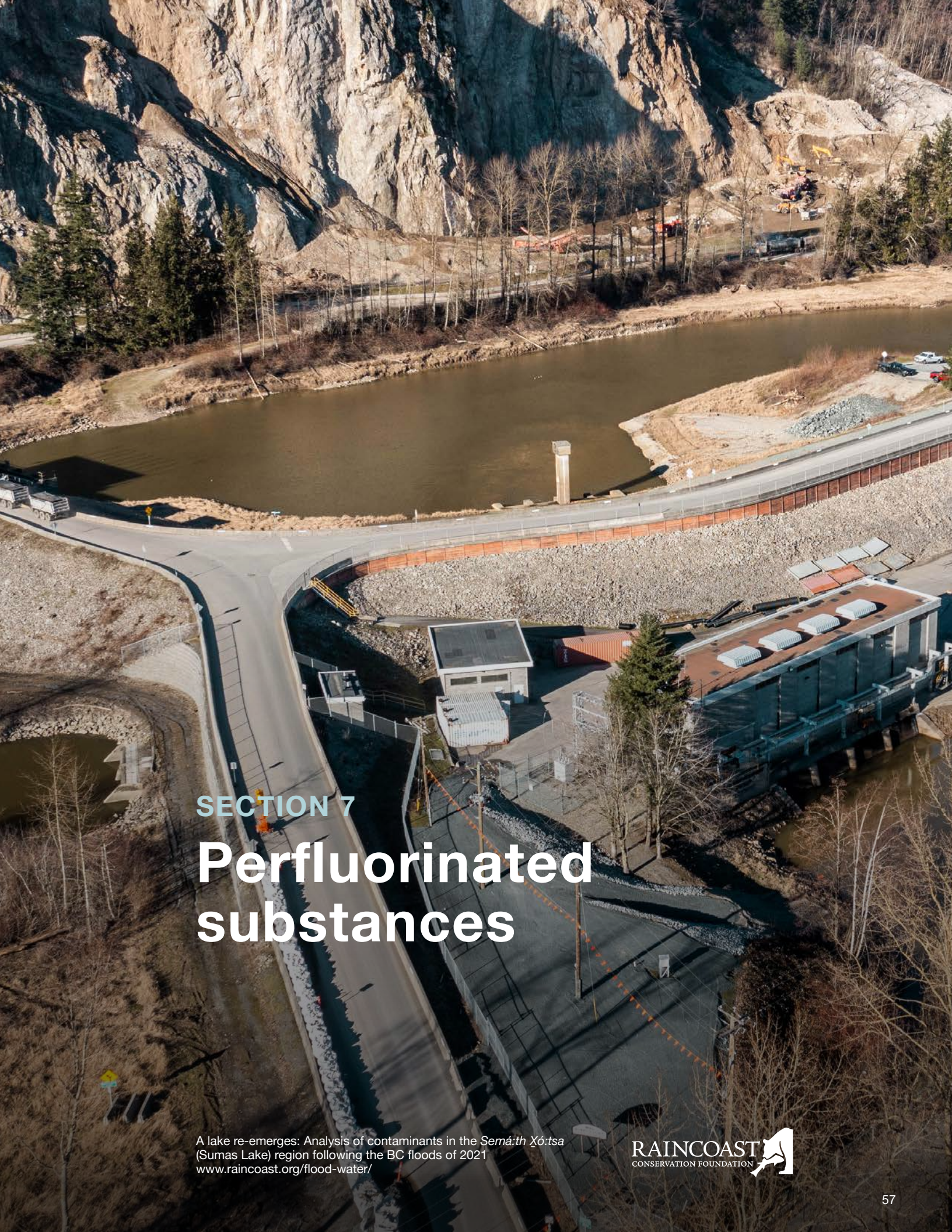

SECTION 7

Perfluorinated substances

A lake re-emerges: Analysis of contaminants in the *Semá:th X̱ó:tsa* (Sumas Lake) region following the BC floods of 2021
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RAINCOAST CONSERVATION FOUNDATION

PERFLUORINATED SUBSTANCES

Capsule

Relatively low concentrations of per- and polyfluoroalkyl substances (PFAS) were detected in the surface waters of the former *Semá:th X̱ó:tsa* (Sumas Lake), but the presence of these 'forever chemicals' warrants concern because of their extreme persistence in the environment. Average PFAS concentrations increased from 0 ng/L at our reference site to 4.4 ng/L at downstream Sumas sites, suggesting that local sources are introducing this class of contaminant into Sumas fish habitat.

Introduction

The catastrophic floods of late 2021 in British Columbia and Washington State overwhelmed urban, agricultural and industrial infrastructure in the *Semá:th X̱ó:tsa* (Sumas Lake) area, raising concerns about the impacts of contaminant discharges into fish habitat. The absence of pre-flood baseline data and ongoing monitoring of freshwater quality in the area highlighted the urgent need for water sampling and analysis to assess the level of risk to fish and the environment.

PFAS are a group of thousands of human-made compounds. They have a variety of applications and can be found in water and grease repellent textiles (clothing, furniture, carpets), food packaging, non-stick cookware, and fire suppression foam. They do not readily degrade and are therefore very persistent and mobile in the environment. They are sometimes referred to as 'forever chemicals', and have been found in the atmosphere, marine environments, freshwater environments, groundwater, and sediment (1).

Due to the prevalence of PFAS in the environment, there are many potential pathways of exposure for humans and aquatic life. Since there are thousands of PFAS compounds, only a limited number have been studied in depth and many data gaps exist. Current studies have shown that particular PFAS chemicals (PFOA, PFOS, PFNA, and PFHxS) contribute the most to human exposure. These compounds are also known to bioaccumulate in fish, bivalves, plankton, and crustaceans living in freshwater and in brackish or marine environments (2). Initial studies have shown exposure in humans can cause negative impacts on the liver, metabolism, the reproductive system, and the immune system (3).

Methods

We collected 25 surface water samples from 11 sites in the Sumas Lake area of the Fraser Valley (British Columbia; 8 on December 15, 2021; 9 on December 23, 2021; 6 on January 27, 2022; and 2 on February 2, 2022), as well as 4 groundwater samples on February 2, 2022. Two of these samples from Abbotsford groundwater sources will be evaluated separately. Details for sampling sites are listed in the Executive Summary. Samples were stored in the field at 4°C in suitable containers supplied by partnering laboratories, and delivered to SGS AXYS Analytical Services (https://www.sgsaxys.com/) in Sidney BC for analysis of 40 per- and polyfluoroalkyl substances (PFAS) compounds using their in-house MLA-110 Rev 2 protocol. Data are presented in nanograms per litre (ng/L).

As one means of interpreting the risk of PFAS-related effects in fish and fish habitat at our sample locations, we compared our PFAS concentrations to the most protective Environmental Quality guidelines for fish and fish habitat available in a Canadian provincial or federal jurisdiction. Jurisdictions with EQGs in Canada included British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, Canada (federal) and the Canadian Council of Ministers of the Environment (CCME). The most protective guideline that exists for a PFAS compound is the BC Working Environmental Quality Guideline for Perfluorooctane Sulfonate (PFOS) and the CCME, which is 6,800 ng/L for surface water. Environmental Quality Guidelines are not available for any of the other PFAS compounds in Canada, nor does this Working Guideline fully explain contaminant risks to fish. Nonetheless, they provide an important benchmark to gauge the health of fish habitat.

We refer to the most protective EQG in Canada herein as the 'pan-Canadian Environmental Quality Guideline to protect fish and fish habitat' or the 'pan-Canadian EQG'.

We report here on PFAS concentrations in 25 surface and 2 ground water samples following the British Columbia floods of late 2021, and evaluate results against the limited availability of Canadian Environmental Quality Guidelines to protect fish and fish habitat.

Results

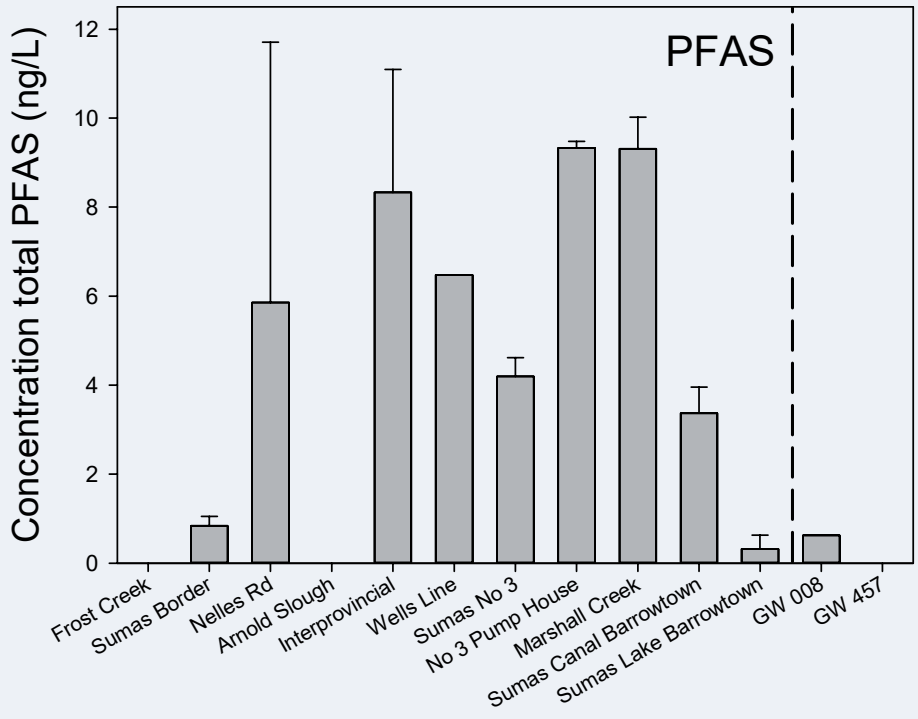
Surface water

- We detected PFAS at 9 out of 10 of our Sumas Lake surface water sites, but none at our upstream reference site (Frost Creek).
- We detected 10 different PFAS compounds out of the 40 measured, ranging from 0 to 8 at individual surface water sites, and an average of 3 per site.
- The concentration of total PFAS (sum at each surface water site) averaged 4.1 ng/L +/- 4.0 ng/L, ranging from 0 ng/L to 11.1 ng/L.
- Marshall Creek and No. 3 Pumphouse in the Sumas Lake area were the two most contaminated surface water sites based on the number of PFAS compounds found and total concentrations.
- The number of PFAS compounds detected was correlated with the sum of PFAS concentrations in each sample.
- Average PFAS concentrations increased from 0 ng/L at our reference site to 4.43 ng/L at downstream Sumas sites.
- There was an increase in average PFAS concentrations in surface water sites by 1.4 times from December 15 to December 23 and an increase of 1.2 times from December 15 to January 27.

Groundwater

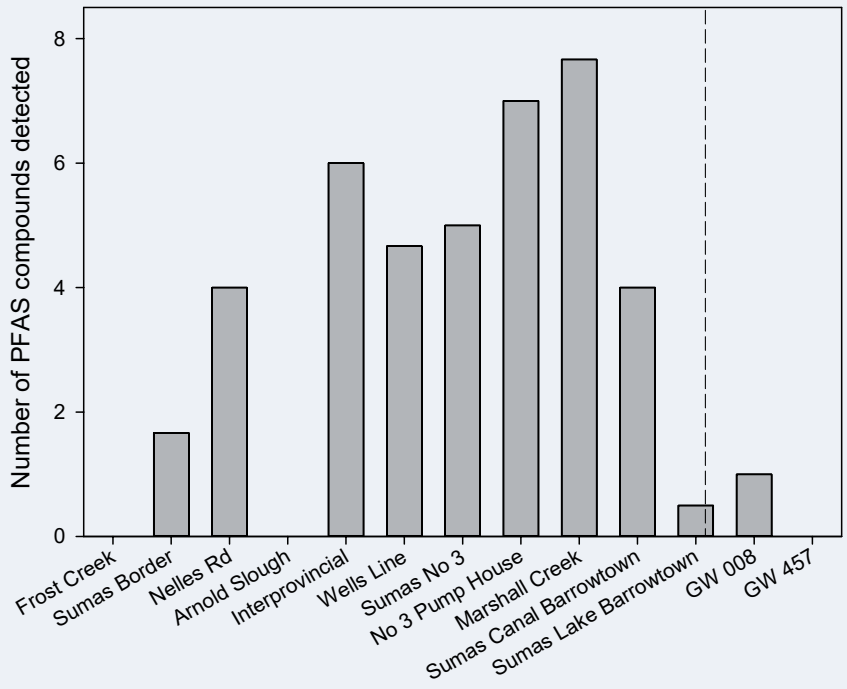
- One PFAS compound (PFBS) was detected at one of the groundwater sites.

Figure 7.1: PFAS 'forever chemicals' were found in most surface waters



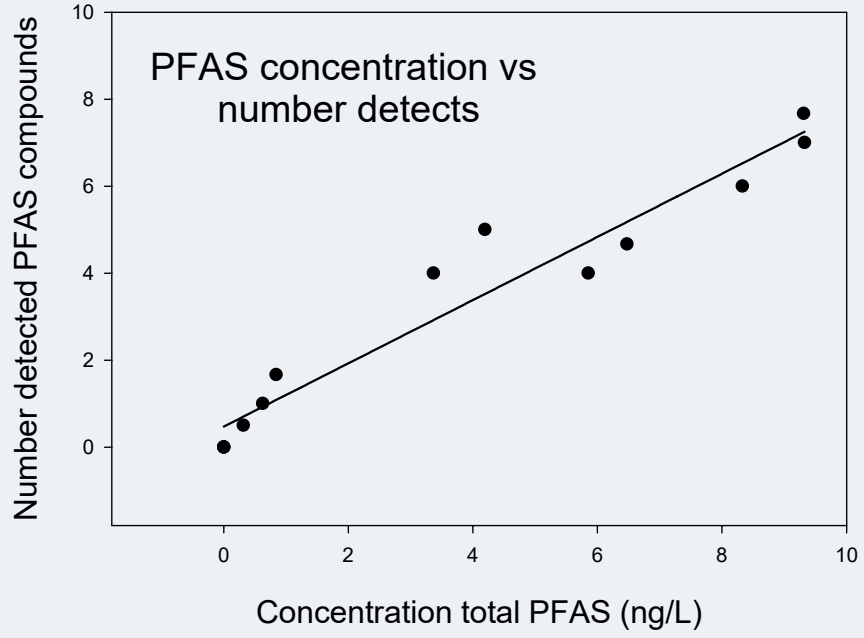
Average PFAS concentrations at each sampling location, across sampling dates.

Figure 7.2: The number of PFAS compounds was highest in Sumas waters



Average number of detected PFAS compounds at each sampling location, across sampling dates.

Figure 7.3: Increasing concentrations of PFAS meant more PFAS compounds



Number of detected PFAS compounds vs. average sum of PFAS concentrations.

Conclusions

Ten PFAS compounds were found in fish habitat in the Sumas Lake area. We found no exceedances of the sole Canadian EQG for a PFAS compound (PFOS), but the virtual lack of EQGs for this class of chemical constrains an adequate assessment of risk to fish and fish habitat.

The concentrations of PFAS compounds in Sumas Lake waterways were below averages reported in a Canada-wide survey of freshwater, except for in PFBA which was higher than average at Nelles Rd., No. 3 Pumphouse, and Interprovincial surface water sites (4). The top four most detected compounds (PFOS, PFOA, PFBA, and PFHxA) were the same in our study and the Canada-wide study. There was an 187% increase in average PFAS concentrations in surface water sites from December 15 to December 23 and an increase of 125% from December 15 to January 27.

Although some PFOS and PFOA compounds have been banned in Canada since 2008 and 2016, respectively (5), they were detected in Sumas waterways. Monitoring of PFAS compounds in Sumas waterways is advisable as these 'forever chemicals' do not readily degrade. These compounds therefore pose a long-term risk to the quality and safety of groundwater, drinking water and surface water.

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Conclusions

We found varying concentrations of the artificial sweetener sucralose in Sumas surface waters and in groundwater, highlighting the widespread distribution of this compound in fish habitat. The higher levels in Sumas Lake waterways compared to the upstream reference site at Frost Creek point to local sources from human waste released from agricultural biosolids, septic fields, and/or wastewater treatment plants (4). The increase in sucralose levels over the time of our study may indicate that the floods of 2021 led to increased contamination of fish habitat.

The presence of sucralose in Sumas Prairie waterways suggests that human waste is entering this fish habitat. Continued monitoring over space and time will provide insight into the sources of this artificial sweetener, what other domestic pollutants may also be found there, and what the consequences may be for fish.

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