Toronto Inner Harbour Floatables Strategy

An adaptive management strategy to improve aesthetics for increased public enjoyment of the Toronto Waterfront.

Version 2.0, February 18, 2022

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INTRODUCTION

Strategy Focus

The City of Toronto waterfront is a world-class feature that is cherished by the millions of people that live, work and play nearby. While environmental conditions along the waterfront continue to improve, aesthetics and public perception of the health of this ecosystem are affected by plastics and other floating anthropogenic debris, known as "floatables".

The focus of the Toronto Inner Harbour Floatables Strategy (the Floatables Strategy) is to identify opportunities for the collection and removal of floatable debris from Lake Ontario within the City of Toronto's Inner Harbour (Inner Harbour). By working collaboratively, multiple agencies can tackle the issue of floatables more efficiently and effectively to make a positive impact on both the aesthetics and environmental health of the Inner Harbour. The Floatables Strategy will outline actions that can be implemented by the stakeholders and partner groups that support the Floatables Strategy. Many of the actions in Version 1.0 of the Floatables Strategy have been carried over to Version 2.0 to advance progress already made. Despite situating some actions upstream, the primary focus will remain on the Toronto Inner Harbour and its stakeholders.

The need for the Floatables Strategy is to ensure a long-term plan for continued action to address floatables in the Inner Harbour. The intent of the Floatables Strategy is to create a long-term maintenance commitment by those with jurisdiction over the area, assisting in maintaining the aesthetic quality for users of the Toronto waterfront. The Floatables Strategy is a living document that will embrace opportunities to work with interested stakeholders in adopting this program in other areas along the Lake Ontario waterfront beyond the Toronto Inner Harbour. Future versions of the Floatables Strategy will incorporate actions that examine how floatable debris behaves in river-based watersheds that feed into the Inner Harbour and its impacts on the Inner Harbour, and eventually, examine drainage systems to those river-based watersheds. Taking part of the focus upstream will help shed light on inter-watershed relationships with respect to marine and land-based plastic pollution and the unique ecological features that connect these waterbodies.

Version 2.0 will begin by applying monitoring best practices from Version 1.0 to the Don River watershed through another Tagging Trash project, led by the University of Toronto Trash Team. The Don River is the most urbanized watershed in Canada and as a consequence, it is a major conduit for pollution into Lake Ontario (Rochman, 2018). This is evidenced by the quantification and characterization of litter captured in the boom systems where the river and lake convene. Monitoring floatables in the Don River is an opportunity to pilot a model for aligning Floatables Strategy mitigation tactics with TRCA's river-based watershed planning priorities and conservation strategies, and those of current and future partners and stakeholders. For example, the TRCA's Watershed & Ecosystems Reporting Hub for the Lake Ontario Nearshore states:

"The nearshore is the area where land and streams meet the lake. This interface area is an important ecological feature — the nearshore often contains wetlands, and it provides important functions, such as food and habitat for fish and other aquatic species. The water resources of the lake are vital for the functioning of bordering cities and towns. Conservation strategies are essential to maintaining both the ecology and the natural beauty of the nearshore." (Lake Ontario Nearshore, Context, 2020).
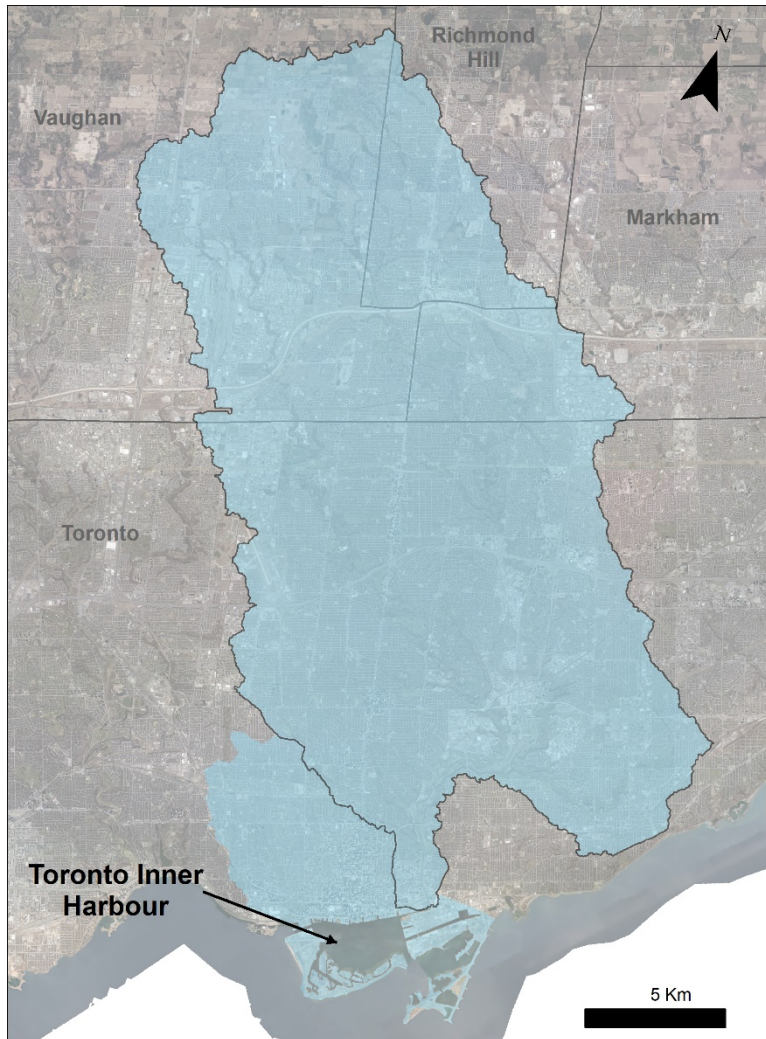
The light blue shaded area in the map to the left, developed by Watershed Planning & Ecosystem Science staff at TRCA, illustrates the total estimated footprint of hydrological catchments that contribute to outflows in the Toronto Inner Harbour. The Don River watershed is outlined while the broader blue area demonstrates that a significant area of Toronto and York Region, including the South end of the Humber River are also implicated. It is suggested that future work include refining this map using sewer-shed data to further understand how floatables travel through hydrological infrastructure.

This map, along with the significance of nearshore areas, emphasizes the importance of applying an upstream, inter-watershed focus to future versions of the Floatables Strategy.

The Floatables Strategy will identify and provide support to ongoing maintenance and further improvement of the health and aesthetics on the waterfront through the removal and prevention of floatables pollution. This will occur through tailored public education campaigns and mitigation tactics at point sources identified through research and monitoring efforts as per Version 1.0. Additionally, through the development of a collaborative strategy, several partners and stakeholders are coming together to create, adopt and implement the goals set out herein. This collaboration is the first of its kind on the waterfront in Toronto and a critical step towards continued protection of Toronto's Inner Harbour.

It is widely recognized that the issues of floatables, marine plastic and water pollution are complex, with many sources and systems involved in creating the current situation (International Joint Commission, 2017; NOAA, 2020; Pettipas, Bernier, & Walker, 2016). The scope of this document is the development of a management strategy for current conditions of the Inner Harbour, involving understanding the root causes of floatables pollution entering the Inner Harbour, and delivering public education and trash trapping technology pilots to address these root causes. As agencies continue the important work of reducing consumer plastics, improving waste management practices and retrofitting water systems, conditions may improve to the point where the actions outlined in this Strategy are no longer needed. Ongoing monitoring of collection rates will be used to evaluate the change in the volume of floatables over time.

What Are Floatables?

The US EPA's Beaches Environmental Assessment and Coastal Health (BEACH) Act defined floatable materials in 2000 as any foreign matter that may float or remain suspended in the water column (United States Congress, 2000). The term includes plastic, aluminum cans, wood products, bottles, and paper products.

Today, plastic is one of the most common types of floatable debris and is a significant environmental concern. Monitoring data suggest that the origin of these plastics is mainly land-based, from urban and storm runoff, sewer overflows, litter from beach visitors, inadequate waste disposal and management, industrial activities, construction and illegal dumping (IUCN, 2020).

FIGURE 1: RESULTS OF THE VISUAL AUDIT CONDUCTED BY THE UNIVERSITY OF TORONTO TRASH TEAM IN THE INNER HARBOUR FOR THE 2021 SEABIN MONITORING SEASON.

FIGURE 2: RESULTS OF THE SEABIN WASTE QUANTIFICATION AND CHARACTERIZATION BY THE UNIVERSITY OF TORONTO TRASH TEAM FOR THE 2021 SEABIN MONITORING SEASON.

Toronto Harbour Floatables

The origin of floatables is diverse and often non-point source, and because of the multitude of methods of entry into the aquatic ecosystem it will take the coordination of multiple agencies and actions to address the problem. At a local level, many agencies, environmental groups and residents are concerned about the presence of floatables in the Toronto Inner Harbour. This Strategy has sought the collaboration and feedback of the Toronto and Region Remedial Action Plan (RAP), Ports Toronto, the City of Toronto departments, Harbourfront Centre, the University of Toronto Trash Team and Swim Drink Fish.

The definition of floatables in the Floatables Strategy does not involve implementing Combined Sewer Outlet (CSO) designed interventions. However, if CSO outputs, such as personal hygiene plastics being evacuated through these outfalls are captured in trash trapping technologies, these materials will be data monitored. The City of Toronto's Wet Weather Flow Master Plan is a long-term plan that seeks to, among other things, address CSOs (City of Toronto, 2017).

FIGURE 3: THE TORONTO INNER HARBOUR IS DEFINED AS THE AREA SPANNING BETWEEN THE EASTERN AND WESTERN GAPS FROM THE TORONTO ISLANDS TO THE MAINLAND.

Marine Plastics and Debris in The Great Lakes

Water pollution and marine plastic is a growing global concern. Researchers estimate that over 8 million tonnes of plastic end up in the world's oceans every year, with much of it coming from urban rivers that carry plastic waste from cities worldwide to marine environments (Jambeck et al., 2015). Approximately 10,000 tonnes of plastic waste enter the Great Lakes each year (Hoffman and Hittinger, 2017), and in 2010 about 8,000 tonnes of plastic waste entered oceans from land in Canada (Canadian Council of Ministers of the Environment, 2018). In Toronto, our rivers and creeks transport waste from all parts of the region to Lake Ontario. From there, debris continues through the St. Lawrence River to the Atlantic Ocean, contributing to the global marine plastic problem.

Floatables have negative impacts on habitat, wildlife, and recreational opportunities in the Great Lakes. Floating debris can cause damage to boats and have a negative impact on tourism as tourists often use cleanliness as a key factor in selecting recreational sites (Driedger, Dürr, Mitchell, & Van

Cappellen, 2015; Earn et al., 2021). Habitat and wildlife can be negatively impacted through entanglement, habitat loss, and even ingestion. Ingestion of plastics has been linked to internal bleeding, or blockage of digestive tract. Some plastics contaminants even persist in animal tissue, causing issues not only for the individual but for the entire aquatic food web (Canadian Council of Ministers of the Environment, 2018; Driedger et al., 2015; International Joint Commission, 2017; Earn et al., 2021). Floatables can also degrade into microplastics, small pieces of plastic debris <5 mm in size, through wave action and photodegradation.

Public Perception of Floatables

The problem of floatables is inextricably linked to human behaviour. Littering is caused by individual people, and a direct source of floatables entering the Toronto Harbour. Shoreline litter surveys have revealed that single use plastic, such as food containers and cigarette butts, are some of the most frequently found debris in the Great Lakes (Driedger et al., 2015; Earn et al., 2021). In 2020 an estimated 24 - 35 million Metric Tonnes of plastic waste entered global aquatic ecosystems due to a combination of increased production of plastic products, consumption of single-use plastic items, and poor waste management (Borrelle et al. 2020). In Canada, single-use packaging accounts for almost 50% of the plastic waste generated every year (ECCC, 2020). Luckily, evidence suggests that there is an appetite amongst the public to undertake change that will reduce production of single use plastic, and in turn, floatables.

The City of Toronto implemented a survey regarding single use plastics and found that the number one reason why people used single use plastics was directly tied to business practices: "The shop or restaurant gives them to me without asking" and a close second "There are no reusable options provided to me by the restaurant or shop" (City of Toronto, 2019, p23). The survey also revealed that 75% of respondents expressed "consistent strong support for mandatory approaches to reduction of plastic bags, black plastic and Styrofoam containers" (City of Toronto 2019). Understanding human perception of plastic debris, and their willingness to engage in modifying behaviours to reduce plastic use are important components of this Strategy.

While the prevalence of single-use plastics floating in Lake Ontario is linked to factors like a lack of alternatives at restaurants and public littering, other commonly found floatables like foam and plastic pellets are more complex and less on the public's radar. Research from the University of Toronto Trash Team reveals that construction and plastic manufacturing are sources for foam and plastic pellet pollution.

Particles of foam used in the construction process are released into the environment through the building installation process and being light and airy, are carried by wind and rain into nearby waterways (Rochman & Gao, date unknown). Similar to foam, plastic pellets used in the manufacturing stages of a plastic product commonly find their way into waterways due to their scale, through shipping and transportation operations (Tsui et al., 2020). By the TRCA leveraging a partnership with the Waterfront BIA and utilizing TRCA program networks within the business community, the Floatables Strategy can support efforts to educate these industries on pollution prevention best practices.

Toronto Remedial Action Plan

The Toronto and Region Remedial Action Plan (Toronto RAP) team has recommended that the "degradation of aesthetics" Beneficial Use Impairment (BUI) be re-designated to "not impaired" status for the Toronto and Region Area of Concern (AOC). Degradation of aesthetics was initially listed as

impaired due to excess foam and oil slicks from industrial discharges (e.g., pulp and paper mills and steel mills). Today however, aesthetic concerns are associated with excessive floating debris, odour, and unnatural turbidity. A three-year (2012, 2013 and 2015) study of aesthetic conditions across the Toronto and Region AOC, found that 94% of 1667 observations met the criteria for "excellent" or "good" aesthetic condition. While the "degradation of aesthetics" BUI has been delisted, the Toronto RAP team is committed to ongoing initiatives to enhance and maintain improved aesthetics along the Toronto Waterfront. This Strategy is one of those commitments.

Support of Existing Policy

The Floatables Strategy supports existing policy that has been developed:

Long Term Waste Management Strategy (City of Toronto, 2016):

- Guiding Principles, #3 "Prioritize our Community's Health and Environment: The health of our residents and the environment is a priority in decision making to minimize negative impacts and to maximize the benefits."

- Single-Use and Takeaway Items Reduction Strategy: On June 9, 2021, Toronto City Council approved the Single-Use and Takeaway Items Reduction Strategy – Stage 1 report to help reduce single-use and takeaway items in Toronto. The Purpose section of this report speaks to mechanisms that will help reduce one of the most prominent pollutant types entering Lake Ontario as floatables which the policy and education objectives of Version 2.0 support.

    o "Reduce the distribution and use of single-use products and packaging;

    o "Reduce the quantities of these materials leaking uncontrolled into the environment; and

    o "Reduce the quantities of these materials entering into Toronto's solid waste management systems."

The Floatable Strategy's goals and objectives are consistent with the following objectives set out in the Made in Ontario Environmental Plan:

- Under the Clean Water: Actions section, the plan states that the Province will "Review and update Ontario's Great Lakes Strategy to continue to protect fish, parks, beaches, coastal wetlands and water by reducing plastic litter... to protect our aquatic ecosystems." (p.12)

- Under the Reduce Litter and Waste: Actions section, the plan states that the Province will "Work with other provinces, territories and the federal government to develop a plastics strategy to reduce plastic waste and limit micro-plastics that can end up in our lakes and rivers." (p.42)

- This plan also supports community involvement in litter prevention and cleanup, stating that the Province will "Develop future conservation leaders through supporting programs that will actively clean up litter in Ontario's green spaces, including provincial parks, conservation areas and municipalities." (p.43)

VISION AND OBJECTIVES

Vision

A City of Toronto Inner Harbour that is free of floatable debris with a thriving aquatic ecosystem and abundant recreational opportunities.

Through the creation of an adaptive management strategy that aims for virtual elimination of floatable debris in the Toronto Inner Harbour we can move towards achieving this vision. This strategy will take a multi-pronged approach, utilizing products, maintenance, education and outreach, policy, and monitoring.

In Version 1.0 of the Floatables Strategy, four objectives were developed to classify actions that would be set into motion. Completion of actions is discussed further in the Actions section. The four Floatables Strategy objectives have been updated to reflect progress made, ongoing needs, and new opportunities for action.

Objective 1: Products and Maintenance

Implement novel products and maintenance regimes that will effectively remove floatables within and that will mitigate floatables from entering the Toronto Inner Harbour.

To improve ecosystem health and BUIs in the Toronto Inner Harbour it is vital that floatables are prevented from entering the Inner Harbour, and those already present are removed. The sources of floatables are diverse and the methods to remove and mitigate the entry of those floatables must also be varied. Safety measures must be considered when collecting floatables. Some debris may pose a risk, for example biohazardous waste in the form of personal hygiene products. Surveys of floatable debris in the Inner Harbour (and in other regions) suggest that much of the debris present is from single use plastics (such as food packaging). Therefore, on-land mitigation tactics must be employed to prevent that litter from entering the water.

Preventing floatables from entering the Inner Harbour will take on-going effort and collaboration across stakeholders. Maintenance regimes such as waste pick-up frequency will be investigated to ensure they are effective and consistent among both private and municipal stakeholders.

Version 2.0 of the Floatables Strategy will continue to implement novel products (e.g., LittaTraps) in areas of the Inner Harbour identified through monitoring actions in Version 1.0. Maintenance regimes will continue to be investigated with private and municipal stakeholders. Best practices for novel products and maintenance regimes will be shared with partners and stakeholders, locally and beyond the Great Lakes Region.

Objective 2: Monitoring

Track the volume of floatables to measure success of implementation and to identify potential additional actions.

To ensure program success, it is crucial to have a method of measuring success. Ongoing monitoring will help determine the baseline of floatables in the Toronto Inner Harbour. This will inform mitigation strategies, the outcomes of which will be measured. The monitoring program developed in collaboration with the University of Toronto Trash Team through Version 1.0 will be continually refined and promoted to partners and stakeholders.

Version 2.0 of the Floatables Strategy proposes continued monitoring of the volume of floatables in the Inner Harbour with existing and new novel products. Monitoring strategies employed in Version 1.0 will be replicated in the Don River to determine a baseline of floatables in this water body and to understand its contribution to floatables to the Inner Harbour.

Monitoring of plastics and floatables is a current gap in TRCA-led monitoring programs and there is need to include this sampling which will be communicated for consideration in future monitoring program updates and reviews.

Objective 3: Public Education

Develop education and awareness programs to mitigate behaviours that result in floatables entering the Toronto Inner Harbour.

Research has revealed that many floatables are caused by human actions. Cigarette butts are overwhelmingly the most often collected item, followed by single use food-related litter (e.g., packaging and take-out containers). Education programs that target littering compliance have had demonstrated positive impact in other jurisdictions and will be developed for the Toronto Inner Harbour to increase public compliance with littering laws. Furthermore, programs should be developed targeting local businesses to promote awareness of the issues related to single use plastics, and educate business owners on alternative solutions (e.g. reusable container programs).

Furthermore, education programs should also target the construction industry and plastic manufacturers on the prevalence of foam and pellets in the Inner Harbour, as demonstrated through the University of Toronto Trash Team's research and promote best practices for pollution prevention. The University of Toronto Trash Team and the TRCA will explore ways to apply this research and leverage industry networks.

Version 2.0 will utilize understandings of floatables pollution characteristics and potential point sources in the Inner Harbour to deliver education and awareness programs that engage diverse stakeholders, including but not limited to the following:

- Toronto Inner Harbour businesses
- Office buildings on the waterfront
- Residents on the waterfront (via Neighbourhood Associations)
    - Multi-unit-residential buildings (condominiums)
    - Single-family homes

- Schools
- Community groups

Objective 4: Policy

Coordinate this Strategy with municipal partners and other stakeholders to support relevant policy.

Floatables and marine litter are a complex problem and will take coordination among multiple agencies to effectively address. There must be connections drawn between existing and future waste management policies at the municipal level, and best management practices among project partners at the ground level. Coordination and communication with businesses that are in the Toronto Inner Harbour in the development of that policy will help with execution of this Strategy.

This objective remains unchanged for Version 2.0.

Reflections on Action 2.5: Track effectiveness of Strategy and continually adapt management strategies and activities

The Floatable Strategy is intended to be a framework for an adaptive management strategy to address floatables in the Toronto Inner Harbour. As such, tracking the progress of goals and adapting activities based on the most recent data are vital to the Floatables Strategy success.

Actions supporting the Floatables Strategy Version 1.0 generated new knowledge about how floatables behave in the Toronto Inner Harbour. This includes the quantity, types, and point-sources of floatables, and best practices for the maintenance and monitoring of trash trapping technologies. It is evident through conversations with partners and stakeholders that they wish to continue collaborating with the TRCA on the Floatables Strategy with the shared goal of managing floatables pollution in the Inner Harbour and educating the public on floatables concerns. Beginning to shift focus upstream to river-based watersheds feeding into Lake Ontario presents opportunities to align with TRCA's river-based watershed planning priorities, and that of current and future partners and stakeholders. This approach will allow us to refine best practices for monitoring and public education through future iterations of this Strategy and apply these in tributary watersheds. An upstream focus will ultimately facilitate longevity and scalability of the Floatables Strategy and applicability to a range of initiatives and funding opportunities.

The University of Toronto Tagging Trash project conducted over a period of 4 months showed that anywhere GPS-tracked bottles were found, there were hundreds of pieces of litter present (A Tale of Tagging Trash, University of Toronto Trash Team, 2021). These findings help identify the fate of local sources of litter and suitable placement for marine-based trash trapping devices (e.g. Seabins). The most common types of debris captured in the Seabins include bottle caps, foam, cigarette butts, food packaging, stir sticks, plastic pellets, and film (Seabin Data 2020 Presentation, University of Toronto Trash Team, 2021).

Policy initiatives involving local business to reduce single-use plastics and public education campaigns to waterfront visitors are some ways we can directly address many of the pollutants on this list, like food packaging, stir sticks, and cigarettes. Research from the University of Toronto Trash Team

tracing foam and plastic pellets back to construction and plastic manufacturing activities will help inform mitigation tactics to these industries. Continued support for these kinds of mitigation tactics and the removal of floatables with novel products is important to maintaining progress on achieving the vision of "**A City of Toronto Inner Harbour that is free of floatable debris with a thriving aquatic ecosystem and abundant recreational opportunities".**

ACTION PLAN

The achievement of the Floatables Strategy hinges on collaboration. The following section identifies actions that can be assigned to each objective identified. Many of these actions are carried over from Version 1.0 and adapted based on progress made, with the addition of a few new actions to reflect new opportunities. These actions are detailed to indicate the intent, potential funding sources, and the partners and stakeholders required. It should be noted, however, that many of the actions in the Floatables Strategy will be constantly adapted based on the newest data and funding available. Therefore, this action plan must be considered a "living document". The achievement of actions will inform tactics and approaches for new actions, resulting in a continuously adaptive regime.

Actions Addressing Objective 1: Products and Maintenance

1.1 Seabin Installation

Seabins are a technology that was developed in Australia for use at marinas to trap floatable debris. This use was extended to harbours through a piloted project in 2019 by Ports Toronto and the University of Toronto Trash Team. With minor modifications to the implementation of the equipment, the pilot was determined to be successful.

Currently, PortsToronto has 8 Seabins in their network in the Toronto Inner Harbour, which they began to procure in 2019. In early 2022, they expect to have 14 Seabins in their network. PortsToronto is working with the University of Toronto Trash Team, Waterfront BIA, the Toronto Zoo Climate Action Learning and Leadership Program, and the Harboufront Centre on its Seabin program. PortsToronto and the University of Toronto Trash Team will continue to manage their own program with these partners and stakeholders.

FIGURE 4: ONE OF THE TWO SEABINS INSTALLED AT TORONTO ISLANDS FOR THE 2021 SEASON.

Two of the Seabins in the PortsToronto network were installed in 2021 on the Toronto Islands at the Ward's Island Ferry Dock and the Centre Island Ferry Dock through Version 1.0 of the Floatables Strategy. Funding for these units was provided by the Ministry of the Environment, Conservation and Parks, and are owned by Parks, Forestry, and Recreation with the City of Toronto. Installation and removal of the Seabins was handled by PortsToronto, daily maintenance of the Seabins was handled by Parks staff, and waste monitoring conducted by the University of Toronto Trash Team. The University of Toronto Trash Team will continue monitoring waste characterization of Seabins and share findings with partners, stakeholders, and the general public. Due to consistent wave action, the Ward's Island Seabin suffered damage and will need to be repaired and relocated in 2022.

Since these Seabins were procured, the availability of Seabins in North America has become limited. Version 2.0 will monitor the availability of additional Seabins or similar technology for the Inner Harbour, and shift focus to piloting catchbasin litter protection (e.g. LittaTraps). The location for additional water-based trash trapping devices in the Inner Harbour will be informed by results of the Tagging Trash project which identified priority pollution cluster zones. These zones include the Shipping Channel, Mouth of Keating Channel, Bathurst Quay, and the Western Gap.

Best practices and lessons learned will be shared with partners across the Great Lakes.

Partners: University of Toronto Trash Team, TRCA

Stakeholders: Ports Toronto, City of Toronto

Funding: TBD (Grants)

1.2 Storm Catchbasin Litter Protection

Install storm catchbasin litter collection technology. Catchment technology could be used to halt debris from entering the Toronto Inner Harbour through storm drain outlets. Site selection for storm catchbasin litter protection will be determined based on a number of factors such as proximity to point sources of floatables (e.g. construction sites), public traffic, monitoring accessibility, and manufacturer installation criteria.

A few LittaTrap units (catchbasin litter protection technology) will be piloted in storm drains that flow into the Inner Harbour through Version 2.0 of the Floatables Strategy. LittaTraps are an innovative catch basin insert designed by Enviropod, a leading stormwater and green infrastructure solutions company based out of New Zealand. LittaTraps are designed to be easily fitted into new and existing stormwater drains and when it rains, catch plastic and litter caught in runoff before it can reach the waterways.

Toronto Water will procure, install, and maintain the LittaTraps. The University of Toronto Trash Team will monitor waste characterization. This pilot will help determine feasibility of widespread implementation of this catchment technology and whether other products require investigation.

Partners: University of Toronto Trash Team, TRCA

Stakeholders: City of Toronto (Toronto Water), PortsToronto

Funding: Toronto Water, University of Toronto Trash Team, External Grants

1.3 Standardized Garbage Receptacles

Identify standardized garbage receptacles to prevent wind-born debris from entering the Toronto Inner Harbour. Data suggests that a vector for debris in the Inner Harbour is the result of wind. Trash from the shore is picked up by the wind and blown into the Inner Harbour. To mitigate this, trash bins should be standardized throughout the Inner Harbour and should include lids, bin straps, or other methods to prevent trash from blowing away.

While most bins on public streets proximal to the Inner Harbour are owned by the City of Toronto and standardized using the above best practices, many privately owned businesses provide garbage receptacles that are frequently used by patrons and the public. Therefore, investigation and

adoption of wind-proof trash receptacles will require the leadership of private business owners, with support from the TRCA, City of Toronto and PortsToronto.

Conversations will continue with partners regarding best practices for garbage receptacles in Version 2.0 of this Strategy. Funding for a pilot of standardized receptacles among a contingent of private businesses will be explored, involving advertising on receptacles to offset costs. Possibilities for incorporating this pilot into public education on litter reduction will be explored.

Partners: TRCA

Stakeholders: City of Toronto (Solid Waste), Waterfront Secretariat, Waterfront BIA

Funding: TBD (Private property owners, Grants)

1.4 Investigate opportunity for end of pipe filtration technology

End of pipe filtration technology refers to the many diverse methods of collecting debris at outlets into the Inner Harbour, for example at storm drains. Other jurisdictions have successfully employed novel technology such as storm sewer outlet nets.

It was determined through Version 1.0 of the Floatables Strategy that because most outfalls in the Toronto Inner Harbour are submerged, conventional storm sewer outlets such as StormX Netting that sit on the water's surface may not be suitable. These conventional models will be investigated for application in river-based watersheds and research into alternative models for the Inner Harbour will continue in Version 2.0.

Partners: TRCA

Stakeholders: City of Toronto (Toronto Water), RAP

Funding: TBD (Toronto Water, Grants)

1.5 Investigate garbage pick-up regimes among both municipal and private stakeholders

The land surrounding the Toronto Inner Harbour is a mix of privately-owned businesses and other stakeholders, and (to a smaller extent) publicly owned. Because of this patchwork of ownership, garbage collection is not only collected municipally but is coordinated by private businesses through independent contracts. As mentioned in Action 1.3, garbage bins should be investigated as an opportunity to mitigate the entry of floatables into the Inner Harbour. Likewise, garbage pick-up regimes should also be investigated to determine where efficiencies can be found and prevent litter from overflowing. Consultation on these topics will continue with the Waterfront BIA, Harbourfront Centre, and Toronto Solid Waste.

Partners: TRCA

Stakeholders: City of Toronto, Waterfront BIA, Local Stakeholders

Funding: TBD (Grants)

1.6 Investigate marine debris removal vessel and other unique technologies

Toronto Inner Harbour Floatables Strategy

Technology has been developed to remove debris that is already in the water – like the Trash Wheels in Baltimore, Maryland. In the past, PortsToronto explored opportunities in the past to purchase a garbage collecting vessel. In addition, a design challenge for novel marine debris removal technology, specific to the Toronto Inner Harbour, will be held via the University of Toronto's Faculty of Engineering Capstone Program. The design challenge will be run by the University of Toronto with the Trash Team and PortsToronto as clients. It is the hope that the design that arises from the winner of the contest will be implemented through PortsToronto with collaboration from the University of Toronto Trash Team.

Preliminary design concepts are being developed and a design is expected by the end of 2022.

Partners: University of Toronto Trash Team, PortsToronto

Funding: PortsToronto, University of Toronto Trash Team, Grants

Actions Addressing Objective 2: Monitoring

2.1 Monitor debris collected in Seabins

Monitoring of material collected in Seabins or similar technology is necessary to identify the effectiveness, potential sources of debris and when they are no longer required or should be moved to alternate locations. Ideally over time, the number of Seabins or similar technology required in the Toronto Inner Harbour will be reduced.

The Floatables Strategy will promote widespread utilization of the Data Trapper App for trash trapping created by University of Toronto Trash Team among partners, stakeholders and the public of existing and future Seabins or similar technology.

Partners: University of Toronto Trash Team, TRCA

Stakeholders: Swim Drink Fish, PortsToronto

Funding: University of Toronto Trash Team, Grants

2.2 Develop long-term monitoring framework with University of Toronto Trash Team that is consistent with the National Oceanic and Atmospheric Administration Marine Debris Program (2020)

Floatables are not only an issue in the Toronto Inner Harbour, but across the Great Lakes. A consistent monitoring framework will allow data to be shared and will help to create better mitigation tactics informed by the experience of others in different jurisdictions. Therefore, a framework for monitoring should be developed that is consistent with the NOAA Marine Debris Program. It is suggested that 2 frameworks be developed for use: one for scientific research and another for citizen science/volunteer clean-ups etc. The University of Toronto Trash Team's Data Trapper App and data from Swim Drink Fish citizen science water monitoring programs can be applied to this framework.

The Floatables Strategy will continually explore efficiencies for sharing monitoring data among partners, stakeholders, and the public (e.g. a shared water quality monitoring platform with a private and public interface).

Partners: University of Toronto Trash Team, TRCA

Stakeholders: Swim Drink Fish

Funding: TBD (Grants)

2.3 Utilize monitoring to identify point-sources

Monitoring will identify the distribution and type of floatable debris in the Toronto Inner Harbour. These data can identify the origin of floatables so that mitigation tactics at the point source can be developed.
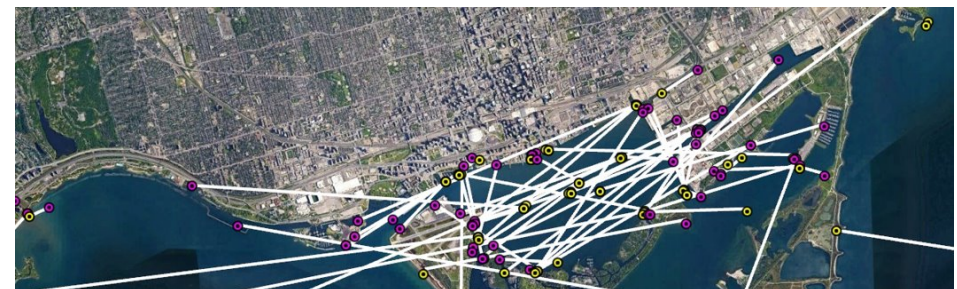

FIGURE 5: TAGGING TRASH PROJECT RESULTS INDICATING PATH OF TRAVEL OF FLOATABLES IN, AND BEYOND, THE TORONTO INNER HARBOUR, LED BY THE UNIVERSITY OF TORONTO TRASH TEAM.

The Tagging Trash project led by the University of Toronto Trash Team revealed data on the distribution and types of floatables debris in the Inner Harbour. Waste characterization and quantification have identified potential-point sources of floatables which will inform future mitigation tactics.

Common types of litter and likely point sources include food packaging from nearby restaurants, foam from construction sites, or plastic pellets and other fragments from industrial facilities. These items enter the Inner Harbour through storm drains, public littering, or wind from overflowing waste receptacles.

Monitoring to identify point-sources will be applied to river-based watersheds upstream from the Inner Harbour, beginning with a Tagging Trash project in the Don River, led by the University of Toronto Trash Team.

Seabins and any new technologies (e.g. storm catchbasin litter protection) will continue to be monitored.

All continued and future monitoring efforts will be supported by a shared, long-term monitoring framework as established under Action 2.2.

Partners: University of Toronto Trash Team, TRCA

Stakeholders: Swim Drink Fish, PortsToronto

Funding: University of Toronto Trash Team, Grants

2.4 Monitor effectiveness of implemented products (objective 1)

New technology that is implemented must be monitored to determine effectiveness. This will provide crucial information to inform adaptation strategies: is the technology effective in the location where it was installed? Is the product still required or available? Is the product effective at reducing floatables? Each technology/product that is utilized will have a monitoring framework in place at the time of installation. This monitoring will also support action 2.3, point source identification.

Partners & Stakeholders: ALL

Funding: TBD (Grants)

2.5 Track effectiveness of Strategy and continually adapt management strategies and activities

The Floatable Strategy is intended to be a framework for an adaptive management strategy to address floatables in the Toronto Inner Harbour. As such, tracking the progress of goals and adapting activities based on the most recent data are vital to the success of this strategy. All future versions of the Floatables Strategy will include a Reflection on Action 2.5 (see page 15).

Partners & Stakeholders: ALL

Funding: TBD (Grants)

Actions Addressing Objective 3: Public Education

3.1 Develop program to increase public awareness of floatables and marine debris

The source of floatables can all be traced to human activity. Reducing floatables in the Inner Harbour cannot be accomplished without addressing human behaviour. The Floatables Strategy supports the continuation and expansion of public education programs among partners and other community groups (e.g. Swim Drink Fish, A Greener Future, etc.) seeking to improve litter law compliance and increase awareness of floatables.

It is proposed that signs will be installed at all publicly visible locations where Seabins or a similar technology are installed and locations where storm catchbasin technologies are installed. Signage was installed for the Seabins at Toronto Islands through Version 1.0 of the Floatables Strategy.

Signage is also recommended at all parks in proximity to watercourses and Lake Ontario, and all swimming beaches. The signs will inform the public about the issue of floatables and identify how the trash trapping technology operates and ways that the public can be involved.

Public awareness programs implemented through Version 2.0 of this Strategy will involve interactive walks, involving signage, continuing to share information through social media, and providing educational webinars to specific groups such as local schools and neigbourhood associations.

Partners: University of Toronto Trash Team, TRCA

Stakeholders: Swim Drink Fish, PortsToronto, City of Toronto (Parks, Forestry & Recreation)

Funding: TBD (Grants)

3.2 Develop outreach program targeting businesses in the Toronto Inner Harbour neighbourhood

The lands surrounding the Toronto Inner Harbour are the sites of many diverse businesses. Their cooperation will be key in the reduction of floatables in the Inner Harbour (see action 4.1). A program will be designed to target businesses ranging from food service to manufacturing based on the research of potential sources of floatables and provide education on pollution prevention. For example, the City of Toronto has undertaken surveys regarding single use plastics and found that the majority of responded cited that businesses provide single use plastics without providing any alternative options to their customers. This suggests that customers would be open to alternatives to single use plastics.

In addition to business engagement, Toronto Parks, Forestry and Recreation will work with the City of Toronto on restricting the allowance of single-use plastics on City beach property. Aligning these initiatives with award programs such as Blue Flag for water quality, environmental management, and environmental education at beaches will be explored to increase public awareness.

Partners: TRCA
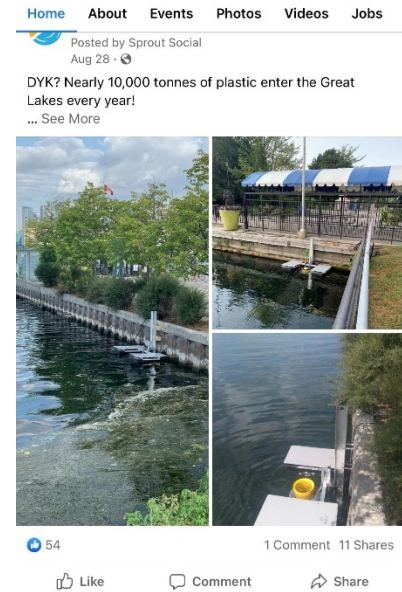

FIGURE 6: SOCIAL MEDIA POST ON INSTALLATION OF SEABINS AT TORONTO ISLANDS, 2021 SEASON.

Stakeholders: Waterfront BIA, City of Toronto (Parks, Forestry & Recreation), Waterfront Secretariat, Swim Drink Fish, Others

Funding: TBD (Grants)

3.3 Utilize partnerships to extend outreach to diverse audiences

There are many different communities and stakeholder groups that have an impact on floatables. In the interest of extending outreach and education to these varied groups, it is important to utilize the existing relationships that partners already have established. An example of this would be educational programs in schools and/or community cleanups across the relevant region and engaging multi-unit residential buildings in the Toronto Inner Harbour neighbourhood on litter reduction.

Partners & Stakeholders: ALL, including other community groups actively working on floatable related educational programs.

Funding: TBD and existing budgets for everyday work.

Actions Addressing Objective 4: Policy

4.1 Work with local BIA to develop guidelines and standards for the local businesses in the Harbour

The Floatables Strategy will pilot guidelines and standards for garbage receptacles to reduce wind-blown litter. Businesses (e.g. food vendors) will be encouraged to reduce single-use plastics and adopt sustainable/reusable packaging.

Partners: TRCA

Stakeholders: Waterfront BIA, City of Toronto (Solid Waste)

Funding: TBD (City of Toronto, Grants)

4.2 Monitoring data to be analyzed to determine potential policy development

This Strategy will utilize water quality monitoring data from the University of Toronto Trash Team, Swim Drink Fish, and others, to determine policy-informed mitigation tactics for point-sources of floatables.

Partners: University of Toronto Trash Team, TRCA

Stakeholders: Swim Drink Fish

Funding: Grants

4.3 Investigate municipal by-law to support garbage pick-up regimes among both municipal and private stakeholders

The Waterfront of the Toronto Inner Harbour is a mix of private, municipal, and federal ownership. As mentioned in Action 1.5 standardized pick-up, municipal by-laws should be investigated to support and formalize a set regimes of garbage pick-up to prevent litter from overflowing receptacles. Examples of municipal by-laws include Chapter 841 Waste Collection, Commercial Properties.

Partners: TRCA

Stakeholders: City of Toronto (By-Law, Solid Waste), Waterfront BIA

Funding: TBD (City of Toronto)

4.4 Investigate municipal by-law to support restricting the use of single-use plastics on City beach properties

Work with Parks, Forestry and Recreation, and other City of Toronto divisions to restrict single use plastics on City Beach property. Follow a similar model to how Provincial Parks do not allow single use food containers for interior camping.

Partners: TRCA

Stakeholders: City of Toronto (Solid Waste, Parks, Forestry & Recreation)

Funding: TBD (City of Toronto)

ACTION PLAN - SUMMARY

The following chart lists the proposed actions included in Version 1.0 of the Floatables Strategy, their status, and actions proposed for Version 2.0.

Action Proposed Version 1.0	Status	Action Proposed Version 2.0
Actions Addressing Objective 1: Products and Maintenance		
1.1 Seabin Installation Install 28 Seabins at identified locations throughout Toronto's Inner Harbour.	• PortsToronto and the University of Toronto Seabin Pilot Project has been implemented • 2 Seabins were installed at Toronto Islands in 2021	• Adapted in Version 2.0 • Seabins have been discontinued by the manufacturer. Version 2.0 will explore availability of a new and improved Seabin or similar technology in the coming years. • If/when feasible, additional water-based trash trapping devices will be prioritized for pollution cluster zones in the Inner Harbour
1.2 Storm Catchbasin Litter Protection Install storm sewer catchbasin litter collection technology.	• Toronto Water is pursuing a LittaTrap pilot on public street adjacent to the Inner Harbour •	• Carry over to Version 2.0 • Implement multi-unit LittaTrap pilot and begin monitoring – document learnings for scalability • Other types of storm catchbasin litter protection will be investigated
1.3 Standardized Garbage Receptacles Identify standardized garbage receptacles to prevent wind-born debris from entering the harbour.	• Conversations have been started with partners	• Carry over to Version 2.0 • Gather information on best practices on standardized garbage receptacles from identified partners and strategies for engaging the private sector
1.4 Investigate opportunity for end of pipe filtration technology End of pipe filtration technology refers to the many diverse methods of collecting debris at outlets into the harbour, for example at storm drains.	• Toronto Water has consulted Georgian Bay Forever on their StormX Netting technology and considering options	• Carry over to Version 2.0 • Investigate other forms of end of pipe filtration technology more suitable for the Toronto Inner Harbour • Investigate feasibility of StormX Netting for river-based watershed applications

1.5 Investigate garbage pick-up regimes among both municipal and private stakeholders Investigate garbage pick-up regimes to determine where efficiencies can be found and prevent litter from overflowing.	• Conversations have been started with partners	• Carry over to Version 2.0 • Consult with Waterfront BIA, Harbourfront Centre and Toronto Solid Waste on garbage pick-up regimes and examine where efficiencies can be found to prevent litter
1.6 Investigate marine debris removal vessel and other unique technologies PortsToronto is exploring opportunities to purchase a garbage collecting vessel. In addition, a design challenge for novel marine debris removal technology, specific to the Toronto Inner Harbour context, will be held via a design challenge through University of Toronto's Faculty of Engineering.	• Design challenge with the University of Toronto Trash Team began in 2021 and is in progress	• Carry over to Version 2.0 • Complete small-scale prototyping of a new marine removal vessel design
Actions Addressing Objective 2: Monitoring		
2.1 Monitor debris collected in Seabins Monitoring material collected in Seabins is necessary to identify their effectiveness, potential sources of debris and when they are no longer required or should be moved to alternate locations.	• Monitoring is ongoing • Data has been acquired • Data is limited for Seabins on Toronto Islands • Strategies for improving monitoring regimes for 2022 season have been proposed	• Carry over to Version 2.0 • Continue monitoring existing Seabins using improved monitoring regimes
2.2 Develop long-term monitoring framework with University of Toronto Trash Team that is consistent with the National Oceanic and Atmospheric Administration Marine Debris Program (2020) A consistent monitoring framework will allow data to be shared and will help to create better mitigation tactics informed by the experience of others in different jurisdictions.	• Data tracking app has been developed by University of Toronto Trash Team and can be used across the Great Lakes Region • Swim Drink Fish is currently using the app	• Carry over to Version 2.0 • Promote awareness of the data tracking app with partners across the Great Lakes Region • Explore a shared water quality monitoring platform with partners and stakeholders and share with the public (e.g. Swim Drink Fish, PortsToronto, etc.)
2.3 Utilize monitoring to identify point-sources	• Tagging Trash monitoring project in the Toronto Inner Harbour has been	• Version 2.0 Action: use data on point sources to determine tailored mitigation

Monitoring will identify the distribution and type of floatable debris in the Toronto Inner Harbour. These data can identify the origin of floatables so that mitigation tactics at the point source can be developed.	completed and travel patterns of floatables have been identified	tactics for Toronto Inner Harbour and pilot select strategies identified in public education section • Replicate monitoring program (Tagging Trash) in the Don River.
2.4 Monitor effectiveness of implemented products (objective 1) New technology that is implemented must be monitored to determine effectiveness.	• 1 season of monitoring Seabins has been completed • Results from 2021 monitoring season have been analyzed and shared with the public • Tagging Trash project results used to identify appropriate placement of future trash trapping devices, for if/when new technology becomes available	• Carry over to Version 2.0 • Compare overall effectiveness of implemented partner and stakeholder-owned products and share out with partners across the Great Lake Region
2.5 Track effectiveness of Strategy and continually adapt management strategies and activities Track progress of goals and adapt activities based on the most recent data are vital to the Floatables Strategy success.	• Ongoing	• See Reflections on Action 2.5 below
Actions Addressing Objective 3: Public Education		
3.1 Develop program to increase public awareness of floatables and marine debris Education programs will be designed that will target the general public, seeking to improve litter law compliance and increasing awareness of floatables.	• Community education and awareness campaign has been completed, involving partner and stakeholder meetings, 4 social media posts, and signage for Toronto Island Seabins installed	• Carry over to Version 2.0 • Potential to expand signage in Version 2.0 to all parks, swimming beaches, and select commercial and residential zones in proximity to Toronto Inner Harbour, identifying litter and floatables concerns
3.2 Develop outreach program targeting businesses in the Toronto Inner Harbour neighbourhood	• Conversations have been started with partners	• Carry over to Version 2.0 • Expand outreach to potential sources of floatables (e.g. waterfront food vendors) and work with Waterfront BIA and

A program will be designed to educate businesses about the kinds of practices that can be implemented to reduce floatables.		Harbourfront Centre on best practices for standardizing garbage receptacles to reduce wind-blown floatables • Investigate feasibility of piloting "Ask First" campaigns for plastics with local businesses and encourage the use of reusable takeout containers, etc.
3.3 Utilize partnerships to extend outreach to diverse audiences Extend outreach and education to varied groups that have an impact on floatables.	• Signage, social media, and other communications have been utilized to reach diverse audiences • Conversations have been started with partners on extending outreach	• Carry over to Version 2.0 • Potential for TRCA Education and Community Engagement Team to lead public education campaigns in Version 2.0 • Develop public education campaigns for multi-unit residential buildings •
Actions Addressing Objective 4: Policy		
4.1 Work with local BIA to develop guidelines and standards for the local businesses in the harbor Partners: Business Improvement Area, Waterfront Secretariat, City of Toronto, TRCA, others. Funding: TBD (City of Toronto, Grants)	• Conversations have been started with partners	• Carry over to Version 2.0 • Continue conversations with partners around best practices and feasibility of implementing standards and guidelines informed by Actions 1.3 (standardized garbage receptacles) and 3.2 (e.g. "Ask First" policy) • Aling with the City of Toronto Solid Waste' Single-Use and Takeaway Items Reduction Strategy
4.2 Monitoring data to be analyzed to determine potential policy development Partners: University of Toronto Trash Team, Swim Drink Fish, TRCA Funding: Grants	• Trash Tagging results and Seabin data collected and to be analyzed through lens of policy development	• Carry over Policy Development to Version 2.0, informed by best practices determined with groups, and monitoring data from Version 1.0

4.3 Investigate municipal by-law to support garbage pick-up regimes among both municipal and private stakeholders Municipal by-laws should be investigated to support and formalize a set regimes of garbage pick-up to prevent litter from overflowing receptacles.	• In progress, conversations have been started with City of Toronto.	• Carry over municipal by-law support in Version 2.0, informed by Toronto Solid Waste • Investigate feasibility of new municipal by-laws restricting the use of single-use plastics on City beach properties

TIMELINE

Goals	Objectives	Timeline						
		2021-2022	2023-2024	2025-2026	2027-2028	2029-2030	2031-2032	2033
1. Products and Maintenance	1.1. Seabin (or alternative device) installation	■						
	1.2. Storm catchbasin litter protection	■	■	■				
	1.3. Standardized garbage receptacles	■	■	■				
	1.4 Investigate opportunity for end of pipe filtration technology	■	■	■	■			
	1.5 Investigate garbage pick-up regimes among both municipal and private stakeholders.	■	■	■	■			
	1.6 Investigate marine debris removal vessel.	■	■					
2. Monitoring	2.1. Monitor debris collected in Seabins.	■	■	■	■	■	■	■
	2.2. Develop long-term monitoring framework with University of Toronto Trash Team that is consistent with the National Oceanic and Atmospheric Administration Marine Debris Program (2020).	■						
	2.3. Utilize monitoring to identify point-sources.	■	■	■	■	■	■	■
	2.4. Monitor effectiveness of implemented products (objective 1)	■	■	■	■	■	■	■
	2.5. Track effectiveness of Strategy and continually adapt management strategies and activities	■	■	■	■	■	■	■
3. Education and Training	3.1. Develop program to increase public awareness of floatables and marine debris.	■	■	■	■			
	3.2. Develop outreach program targeting businesses in the Toronto Inner Harbour neighbourhood.	■	■	■	■			

	1.1. Utilize partnerships to extend outreach to diverse audiences.								
4. Policy	4.1. Work with local BIA to develop guidelines and standards for the local businesses in the harbor.								
	4.2. Monitoring data to be analyzed to determine potential policy development.								
	4.3. Investigate municipal by-law to support garbage pick-up regimes among both municipal and private stakeholders.								

STAKEHOLDERS AND PARTNERS

Stakeholders

The groups, businesses, or persons with a direct interest as they perform and are held to a prescribed mandate along Toronto's waterfront (business, public service, federally mandated roles etc.). The stakeholders involved in the development and execution of Version 1.0 and/or Version 2.0 of this Strategy are:

- PortsToronto

- City of Toronto

    - o Solid Waste Management

    - o Toronto Water

    - o Parks Forestry and Recreation

    - o Waterfront Secretariat

    - o By-law

- Harbourfront Centre

- U Drink Fish

Partners

Parties interested in or that have work focused on waterfront that is not mandated, however are critical in the successful implementation and development of this Strategy. Partners in this Strategy are:

- University of Toronto Trash Team

- TRCA

    - o Partners in Project Green, Education and Training Division

    - o Community Learning, Education and Training Division

    - o Watershed Planning and Ecosystem Science, Development and Engineering Division

Acknowledgements

Implementation of actions from Version 1.0 of this Strategy has been supported by a grant from the Ministry of the Environment Conservation and Parks managed by the Toronto and Region Conservation Authority.

Key stakeholders and partners have provided their time to meet, review and supply necessary information to the Floatables Strategy at no cost.

Partners have also provided valuable resources and time supporting the development of the Floatables Strategy at no cost.

Implementation of additional actions in Version 2.0 and subsequent versions will be funded through our partners and stakeholders and through the application of additional funding.

CONCLUSION

Floatables in the Toronto Inner Harbour are a complex problem that will take coordination across multiple agencies and jurisdictions to address. The Floatables Strategy represents a critical step in that process - bringing together multiple stakeholders to carry out an adaptive management plan that will mitigate floatables in the Toronto Inner Harbour. Actions carried out in this plan will inform future actions and policy development. As a long-term, living document, the Floatables Strategy will help identify point sources and provide grounds for complementary "on land" policy and programs to help address floatables at the source.

Version 1.0 of the Floatables Strategy was aimed at managing the presence of floatables in the Inner Harbour and identifying point sources, such as in and around businesses. Version 2.0 will expand to focusing on addressing floatables at sources "upstream" and the impacts to watersheds which feed into the Inner Harbour. Although the Floatables Strategy Vision revolves around the Toronto Inner Harbour, taking part of the focus upstream beginning with Version 2.0 is anticipated to inspire action at a larger geographic level. To help guide this work, TRCA staff will develop a Floatables Strategy workplan to track initiatives that support the Floatables Strategy vision. Meetings will be held with all partners and stakeholders on a minimum quarterly basis to review ongoing work and opportunities for collaboration.

The Floatables Strategy will continuously evolve as actions are implemented and new opportunities, information, and partnerships emerge. The Floatables Strategy will continue to support and guide the great work of partners and stakeholders advancing action and serve as a replicable model for managing floatable pollution across the Great Lakes Region.

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