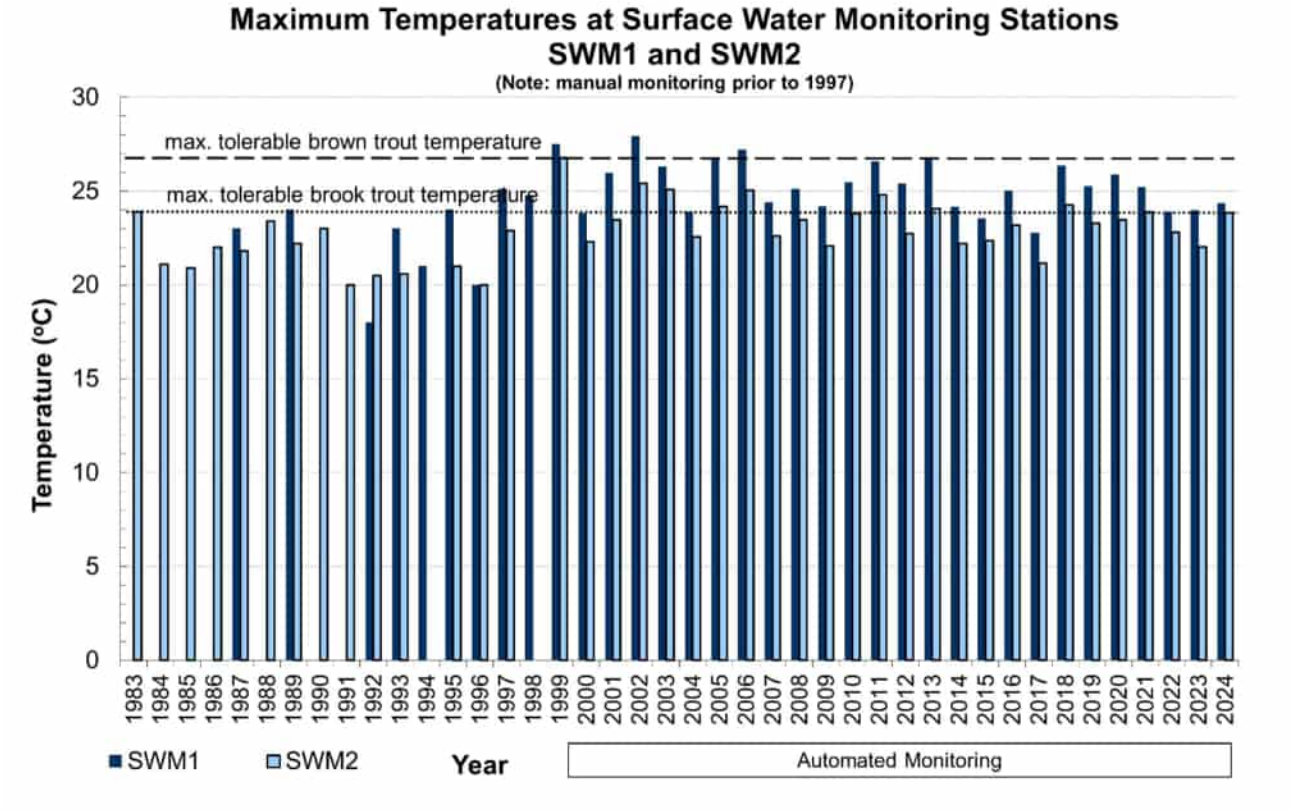

Figure 7: Historical Maximum Mid-Summer Water Temperatures in Mill Creek (1983 to 2024) at SWM1 and SWM2

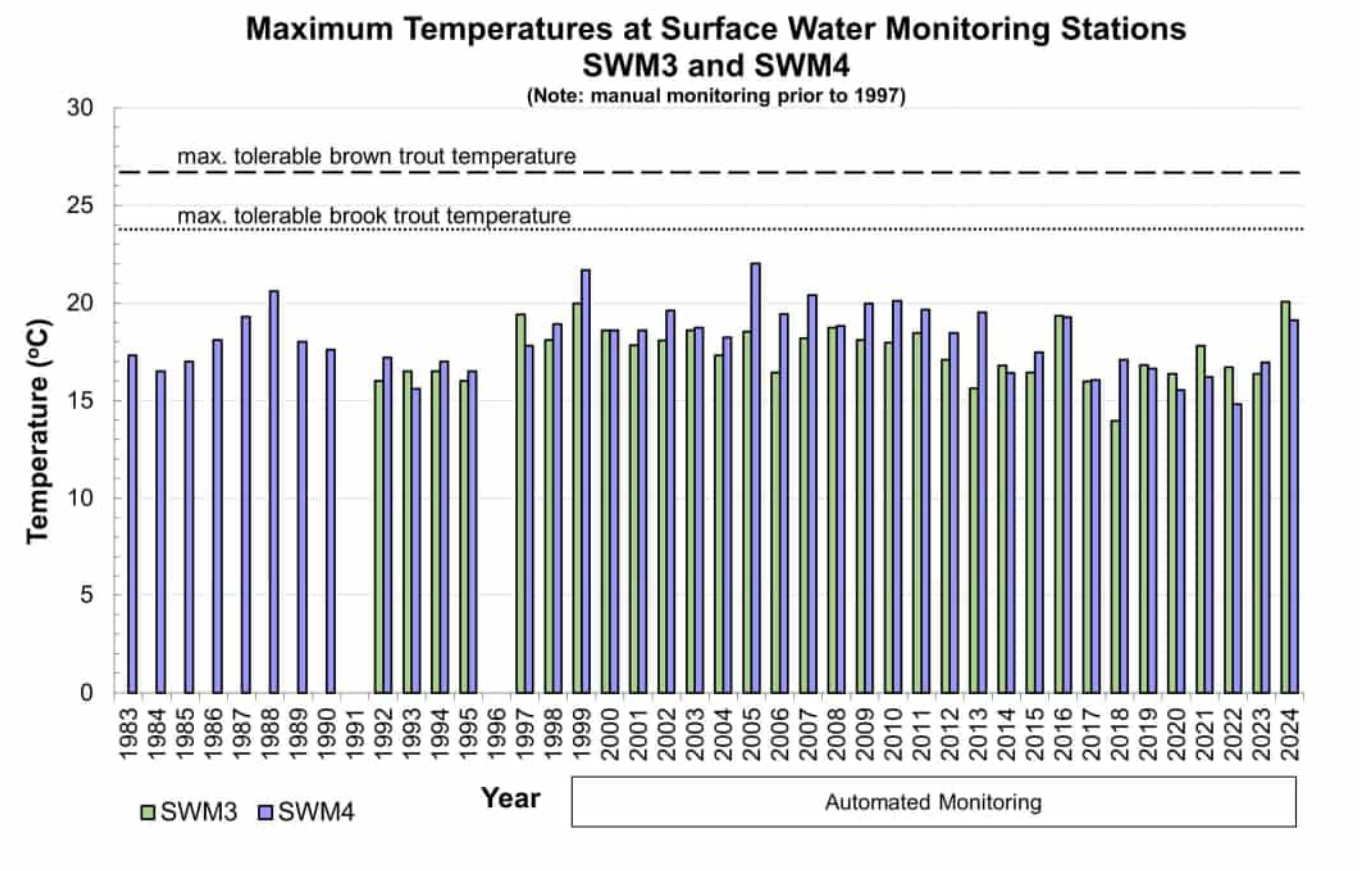

Figure 8: Historical Maximum Mid-Summer Water Temperatures in Mill Creek (1983 to 2024) for SWM3 and SWM4

3.3 Fish Community Surveys

3.3.1 Brown Trout Population Estimates

The population estimates for Brown trout can be influenced by differences in stream flow between sampling events and the proportion of marked fish that are recaptured as discussed in the following sections. Detailed results are provided in **Sub-Appendix B**.

Changes in flow between the mark and recapture runs, which are separated by approximately one week, can significantly affect fishing efficiency and thereby affect the population estimates. In general, there are higher capture rates with lower stream flows. Water levels were similar between the mark and recapture runs in 2024, which is positive as it keeps the capture efficiency similar.

The population estimate relies on re-capturing a certain proportion of marked fish. The general target is to recapture 30% or more to provide greater confidence in the estimate. Overall, the proportion of marked fish that were recaptured in 2024 (for adult and young of year combined) were 36.7% for the University reach, 27.4% for the Hanlon By-pass reach, and 20.3% for the Bond Tract reach (Table 4). Historical recapture rates are provided in **Sub-Appendix B**.

Table 4: Recapture Rates from the 2024 Electrofishing Survey

Reach	Young-of-Year (YOY) Recapture Rate	Adult Recapture Rate	Overall Recapture Rate
University of Guelph	24%	49.3%	36.7%
Hanlon	0%	54.7%	27.4%
Bond Tract	0%	40.6%	20.3%

The recapture rate greatly influences the estimated fish population. As the proportion of recaptures increases, the estimated fish population decreases. Having a high proportion of recaptures increases confidence in the population estimate but does tend to skew the estimates downward, therefore an overall recapture rate of 25% should yield an accurate population estimate with relatively high confidence. A lower proportion of recaptures in Bond Tract, in this case 20.3% overall, decreases confidence in the population estimate but does tend to skew the estimates upward.

Brown trout population data for young of the year (YOY) and adult (age 1+ and older) fish from 1989 to 2024 are summarized below for the University of Guelph, Hanlon By-pass, and Bond reaches. For the purposes of this report, all fish aged 1+ or greater are considered adults. Fish surveys were not conducted in 1996, 2002, 2008, 2012, 2014, 2016, 2018, 2019, 2021 or 2023.

3.3.2 University of Guelph Reach

During the initial mark run, a total of 207 Brown trout (161 adult, 46 YOY) were captured and marked (fin-clipped) within the University of Guelph reach. During the recapture run, a total of 175 Brown trout were captured (150 adults, 25 YOY). Of these, 80 were recaptured fish (74 adult, 6 YOY) providing a moderate percentage (45.7 %) of recaptured fish. The relative proportion between the mark and recapture events was 49.3% for adults and 24% for YOY. The data gathered from the mark and recapture surveys were then used to estimate trout population numbers which are expressed as the number of fish per hectare (Figure 9 and Figure 10). Expressing the population estimates as number of fish per ha takes into account the different lengths of the study reaches to provide numbers that are more directly comparable.

The estimated number of YOY trout is lower than some recent sampling years at 341 fish/hectare but within the historical range observed (Figure 9). The number of adults per hectare in 2024, 415 fish/hectare, is also lower than recent sampling years but again within the historical range observed (Figure 9). Although the population estimates are lower, the fluctuation in estimated size is expected and within historic observations for cyclical patterns in population numbers.

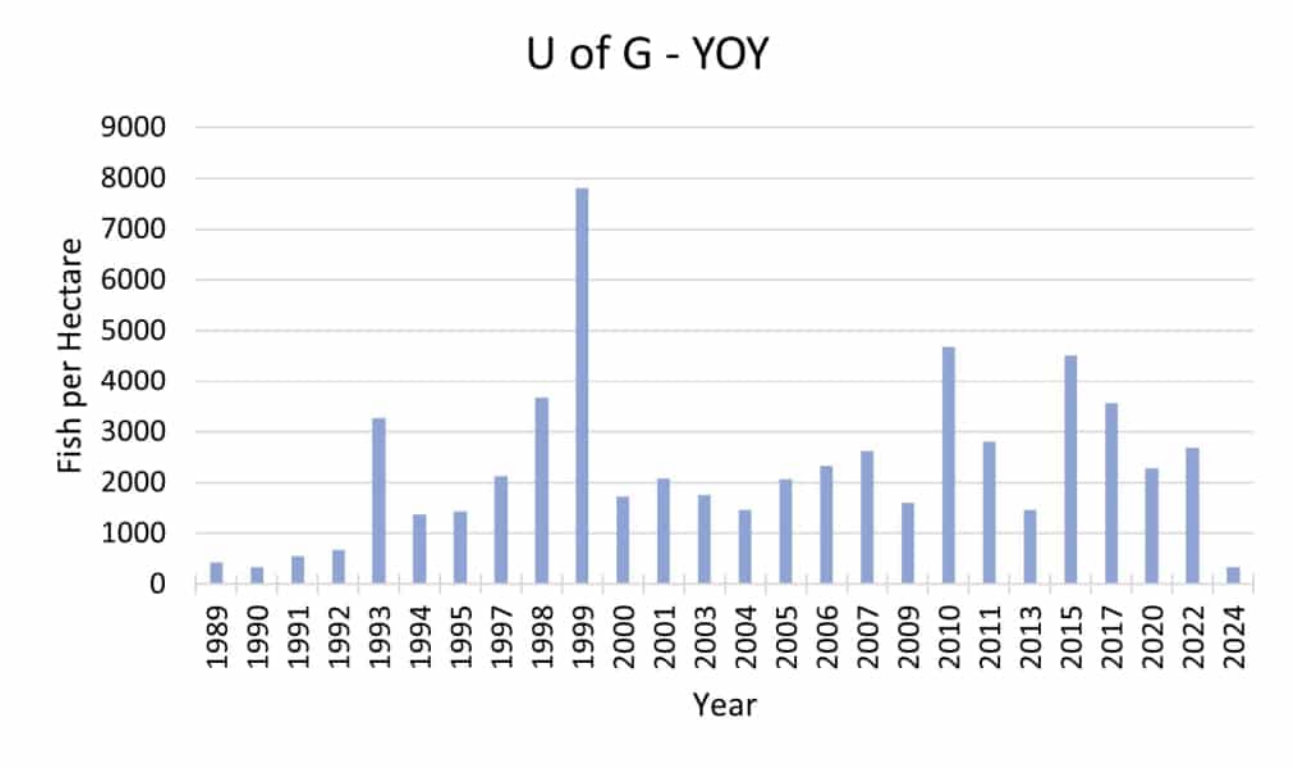

Figure 9: YOY Brown Trout Population Estimates - University of Guelph Reach

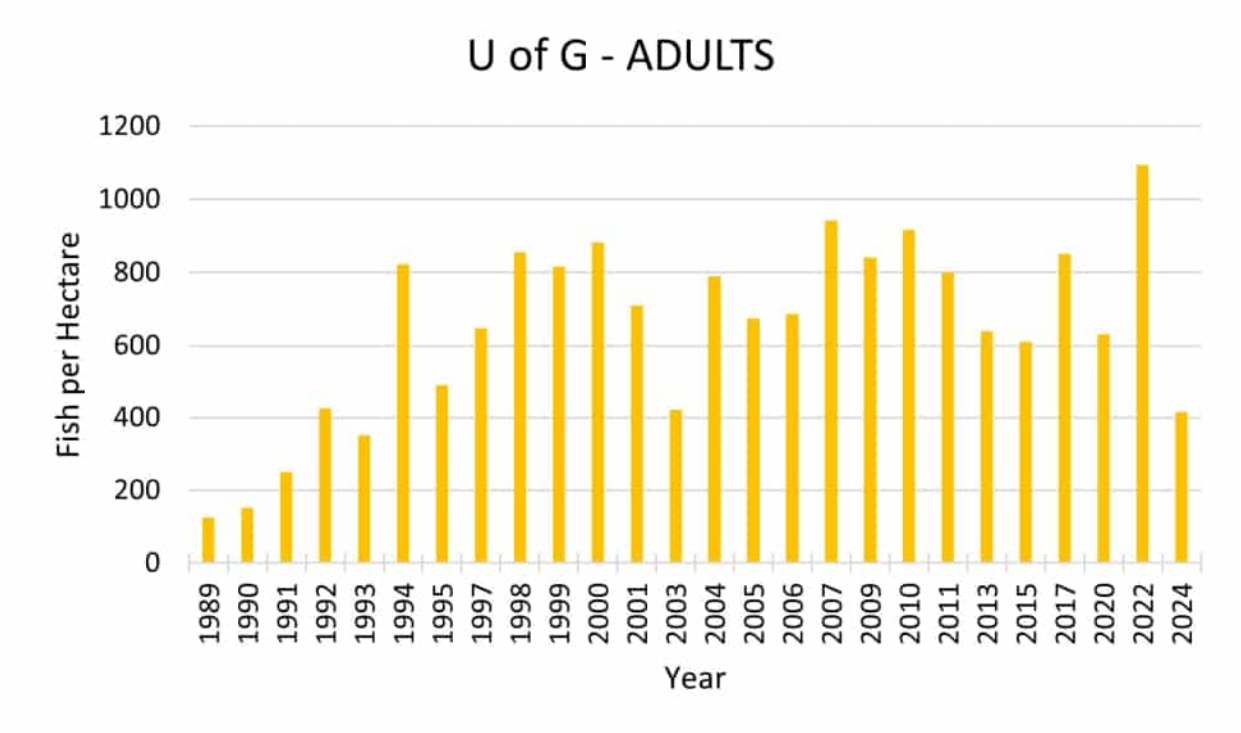

Figure 10: Adult Brown Trout Population Estimates - University of Guelph Reach

3.3.3 Hanlon By-pass Reach

A total of 99 Brown trout were captured during the mark run comprised of 85 adults and 14 YOY. During the recapture run, 84 Brown trout were captured (75 adults, 9 YOY), of which 41 were recaptured (41 adult, 0 YOY). The recapture rate of the adults in this reach was moderate at 54.7%, with no recapture for YOY.

The estimated number of YOY, 427 fish/hectare, is the lowest number since 2004 but within the historical range observed (Figure 11). Similarly, the estimate for adults, 197 fish/hectare, is the lowest number since 2005 (Figure 12). Although the YOY population estimates are lower than recent years, the fluctuation in estimated size is within historic observations of population fluctuations.

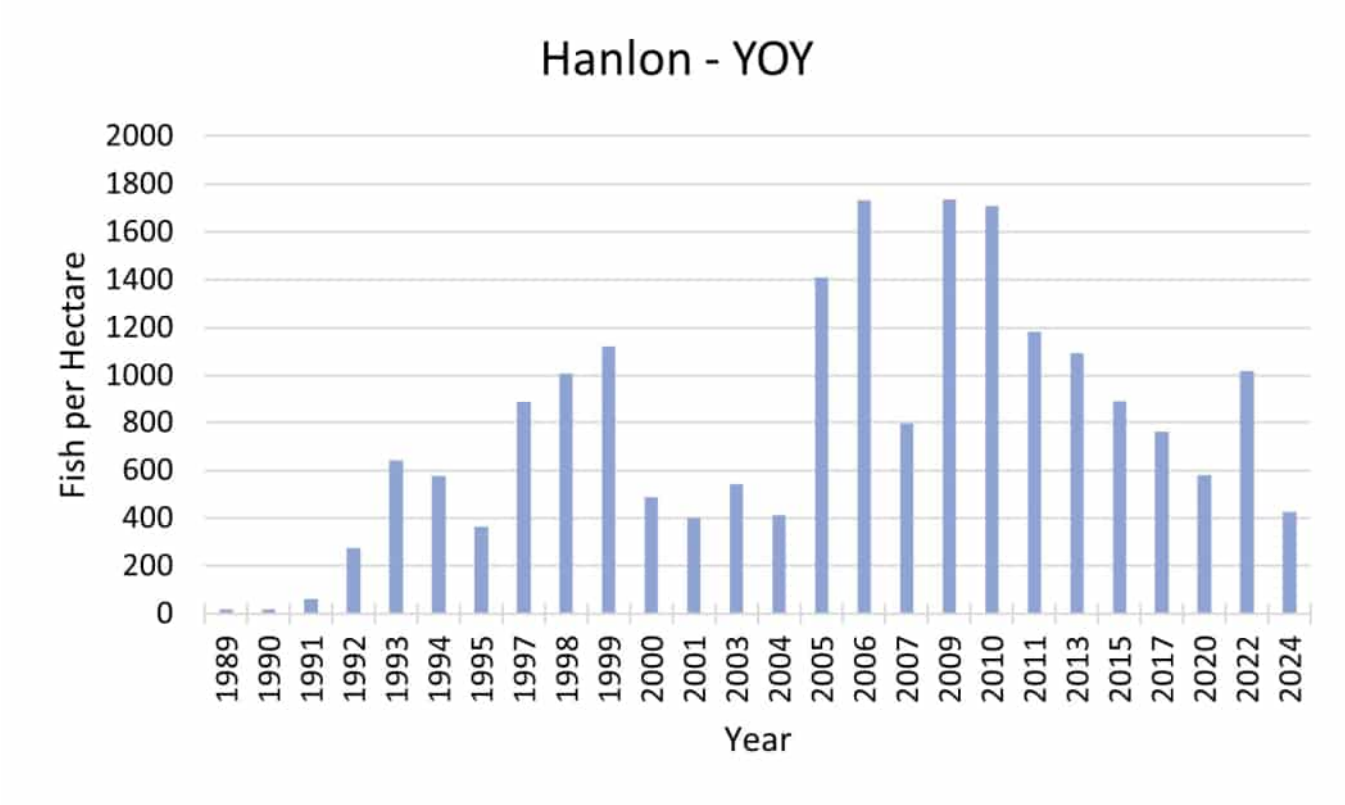

Figure 11: YOY Brown Trout Population Estimates – Hanlon Bypass Reach

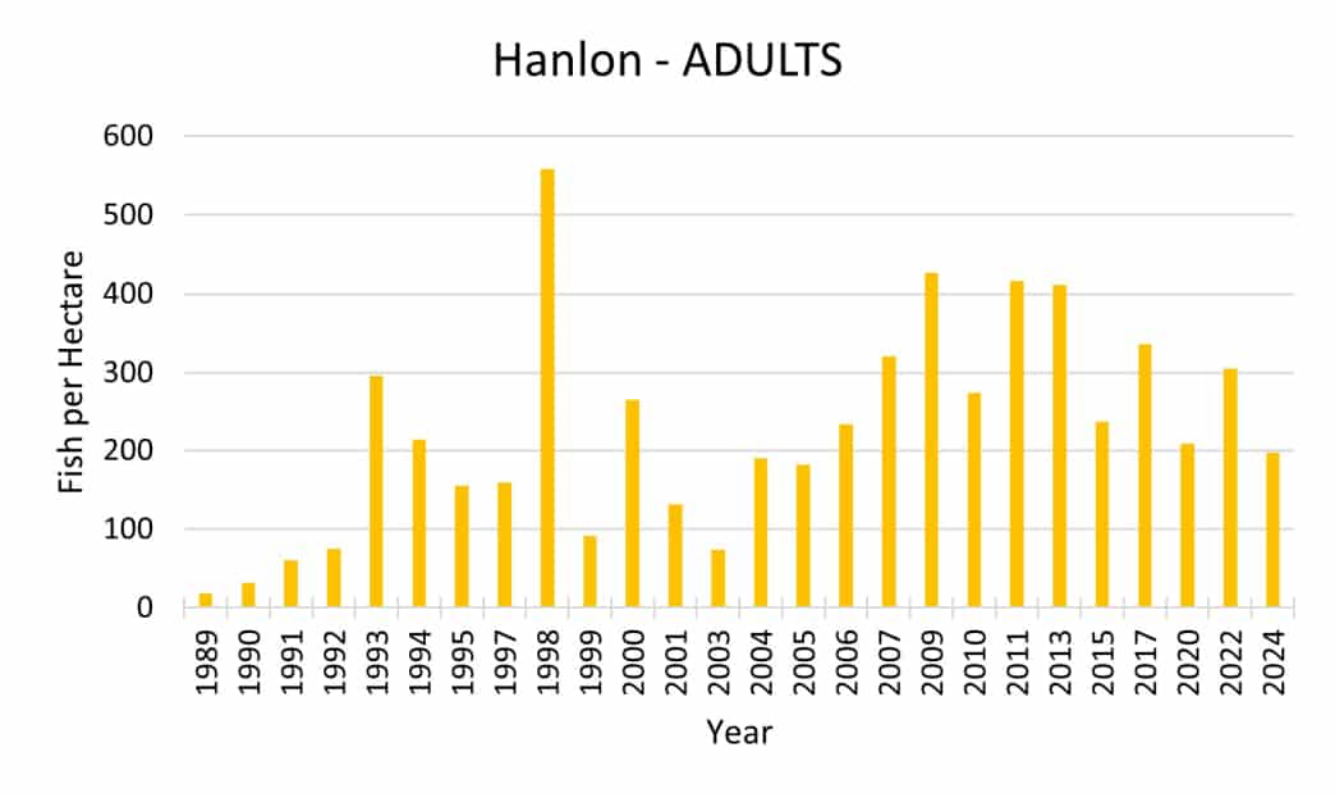

Figure 12: Adult Brown Trout Population Estimates – Hanlon Bypass Reach

3.3.4 Bond Tract Reach

In 2024, 30 adult brown trout were captured on the mark run and a total of 32 adults were caught on the recapture run. Of these 32 adults, 13 were recaptured fish representing a recapture rate of 40.6%. Following analysis, the estimated number of adult trout per hectare is 131 fish/ha which is similar to previous years. One single YOY was captured and marked during the mark run and 3 YOY were captured during the recapture run, none of which were recaptures. Therefore, a conservative estimate of the population is 7 YOY per hectare (Figure 13), which is one of the lowest recorded estimates during sampling years but is directly linked with the low number of YOY fish caught this year.

The Bond Tract continues to provide a poor reference site compared with the University and Hanlon reaches due to the difference in the nature of the habitat. The Bond Tract is much deeper and contains little or no spawning and nursery habitat like the two upstream reaches. In addition, it is very likely that the Bond Tract is heavily fished by local anglers which could also remove a significant proportion of the adult trout population. The reach is much larger/wider and deeper then the other two reaches which may also contribute to fish being missed/escaping during electrofishing (i.e. a bias for larger fish to be targeted over smaller fish).

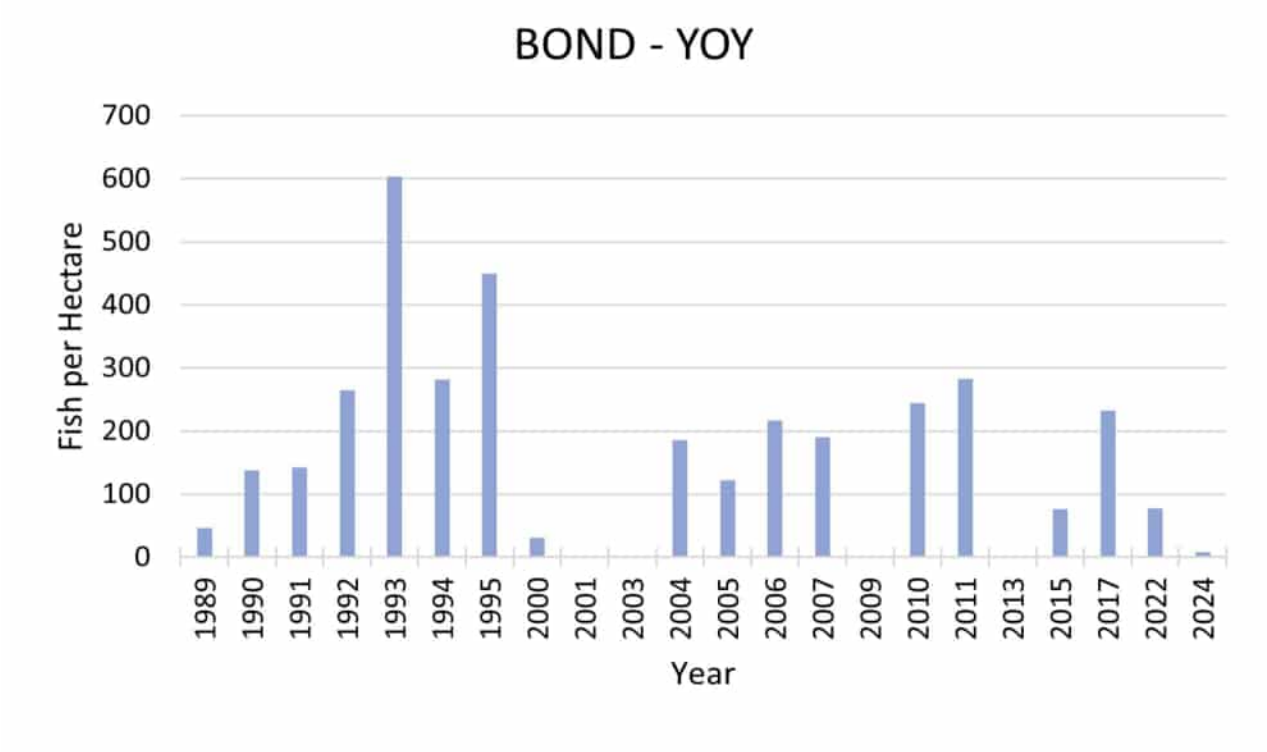

Figure 13: YOY Brown Trout Population Estimates – Bond Tract Reach

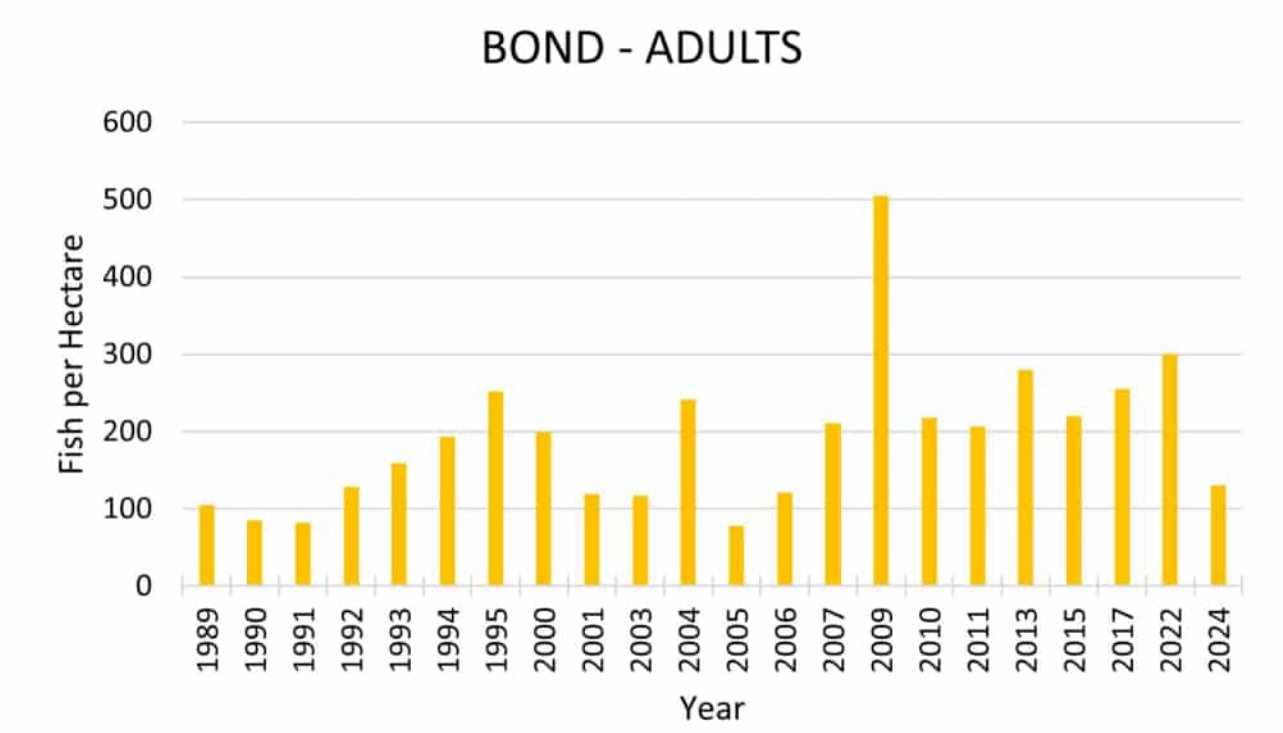

Figure 14: Adult Brown Trout Population Estimates – Bond Tract Reach

3.3.5 Stream Flow During Fish Survey Period

As mentioned above, fish population estimates by electrofishing are subject to a number of variables that can influence the results. However, we have tried to standardize our methodology by using the same types of equipment, dates, and experienced staff from year to year, however there was a staffing turnover in 2020 with WSP taking over the mark-recapture sampling. Water level can differ between years as well as between mark and recapture runs. During periods of lower flow, the number of fish present may be more susceptible to capture, although the actual numbers could be lower if the fish have moved elsewhere. A higher proportion of recaptured fish increases our reliability and confidence in the population estimate; however, it also means a lower population estimate.

In 2024, water levels during the electrofishing survey were comparable to previous electrofishing surveys (2011, 2013, and 2015, 2017, 2020 and 2022) with the exception of 2017 when flows were higher due to rainfall events. Water levels in 2024 remain typical, with no extreme low or high flow rates. Daily average flow rates during the electrofishing survey are presented in Table 5 below. Flows were similar during the mark and recapture runs, thereby increasing the confidence in the results between the two surveys.

Table 5: Daily average flow rates at SWM1 during population survey, September 2024

Mark Run			Recapture Run		
Reach	**Date**	**Flow (m3/s)**	**Reach**	**Date**	**Flow (m3/s)**
University	Sep. 5, 2024	0.092	University	Sep. 12, 2024	0.085
Hanlon	Sep. 6, 2024	0.091	Hanlon	Sep. 13, 2024	0.084

3.3.6 Pre Versus Post- Extraction Brown Trout Population Estimates

The number of YOY and adult Brown trout are higher throughout the study area since extraction began compared to pre-operational (before 1995) population estimates. A statistical analysis of Brown trout populations in the University of Guelph and Hanlon reaches was performed to compare population size prior to extraction below the water table to the population after extraction. Both YOY and adult (age 1+) populations in each reach were considered. The available database was divided into pre-operational (1983-1994) and post-operational (1995-2024) periods. Although topsoil stripping began in 1993, extraction below the water table began in spring of 1995. Therefore, 1995 was considered as the starting timeframe for evaluation of potential effects of extraction below the water table on fisheries' resources in the area.

A one-tailed t-test (assuming unequal variance) was performed to determine if there has been a significant change in Brown trout population size since 1995. The test calculates whether the pre-operational period population estimates are greater than or less than the post-operational period. The test calculates a probability value (P value) or percent probability of incorrectly concluding a statistical significance. For this analysis, a confidence level of 5% was used, therefore any P value less than 0.05 indicates a significant difference between the two periods.

Adult and YOY populations were significantly ($P<0.05$) greater in the University of Guelph reach during post-operational years (Table 6). The average number of adult fish (age 1+) increased from approximately 354 per hectare during the pre-operational period to 736 per hectare during the post-operational period. The average

number of YOY also increased significantly during post-operational period (2649 per hectare) compared with the pre-operational numbers (1104 per hectare) (Table 6).

Similarly, the mean number of YOY populations were significantly (P<0.05) greater in the Hanlon By-pass reach during post operational years. The Hanlon By-pass reach had an average of 929 individuals per hectare during post-operation, compared to 264 individuals per hectare pre-operation (Table 6). Adult populations have also remained higher post-operation at 259 individuals compared to the pre-operation periods with 116 and 259 individuals.

This analysis indicates there has been no decrease, and in fact, the Brown trout population has generally increased since the 1995 commencement of aggregate extraction below the water table.

Table 6: Statistical Comparison of Brown Trout Population Size in Mill Creek Before and After Aggregate Extraction

Statistic	Pre-Operational Mean (SE)	Post-Operational Mean (SE)	P Value
University of Guelph			
YOY per ha	1104.0 (457.2)	2649.1 (361.1)	0.0106
Age 1+ per ha	354.0 (104.7)	735.7 (39.4)	0.0063
Hanlon By-Pass			
YOY per ha	264.3 (115.7)	928.6 (101.5)	0.0004
Age 1+ per ha	116.3 (46.0)	258.7 (27.9)	0.0131

SE = Standard Error

3.3.7 Trout Population Characteristics

3.3.7.1 Fork Length Distribution

The size of fish in an area and relative proportion of age/size classes provides some information on the relative community structure and health of the population. Ideally there will be a wide range of size classes represented in the population, with a higher proportion of younger fish. Fork length distributions from fish measured during the mark run of the 2024 population survey are illustrated in Figure 15 for the University, and in Figure 16 for the Hanlon stations. Note the differences in vertical scale between the graphs.

Within the University and Hanlon stations, the number of small (less than 10 cm) Brown trout was high. The YOY year class is easily distinguished. In previous years a comparison between these two stations shows YOY Brown trout in the University reach were slightly smaller than those in the Hanlon reach, however in 2024 YOY caught at both stations were of similar size. The most dramatic differences between the community structure at the Bond Tract and the other two stations, are the significantly lower number of YOY brown trout and the greater number of relatively large fish (over 30 cm long) at the Bond Tract. There are areas of the Bond Tract that are significantly deeper than any areas in the University and Hanlon reaches, which provide excellent habitat for large brown trout, as well as little spawning or nursery habitat present in this reach.

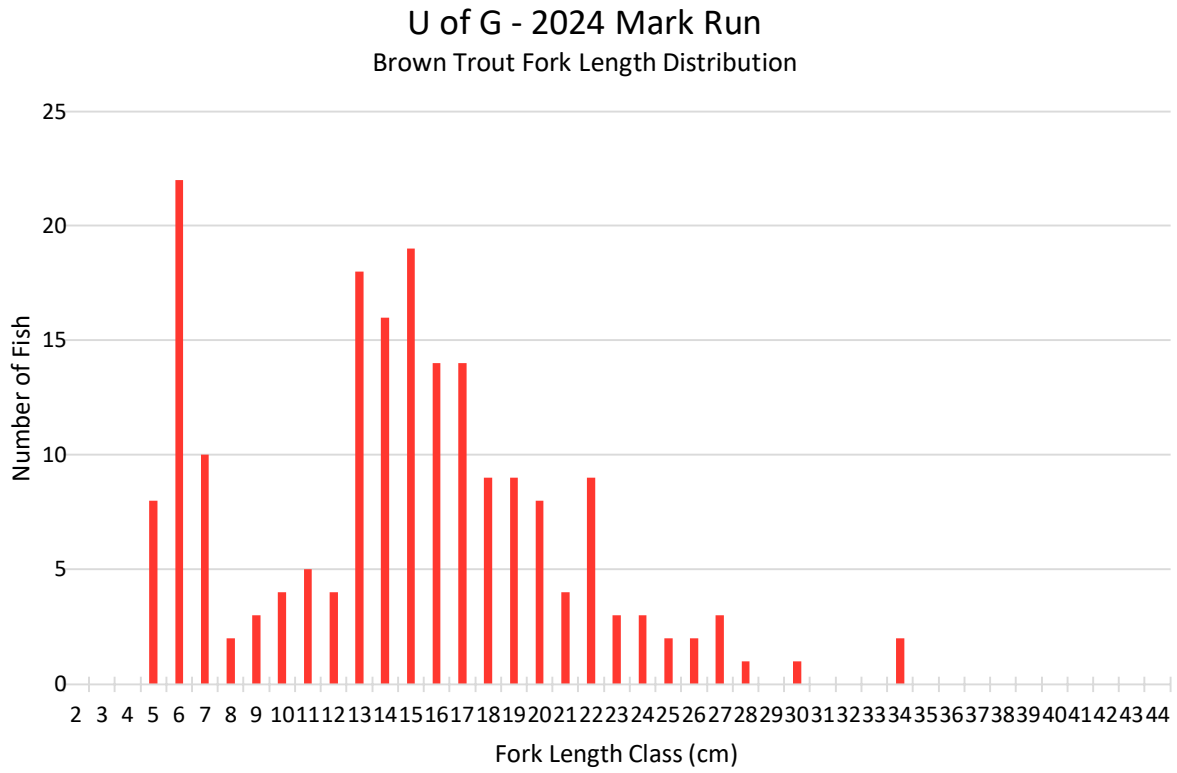

Figure 15: Fork Length Distribution of Brown Trout Collected During the Mark Run (2024) in the University of Guelph Station

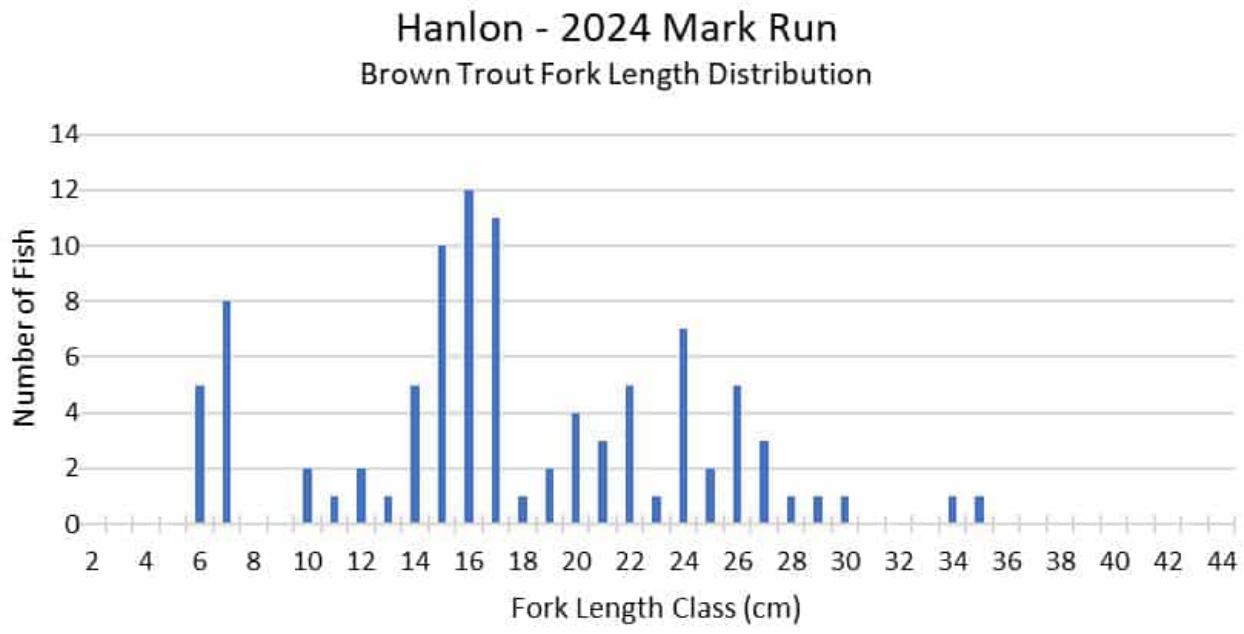

Figure 16: Fork Length Distribution of Brown Trout Collected During the Mark Run (2024) in the Hanlon Station

3.3.7.2 *Brown Trout Biomass*

Total trout biomass was calculated for each reach of Mill Creek by summing the weights of each size or year class. For the 2024 data, WSP has assumed the year class for each fish based on historical values and comparisons of the fork length and scale aging as well as the current fork length distribution data above.

The number of fish in each estimated age class was then extrapolated from total estimated adult population as determined by the Petersen estimate (Table 7). As expected, trout biomass in the University of Guelph reach (24.44 kg/ha) is greater than in the Hanlon reach (14.08 kg/ha). Biomass in the Bond Tract was 44.69 kg/ha due to higher proportion of larger fish with higher weight despite the lower number of fish captured.

Table 7: Estimate of Brown Trout Biomass in Mill Creek (2024 Electrofishing Data)

Stream Reach	Year Class (yr)	# Per Year Class (mark)	# Per Year Class (extrapolated)	Weight (g) (mean or range)	Density (#/ha)**	Biomass (kg/ha)	Biomass (g/m^3)
Hanlon By-pass	YOY*	45	135.0	3.9	340.91	1.32	0.13
	1	17	39.7	18.9	100.17	1.89	0.19
	2	89	79.1	40.7	199.78	8.12	0.81
	3	35	33.1	92.1	83.47	7.69	0.77
	4	16	12.4	172.4	31.43	5.42	0.54
	5	3	0	209.8	0.00	0.00	0.00
	6	2	0	325.0	0.00	0.00	0.00
	TOTAL	**207**	**299.3**	**862.7**	**755.75**	**24.44**	**2.44**
University of Guelph	YOY*	13	169.0	4.1	426.8	1.74	0.17
	1	8	8.0	22.5	20.2	0.45	0.05
	2	40	57.1	47.3	144.3	6.82	0.68
	3	14	6.0	109.8	15.2	1.66	0.17
	4	17	4.3	171.5	10.7	1.84	0.18
	5	5	2.5	247.5	6.3	1.56	0.16
	6	2	0.0	375,5	0	0	0
	TOTAL	**99**	**246.9**	**978.1**	**623.5**	**14.08**	**1.41**
Bond Tract	YOY*	1	3.0	5.6	7.6	0.04	0.0
	1	0	0.0	0.0	0.0	0.00	0.0
	2	6	0.0	39.1	0.0	0.00	0.0
	3	3	12.0	113.4	30.3	3.44	0.34
	4	4	8.0	156.0	20.2	3.15	0.32
	5	12	16.8	295.5	42.4	12.54	1.25
	6	5	15.0	673.8	37.9	25.52	2.55
	TOTAL	**31**	**54.8**	**1283.4**	**138.4**	**44.69**	**4.47**

3.3.8 Other Species

Since 1998 the number of other fish species caught in the study area has been recorded as this provides an indication of general habitat quality and could represent possible competition with the trout. During the 2024 survey, 10 non-trout species were observed in the University reach, 19 non-trout species were captured in the Hanlon reach, and 18 non-trout species were captured in the Bond reach. Table 8 and 9 provides a summary of fish captured during the mark runs of the 2005-2024 electrofishing surveys in the University of Guelph and Hanlon reaches.

In 2024, one Brook trout (*Salvelinus fontinalis*) was captured in the Hanlon reach during the mark run. The captured Brook trout was recorded as a healthy adult measuring 21 cm in length, weighing 94.2 g. No other Brook trout were captured in the University of Guelph, or the Bond Tract reaches. Other new captures in 2024 included; Banded Killifish, Blacknose Shiner, Bluegill, Northern Redbelly Dace, and Yellow Perch.

Table 8: Other Fish Species Captured During Electrofishing Surveys of University of Guelph 2005-2024 (Mark run only)

	University of Guelph											
	2005	**2006**	**2007**	**2009**	**2010**	**2011**	**2013**	**2015**	**2017**	**2020**	**2022**	**2024**
Blacknose Dace	158	123	210	24	112	126	286	163	233	156	125	326
Bluntnose Minnow	-	-	1	-	-	-	-	-	-	-	-	-
Brook Stickleback	-	7	11	-	-	-	1	-	2	-	1	14
Central Mudminnow	-	1	-	-	4	13	5	29	7	3	2	7
Common Shiner	-	-	-	-	-	-	-	-	-	-	1	-
Common White Sucker	38	40	51	24	29	26	3	63	45	26	19	51
Creek Chub	53	52	30	2	35	56	25	55	61	9	30	112
Golden Shiner	-	-	-	-	-	-	-	1	-	-	-	-
Greenside Darter	-	4	-	-	-	-	-	-	-	-	37	-
Iowa Darter	14	-	2	1	1	-	8	-	1	-	-	13
Johnny Darter	16	30	21	3	8	15	11	29	27	47	14	53
Largemouth Bass	-	-	-	-	-	4	-	-	1	-	-	-
Longnose Dace	-	-	-	-	-	-	-	1	-	-	-	-
Pumpkinseed	-	-	4	-	-	-	-	2	-	-	-	-
Rainbow Darter	28	40	45	36	114	71	56	57	69	23	6	18
Rock Bass	2	1	6	1	-	1	3	2	2	1	1	1
Yellow Perch	-	-	-	-	-	-	-	-	-	-	-	1
Total No. of Other Fish Captured	309	298	381	91	303	312	298	402	448	265	236	596
Total No. of Other Species	**7**	**9**	**10**	**7**	**7**	**8**	**9**	**10**	**10**	**7**	**10**	**10**

Table 9: Other Fish Species Captured During Electrofishing Surveys of Hanlon 2005-2024 (Mark run only)

	Hanlon											
	2005	**2006**	**2007**	**2009**	**2010**	**2011**	**2013**	**2015**	**2017**	**2020**	**2022**	**2024**
Banded Killifish	-	-	-	-	-	-	-	-	-	-	-	1
Blacknose Dace	428	424	420	144	233	314	390	257	287	207	387	344
Blacknose Shiner	-	-	-	-	-	-	-	-	-	-	-	2
Bluegill	-	-	-	-	-	-	-	-	-	-	-	1
Bluntnose Minnow	14	11	11	-	-	2	1	-	1	-	5	1
Brook Stickleback	1	16	12	32	1	6	5	6	2	-	-	16
Brook Trout	-	-	-	-	-	-	-	-	-	-	-	1
Central Mudminnow	-	1	2	4	6	5	-	27	2	1	-	6
Common Shiner	46	73	56	4	21	16	16	41	5	12	17	27
Common White Sucker	190	203	201	92	135	241	84	170	104	136	165	206
Creek Chub	386	477	346	109	189	306	189	256	150	91	317	248
Fantail Darter	-	-	-	-	-	-	-	-	-	-	4	-
Fathead Minnow	2	1	-	-	-	-	-	-	-	5	-	3
Greenside Darter	-	-	-	-	1	-	-	-	-	-	30	-
Iowa Darter	14	23	-	-	-	1	-	-	1	-	-	2
Johnny Darter	92	152	193	135	90	158	72	88	46	61	138	45
Largemouth Bass	4	-	5	1	8	4	1	-	-	1	-	4
Longnose Dace	-	-	-	-	-	-	-	-	-	32	3	-
Northern Redbelly Dace	-	-	-	-	-	-	-	-	-	-	-	1
Pearl Dace	-	-	1	-	-	-	-	1	-	-	-	-
Pumpkinseed	-	4	29	-	-	3	4	2	-	-	2	1
Rainbow Darter	42	53	50	80	69	104	54	87	102	39	68	23
Rock Bass	7	12	-	4	1	6	3	6	10	14	4	-
Yellow Perch	-	-	-	-	-	-	-	-	-	-	-	2
Total No. of Other Fish Captured	1226	1450	1326	605	754	1166	819	941	710	599	1140	934
Total No. of Other Species	**12**	**13**	**12**	**10**	**11**	**13**	**11**	**11**	**11**	**11**	**12**	**19**

3.4 Redd Surveys

The 2024 redd spawning survey indicated a total of 36 probable redds within the Mill Creek project limits. The project limits extend approximately 1.2 km and are comprised of two reaches: the University of Guelph reach and the Hanlon by-pass reach. Historically the University of Guelph section has higher redd counts, with the Hanlon section having lower counts. However, in 2024, the redd surveys did not follow this trend. There were 16 redds noted in the University stretch, and 20 in the Hanlon stretch.

The number of redds within the University of Guelph section has been generally trending downwards for the past 10 years, as noted in Figure 15 and Figure 16. The lack of scrapes noted in the 2024 survey may indicate the declining options for desirable spawning conditions but may also be a result of the other factors impacting access to the spawning habitat. The relatively lower redd count in the past three years has similar results compared to data from 1983 to 1987, prior to any rehabilitation efforts, suggesting that the spawning activity in the reach is cyclic, and the results from 2024 are following historic trends. It may also suggest that the habitat has been degrading since the mid-1980's rehabilitation projects carried out by the GRCA, MNR, and local fishing enthusiast. Updating the habitat mapping and comparing the habitat quality to those works immediately following the rehabilitation works may provide some additional insight into the decline of the population within the last 10 years.

The highest number of redds recorded to date in this reach was 194 in 2010, and the lowest value on record was 9 total redds measured in 1984. Although redd counts are low, they are not below historic records, and the water quality and temperate readings do not point directly to any thermal or chemical concerns for the trout population beyond historic fluctuations in results. However, these measures do not directly account for the healthy of the habitat for the life cycle functions it provides.

In the Hanlon section, the redd count was 20 in 2024, compared to 10 in 2023, 15 in 2022, and 39 in 2021 (Figure 16). This 2024 redd count indicated a slight increase following a steady decline in redd counts compared over the prior counts. The numbers recorded in the past three years may be an indication of a general decline in spawning habitat available in the Hanlon section but may also be a result of the other factors impacting access to the spawning habitat (i.e., beaver damming downstream of the study limits). The lack of scrapes noted in the 2024 survey may also indicate the declining options for desirable spawning conditions. The highest number of redds recorded to date in this reach was 107 in 2016 which was also the first time that the number of redds in the Hanlon reach exceeded the number of redds in the University reach. Although generally trending downward, the spawning results appear to be following historic trends similar to the University reach, and the 2024 results indicate the population may be heading upwards. The lowest redd count recorded for the project was 1, documented in 1988, and our recent 2024 results are still well above this historic low.

As previously discussed, a scrape is a less defined or small clearing of disturbed substrate with no fish visually observed. They could be indicators or redds being created but were then abandoned either due to fish being startled off, or the fish uncovered less then desirable spawning conditions in the substrate. 2020 was the first year in which scrapes had been reported in the University and Hanlon sections, therefore it is unclear whether this is comparable to previous years; however, as more scrape data is recorded, trends may become evident. The number of scrapes in the University section was 6 in 2022 compared to 23 in 2021 and 18 in 2020. The number of scrapes in the Hanlon section in 2022 was 2, with 35 and 43 in 2021 and 2020, respectively. Due to an absence of scrapes none were recorded during the 2023 and 2024 redd surveys. The lack of scrape presence may be due to a decrease in activity, as well as the survey being completed after the main trout migration causing the scrapes to be less identifiable. There are a number of variables that may be impacting the spawning conditions in the two

reaches, but overall, the results do appear to be following historic trends, and the water chemistry and temperatures of the two reaches have not returned any results that would suggest the spawning activity is being impacted directly by the pumping works.

Redd survey dates and results are summarized in **Sub-Appendix B**. Redd surveys are not conducted at the Bond Tract Station due to absence of suitable spawning habitat and depth of the channel would limit visibility.

In 2018 the very low numbers of Brown trout redds observed were largely attributed to the presence of beaver dams in the study reaches of Mill Creek. Although no beaver dams were observed in the reaches assessed in 2024, the area has a lot of beaver activity and there might have been dams built beyond the study limits impacting flows. Since WSP's spawning surveys are only a once-a-year event, there may have been seasonal events like sedimentation from another dam release that also could have impacted spawning in 2024.

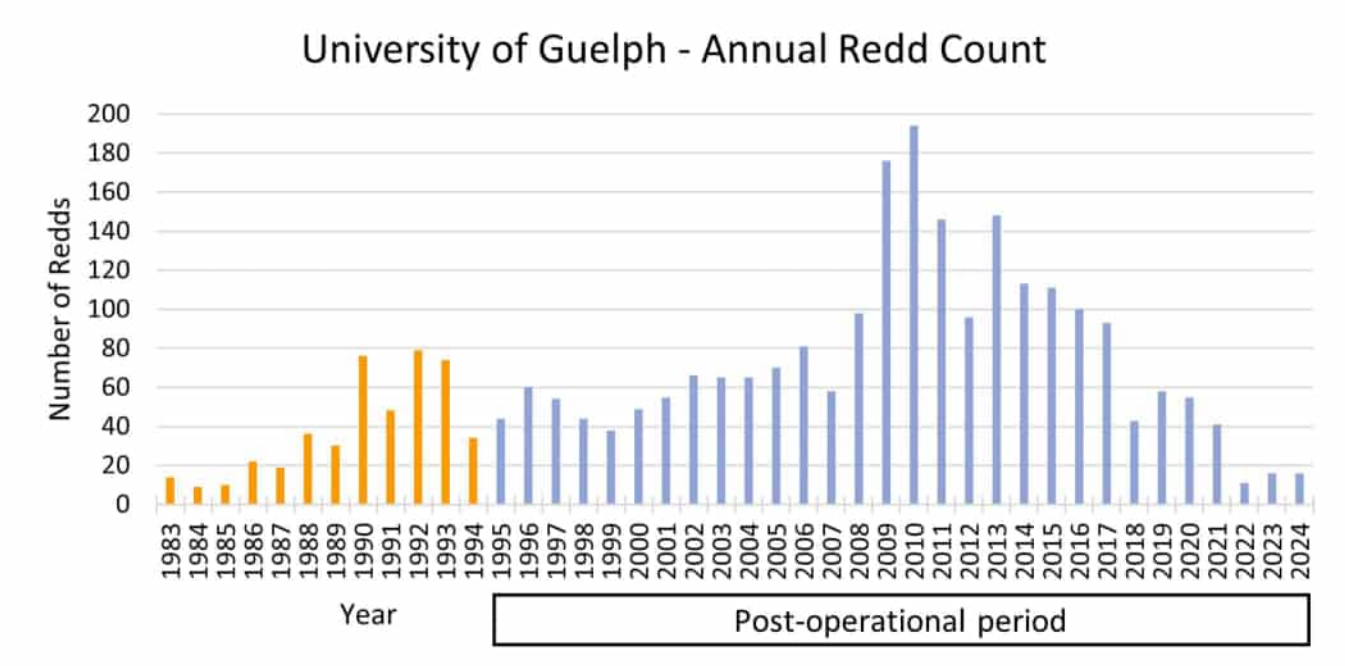

Figure 15: Annual Brown Trout Redd Counts in the University of Guelph Station

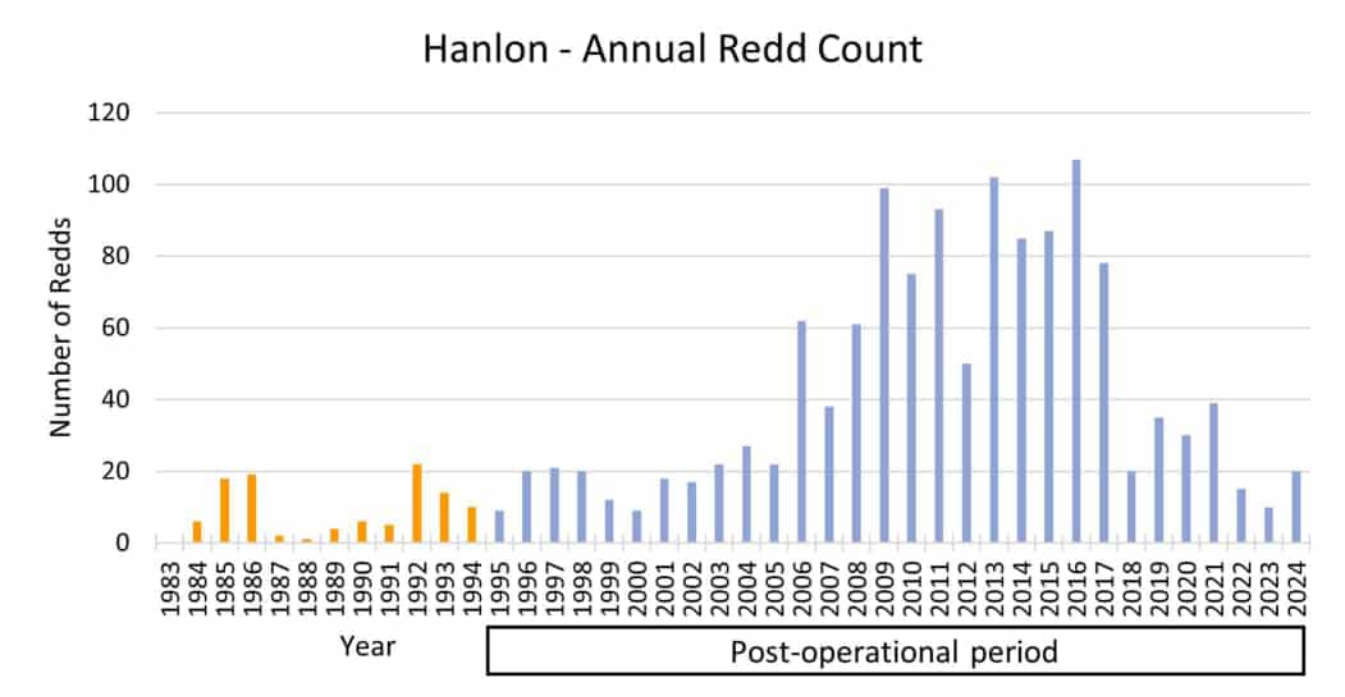

Figure 16: Annual Brown Trout Redd Counts in the Hanlon By-pass Station

4.0 SUMMARY AND RECOMMENDATIONS

4.1 Summary

The fisheries monitoring program again demonstrates that the Brown trout population remained relatively healthy in the study area in 2024, and within historic trends. The 2024 estimated adult Brown trout population for the reaches is comparable to historical populations, which exhibit a cyclical growth pattern.

Water chemistry has not changed notably in Mill Creek or its tributaries in 2024, although chloride and conductivity levels appear to be trending upwards in recent years. Chloride and conductivity may be a reflection of road salt entering the environment.

In 2024, the fecal coliform count indicated an increase among all samples with the highest concentrations ever recorded with 270 CFU/100 mL at the SWM2 station in 2024. High fecal coliform reports are usually associated with sewage or animal waste contamination. The sampling site is located at the Concession 2 road crossing, downstream of a residential property and upstream of an agricultural field. It is possible that the increased fecal coliform levels are a result of contamination from one of these three sources (road spill, failure or residential sewage storage, or use of manure on agricultural fields).

The maximum summer water temperatures in Mill Creek in 2024 were similar to recent years. The maximum tolerable temperature for Brown trout was not exceeded at any of the stations in 2024. However, the maximum temperature which Brook trout can tolerate was exceeded on June 19, 2024, at SWM1 and was very close to being matched on June 19, 2024, at SWM2. Water temperature in Mill Creek continues to remain low as it passes through the study area as a result of groundwater input, contributions from two coldwater tributaries, and increases in good riparian shading (forested stands).

This was the 42nd consecutive year of trout redd surveys. Spawning activity as indicated by the observed number of redds has been trending downwards for the past 10 years, but within the past three suggest the beginning of an increase again. Typically, the University reach has higher spawning activity due to better habitat conditions, though in recent years the spawning data were comparable and showed a general cyclic pattern to the results that is consistent with historical observations and may be an indicated in the decline of the habitat suitability in the reaches.

While the redd counts are more similar to numbers prior to the aggerate extraction below the water table, the 2024 fisheries monitoring program demonstrated that the Brown trout population within Mill Creek has remained healthy with good recruitment that also suggests that spawning remains successful even if redd counts are down.

This was the 30th year of monitoring the trout population since below water table extraction commenced. The results from 2024 surface water, water chemistry, and spawning surveys provide continued evidence that aggregate extraction below the water table (beginning in 1995) has had no measurable impact on the level of Brown trout spawning activity. Therefore, Dufferin Aggregates continues to be in compliance with Licence Condition #23, which states there must be no “net loss of the productive capacity of fish habitat in Mill Creek or its tributaries.”

4.2 Biological Thresholds

Warning threshold values to be considered over the course of the monitoring program for the aggregate licence were originally proposed in the initial 1993 *Coordinated Report on Monitoring Program*. Actions designed for these warning thresholds were then implemented for Mill Creek to identify actions to address the threshold warnings, which included mitigation and/or habitat enhancement ideas. For the fisheries and biological parameters, the “action thresholds” to be considered were:

1) Consistent reduction in fisheries production as indicated by spawning activity, salmonid biomass estimates or other biological indicators.

2) Consistent reduction in fisheries habitat as indicated by physical habitat attributes (e.g. stream cross sections); and

3) Measured changes in water quality for fish.

To date, there has not been a measurable reduction in fisheries (trout) production in any of the study reaches. On the contrary, the average number of trout is higher, for the post-extraction period. It does not appear there has been a significant reduction in fish habitat, and there has been no measurable change in water quality in Mill Creek.

Numerical threshold levels would be difficult to establish for this component of the program. Historic fluctuations in fish populations and redd counts (42 years of data) have occurred in the past and are attributed to several factors unrelated to gravel extraction.

4.3 Recommendations

The trout population and the redd survey form the core of the fisheries monitoring program for the pit licence. In the four decades that the trout populations have been monitored, the results have indicated a cyclic pattern to the growth and productivity of the trout population, with declines typically associated with increased beaver activity or other external sources (i.e. jet fuel spill) influencing the population for a short period of time, before the population rebounds. There are no indications in the water chemistry or water temperature monitoring results that would

suggest that the below water aggregate extraction has had a negative impact on the trout productivity in Mill Creek. Since the water chemistry and temperature are the two main factors that would directly impact trout health and habitat suitability in the creek, provided that these measures do not change, WSP does not anticipate any significant negative impact on trout productivity in Mill Creek.

WSP's 2024 spawning results align with historic trends in Mill Creek, with the spawning results currently at the dip in cycle showing the start of a possible rebound. WSP recommends that annual spawning surveys continue to ensure that the spawning activity continues to follow historic trends and continues to rebound in the next few years. The water chemistry and temperature monitoring does not suggest that the habitat suitability has changed significantly that would point to future concerns for the trout population or the steady decline of the trend. As there are no concerns in the monitoring data, directly attributed to the aggregate extraction, WSP is of the opinion that increasing the time between sampling periods for the mark/recapture surveys would only provide positive support for the trout population by not stressing the population out during a low period in their reproductive cycle. Instead of completing mark/recapture surveys in 2026, they can be moved to 2028. By allowing the population to grow un-impacted for a couple of years, the young of year from 2024 will have a chance to grow to reproductive age and establish spawning patterns in the Mill Creek reaches assessed.

WSP recommends a comprehensive habitat assessment be completed (i.e. mapping of habitat units, estimates of suitability for all life stages, etc.) to understand the current habitat structure of the reaches. The updated habitat assessment would determine if there are impacts to the reaches (i.e. sediment load, erosion, etc.) that could contribute to the habitat suitability for spawning and the general decline in the redd count observed over the last ten years. There may be some areas identified within the reaches that could benefit from rehabilitation (i.e., bank work, woody bank treatment, beaver dam removal, etc.) that could result in an increase in the productivity of Mill Creek.

As the spawning, water temperature and quality surveys will continue annually, their results can be used as a trigger to initial more frequent mark/recapture surveys. For example, if the number of redds continues to decline, then WSP may recommend that the mark/recapture program be completed in 2026 or 2027. Or if there are significant changes in the water chemistry and or temperature readings, then the mark/recapture program can be used to determine impacts on the trout populations. By increasing the time between mark/recapture programs, there will be less human related stress on the population (from sampling), and less of a need to defend a difference in the numbers that are not directly linked to the aggregate extraction below the water table. There is now 25 years of historic data to compare any results received through a delayed mark/recapture program.

While it is agreed that the Bond Tract reach is a poor reference area when compared to the Hanlon By-pass and University reaches due to the different fish habitat elements it provides (or lacks as is the case for preferred adult habitat), WSP recommends continuing to monitor its trout population concurrently with the other two reaches to help highlight any general trends in the Mill Creek watershed related to the Brown trout population.

To help facilitate future redd surveys, it is recommended that some of the more cumbersome large fallen trees and woody debris in the study reaches be removed, if feasible, to minimize impacts on flow and debris jamming seasonally that could impact migration to the area for spawning. Any reoccurring beaver activity and dam building should also be addressed prior to the initiation of the population sampling and fall spawning run.

As of this report, the habitat mapping is historic and WSP has noted a number of changes in the reaches not captured on the habitat maps reviewed each year. Updated habitat mapping could be essential in helping to determine any cause of the decline in redd counts in the past few years, and if the general habitat suitability for spawning has changed.

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Signature Page

WSP Canada Inc.

Courtney Huber, HBSc
Aquatic Ecologist

Kim LeBrun, HBSc
Senior Ecologist - Fisheries

APPENDIX A

WATER QUALITY DATA (1993-2024)

Appendix Table A-1.	Mill Creek Water Quality Monitoring; Nov. 25, 1993 (ESP).					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	SWM2 (boundary)	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)	0	1.5	3	1.5	-	
pH (units)	7.4	7.3	7.3	7.3	6.5-8.5	0.01
Conductivity (umhos/cm)	590	700	600	620	-	1
Hardness (mg/L as CaCo3)	320	320	310	300	-	1
Alkalinity (bicarbonate)	250	240	250	250	-	
Alkalinity (carbonate)	5	5	5	5	-	
Alkalinity (Total)	250	240	250	250	-	1
Chloride	20.7	56.7	15.8	31.5	-	0.05
Nitrate	0.45	1.55	3.62	0.68	see[3]	0.03
Nitrite	0.15	0.15	0.15	0.15	0.06[4]	0.03
Ammonia[5]	0.042 (0.0005)	0.042 (0.0005)	0.042 (0.0005)	0.07 (0.0008)	1.2 (0.02)	0.02
Orthophosphate	0.022	0.022	0.022	0.022	-	0.05
Total Phosphorus	0.022	0.022	0.022	0.022	0.03	0.01
Total Organic Carbon	4.25	3.18	2.48	3.78	-	0.05
BOD5	1.7	2	2	1.7	-	1
Chemical Oxygen Demand	31	14	2.7	57	-	5
Total Suspended Solids	2.3	1.6	4.3	2.0		1
Fecal Coliforms (CFU/100ml)	2	4	3	4		
Total Coliforms (CFU/100ml)	18	23	17	19		

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] at pH 7.5 and 20°C

Appendix Table A-2.	Mill Creek Water Quality Monitoring; May 11, 1994 (ESP).					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	SWM2 (boundary)	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)						
pH (units)	7.9	8.06	8.05	8.1	6.5-8.5	0.01
Conductivity (umhos/cm)	522	641	557	559	-	1
Hardness (mg/L as CaCo3)	280	294	299	287	-	1
Alkalinity (bicarbonate)	230	235	244	233	-	
Alkalinity (carbonate)	1.7	2.5	2.6	2.8	-	
Alkalinity (Total)	234	237	247	236	-	1
Chloride	16.7	49.9	16.6	25.5	-	0.05
Nitrate	0.30	0.77	3.05	0.46	see[3]	0.03
Nitrite	nd	nd	nd	nd	0.06[4]	0.03
Ammonia[5]	0.03 (0.001)	nd (0.000)	nd (0.000)	0.04 (0.002)	1.2 (0.02)	0.02
Orthophosphate	nd	nd	nd	nd	-	0.05
Total Phosphorus	0.06	0.04	0.04	nd	0.03	0.01
Total Organic Carbon	3.44	3.13	1.47	3.23	-	0.05
BOD5	nd	nd	nd	nd	-	1
Chemical Oxygen Demand	15	13	7	14	-	5
Total Suspended Solids	2	1	1	1		1
Fecal Coliforms (CFU/100ml)	<1	3	<1	3		
Total Coliforms (CFU/100ml)	<2	6	<2	10		

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20EC

Appendix Table A-3.	Mill Creek Water Quality Monitoring; Oct. 17, 1994 (ESP).					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	DP2	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)						
pH (units)	8.6	8.4	8.3	8.5	6.5-8.5	0.01
Conductivity (umhos/cm)	592	765	630	673	-	1
Hardness (mg/L as CaCo3)	293	335	329	313	-	1
Alkalinity (bicarbonate)	229	254	252	238	-	
Alkalinity (carbonate)	3	3	2	2	-	
Alkalinity (Total)	232	257	254	240	-	1
Chloride	21.2	61.1	14.3	37.6	-	0.05
Nitrate					see[3]	0.03
Nitrite					0.06[4]	0.03
Ammonia[5]	nd	nd	0.05	nd	1.2 (0.02)	0.01
Orthophosphate	<0.01	<0.01	<0.01	0.06	-	0.05
Total Phosphorus	0.03	0.07	0.03	0.03	0.03	0.02
Total Organic Carbon	2.1	0.3	nd	1.5	-	0.3
BOD5	nd	nd	nd	nd	-	2
Chemical Oxygen Demand	14	36	nd	12	-	10
Total Suspended Solids	2	2	2	2		1
Fecal Coliforms (CFU/100ml)	15	12	14	10		
Total Coliforms (CFU/100ml)	42	38	40	66		

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20EC
nd not detected

Appendix Table A-4.	Mill Creek Water Quality Monitoring; May 17, 1995 (Jagger Hims Ltd).					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	DP2	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)						
pH (units)	8.11	8.06	8.19	8.12	6.5-8.5	0.01
Conductivity (umhos/cm)	514	635	572	556	-	1
Hardness (mg/L as CaCo3)	291	309	249	298	-	1
Alkalinity (bicarbonate)	206	228	149	216	-	0.1
Alkalinity (carbonate)	2.5	2.5	2.2	2.7	-	0.1
Alkalinity (Total)	208	231	151	219	-	1
Chloride	27.2	84.5	86.8	38.4	-	0.05
Nitrate	0.34	0.95	2.87	0.63	see[3]	0.03
Nitrite	nd	nd	nd	nd	0.06[4]	0.03
Ammonia[5]	0.21	0.07	0.01	0.3	1.2 (0.02)	0.01
Orthophosphate	nd	nd	nd	nd	-	0.05
Total Phosphorus	nd	nd	nd	nd	0.03	0.06
Total Organic Carbon	4.9	4.9	nd	3.9	-	0.5
BOD5	2	2	6	2	-	2
Chemical Oxygen Demand	17	15	nd	15	-	10
Total Suspended Solids	nd	nd	nd	nd		5
Fecal Coliforms (CFU/100ml)	89	61	nd	70		1
Total Coliforms (CFU/100ml)	260	160	4	240		2

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20EC
nd not detected

Appendix Table A-5.	Mill Creek Water Quality Monitoring; Nov. 16, 1995 (ESP).					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	DP2	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)						
pH (units)	7.5	7.7	7.7	7.7	6.5-8.5	0.01
Conductivity (umhos/cm)	567	806	604	681	-	1
Hardness (mg/L as CaCo3)	250	263	277	254	-	1
Alkalinity (bicarbonate)	185	191	228	191	-	10
Alkalinity (carbonate)	0	0	0	0	-	
Alkalinity (Total)	185	191	228	191	-	10
Chloride	23.8	103	209	62.4	-	0.11
Nitrate	0.29	0.66	3.15	0.46	see[3]	0.05
Nitrite					0.06[4]	0.04
Ammonia[5]	nd	nd	nd	nd	1.2 (0.02)	0.057
Orthophosphate	nd	nd	nd	nd	-	0.022
Total Phosphorus	nd	nd	nd	nd	0.03	0.022
Total Organic Carbon	13.2	12.7	4.84	12.5	-	1
BOD5	nd	nd	nd	nd	-	2
Chemical Oxygen Demand	33	33	17	31	-	5
Total Suspended Solids	3.2	2.8	nd	2.0		1.4
Fecal Coliforms (CFU/100ml)	20	60	4	28		0
Total Coliforms (CFU/100ml)	300	600	180	200		0

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20EC
nd not detected

AppendixTableA-6.	Mill Creek Water Quality Monitoring; Nov. 19, 1996 (ESP)					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	SWM2 (boundary)	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)						
pH (units)	8.2	8.0	8.0	8.1	6.5-8.5	0.01
Conductivity (umhos/cm)	570	670	600	620	-	0.8
Hardness (mg/L as CaCo3)	310	310	310	310	-	10
Alkalinity (bicarbonate)	260	250	260	260	-	10
Alkalinity (carbonate)	nd	nd	nd	nd	-	10
Alkalinity (Total)	260	250	260	260	-	10
Chloride	22	57	16	34	-	0.2
Nitrate	0.65	1.2	3.7	0.90	see[3]	0.05
Nitrite	nd	nd	nd	nd	0.06[4]	0.1
Ammonia[5]	nd	nd	nd	nd	1.2 (0.02)	0.10
Orthophosphate	nd	nd	nd	nd	-	0.3
Total Phosphorus	0.03	0.08	0.08	0.12	0.03	0.02
Total Organic Carbon	20	12	12	10	-	1
BOD5	nd	nd	nd	nd	-	2
Chemical Oxygen Demand	nd	nd	nd	nd	-	5
Total Suspended Solids	2	nd	nd	1.6		1
Fecal Coliforms (CFU/100ml)	10	0	20	10		0
Total Coliforms (CFU/100ml)	470	270	420	400		0

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantification
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20□C
nd not detected

Appendix Table A-7.	Mill Creek Water Quality Monitoring; Nov. 6, 1997 (ESP).					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	SWM2 (boundary)	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)	7	6.5	6	6		
pH (units)	7.8	7.8	7.7	7.7	6.5-8.5	0.01
Conductivity (umhos/cm)	580	720	610	620	-	0.8
Hardness (mg/L as CaCo3)	340	350	340	320	-	10
Alkalinity (bicarbonate)	220	240	260	230	-	10
Alkalinity (carbonate)	nd	nd	nd	nd	-	10
Alkalinity (Total)	220	240	260	230	-	10
Chloride	25	61	18	36	-	0.2
Nitrate	0.64	1.1	3.8	0.86	see[3]	0.05
Nitrite	nd	nd	nd	nd	0.06[4]	0.1
Ammonia[5]	nd	nd	nd	nd	1.2 (0.02)	0.10
Orthophosphate	nd	nd	nd	nd	-	0.02
Total Phosphorus	nd	nd	nd	nd	0.03	0.02
Total Organic Carbon	9.2	6.6	4.0	9.2	-	0.5
BOD5	nd	nd	nd	nd	-	2
Chemical Oxygen Demand	10	9	nd	19	-	5
Total Suspended Solids	4	2	2	2		1
Fecal Coliforms (CFU/100ml)	40	50	5	30		0
Total Coliforms (CFU/100ml)	80	160	150	100		0

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20EC
nd not detected

Appendix Table A-8.	Mill Creek Water Quality Monitoring; Nov. 6, 1998.					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	SWM2 (boundary)	PWQO1	LOQ2
All unitsare mg/L unless indicated otherwise.						
Temperature (°C)	6	4	5	6		
pH (units)	8.3	8.2	7.9	8.2	6.5-8.5	0.01
Conductivity (umhos/cm)	580	630	690	650	-	0.8
Hardness (mg/L as CaCo3)	310	360	370	320	-	10
Alkalinity (bicarbonate)	260	280	270	260	-	10
Alkalinity (carbonate)	nd	nd	nd	Nd	-	10
Alkalinity (Total)	260	280	270	260	-	10
Chloride	23	16	31	39	-	0.2
Nitrate	0.47	5	0.21	1.2	see[3]	0.05
Nitrite	nd	nd	nd	nd	0.06[4]	0.1
Ammonia[5]	nd	nd	nd	nd	1.2 (0.02)	0.10
Orthophosphate	nd	nd	nd	nd	-	0.02
Total Phosphorus	0.07	0.05	0.06	0.06	0.03	0.02
Total Organic Carbon	2.5	0.8	0.69	2.9	-	0.5
BOD5	nd	nd	nd	2	-	2
Chemical Oxygen Demand	nd	nd	nd	7	-	5
Total Suspended Solids	22	6	nd	4		1
Fecal Coliforms (CFU/100ml)	170	nd	<10	70		0
Total Coliforms (CFU/100ml)	>2000	640	1600	2500		0

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
nd not detected

Appendix Table A-9.	Mill Creek Water Quality Monitoring; Nov. 11, 1999.					
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	SWM2 (boundary)	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)						
pH (units)	8.10	8.10	7.74	8.12	6.5-8.5	0.01
Conductivity (umhos/cm)	635	634	922	683	-	0.8
Hardness (mg/L as CaCo3)	312	353	395	349	-	10
Alkalinity (bicarbonate)					-	10
Alkalinity (carbonate)					-	10
Alkalinity (Total)	237	284	239	243	-	10
Chloride	32.7	18.8	63.5	45.4	-	0.2
Nitrate	0.5	3.2	0.2	0.7	see[3]	0.05
Nitrite	<0.1	<0.1	<0.1	<0.1	0.06[4]	0.1
Ammonia[5]	<0.05	<0.05	<0.05	<0.05	1.2 (0.02)	0.10
Orthophosphate	0.012	0.009	0.014	0.011	-	0.02
Total Phosphorus	<0.02	<0.02	<0.02	<0.02	0.03	0.02
Total Organic Carbon	4.7	1.9	6.7	4.3	-	0.5
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	18.0	<4	19.0	12.0	-	5
Total Suspended Solids	<1	1	5	<1		1
Fecal Coliforms (CFU/100ml)	60	<10	<10	50		0
Total Coliforms (CFU/100ml)	1200	900	300	2200		0

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
nd not detected

Appendix Table A-10. Mill Creek Water Quality Monitoring; Oct. 31, 2000.						
	SWM1 Hwy 401	SWM4 Galt Ck	SWM3 Pond Ck	SWM2 (boundary)	PWQO1	LOQ2
All units are mg/L unless indicated otherwise.						
Temperature (°C)						
pH (units)	8.35	8.3	8.31	8.29	6.5-8.5	0.01
Conductivity (umhos/cm)					-	0.8
Hardness (mg/L as CaCo3)	316	359	343	334	-	10
Alkalinity (Total)	252	262	276	253	-	10
Chloride	22	82	16	47	-	0.2
Nitrate	0.4	1.48	4.38	0.84	see[3]	0.05
Nitrite	<0.06	<0.06	<0.06	<0.06	0.06[4]	0.1
Ammonia[5]	0.2	<0.1	<0.1	0.4	1.2 (0.02)	0.10
Orthophosphate	0.012	0.009	0.014	0.011	-	0.02
Total Phosphorus	0.04	<0.03	<0.03	<0.03	0.03	0.02
Total Organic Carbon	4.3	2.5	1.9	3.9	-	0.5
BOD5	2	2	2	2	-	2
Chemical Oxygen Demand	<8	<8	<8	8	-	5
Total Suspended Solids	<3	4	<3	<3		1
Fecal Coliforms (CFU/100ml)	18	8	24	15		0
Total Coliforms (CFU/100ml)	34	31	45	29		0

[1] PWQO = Provincial Water Quality Guideline for the Protection of Aquatic Life (- no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
nd not detected

Appendix Table A-11. Mill Creek Water Quality Monitoring; Nov. 14, 2001.						
	SWM 1 Hwy. 401	SWM 4 Galt Crk.	SWM 3 Pond Crk.	SWM 2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.28	8.06	8.16	8.20	6.5 – 8.5	0.01
Conducivity (μmhos/cm)	611	810	644	665	-	0.2
Hardness (mg/L as CaCo3)	335	384	356	343	-	10
Alkalinity (Total)	235	253	266	241	-	1
Chloride	27.0	80.6	21.4	44.8	-	0.15
Nitrate	0.5	1.5	4.2	0.9	See[3]	0.1
Nitrite	ND	ND	ND	ND	0.06[4]	0.1
Ammonia[5]	ND	ND	ND	ND	1.2 (0.02)	0.05
Orthophosphate	ND	ND	ND	ND	-	0.005
Total Phosphorus	0.12	0.05	0.19	0.04	0.03	0.02
Total Organic Carbon	6.2	2.9	2.1	5.1	-	0.2
BOD5	ND	ND	ND	ND	-	2
Chemical Oxygen Demand	17.4	12.1	10	18.0	-	5
Total Suspended Solids	ND	ND	3	ND		1
Fecal Coliforms (CFU/100ml)	<10	200	<10	200	100	0
Total Coliforms (CFU/100ml)	240	200	180	500		0

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected

Appendix Table A-12. Mill Creek Water Quality Monitoring; Nov. 14, 2002.

	SWM 1 Hwy. 401	SWM 4 Galt Ck.	SWM 3 Pond Ck.	DP2	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.15	8.12	8.03	8.12	6.5 – 8.5	0.01
Conducivity (μmhos/cm)	571	804	609	645	-	0.2
Hardness (mg/L as CaCo3)	328	374	355	344	-	N/A
Alkalinity (Total)	250	280	277	259	-	1
Chloride	24.8	95.8	21.5	46.4	-	0.15
Nitrate	0.6	1.6	3.5	1.0	See[3]	0.1
Nitrite	ND	ND	ND	ND	0.06[4]	0.1
Ammonia[5]	ND	ND	ND	ND	1.2 (0.02)[5]	0.05
Orthophosphate	0.005	0.006	0.010	0.005	-	0.005
Total Phosphorus	0.10	ND	ND	ND	0.03	0.02
Total Organic Carbon	7.5	6.0	6.0	7.5	-	0.1
BOD5	4	7	ND	ND	-	1[6]
Chemical Oxygen Demand	13.0	17.0	13.7	15.0	-	4
Total Suspended Solids	ND	ND	ND	ND	-	1
Fecal Coliforms (CFU/100ml)	>200	16	27	>200	100	N/A
Total Coliforms (CFU/100ml)	>200	27	32	>200	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
[6] LOQ is 3 for samples DP2 and SWM3
ND = not detected
N/A = not applicable

Appendix Table A-13. Mill Creek Water Quality Monitoring; Nov. 14, 2003.						
	SWM 1 Hwy. 401	SWM 4 Galt Ck.	SWM 3 Pond Ck.	DP2	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.19	8.10	8.13	8.15	6.5 – 8.5	0.01
Conducivity (μmhos/cm)	631	767	620	676	-	0.2
Hardness (mg/L as CaCo3)	313	323	340	320	-	N/A
Alkalinity (Total)	243	249	265	244	-	1
Chloride	33.9	81.6	21.9	49.8	-	0.15
Nitrate	0.7	1.4	3.7	1.0	See[3]	0.1
Nitrite	ND	ND	ND	ND	0.06[4]	0.1
Ammonia[5]	0.06	ND	ND	0.06	1.2 (0.02)[5]	0.05
Orthophosphate	0.006	0.009	0.005	0.006	-	0.005
Total Phosphorus	ND	ND	ND	ND	0.03	0.02
Total Organic Carbon	6.0	5.2	1.7	5.4	-	0.1
BOD5	ND	ND	ND	ND	-	1[6]
Chemical Oxygen Demand	21.0	15.0	11.0	15.0	-	4
Total Suspended Solids	1	ND	ND	ND	-	1
Fecal Coliforms (CFU/100ml)	>200	41	4	>200	100	N/A
Total Coliforms (CFU/100ml)	>200	>200	>200	>200	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
[6] LOQ is 3 for samples DP2 and SWM3
ND = not detected
N/A = not applicable

Appendix Table A-14. Mill Creek Water Quality Monitoring; Dec. 2, 2004.

	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.22	8.19	8.24	8.23	6.5 – 8.5	0.01
Conductivity (μmhos/cm)	568	700	577	618	-	0.2
Hardness (mg/L as $CaCO_3$)	313	324	326	319	-	n/a
Alkalinity (Total)	227	232	254	228	-	1
Chloride	33.2	78.8	29.3	48.5	-	0.15
Nitrate	0.8	1.1	2.6	0.8	See[3]	0.1
Nitrite	ND	ND	ND	ND	0.06[4]	0.1
Ammonia	n/a	n/a	n/a	n/a	1.2 (0.02)[5]	0.05
Orthophosphate	ND	0.005	ND	ND	-	0.005
Total Phosphorus	ND	ND	ND	ND	0.03	0.02
Total Organic Carbon	7.8	9.6	5.6	8.3	-	0.1
BOD5	2	ND	2	2	-	1[6]
Chemical Oxygen Demand	25	22	18	26	-	4
Total Suspended Solids	1	1	ND	5	-	1
Fecal Coliforms (CFU/100ml)	>200	10	4	>200	100	n/a
Total Coliforms (CFU/100ml)	>200	>200	>200	>200	-	n/a

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
[6] LOQ is 2 for sample SWM4
ND = not detected
n/a = not applicable

Appendix Table A-15. Mill Creek Water Quality Monitoring; Nov. 8, 2005.

	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.34	8.33	8.30	8.33	6.5 – 8.5	0.01
Conductivity (μmhos/cm)	587	772	592	666	-	2
Hardness (mg/L as $CaCO_3$)	300	330	320	310	-	n/a
Alkalinity (Total)	269	289	296	272	-	1
Chloride	35	86	23	55	-	1
Nitrate	0.3	2.2	3.5	0.8	See[3]	0.1
Nitrite	ND	ND	ND	ND	0.06[4]	0.01
Ammonia	0.05	ND	ND	0.08	1.2 (0.02)[5]	0.05
Orthophosphate	0.010	0.010	0.011	0.010	-	0.005
Total Phosphorus	ND	ND	0.02	ND	0.03	0.02
Total Organic Carbon	4.5	3.7	2.7	4.5	-	0.1
BOD5	ND	ND	ND	ND	-	2
Chemical Oxygen Demand	10	9	23	6	-	4
Total Suspended Solids	ND	2	2	5	-	1
Fecal Coliforms (CFU/100ml)	30	10	<10	20	100	10
Total Coliforms (CFU/100ml)	100	100	200	500	-	10

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-16. Mill Creek Water Quality Monitoring; Oct 13, 2006.

	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.3	8.0	8.2	8.1	6.5 – 8.5	0.01
Conductivity (μmhos/cm)	612	726	592	645	-	2
Hardness (mg/L as $CaCO_3$)	280	300	270	290	-	1
Alkalinity (Total)	236	242	241	233	-	1
Chloride	34	66	28	43	-	1
Nitrate	0.2	1.1	2.4	0.4	See[3]	0.1
Nitrite	ND	ND	0.01	ND	0.06[4]	0.01
Ammonia	0.06	ND	ND	0.05	1.2 (0.02)[5]	0.05
Orthophosphate	ND	ND	ND	ND	-	0.01
Total Phosphorus	ND	ND	ND	ND	0.03	0.002
Total Organic Carbon	10.6	10.6	6.3	10.8	-	0.1
BOD5	ND	ND	ND	ND	-	2
Chemical Oxygen Demand	24	34	19	29	-	4
Total Suspended Solids	3	1	1	1	-	1
Fecal Coliforms (CFU/100ml)	160	360	1000	100	100	10
Total Coliforms (CFU/100ml)	300	360	2100	600	-	10

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Table A-17 Mill Creek Water Quality Monitoring; January 24, 2008 (reported for the 2007 monitoring year).

	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.07	8.10	8.09	8.05	6.5 – 8.5	0.001
Conductivity (μmhos/cm)	645	798	624	699	-	0.4
Hardness (mg/L as $CaCO_3$)	360	360	350	350	-	10
Alkalinity (Total)	240	260	270	240	-	10
Chloride	43	84	26	57	-	2
Nitrate	0.9	3.9	4.6	1.6	See[3]	0.1
Nitrite	<0.1	<0.1	<0.1	<0.1	0.1[4]	0.1
Ammonia	0.14	<0.05	<0.05	0.09	1.2 (0.02)[5]	0.05
Orthophosphate	<0.003	0.003	<0.003	0.003	-	0.003
Total Phosphorus	0.010	<0.006	0.013	0.016	0.03	0.006
Total Organic Carbon	3	<1	<1	2	-	1
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	<10	70	40	<10	-	10
Total Suspended Solids	1	1	3	6	-	1
Fecal Coliforms (CFU/100ml)	3	4	27	4	100	0
Total Coliforms (CFU/100ml)	280	150	190	130	-	10

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-18 Mill Creek Water Quality Monitoring; October, 2008.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.1	8.2	8.1	8.2	6.5 – 8.5	0.001
Conductivity (μmhos/cm)	671	812	634	727	-	2
Hardness (mg/L as $CaCO_3$)	300	350	310	330	-	1
Alkalinity (Total)	262	276	271	261	-	1
Chloride	46	81	25	60	-	1
Nitrate	0.4	3.2	4.1	1.1	See[3]	0.1
Nitrite	<0.01	<0.01	<0.01	<0.01	<0.1[4]	0.01
Ammonia	<0.05	<0.05	<0.05	<0.05	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	0.013	0.010	0.013	0.030	0.03	0.002
Total Organic Carbon	5.6	3.1	2.1	4.2	-	0.1
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	11	<4	<4	16	-	4
Total Suspended Solids	1	1	2	1	-	1
Fecal Coliforms (CFU/100ml)	20	<10	10	30	100	10
Total Coliforms (CFU/100ml)	150	480	130	70	-	10

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-19 Mill Creek Water Quality Monitoring; October, 2009.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.2	8.2	8.2	8.1	6.5 – 8.5	0.001
Conductivity (μmhos/cm)	614	788	631	670	-	2
Hardness (mg/L as $CaCO_3$)	280	320	300	280	-	1
Alkalinity (Total)	246	273	264	259	-	1
Chloride	41	75	27	52	-	1
Nitrate	0.4	3.7	5.0	1.1	See[3]	0.1
Nitrite	<0.01	<0.01	0.02	<0.01	<0.1[4]	0.01
Ammonia	<0.05	<0.05	<0.05	<0.05	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	0.01	<0.01	<0.01	-	0.01
Total Phosphorus	0.014	0.018	0.014	0.014	0.03	0.002
Total Organic Carbon	9.0	5.9	2.5	8.1	-	0.1
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	13	7	4	10	-	4
Total Suspended Solids	<10	<10	<10	<10	-	1
Fecal Coliforms (CFU/100ml)	80	120	190	150	100	10
Total Coliforms (CFU/100ml)	330	390	370	250	-	10

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-20 Mill Creek Water Quality Monitoring; November, 2010.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.28	8.22	8.28	8.26	6.5 – 8.5	
Conductivity (μmhos/cm)	631	773	650	680	-	1
Hardness (mg/L as $CaCO_3$)	270	290	290	270	-	1
Alkalinity (Total)	242	254	264	244	-	1
Chloride	37	76	29	47	-	1
Nitrate	0.4	2.7	4.4	0.9	See[3]	0.1
Nitrite	<0.01	<0.01	<0.01	<0.01	<0.1[4]	0.01
Ammonia	<0.05	<0.05	<0.05	<0.05	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	<0.02	<0.02	<0.02	<0.02	0.03	0.02
Total Organic Carbon	5.9	6.2	3.4	5.8	-	0.2
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	18	17	11	19	-	4
Total Suspended Solids	<10	<10	<10	<10	-	10
Fecal Coliforms (CFU/100ml)	37	8	250	62	100	N/A
Total Coliforms (CFU/100ml)	>2000	130	300	210	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-21 Mill Creek Water Quality Monitoring; November, 2011.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.26	8.19	8.23	8.23	6.5 – 8.5	
Conductivity (μmhos/cm)	657	796	648	699	-	1
Hardness (mg/L as $CaCO_3$)	300	320	320	310	-	1
Alkalinity (Total)	234	231	255	233	-	1
Chloride	43	81	29	57	-	1
Nitrate	0.4	2.8	4.3	1.0	See[3]	0.1
Nitrite	<0.01	<0.01	<0.01	<0.01	<0.1[4]	0.01
Ammonia	<0.05	<0.05	<0.05	<0.05	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	0.03	0.03	0.02	0.03	0.03	0.02
Total Organic Carbon	5.8	5.5	3.5	6.0	-	0.2
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	18	15	<4	<4	-	4
Total Suspended Solids	<10	<10	<10	<10	-	10
Fecal Coliforms (CFU/100ml)	25	20	85	22	100	N/A
Total Coliforms (CFU/100ml)	160	200	160	140	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-22 Mill Creek Water Quality Monitoring; December, 2012.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.18	8.11	8.17	8.11	6.5 – 8.5	
Conductivity (μmhos/cm)	640	780	670	690	-	1
Hardness (mg/L as $CaCO_3$)	320	330	350	320	-	1
Alkalinity (Total)	240	240	270	240	-	1
Chloride	39	73	28	46	-	1
Nitrate	0.43	2.8	4.6	1.1	See[3]	0.1
Nitrite	<0.01	<0.01	<0.01	<0.01	<0.1[4]	0.01
Ammonia	0.073	<0.05	<0.05	<0.05	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	0.021	0.005	0.007	0.010	0.03	0.002
Total Organic Carbon	5.7	5.7	2.4	5.7	-	0.2
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	13	12	9.6	13	-	4
Total Suspended Solids	<10	<10	<10	<10	-	10
Fecal Coliforms (CFU/100ml)	34	18	4	45	100	N/A
Total Coliforms (CFU/100ml)	200	>2000	130	200	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-23 Mill Creek Water Quality Monitoring; November, 2013.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQ01	L0Q2
All units are mg/L, unless otherwise indicated.						
pH (units)	8.27	8.26	8.26	8.16	6.5 – 8.5	
Conductivity (μmhos/cm)	679	790	652	739	-	1
Hardness (mg/L as $CaCO_3$)	310	320	310	310	-	1
Alkalinity (Total)	270	270	270	270	-	1
Chloride	40	72	26	49	-	1
Nitrate	0.44	3.0	4.2	0.69	See[3]	0.1
Nitrite	<0.01	<0.01	<0.01	<0.01	<0.1[4]	0.01
Ammonia	0.062	<0.05	<0.05	<0.05	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	0.002	<0.002	0.006	<0.002	0.03	0.002
Total Organic Carbon	4.9	4.8	2.5	4.7	-	0.2
BOD5	<2	<2	<2	2	-	2
Chemical Oxygen Demand	16	16	4.5	14	-	4
Total Suspended Solids	<10	<10	<10	<10	-	10
Fecal Coliforms (CFU/100ml)	34	52	16	13	100	N/A
Total Coliforms (CFU/100ml)	>2000	>2000	>2000	>2000	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-24 Mill Creek Water Quality Monitoring; November 26, 2014.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.09	8.11	8.18	8.11	6.5 – 8.5	
Conductivity (μmhos/cm)	569	692	633	593	-	1
Hardness (mg/L as $CaCO_3$)	260	280	310	270	-	1
Alkalinity (Total)	220	240	260	230	-	1
Chloride	37	66	31	44	-	1
Nitrate	0.31	1.8	3.4	0.59	See[3]	0.1
Nitrite	<0.01	<0.01	<0.01	<0.01	<0.1[4]	0.01
Ammonia	0.079	0.059	0.059	0.081	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	0.015	0.015	0.008	0.026	0.03	0.004
Total Organic Carbon	9.2	8.0	4.1	9.1	-	0.2
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	21	18	7.1	22	-	4
Total Suspended Solids	<10	<10	<10	<10	-	10
Fecal Coliforms (CFU/100ml)	180	110	4	190	100	N/A
Total Coliforms (CFU/100ml)	>2000	>2000	>2000	>2000	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-25 Mill Creek Water Quality Monitoring; December 14, 2015.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.26	8.22	8.22	8.26	6.5 – 8.5	N/A
Conductivity (μmhos/cm)	688	833	668	747	-	1
Hardness (mg/L as $CaCO_3$)	310	330	330	320	-	1
Alkalinity (Total)	250	260	270	260	-	1
Chloride	46	88	28	66	-	1
Nitrate	0.42	3.69	4.50	1.37	See[3]	0.1
Nitrite	<0.01	<0.01	<0.01	<0.01	<0.1[4]	0.01
Ammonia	<0.050	<0.050	<0.050	<0.050	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	0.012	-	0.01
Total Phosphorus	<0.020	<0.020	<0.020	<0.020	0.03	0.020
Total Organic Carbon	3.6	3.2	2.0	3.5	-	0.2
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	11	9.3	<4.0	14	-	4
Total Suspended Solids	<10	<10	<10	<10	-	10
Fecal Coliforms (CFU/100ml)	32	2	2	120	100	N/A
Total Coliforms (CFU/100ml)	>2000	49	92	120	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
ND = not detected
n/a = not applicable

Appendix Table A-26 Mill Creek Water Quality Monitoring; December 14, 2016.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.31	8.27	8.20	8.28	6.5 – 8.5	N/A
Conductivity (μmhos/cm)	744	883	674	802	-	1
Hardness (mg/L as $CaCO_3$)	320	330	320	310	-	1
Alkalinity (Total)	270	270	280	270	-	1
Chloride	62	100	29	81	-	1
Nitrate	0.46	3.89	4.25	1.57	See[3]	0.1
Nitrite	<0.01	<0.01	<0.01	<0.01	<0.1[4]	0.01
Ammonia	<0.050	<0.050	<0.050	<0.050	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	<0.020	<0.020	<0.020	<0.020	0.03	0.020
Total Organic Carbon	4.4	2.9	2.9	3.9	-	0.2
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	4.2	<4.0	12	<4.0	-	4
Total Suspended Solids	<10	<10	<10	<10	-	10
Fecal Coliforms (CFU/100ml)	11	4	0	17	100	N/A
Total Coliforms (CFU/100ml)	140	68	190	100	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
n/a = not applicable

Appendix Table A-27 Mill Creek Water Quality Monitoring; September 21, 2017.						
	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.29	8.30	8.25	8.31	6.5 – 8.5	N/A
Conductivity (μmhos/cm)	684	857	661	755	-	1
Hardness (mg/L as $CaCO_3$)	330	390	380	350	-	1
Alkalinity (Total)	260	280	280	260	-	1
Chloride	47	86	23	70	-	1
Nitrate	0.26	4.72	4.84	1.55	See[3]	0.1
Nitrite	<0.01	<0.01	0.017	<0.01	<0.1[4]	0.01
Ammonia	<0.050	<0.050	<0.050	<0.050	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	<0.020	<0.020	<0.020	<0.020	0.03	0.020
Total Organic Carbon	3.2	2.0	1.6	2.8	-	0.2
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	10	<4.0	4.6	9.0	-	4
Total Suspended Solids	<10	<10	<10	<10	-	10
Fecal Coliforms (CFU/100ml)	20	40	70	30	100	N/A
Total Coliforms (CFU/100ml)	No Analysis	No Analysis	No Analysis	No Analysis	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
n/a = not applicable

Table A-28. Mill Creek Water Quality December 7, 2018.

	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.30	8.27	8.30	8.30	6.5 – 8.5	N/A
Conductivity (μmhos/cm)	700	860	660	750	-	1
Hardness (mg/L as $CaCO_3$)	320	350	350	330	-	1
Alkalinity (Total)	260	270	270	260	-	1
Chloride	59	97	31	73	-	1
Nitrate	0.45	3.50	4.33	1.15	See[3]	0.1
Nitrite	No analysis	No analysis	No analysis	No analysis	<0.1[4]	0.01
Ammonia	0.080	<0.050	<0.050	0.076	1.2 (0.02)[5]	0.05
Orthophosphate	<0.01	<0.01	<0.01	<0.01	-	0.01
Total Phosphorus	<0.020	0.035	<0.020	<0.020	0.03	0.020
Total Organic Carbon	6.4	5.0	2.5	6.0	-	0.2
BOD5	<2	<2	<2	<2	-	2
Chemical Oxygen Demand	15	11	11	13	-	4
Total Suspended Solids	<10	<10	<10	11	-	10
Fecal Coliforms (CFU/100ml)	10	20	<10	<10	100	N/A
Total Coliforms (CFU/100ml)	40	50	120	40	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] value in brackets is calculated un-ionized ammonia at pH 8.0 and 20°C
n/a = not applicable

Table A-29. Mill Creek Water Quality December 13, 2019.

	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.55	8.57	8.58	8.56	6.5 – 8.5	N/A
Conductivity (μmhos/cm)	680	840	650	730	-	1
Hardness (mg/L as $CaCO_3$)	330	360	350	330	-	1
Alkalinity (Total)	260	270	280	260	-	1
Chloride	61	96	31	71	-	1
Nitrate	0.41	3.6	4.49	1.07	See[3]	0.1
Nitrite	ND	ND	ND	ND	<0.14[4]	0.01
Ammonia	0.057	ND	0.051	0.062	1.2	0.05
Orthophosphate	ND	ND	ND	ND	-	0.01
Total Phosphorus	ND	ND	ND	ND	0.03	0.020
Total Organic Carbon	6.0	3.9	2.3	5.5	-	0.2
BOD5	ND	ND	ND	ND	-	2
Chemical Oxygen Demand	12	12	ND	12	-	4
Total Suspended Solids	ND	ND	ND	ND	-	10
Fecal Coliforms (CFU/100ml)	29	47	9	56	100	N/A
Total Coliforms (CFU/100ml)	63	71	120	58	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
n/a = not applicable

Table A-30. Mill Creek Water Quality November 19, 2020.

	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.21	8.22	8.21	8.18	6.5-8.5	N/A
Conductivity (μmhos/cm)	0.695	0.763	0.679	0.884	-	0.001
Hardness (mg/L as $CaCO_3$)	320	330	330	350	-	1.0
Alkalinity (Total)	260	260	280	280	-	1.0
Chloride	57	72	32	100	-	1.0
Nitrate	0.34	1.20	4.68	3.90	See3	0.10
Nitrite	ND	ND	ND	ND	<0.14	0.010
Ammonia	0.34	1.20	ND	ND	1.20	0.050
Orthophosphate	ND	ND	ND	ND	-	0.010
Total Phosphorus	0.023	ND	ND	ND	0.030	0.020
Total Organic Carbon	4.6	4.2	2.1	3.1	-	0.40
BOD5	ND	ND	ND	ND	-	2
Chemical Oxygen Demand	11	9.9	5.0	9.6	-	4.0
Total Suspended Solids	ND	ND	ND	ND	-	10
Fecal Coliforms (CFU/100ml)	20	20	30	10	100	N/A
Total Coliforms (CFU/100ml)	220	120	280	180	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
n/a = not applicable

Table A-31. Mill Creek Water Quality November 21, 2021.

	SWM1 Hwy. 401	SWM4 Galt Ck.	SWM3 Pond Ck.	SWM2 (boundary)	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.33	8.18	8.22	8.24	6.5-8.5	N/A
Conductivity (mS/cm)	0.68	0.75	0.69	0.84	-	1.0
Hardness (mg/L as CaCO3)	310	310	330	320	-	1.0
Alkalinity (Total mg/L as Ca CO3)	270	260	280	270	-	1.0
Chloride	59	73	34	92	-	1.0
Nitrate (mg/L)	0.39	1.02	4.35	2.69	See3	0.10
Nitrite (mg/L)	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	<0.14	0.010
Total Ammonia-N	0.39	1.02	4.35	2.69	1.20	0.10
Orthophosphate	0.021	<0.010/ND	<0.010/ND	<0.010/ND	-	0.010
Total Phosphorus	0.025	0.026	<0.020/ND	<0.020/ND	0.030	0.020
Total Organic Carbon	6.6	6.2	2.5	6.5	-	0.40
Total BOD	<2/ND	<2/ND	<2/ND	<2/ND	-	2
Total Chemical Oxygen Demand	16	13	4.7	15	-	4.0
Total Suspended Solids	<10/ND	<10/ND	<10/ND	<10/ND	-	10
Fecal Coliforms (CFU/100mL) 5	97	53	1	16	100	N/A
Total Coliforms (CFU/100mL) 5	160	260	1	230	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)
[5] Sample collected on December 3, 2021

N/A = not applicable

Table A-32. Mill Creek Water Quality November 18, 2022.

	SWM1 Hwy. 401	SWM2 (boundary)	SWM3 Pond Ck.	SWM4 Galt Ck.	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.35	8.41	8.27	8.28	6.5-8.5	N/A
Conductivity (mS/cm)	0.72	0.81	0.70	0.95	-	0.001
Hardness (mg/L as CaCO3)	320	320	340	360	-	1.0
Alkalinity (Total mg/L as Ca CO3)	270	270	290	280	-	1.0
Chloride	58	83	31	110	-	1.0
Nitrate (mg/L)	0.41	1.63	5.02	4.72	See3	0.10
Nitrite (mg/L)	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	<0.14	0.010
Total Ammonia-N	<0.050	<0.050	<0.050	<0.050	1.20	0.050
Orthophosphate	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	-	0.010
Total Phosphorus	<0.020/ND	<0.020/ND	<0.020/ND	<0.020/ND	0.030	0.020
Total Organic Carbon	3.0	2.6	1.6	1.7	-	0.40
Total BOD	<2/ND	<2/ND	<2/ND	<2/ND	-	2
Total Chemical Oxygen Demand	8.0	6.0	<4.0	<4.0	-	4.0
Total Suspended Solids	<10/ND	<10/ND	<10/ND	<10/ND	-	10
Fecal Coliforms (CFU/100mL) 5	120	30	<10	30	100	10
Total Coliforms (CFU/100mL) 5	160	260	1	230	-	N/A

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)

N/A = not applicable

Table A-33. Mill Creek Water Quality November 24, 2023.

	SWM1 Hwy. 401	SWM2 (boundary)	SWM3 Pond Ck.	SWM4 Galt Ck.	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.34	8.33	8.35	8.30	**6.5-8.5**	**N/A**
Conductivity (mS/cm)	0.74	0.80	0.69	0.88	**-**	**0.001**
Hardness (mg/L as CaCO3)	330	350	350	350	**-**	**1.0**
Alkalinity (Total mg/L as Ca CO3)	270	270	280	270	**-**	**1.0**
Chloride	53	70	33	88	**-**	**1.0**
Nitrate (mg/L)	0.43	1.02	4.21	2.58	**See[3]**	**0.10**
Nitrite (mg/L)	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	**<0.1[4]**	**0.010**
Total Ammonia-N	<0.050	<0.050	<0.050	<0.050	**1.20**	**0.050**
Orthophosphate	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	**-**	**0.010**
Total Phosphorus	<0.020/ND	<0.020/ND	<0.020/ND	<0.020/ND	**0.030**	**0.020**
Total Organic Carbon	5.9	5.3	2.7	5.5	**-**	**0.40**
Total BOD	<2/ND	<2/ND	<2/ND	<2/ND	**-**	**2**
Total Chemical Oxygen Demand	17	18	11	16	**-**	**4.0**
Total Suspended Solids	<10/ND	<10/ND	<10/ND	<10/ND	**-**	**10**
Fecal Coliforms (CFU/100mL) 5	20	40	10	20	**100**	**10**
Total Coliforms (CFU/100mL) 5	610	480	610	310	**-**	**10**

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)

N/A = not applicable

Table A-34. Mill Creek Water Quality November 21, 2024.

	SWM1 Hwy. 401	SWM2 (boundary)	SWM3 Pond Ck.	SWM4 Galt Ck.	PWQO[1]	LOQ[2]
All units are mg/L, unless otherwise indicated.						
pH (units)	8.29	8.34	8.34	8.30	**6.5-8.5**	**N/A**
Conductivity (mS/cm)	0.73	0.79	0.7	0.87	**-**	**0.001**
Hardness (mg/L as CaCO3)	270	270	270	270	**-**	**1.0**
Alkalinity (Total mg/L as Ca CO3)	56	72	37	86	**-**	**1.0**
Chloride	0.49	0.91	4.13	2.70	**See[3]**	**0.10**
Nitrate (mg/L)	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	**<0.1[4]**	**0.010**
Nitrite (mg/L)	<0.050	<0.050	<0.050	<0.050	**1.20**	**0.050**
Total Ammonia-N	<0.010/ND	<0.010/ND	<0.010/ND	<0.010/ND	**-**	**0.010**
Orthophosphate	<0.020/ND	<0.020/ND	<0.020/ND	0.020	**0.030**	**0.020**
Total Phosphorus	6.7	6.9	6.6	7.4	**-**	**0.40**
Total Organic Carbon	<2/ND	<2/ND	<2/ND	<2/ND	**-**	**2**
Total BOD	26	27	29	30	**-**	**4.0**
Total Chemical Oxygen Demand	<10/ND	<10/ND	17	<10/ND	**-**	**10**
Total Suspended Solids	20	270	60	100	**100**	**10**
Fecal Coliforms (CFU/100mL) 5	640	490	910	270	**-**	**10**
Total Coliforms (CFU/100mL) 5	60	250	10	50	**-**	**10**

[1] PWQO = Provincial Quality Guideline for the Protection of Aquatic Life (- denotes no guideline)
[2] LOQ = Limit of Quantitation (Reportable Detection Limit)
[3] concentrations that stimulate prolific weed growth should be avoided
[4] federal guideline (CCREM)

N/A = not applicable

Appendix Table A31. Historical Conductivity and Alkalinity Values in Mill Creek

Source	Date	Conductivity (μmhos/cm)	Alkalinity (mg/L)	Location
MNR	1971	--	215	SWM2
	1976	550	226	SWM2
Faun Aquatics (FA)	Aug-1980	560	--	SWM2
	Sep-1980	590	--	SWM2
	Jul-1982	620	--	SWM2
FA/ MOE	1975 – 1988	425 – 652	134 – 270	All stations.
ESP/ESG/CWA	Nov-1993	620	250	DP2
	May-1994	559	233	DP2
	Oct-1994	673	238	DP2
	May-1995	556	219	DP2
	Nov-1995	681	191	DP2
	Nov-1996	620	260	SWM2
	Nov-1997	620	230	SWM2
	Nov-1998	650	260	SWM2
	Nov-1999	683	243	SWM2
	Nov-2000	638	253	DP2
	Nov-2001	665	241	DP2
	Nov-2002	645	259	DP2
	Dec-2003	676	244	SWM2
	Dec-2004	618	228	SWM2
	Nov-2005	666	272	SWM2
GLL	Oct-2006	645	233	SWM2
	Jan-2008	699	240	SWM2
AECOM Canada/ LRG Environmental	Oct- 2008	727	261	SWM2
	Aug-2009	670	259	SWM2
LRG Environmental	Nov-2010	680	244	SWM2
	Nov-2011	699	233	SWM2
	Dec-2012	690	240	SWM2
	Nov-2013	739	270	SWM2
	Nov-2014	593	230	SWM2
	Dec 2015	747	260	SWM2
	Dec 2016	802	270	SWM2
	Sept 2017	755	260	SWM2
	Dec. 2018	750	260	SWM2
	Dec. 2019	730	260	SWM2
WSP	Nov. 2020	763	260	SWM2
	Nov. 2021	750	260	SWM2
	Nov. 2022	810	270	SWM2
	Nov. 2023	800	270	SWM2
	Nov. 2024	790	270	SWM2

APPENDIX B

ANNUAL ELECTROFISHING RESULTS AND POPULATION ESTIMATES

Appendix Table B-1. University of Guelph Station - Trout Mark/Recapture Data Summary, 1989 to Present (2024)

where: N = population estimate (N=MC/R), M = number of fish marked, C = total number of fish caught on the recapture run
R = number of fish recaptured on the recapture run (*i.e.* number of marked fish)

Note: Fish shorter than 100 mm are classified as young-of-the-year.

Note: U of G Station is 660 meters long, with an area of 3960 square meters

Year	YOY M	YOY C	YOY R	YOY N	YOY per ha.	Adults M	Adults C	Adults R	Adults N	Adults per ha.	Total Population Per ha.
1989	76	72	32	171	432	39	33	26	50	125	557
1990	84	79	51	130	329	50	43	36	60	151	479
1991	78	87	31	219	553	76	73	56	99	250	803
1992	177	157	104	267	675	97	78	45	168	425	1099
1993	402	331	103	1292	3262	104	119	89	139	351	3613
1994	263	273	132	544	1374	192	151	89	326	823	2196
1995	154	85	23	569	1437	104	82	44	194	489	1927
1996					No Survey						
1997[a]	210	164	62	842	2125	131	111	86	256	647	2772
1998	250	296	51	1451	3664	151	148	66	339	855	4519
1999	560	215	39	3087	7796	197	123	75	323	816	8612
2000	154	146	33	681	1721	155	187	83	349	882	2602
2001	121	116	17	826	2085	93	136	45	281	710	2795
2002					No Survey						
2003	89	94	12	697	1761	59	51	18	167	422	2183
2004	168	141	41	578	1459	153	137	67	313	790	2249
2005	143	177	31	816	2062	115	100	43	267	675	2737
2006	168	181	33	921	2327	86	120	38	272	686	3013
2007	209	238	48	1036	2617	204	221	121	373	941	3558
2008					No Survey						
2009	44	130	9	636	1605	54	154	25	333	840	2445
2010	275	290	43	1855	4683	191	175	92	363	917	5601
2011	204	218	40	1112	2808	145	177	81	317	800	3608
2012					No Survey						
2013	135	141	33	577	1457	151	136	81	254	640	2097
2014					No Survey						
2015	156	172	15	1789	4517	121	108	54	242	611	5128
2016					No Survey						
2017	139	152	15	1409	3557	161	159	76	337	851	4407
2018					No Survey						
2019					No Survey						
2020	61	59	4	900	2273	68	92	25	250	632	2905
2022	168	247	39	1064	2687	163	176	69	434	1095	3782
2023					No Survey						
2024	45	18	6	135	341	162	77	74	169	415	756

*Relative to other years, 1993 adults likely over-estimated and YOY under-estimated (fish up to 12 cm assigned as YOY, also some in 13 cm FL range
Estimates in 1998 may under-estimate adults and over-estimate YOY (fish in 9.0 cm FL class counted as 'adults')

[a] GRCA survey: population estimate divided by 0.66 to correct for shorter station length in 1997

Appendix Table B-2. Hanlon By-pass Station - Brown Trout Mark Recapture Data Summary, 1989 to Present (2024)

where: N = population estimate (N=MC/R), M = number of fish marked, C = total number of fish caught on the recapture run
R = number of fish recaptured on the recapture run (*i.e.* number of marked fish)

Note: Fish shorter than 100 mm are classified as young-of-the-year.

Note: Hanlon By-pass Station is 610 meters long, with an area of 6893 square meters

	YOY	YOY	YOY	YOY	YOY	Adults	Adults	Adults	Adults	Adults	Total
Year	M	C	R	N	per ha.	M	C	R	N	per ha.	Per
1989	9	10	7	13	19	11	9	8	12	18	37
1990	5	9	4	11	16	19	20	17	22	32	49
1991	9	14	3	42	61	31	30	22	42	61	122
1992	data not available			189	274	data not available			52	75	350
1993	201	235	107	441	640	106	133	69	204	296	937
1994	242	200	122	397	576	104	139	98	148	214	790
1995	87	52	18	251	365	71	63	42	107	155	519
1996					No Survey						
1997[a]	158	159	54	612	888	60	64	46	110	159	1047
1998	190	238	65	696	1009	190	233	115	385	558	1568
1999	345	202	90	774	1123	45	39	28	63	91	1214
2000[b]	93	49	17	335	486	84	71	41	182	264	750
2001	80	76	22	276	401	40	41	18	91	132	533
2002					No Survey						
2003	69	114	21	375	543	17	15	5	51	74	617
2004	95	57	19	285	413	64	92	45	131	190	603
2005	134	312	43	972	1411	68	81	44	125	182	1592
2006	249	302	63	1194	1732	85	106	56	161	233	1965
2007	147	164	44	548	795	130	131	77	221	321	1116
2008					No Survey						
2009	171	217	31	1197	1737	98	132	44	294	427	2163
2010[c]	246	226	59	1178	1709	71	96	45	189	275	1983
2011[c]	164	211	53	816	1184	159	149	103	288	417	1601
2012					No Survey						
2013[c]	72	109	13	755	1095	85	88	33	283	411	1506
2014					No Survey						
2015[c]	132	123	33	615	892	88	89	60	163	237	1129
2016					No Survey						
2017[c]	83	81	16	525	762	119	95	61	232	336	1098
2018					No Survey						
2019					No Survey						
2020	25	16	1	400	580	74	74	38	144	209	789
2022	82	60	7	703	1020	69	65	24	210	305	1325
2023					No Survey						
2024	13	13	1	169	427	86	30	40	65	197	624

*Relative to other years, 1993 adults likely over-estimated and YOY under-estimated (fish up to 12 cm assigned as YOY, also some in 13 cm FL range

Estimates in 1998 may under-estimate adults and over-estimate YOY (fish in 9.0 cm FL class counted as 'adults')

[a] GRCA survey: population estimate divided by 0.76 to correct for shorter station length in 1997

[b] ESG survey: population estimate divided by 0.8 to correct for shorter station length in 2000

[c] LRG survey: population estimate divided by 0.8 to correct for shorter station length since 2010

Appendix Table B-3 Bond Tract - Brown Trout Mark Recapture Data Summary, 1989 to Present (2024)

where: N = population estimate (N=MR/C), M = number of fish marked, C = total number of fish caught on the recapture run

R = number of fish recaptured on the recapture run (*i.e.* number of marked fish)

Note: Fish shorter than 100 mm are classified as young-of-the-year.

Note: Bond Tract is 560 meters long, with an area of 5152 square meters

Year	YOY M	YOY C	YOY R	YOY N (population)	YOY per ha.	Adults M	Adults C	Adults R	Adults N (population)	Adults per ha.	Total Population Per Hectare
1989	6	4	1	24	47	42	43	34	54	105	151
1990	data not available			71	138	data not available			44	85	223
1991	data not available			73	142	40	36	34	42	82	224
1992	21	26	4	137	265	38	40	23	66	128	393
1993	111	84	30	311	603	57	49	34	82	159	762
1994	56	70	27	145	282	54	92	50	99	193	475
1995	32	29	4	232	450	87	73	49	130	252	702
1996					No Survey						
1997					No Survey						
1998					No Survey						
1999					No Survey						
2000	4	4	1	16	31	41	35	14	103	199	230
2001	2	7	0	*		23	24	9	61	119	119
2002					No Survey						
2003	4	0	0	*		10	18	3	60	117	117
2004	32	9	3	96	186	52	24	10	125	242	429
2005	12	21	4	63	122	29	25	18	40	78	200
2006	29	27	7	112	217	43	29	20	62	121	338
2007	31	19	6	98	191	43	43	17	109	211	402
2008					No Survey						
2009	5	0	0	*		13	20	1	260	505	505
2010	18	14	2	126	245	45	40	16	113	218	463
2011	35	25	6	146	283	44	51	21	107	207	490
2012					No Survey						
2013	1	3	0	*	*	51	48	17	144	280	280
2014					No Survey						
2015	13	3	1	39	76	39	29	10	113	220	295
2016											
2017	12	10	1	120	233	41	48	15	131	255	488
2018					No Survey						
2019					No Survey						
2020					No Survey						
2022	10	4	0	40	78	71	55	28	154	300	378
2023					No Survey						
2024	1	3	0	0	8	30	16	13	37	131	139

Appendix Table B-4. Annual Total Recapture Rate Summary for Trout Population Survey			
	Recapture Rates (%)		
	University	Hanlon	Bond
1989	50.4	75	72.9
1990	64.9	87.5	N/A
1991	56.5	62.5	N/A
1992	54.4	N/A	45.8
1993	37.9	57.3	38.1
1994	48.6	63.6	70.0
1995	26.0	38.0	44.5
1996	No Survey		
1997	43.4	45.9	N/A
1998	29.2	47.4	N/A
1999	15.1	30.3	N/A
2000	37.5	32.8	33.3
2001	29.0	33.3	36.0
2002	No Survey		
2003	20.3	30.2	21.4
2004	33.6	40.3	15.5
2005	28.7	43.1	53.7
2006	28.0	35.6	37.5
2007	40.9	43.7	31.1
2008	No Survey		
2009	34.7	27.9	5.6
2010	29.0	32.8	28.6
2011	34.7	48.3	34.2
2012	No Survey		
2013	39.5	29.3	32.7
2014	No Survey		
2015	24.9	42.3	21.2
2016	No Survey		
2017	30.3	38.1	30.2
2018	No Survey		
2019	No Survey		
2020	19.2	43.3	No Survey
2021	No Survey		
2022	25.5	24.8	47.5
2023	No Survey		
2024	36.7	27.4	20.3

Appendix Table B-5. Flow at SWM1 during annual electrofishing surveys (m^3/s)				
Year	MARK run		RECAP run	
	high	low	high	low
1998	0.253	0.202	0.202	0.177
1999	0.063	0.046	0.186	0.129
2000	0.136	0.122	0.205	0.136
2001	0.089	0.108	0.072	0.083
2002	No Survey			
2003	0.344	0.095	0.108	0.089
2004	0.221	0.082	0.094	0.085
2005	0.254	0.207	0.224	0.172
2006	0.121	0.112	0.199	0.121
2007	0.074	0.052	0.077	0.06
2008	No Survey			
2009	0.913	0.487	0.434	0.353
2010	0.24	0.215	0.314	0.255
2011	0.126	0.115	0.141	0.125
2012	No Survey			
2013	0.161	0.138	0.190	0.150
2014	No Survey			
2015	0.185	0.155	0.165	0.123
2016	No Survey			
2017	0.235	0.204	0.266	0.220
2018	No Survey			
2019	No Survey			
2020	0.124	0.110	0.106	0.104
2022	0.063	0.057	0.078	0.069
2023	No Survey			
2024	0.092	0.091	0.085	0.084

Appendix Table B-6. Incidence of brook trout during annual population surveys in Mill Creek; A = adult, yoy = young of the year.

Year	U of G		Hanlon	
	Mark	Recap	Mark	Recap
1998	1A	6A, 3yoy	1A	0
1999	0	0	0	0
2000	1A	1A, 1yoy	0	0
2001	0	0	0	0
2002	No Survey			
2003	0	0	0	0
2004	21A, 3yoy	4A, 3yoy	0	0
2005	1A, 1yoy	1A, 5yoy	1A*	1A
2006	1A, 2yoy	1A, 3yoy	0	0
2007	2A, 2yoy	4A (1 recap), 8yoy	2yoy	1yoy
2008	No Survey			
2009	1A, 3yoy	3A, 2yoy	2yoy	1A
2010	5A, 6yoy	1A, 4yoy	0	0
2011	2A, 2yoy	2 yoy	0	0
2012	No Survey			
2013	2A, 2yoy	1A, 1yoy	0	0
2014	No Survey			
2015	2A, 1yoy	3A (2 recap)	1A	1A Rainbow trout
2016	No Survey			
2017	2yoy	2A, 1yoy (1 recap – possible tiger trout)	1A, 2yoy	1A (recap)
2018	No Survey			
2019	No Survey			
2020	0	0	0	0
2021	No Survey			
2022	0	0	0	0
2023	No Survey			
2024	0	1A	0	0

*Recapture from U of G reach the previous day

APPENDIX C

REDD SURVEY DATES AND RESULTS

Appendix Table C-1. Summary of Mill Creek redd survey dates

	Stream Reach			
	Hanlon By-pass	**University of Guelph**	**Marker**	**Surveyed By:***
1995	23-Oct	23-Oct	-	MZ
	10-Nov	10-Nov		
	11-Dec	11-Dec		
1996	29-Oct	29-Oct	orange flag	MZ, NH
	18-Nov	18-Nov		
	06-Dec	06-Dec		
1997	06-Nov	06-Nov	blue flag	RB, NH
	20-Nov	20-Nov		
	08-Dec	08-Dec		
1998	06-Nov	06-Nov	orange flag	RB, NH
	07-Dec	07-Dec		
	18-Dec	18-Dec		
1999	11-Nov	11-Nov	blue flag	RB, NH
	04-Dec	07-Dec		
	18-Dec	18-Dec		
2000	11-Nov	11-Nov	-	MJ
	02-Dec	02-Dec		
2001	14-Nov	14-Nov	-	NH
	05-Dec	05-Dec		
2002	14-Nov	14-Nov	orange flag	NH, MJ
	27-Nov	27-Nov		
2003	11-Nov	11-Nov	orange flag	MJ, KH
	02-Dec	02-Dec		
2004	09-Nov	09-Nov	orange flag	MJ, KH, RP
	10-Dec	10-Dec		
2005	23-Nov	23-Nov	orange flag	MJ
2006	28-Nov	28-Nov	blue flag	MJ, LW
	11-Dec	11-Dec		
2007	01-Dec	01-Dec	orange flag	MJ
	17-Dec	17-Dec		
2008	25-Nov, 18-Dec	25-Nov, 18-Dec	-	VS, SB
2009	26-Nov	26-Nov	orange flag	MJ, LW
2010	24-Nov	24-Nov	orange flag	MJ, LW
2011	25-Nov	25-Nov	-	LW, KC
2012	7-Dec	7-Dec	-	KM, NB
2013	27-Nov	27-Nov	-	LW, KM
2014	26-Nov	26-Nov	-	LW, KM
2015	8-Dec	8-Dec	-	LW, ME
2016	29-Nov	29-Nov	-	LW, ME
2017	23-Nov	23-Nov	-	LW, NB
2018	8-Dec	8-Dec	-	LW
2019	13-Dec	13-Dec	-	LW, LK
2020	19-Nov	19-Nov	-	LK, KL
2021	19-Nov	19-Nov	-	KL, RS
2022	18-Nov	17-Nov	-	RS, CH
2023	24-Nov	24-Nov	-	CH,ND
2024	21-Nov	21-Nov	-	CH, RJ

* NH – Nancy Harttrup
MZ – Mike Zimmer
RB – Rick Baldwin
MJ – Mike Johns
LK – Leslie Keith
CH – Courtney Huber
LW – Lisa Wren
VS – Valerie Stevenson
SB – Sarah Burgess
RP – Rob Price
KL – Kim LeBrun
RJ – Riley Jauniaux
KC/KM – Kelly Clayton/Mason
NB – Nathan Burnett
KH – Kara Hearne
ME – Mitch Ellah
RS – Rachel Stephens
ND – Nathan DeCarlo

Appendix Table C-2. Redd Count Summary; 1983 to 2024

Year	University of Guelph	Hanlon By-pass
1983	14	0
1984	9	6
1985	10	18
1986	22	19
1987	19	2
1988	36	1
1989	30	4
1990	76	6
1991	48	5
1992	79	22
1993	74	14
1994	34	10
1995	44	9
1996	60	20
1997	54	21
1998	44	20
1999	38	12
2000	49*	9
2001	55	18
2002	66	17
2003	65	22
2004	65	27
2005	70	22
2006	81	62
2007	58	38
2008	98	61
2009	176	99
2010	194	75
2011	146	93
2012	96	50
2013	148	102
2014	113	85
2015	111	87
2016	100	107
2017	93	78
2018	43	20
2019	58	35
2020	55	30
2021	41	39
2022	11	15
2023	16	10
2024	16	20

* redd count in 2000 was incorrectly reported as 46 in this table in the 2001 Monitoring Report.

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