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Canada

Evaluation of the Effectiveness of Risk Management Measures for Bisphenol A (BPA) – Ecological Component

Environment and Climate Change Canada

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Summary

Bisphenol A (BPA) is a human-made chemical used in hard plastic products and specialized paper, such as receipts. In 2008, the Government of Canada assessed the risks posed by this substance and concluded that BPA could harm people, animals, and plants. To address this, the Government of Canada created a Proposed Risk Management Approach to protect the health of Canadians and the environment from BPA.

The purpose of this report is to evaluate the effectiveness of the Government of Canada's actions in reducing the concentration of BPA in the environment. For an evaluation of the effectiveness of the Government of Canada's actions to protect human health, see Health Canada's report: Performance Evaluation for BPA - HEALTH Component (Health Canada 2018).

This report evaluates the effectiveness of actions taken to manage the risks posed by BPA to the environment and compares concentrations of BPA in the environment to the Federal Environmental Quality Guidelines (FEQGs). The FEQGs identify the concentration of BPA that is protective to aquatic life. The focus of this report is BPA in surface water (lakes and rivers) and sediment (the ground beneath the water) because most BPA releases are to surface water and from there it can move to sediment.

To protect the environment, the Government of Canada put in place a Pollution Prevention Planning Notice for industrial and commercial users of BPA and an Environmental Performance Agreement Respecting Bisphenol A in Paper Recycling Mill Effluents. These are referred to as risk management actions.

Across Canada, the current concentration of BPA in surface water is well below levels considered protective to aquatic life and is generally decreasing in areas where risk management actions have taken place. For these reasons, no further risk management for BPA in surface water is necessary at this time.

Environmental data for sediment also supports the conclusion that no further risk management is necessary. However, 1% of samples had concentrations of BPA above levels considered protective to aquatic life. In order to monitor the concentration of BPA in sediment and ensure that levels are decreasing, this report recommends that sediment sampling continue.

Introduction

Bisphenol A (BPA) is a human-made chemical used in hard plastics and specialized paper, such as receipts. BPA is a concern for human health and the environment. This report evaluates BPA in the environment. For BPA and human health, see Health Canada's report: Performance Evaluation for BPA - HEALTH Component (Health Canada 2018).

The purpose of this report is to measure the effectiveness of the Government of Canada's actions in reducing the concentration of BPA in the environment. It evaluates the effectiveness of actions taken and compares concentrations of BPA in the environment to the levels recommended in the Federal Environmental Quality Guidelines (FEQGs). This report looks at concentrations of BPA in surface water (lakes and rivers) and sediment (the ground beneath the water), because most BPA is released to surface water and from there it can move to sediment.

Background

Risk management performance evaluation

In 2009, the Commissioner of the Environment and Sustainable Development published a review of federal risk management actions on the Risks of Toxic Substances. It stated that the Government of Canada did not have "a formal process for tracking new information and emerging risks" and that "departments lack a systematic process for periodically assessing progress made in managing the risks" (Office of the Auditor General of Canada 2009).

In response to this review, Environment and Climate Change Canada (ECCC) and Health Canada agreed to evaluate the performance of risk management of substances declared toxic under t*he Canadian Environmental Protection Act*, and have created a strategy for doing so. Performance evaluation involves looking at how well all of the actions taken to reduce the risks of a chemical have worked, including looking for signs of environmental or human exposure.

BPA risk assessment and risk management

In the screening assessment report for BPA, the Government of Canada concluded that BPA has the ability to harm people, animals, and plants (Canada 2008). To address these risks, the Government of Canada released a Proposed Risk Management Approach to protect Canadians and the environment from BPA (Canada 2008).

The majority of BPA in the environment comes from the manufacturing and disposal of products containing it. Most releases of BPA are to water; however, it can enter the environment through air, water, or soil. BPA can move from water to sediments where it can remain in the environment for a long time due to a lack of oxygen.

The Proposed Risk Management Approach included an environmental objective and a risk management objective. The environmental objective is the goal for levels of BPA in the environment. The risk management objective sets specific targets for the risk management actions that are used to work towards the environmental objective. The environmental objective is to prevent or minimize releases of BPA into the Canadian environment and the risk management objective is to achieve the lowest level of release of BPA to water that is technically and economically feasible (Canada 2008). To work towards these goals, ECCC has taken risk management actions to reduce releases of BPA to the environment from industrial users of BPA and paper recycling mills.

Federal Environmental Quality Guidelines for BPA

ECCC designs FEQGs to protect aquatic life and the animals that eat it from the harmful effects of a chemical, no matter the length of exposure. This means that as long as the concentration of the chemical in surface water, sediment, or food is below the FEQG, it should not affect the health of animals or aquatic plants. ECCC examines all relevant research when developing FEQGs, and thus they are based on how toxic a chemical is according to the best available science.

The FEQGs for BPA are 3500 ng/L in surface water and 25 000 ng/kg dry weight in sediment (Environment and Climate Change Canada 2018). In this report, the FEQGs are used to see if the environmental objective for BPA has been met. The FEQGs for BPA were developed after the screening assessment report was published and used the latest available information. As a result, the FEQG for BPA concentration in water is different from the predicted 'no effect' concentration given in the screening assessment report.

Performance evaluation

Environmental monitoring data

ECCC collects surface water and sediment samples from across Canada as part of the Chemicals Management Plan. ECCC measured the progress towards meeting the environmental objective by comparing this data to the FEQGs. The environmental concentrations used in this section are from the report *Bisphenol A in the Canadian Environment* (Environment and Climate Change Canada 2020).

Surface Water

Of the 1151 surface water samples collected from 2012-2018 across Canada, none had concentrations above the FEQG for BPA in water (3500 ng/L). The concentrations of BPA in these samples ranged from undetectable to 1889 ng/L.

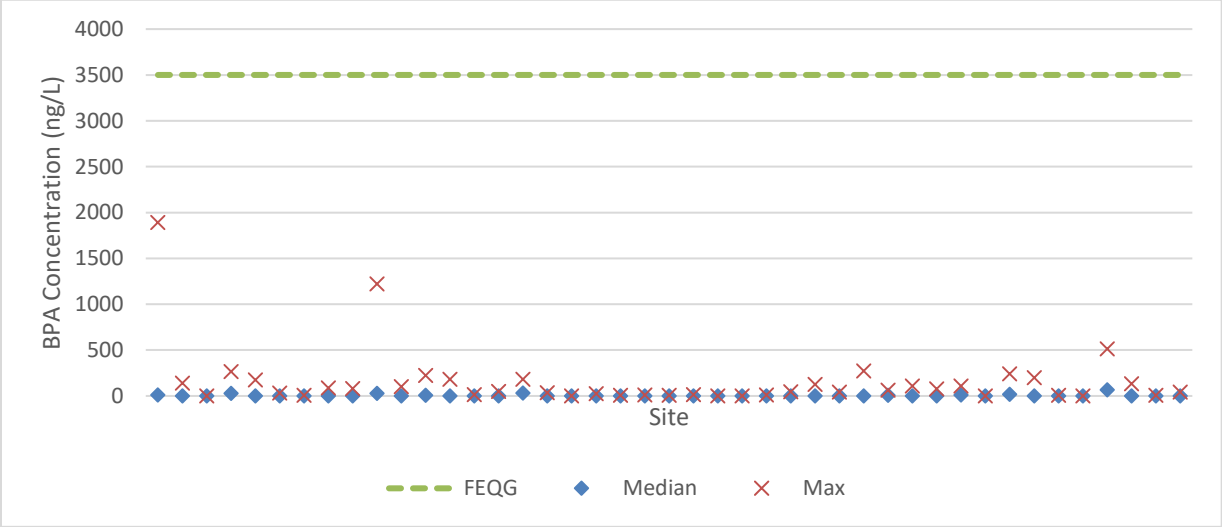

Figure 1: The median[1] and maximum BPA concentrations in surface water samples collected from 2012-2018 at 43 sites across Canada compared to the FEQG for BPA in surface water. The location of sampling sites is provided in Appendix A.

ECCC performed a statistical analysis for sampling sites that had ten years of data. Twelve sampling sites fit this category. Statistically significant trends showed that the concentration of BPA was decreasing at nine of these sites. No statistical trend could be seen for the other sites (Environment and Climate Change Canada 2020).

There are six sampling sites near paper recycling mills where risk management actions have taken place. Of these six sites, five had ten years of data. Statistically significant decreasing trends were found at four of these sites, and no statistical trend was observed at the fifth site. For the sixth site that did not have ten years of data, statistical analysis was performed on the seven available years of data (2012-2018). From this analysis, ECCC observed a statistically significant decreasing trend in the concentration of BPA.

[1] A median is a middle point in a set of data. Half of the samples taken will have concentrations above the median, and the other half will have concentrations below the median.

Beaverdams Creek is one of the sites near risk management activities where a decreasing trend was seen. It previously had the highest recorded concentration of BPA, but BPA has not been detected since 2014. Figure 2 below shows a 10-year trend for this site.

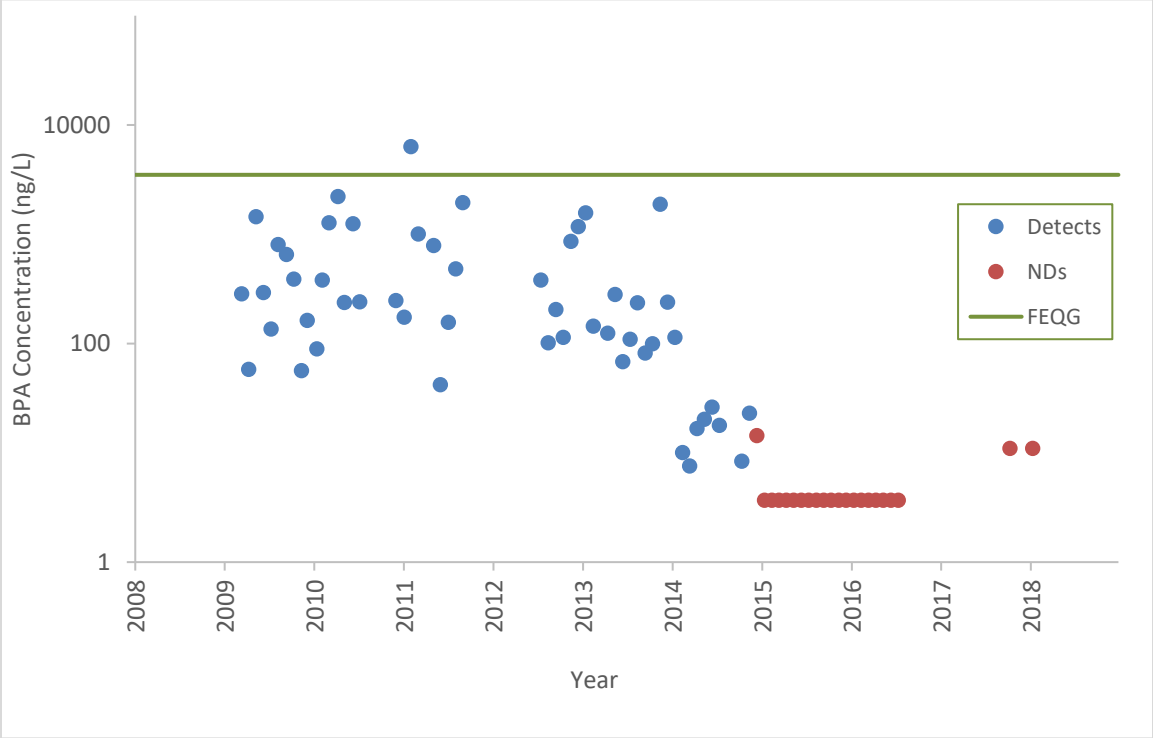

Figure 2: Time trend for BPA concentration at Beaverdams Creek from 2008-2018, showing when BPA was detected (detects), and when it was not detected (NDs) (Environment and Climate Change Canada 2020). The ND concentrations are plotted at the detection limit; the actual concentrations for ND samples could be anywhere from zero to the detection limit.

At the majority of the sites near risk management activities (five out of six) the concentration of BPA has decreased with time, while the other site appears to have remained stable. Additionally, none of the sites had concentrations above the FEQG for BPA in water after the implementation of risk management actions.

Sediment

From 2012 to 2018, ECCC took 260 sediment samples across Canada. Of these samples, 99% had concentrations below the FEQG for BPA in sediment, when adjusted to 1% organic carbon. Therefore, BPA was found at concentrations above the FEQG of 25 µg/kg dry weight (or 25 000 ng/kg dry weight) in 1% of samples. Table 1 below shows the samples that had concentrations above the FEQG.

Table 1: Sediment samples that had concentrations of BPA above the FEQG after an adjustment for 1% organic carbon

Region	Site	Sample Year	BPA Concentration (µg/kg dry weight)
Atlantic	Waterford River	2011	48
Pacific	Still Creek BC	2013	26
Québec	Lake Saint-Pierre	2013	42

The presence of BPA in the sediment is due to the movement of BPA from the surface water (Environment and Climate Change Canada 2018). Samples were taken from the top layer of the sediment, which can contain several years of sedimentation. Because sediment is an area with little to no oxygen, BPA can remain there for longer than it can in water, and the flame retardant tetrabromobisphenol A can degrade to BPA over time (Environment and Climate Change Canada 2020). These sites should be sampled again in the future to see if the concentration of BPA has decreased.

Releases from industrial users of BPA

Under the Pollution Prevention Planning Notice with respect to Bisphenol A in Industrial Effluents, published on April 14, 2012 (Canada 2012), four industrial users of BPA were required to prepare and implement a plan to reduce the concentration of BPA in their wastewater to less than 1750 ng/L. They were required to submit reports on their progress in developing and implementing the plan, as well as monitoring and use information. Indicators to measure the effectiveness of this risk management action include the number of facilities that prepared and implemented their plans, as well as the number of those facilities that achieved the risk management objective. All four industrial users submitted final reports to ECCC in January 2017.

The data from these reports was summarized in the Bisphenol A in industrial effluents: P2 notice performance report. Of the four industrial users of BPA, one met the goal by using BPA-free alternatives; another still uses BPA but is meeting the goal; and two stopped using BPA but have not yet met the goal.

The two facilities not meeting the objective are expected to have leftover BPA in their equipment. These two companies have agreed to take samples of their wastewater twice a year until they meet the objective.

Compared to before risk management action was taken, the facilities use 99% less BPA, send 94% less BPA to off-site wastewater treatment systems, and have not sent any BPA to landfill. From 2012 to 2017, the average concentration of BPA in the wastewater of these facilities decreased by 83%.

Releases from paper recycling mills

Thirteen companies signed the Environmental Performance Agreement Respecting Bisphenol A in Paper Recycling Mill Effluents. It was in effect from March 5, 2013, to March 5, 2017 (Environment Canada 2013). The participating mills agreed to reduce the concentration of BPA in their wastewater to less than 1750 ng/L. During this agreement, the paper-recycling mills submitted progress and final reports to ECCC. The percentage of facilities that met the performance objective is an indicator of the success of this risk management activity.

During the last year of the environmental performance agreement, all recycling mills took samples of their wastewater and provided a final report to ECCC to show if they had met the performance objectives.

Twenty-two paper-recycling mills originally signed the agreement and 17 mills submitted final reports. Of the facilities that did not submit final reports, three stopped their paper recycling operations and two were sold and ended their participation in the Agreement. ECCC reviewed the 17 reports against the objectives of the Agreement, and 16 met the performance objective of 1750 ng/L of BPA or less in their wastewater.

The mill that did not meet the objective collected 12 industrial wastewater samples: two had concentrations higher than 1750 ng/L, while the other 10 met the objective. According to this mill, the quality of waste paper available on the market has been decreasing, and contains more contaminants, including plastic. For this reason, the amount of BPA in their recycled paper may have stayed high, leading to more BPA in their wastewater. This mill also treats the municipal wastewater for the surrounding area in their treatment facility. For this reason, the mill effluent may not be the only source of BPA.

Conclusion

Across Canada, the current concentration of BPA in surface water is well below the FEQG and generally decreasing overtime in areas where risk management activities have taken place. For these reasons, no further risk management for BPA in surface water is necessary at this time.

Environmental data for sediment also supports the conclusion that no further risk management is necessary. The majority (99%) of samples taken from 2012 to 2018 had concentrations of BPA below levels of concern.

Since the concentration of BPA measured in surface water has consistently been well below the FEQG, no further surface water sampling is recommended at this time. Future

effluent monitoring for the industrial users of BPA that did not meet the risk management objectives should continue as agreed.

In order to monitor the concentration of BPA in sediment and ensure that levels are decreasing, this report recommends that sediment sampling continue. If data does not show a sufficient decrease in the concentration of BPA in sediment, other potential sources of BPA should be examined, such as the flame retardant tetrabromobisphenol A, which can degrade to BPA in sediment due to the lack of oxygen (Environment and Climate Change Canada 2020).

References

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Appendix A

Table A-1: Identity of the sampling sites shown in Figure 1

Site Number	Site Name	Site Region
1	Beaverdams Creek	Ontario
2	St Lawrence River at Berthierville	Quebec
3	Credit River	Ontario
4	Dicks Creek	Ontario
5	Grand River	Ontario
6	Lower Grand River	Ontario
7	Upper Grand River	Ontario
8	Hamilton Harbour - Site 1001	Ontario
9	Hamilton Harbour - Site 909	Ontario
10	Hamilton Harbour - Site 914	Ontario
11	Hamilton Harbour - Site 926	Ontario
12	Highland Creek	Ontario
13	St. Lawrence River at Laval	Quebec
14	Little Sackville River	Atlantic
15	Lower Mill Creek	Pacific
16	Mimico Creek	Ontario
17	Mill Creek - Kelowna	Pacific
18	Upper Mill Creek	Pacific
19	Napan River	Atlantic
20	Niagara River at Niagara-on-the-Lake	Ontario
21	Okanagan River	Pacific
22	Okanagan River at Penticton	Pacific
23	Osoyoos Lake	Pacific
24	St. Lawrence River at Prescott	Ontario
25	Princeville	Quebec
26	St. Lawrence River at Quebec City	Quebec
27	Red River at Emerson	Prairies
28	Red River at Highway 4	Prairies
29	Red River at Winnipeg	Prairies
30	Red Rive at Selkirk	Prairies
31	Serpentine River	Pacific
32	St. John River - Downstream	Atlantic
33	St. John River - Upstream	Atlantic
34	Still Creek	Pacific
35	Le Bras River at Victor	Quebec
36	Taylor Creek	Ontario
37	Thames River - Downstream	Ontario
38	Upper Thames River	Ontario
39	Trent River	Ontario
40	Wascana Creek - Downstream	Prairies
41	Wascana Creek - Upstream	Prairies
42	Waterford River	Atlantic
43	St. Lawrence River at Wolfe Island	Ontario