'SUP with Nova Scotia: Characterizing Nova Scotia's Single-Use Plastic Waste within the

Canadian Federal Single-Use Plastic (SUP) Ban

By

Kali Hines

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Supervisor: Dr. Tony R. Walker

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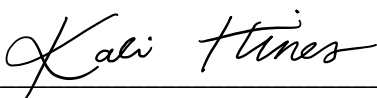
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Table of Contents

Territorial Acknowledgement

This research was completed in the traditional and unceded territory of the Mi'kmaq people, known as K'jipuktuk (Halifax, Nova Scotia). This territory is covered by the "Treaties of Peace and Friendship" which Mi'kmaq and Wolastoqiyik (Maliseet) Peoples first signed with the British Crown in 1725. The treaties did not deal with the surrender of lands and resources, but in fact recognized Mi'kmaq and Wolastoqiyik (Maliseet) title and established the rules for what was to be an ongoing relationship between nations. As a student and settler, I recognize my duty

to protect these lands and to amplify the voices of Indigenous Peoples. We recognize that we are all treaty people.

Abstract

The use of single-use plastics (SUPs) has increased rapidly over the years, and the contribution of SUPs to global waste quantities has been rising steadily (Xanthos & Walker, 2017). In 2019 alone, Canada produced an estimated 23,587 tonnes of mismanaged plastic in 2019 (Our World in Data, n.d.). To target the most problematic SUPs, Canada implementing the *Single-use Plastics Prohibition Regulations* (SUPPR), prohibiting six SUP categories (ECCC, 2022d). This study will seek to determine how the amount of SUP waste discarded in Nova Scotia compares pre- and post-announcement of the *Single-use Plastics Prohibition Regulations?*

This research conducts a secondary data analysis to gather data from managed waste sources, and mismanaged waste sources. Publicly available data is gathered from reports, online websites, and data records made available upon request. The data analysis reveals several key themes: 1) There is a lack of managed waste data; 2) SUP quantities in Nova Scotia's waste has seen a relative decrease to other items; 3) 2020 experienced a large decrease in data availability, likely due to the COVID-19 pandemic.

This paper concludes by providing two key recommendations. These recommendations are to improve Nova Scotia's managed waste tracking systems, and to conduct addition waste monitoring for an additional five years, to determine the effectiveness of the SUPPR.

Keywords: Nova Scotia (NS), Single-use plastic (SUP), Single-use Plastic Prohibition Regulations (SUPPR), Managed waste, Mismanaged waste

List of Abbreviations

AAH: Nova Scotia Adopt-A-Highway

CBRM: Cape Breton Regional Municipality

ECCC: Environment and Climate Change Canada

HDPE: High-Density Polyethylene

HRM: Halifax Regional Municipality

Kg: Kilograms

LDPE: Low-Density Polyethylene

Mt: Million metric tons

MPW: Mismanaged plastic waste

MSW: Municipal solid waste

PADI: Professional Association of Diving Instructors

PET: Polyethylene terephthalate

PMU: Great Nova Scotia Pick-Me-Up

PP: Polypropylene

PS: Polystyrene

PVC: Polyvinyl chloride

RIC: Resin Identification Code

SI: Standard International System of Units

SPI: Society of the Plastics Industry, Inc.

SUP: Single-use plastic

SUPPR: *Single-Use Plastic Prohibition Regulations*

SWRM: Solid waste resource management

List of Tables

List of Figures

Chapter 1: Introduction

1.1 Background

The use of single-use plastics (SUPs) has increased rapidly over the years. It was estimated that globally in 2016, between 19 – 23 million metric tons (Mt) of plastic waste entered aquatic ecosystems (Borrelle et al., 2020). Furthermore, any waste within 50 km of a coastline is considered ocean-bound (Watt et al., 2021). Nova Scotia is no more than 130 km wide, broken up by bodies of water such as rivers, lakes, and Straits (O'Grady & Moody, 2021). In the few locations not within 50 km of the Nova Scotian coast, bodies of water and weather are able to carry waste within those limits. This puts Nova Scotia in a unique circumstance, where nearly all its waste is classified as ocean bound. Unless waste management practices begin to improve, the quantity of plastic waste produced and entering the oceans will only continue rising (Jambeck et al., 2015).

1.2 Purpose of the Study

The purpose of this study is to explore Nova Scotia's single-use plastic waste data through properly managed and mismanaged sources. This will create an extensive waste data set in relation to the six categories of single-use plastics, spanning the five years prior to the SUPPR announcement and the months following.

1.3 Problem Statement

The amount that single-use plastics contribute to global waste totals has been increasing steadily over the years (Xanthos & Walker, 2017). It was estimated that Canada alone produced around 23,597 tonnes of mismanaged plastic in 2019 (Our World in Data, n.d.). To curb the most problematic single-use plastics, Canada has implemented the *Plastic Bags Reduction Act* (Government of Nova Scotia, n.d.) and is aiming to implement a *Single-use Plastics Prohibition*

Regulations (SUPPR) (ECCC, 2022d). Roll-out of these acts and regulations has been slow, with few provinces implementing them prior to federal requirements. In Nova Scotia, there have been no published studies as to how and if these bans are impacting the amount and type of waste produced.

1.4 Research Question

How does the amount of single-use plastic waste discarded in Nova Scotia compare pre- and post-announcement of the *Single-use Plastics Prohibition Regulations?*

1.5 Definitions

The below terms and words will be referenced frequently throughout this research. They are defined as follows:

- 'Citizen science' refers to volunteers from the public who assist with projects by collecting, processing, and categorizing data (Bonney et al., 2014).

- 'Grey literature' is material that is less formal and does not undergo peer-reviewing in scientific databases and journals (Massachusetts College of Pharmacy and Health Sciences Libraries [MCPHS], 2023). Examples of grey literature include, but are not limited to, conference presentations, governmental reports, raw data, news articles, and blog posts (MCPHS, 2023).

- 'Mismanaged waste' refers to waste that has been improperly or inadequately disposed (Richie & Roser, 2018).

- 'Mobius loop' refers to the triangular symbol on plastic items, that features a number from one to seven in the center (Tso et al, 2022, p. 187).

- 'Ocean-bound plastic' refers to plastic waste that is expected to land in the ocean if not collected or recycled properly (Baron et al., 2022).

- 'Peer-reviewed literature' refers to material that has undergone peer-reviewed processes before publication in a scholarly journal or database (MCPHS, 2023).

- *'Plastic Bags Reduction Act'* refers to the ban implemented October 30, 2020, in Nova Scotia halting the use and provision of plastic bags (Government of Nova Scotia, n.d.).

- 'Plastic' refers to synthetic chemicals called polymers (ECCC, 2022d). Plastic material can be divided into 7 categories: Polyethylene terephthalate (PET), High-Density Polyethylene (HDPE), Polyvinyl chloride (PVC), Low-Density Polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS) and 'Other' (Plastics for Change, 2021).

- 'Primary Data' refers to data that has been collected first-hand by the researcher to assist in understanding and solving the research problem (Wagh, 2022).

- 'Properly managed waste', or 'managed waste' refers to waste that has entered organized waste management and disposal systems, such as landfills, sorting facilities, and waste depots (Ritchie & Roser, 2018).

- 'Secondary data' refers to the use of pre-existing data (Wagh, 2022).

- Single-use plastics (SUPs) are intended to be used once prior to discarding (ECCC, 2022d). The most common plastic polymers found in SUPS are polyethylene (PE), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), polylactic acid and polyhydroxyalkanoates (ECCC & Health Canada, 2020).

- *'Single-use Plastics Prohibition Regulations'* (SUPPR) was published by the Government of Canada on June 22, 2022 (ECCC, 2022d). SUPPR prohibits manufacturing, import, sale, and export of the following six categories of SUP items: checkout bags, cutlery, foodservice ware, ring carriers, stir sticks and straws (ECCC, 2022d).

1.6 Study Limitations

1.6.1 Delimitations – Included in the Study

(1) Location

   This research will examine SUP waste within Nova Scotia. This will allow the research
   to examine correlations between Nova Scotia's SUP waste data and SUPPR.

(2) Secondary Data

   This research will be conducted using secondary data that is readily available to the
   public. This will allow the research to analyze a variety of data in the most time-efficient
   way possible. The research will analyze waste data provided from Nova Scotian waste
   regions for the five years prior to SUPPR (i.e., 2017 – 2021) and data retrieved since
   (i.e., 2022). Additionally, the research will source data within the same timeline from
   local waste organizations and initiatives, such as Nova Scotia Adopt-A-Highway (AAH)
   and the Great Nova Scotia Pick-Me-Up (PMU). The research will also gather data from
   public waste reports within Nova Scotia.

1.6.2 Limitations

(1) Lack of Pre-existing Studies

   There is few, if any, pre-existing published research focused on Nova Scotia's SUP
   waste over the years. While there exists Nova Scotian reports pertaining to the total
   waste gathered and produced during a short timeframe, there is a lack of data
   combined from several sources. Furthermore, there is a lack of research exploring the
   meaning of this data or examining Nova Scotia's SUP waste in relation to SUPPR.

(2) Time

This is a short situational analysis of existing, publicly available data to provide a baseline for further research. The study will be completed during the span of eight months, with a completion date of April.

Chapter 2: Literature Review

2.1 History of Plastics

Plastics were introduced commercially during the 1930s and 1940s (Daltry et al., 2021, p.535). At the time, manufacturing relied on naturally found materials, such as wood, metals, and stone (Meikle, 1995, p.1). The maker of the first synthetic plastic, Bakelite, described plastic as having a thousand uses, as it was so different from the common materials at the time (Meikle, 1995, p.1). Sourced from petrochemicals, plastics are monomers that began replacing materials such as wood, metals, and glass (Daltry et. al, 2021, p. 535). Prior to its' introduction, plastic was not a global problem.

In the 1950s, plastic polymers achieved large-scale production and use increasing their production from 2 million metric tons (Mt) to around 380 Mt by 2015 (Geyer et al., 2017). (Geyer et al., 2017). Society no longer relied on materials only found naturally in the environment. Plastic was able to provide the illusion of replicating expensive, rare, and time-costly materials without naturally appearing irregularities and flaws (Meikle, 1995, p.2). It appeared light, smooth, and was easily replaceable and disposable (Meikle, 1995, p.2).
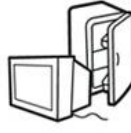
Society's relationship with plastic didn't slow. As use and popularity increased, new types of plastic were developed. In 1988, the Resin Identification Code (RIC) was introduced, separating the vast number of plastic resins into 7 categories: Polyethylene terephthalate (PET), High-Density Polyethylene (HDPE), Polyvinyl chloride (PVC), Low-Density Polyethylene (LDPE), Polypropylene (PP), Polystyrene (PS) and 'Other' (Plastic Action Centre, 2022). Figure 1 provides examples of items from each plastic resin category.

Figure 1:

Resin identification code for plastic polymers.

Note. Reprinted from "Plastic coding system guide for resin types," by Polychem USA, 2017, https://polychem-usa.com/plastic-coding-system/. Copyright 2016 by Polychem USA.

According to the Society of the Plastics Industry, Inc. (SPI), the RIC created a consistent classification and coding system for recycling plastics and managing their end-of-life cycle (Targeted News Service, 2014). Each plastic category has different potentials and restrictions on re-use, disposal and recycling (Plastics For Change, 2021). While the recycling and disposal regulations vary within every country and community, Figure 2 shows general recyclability of each plastic category (3devo, 2020). As seen in Figure 2, PETE, HDPE, and PP (shaded green) are the most easily recyclable, and therefore recycled in most locations. PVC, LDPE, and PS

(shaded yellow) are somewhat recyclable, meaning they might require special recycling systems, and 'other' (shaded red) is not easily recyclable or commonly accepted (3devo, 2020).

Figure 2:

Recyclability of each RIC category.

Note. Reprinted from "Types of plastics," by 3devo, 2020, https://www.3devo.com/blog/recycling-plastics. Copyright 2022 by 3devo B.V.

Since 1975, global plastic resin production has seen an increase of 620% (Daltry et. al, 2021, p.535). In 2012, an approximate 280 million tons of plastic were produced globally, with less than half properly disposed or recycled (Daltry et. al, 2021, p.535). Why is this the case when the RIC was created with the purpose of making recycling and disposal of plastics easier? This is because as humans we rely on visually classifying and segregating waste, which is not possible in the case of plastics (Agarwal et al., 2022). All the categories of plastic require different disposal and recycling, and to the average person, it is near impossible to distinguish the different categories from one another by their appearance alone (Agarwal et al., 2022).

The mobius loop provides a solution to the difficulty of visually categorizing plastic resin types. The mobius loop refers to the small tringle recycling logo inscribed on plastic items to

guide their disposal (Tso et al, 2022, p. 187). This triangular symbol features a number in the center, ranging from one to seven (Tso et al, 2022, p. 187). These numbers refer to the category of plastic resin the item falls under, as indicated in Figure 1 and Figure 2. The mobius loop is meant to be used to identify an items plastic composition, assisting consumers in determining how to properly discard or recycle the item (Tso et al., 2022, p. 187). Despite the intention of this symbol, there is a lack public knowledge as to what the mobius loop indicates. Upon seeing the mobius loop, many individuals deem the product recyclable without understanding the impact of the number categorization (Buelow et al., 2010, p. 206). In Australia, 70% of survey respondents assumed anything with a mobius loop could be recycled (Buelow et al., 2010, p. 206). This confusion is just as prevalent in Nova Scotia. At a Waste Resource Association of Nova Scotia (WRANS) workshop in November 2022, Norm Mensour, an employee of Scotia Recycling Ltd., showed items he had collected during one hour at a recycling plant (Mensour, 2022). In their recycling bags, Nova Scotians were throwing trash, food clamshells, and other non-recyclable plastics (Mensour, 2022). Although there are regulatory efforts, such as the mobius loop, to assist consumers in sorting and disposing their plastics, widespread public education is needed to ensure regulations prove effective.

2.2 Framing the Context of SUPs

SUPs are plastic polymers that are produced with the intention of being disposed after one use (ECCC, 2022d). Some of the most used plastic resins in SUP items are Polyethylenes, PP, PS, and PVC (Viera et al., 2020, p.177). These plastics are cost-effective, durable, and versatile, but have a short lifespan and are discarded shortly after use (Viera et al., 2020, p.177). Most consumer plastics are intended for single use, and difficult to recycle (Walker & McGuinty, 2021, p.2).

Between 30 – 40% of all plastic is used to make SUP items (Sicotte & Seamon, 2020). These items include plastic bags, plastic straws, plastic wrap, and water bottles (Sicotte & Seamon, 2020); essentially, any item that is made for convenience and disposed of shortly after use.

2.3 Framing the Context of Waste in Nova Scotia

In 2010 roughly 275 Mt of the world's waste was plastic (Jambeck et al., 2015). Although waste is often divided into two main categories that result from society – municipal solid waste (MSW) and industrial – MSW is the material most people associate with 'waste' and 'garbage' (Singh et al., 2014). MSW refers to waste material generated from commercial sources (e.g., retailers) and residential sources (e.g., households) (Vergara & Tchobanoglous, 2012). It also includes waste from institutional sources (e.g., schools) and industry (e.g., offices, restrooms) (Tchobanoglous & Kreith, 2002). This is the waste that would enter household trashcans, mall garbage bins, and dumpster bins.

In 2016, 19 – 23 Mt of plastic waste generated globally entered aquatic systems (Borrelle et al., 2020). These numbers are predicted to rise as high as 53 Mt by 2030 (Borrelle et al., 2020). Waste enters the ocean through waterways, wastewater, wind, tides, and other methods (Jambeck et al., 2015). Any plastics within 50 km of a waterway is considered ocean-bound plastic (Jambeck et al., 2015). This places Nova Scotia in a unique position, as the province is no more than 130km wide at any point, and intersected with countless lakes, rivers, and watersheds (O'Grady & Moody, 2021). Figure 3 provides a brief overview into Nova Scotia's topography, showing its dimensions how frequently it is intersected by lakes, straits rivers, and bays.

Figure 3:

Nova Scotia's boundaries.

Note. Reprinted from "Nova Scotia," by Encyclopædia Britannica, 2009,

https://www.britannica.com/place/Nova-Scotia#/media/1/420996/64082.

2.3.1 Properly Managed Waste

Properly managed waste is material that has entered organized waste management and disposal systems, such as landfills, sorting facilities, and waste depots (Ritchie & Roser, 2022). Managed waste is disposed of through landfills and proper waste management systems, such as municipal landfills, incineration, and recycling (Singh et al., 2014).

Proper waste management is one of the largest challenges in urban environments (Un-Habitat, 2010). Larger quantities of waste being produced globally has resulted in many issues

with managed MSW, such as a lack of quality data and a lack of enforcement regulations and standards regarding disposal (Tchobanoglous & Kreith, 2002). In higher-income countries, efforts are being driven to gather information on the generation, recovery, and disposal of waste within communities through their waste management systems (Singh et al., 2014). In Nova Scotia, Divert NS works to increase public education and knowledge about the waste management systems local to them (Divert NS, n.d.-a). On their website, Divert NS provides waste sorting guides unique to each community (Divert NS, n.d.-c). This serves as a tool for the public to increase their knowledge about proper waste management and disposal processes.

2.3.2 Mismanaged Waste

Mismanaged waste is material that has been improperly or inadequately disposed of (Ritchie & Roser, 2018). Mismanaged waste includes littered material, as well as waste that was not managed or contained properly (i.e., waste material in dumps and uncontrolled landfills) (Ritchie & Roser, 2018). Due to its improper handling, mismanaged waste is at high risk of entering the oceans, rivers, and waterways (Ritchie & Roser, 2018). Mismanaged waste is often collected by street sweepers, and citizen groups concerned about cleaning their communities (Lebreton & Andrady, 2019).

Mismanaged waste tracking relies heavily on citizen science. Citizen science refers to volunteers from the public who assist with projects by collecting, processing, and categorizing data (Bonney et al., 2014). Modern citizen science allows participation and involvement of all interested parties (Silvertown, 2009). Community groups who clean litter from the streets and report their findings to interested parties are a prime example of citizen-science.

2.3.3 Nova Scotia's Waste Regions

Nova Scotia's communities, towns, and municipalities are separated into 18 counties (Nova Scotia Archives, 2023). These counties, as seen in Figure 4, are the following: Annapolis; Antigonish; Cape Breton; Colchester; Cumberland; Digby; Guysborough; Halifax; Hants; Inverness; Kings; Lunenburg; Pictou; Queens; Richmond; Shelburne; Victoria; and Yarmouth (Nova Scotia Archives, 2023).

Nova Scotia divides its counties into seven solid waste resource management (SWRM) regions (ECCC, n.d.-a). These seven waste regions are separated to best facilitate the collection of recycling and organics (ECCC, n.d.-a). Despite being within the same province, recycling and composting programs may vary between them. (ECCC, n.d.-a). Due to this variation, Divert NS provides waste sorting guides on their website, unique to each community (Divert NS, n.d.-c).

Figure 4:

Nova Scotia's counties (Nova Scotia Archives, 2023).

Note. Reprinted from "County Map of Nova Scotia," by Nova Scotia Archives, n.d.,

https://archives.novascotia.ca/maps/county/. Crown copyright 2023 by Province of Nova Scotia.

The seven solid waste resource management regions, as seen in Figure 5, are divided as

follows (ECCC, n.d.-a):

(1) Cape Breton: Cape Breton Regional Municipality (CBRM), Inverness, Victoria,

Richmond, Port Hawkesbury

(2) Eastern: Municipality of the District of Guysborough, Municipality of the County of

Antigonish, Municipality of the Town of Antigonish, Pictou County

(3) Northern: Colchester, Cumberland, East Hants

(4) Halifax: Halifax Regional Municipality (HRM)

(5) Valley: Annapolis, Kings, Berwick, Bridgetown, Hantsport, Kentville, Middleton, Wolfville

(6) South Shore/West Hants: Barrington, Bridgewater, Lockeport, Lunenburg, Mahone Bay, Shelburne, Windsor, West Hants, Chester, Queens

(7) Western: Town and County of Digby, Clare, Argyle, Town of Yarmouth, District of Yarmouth, Clark's Harbour

Despite having seven solid waste resource management regions, each region does not have solid waste disposal sites (ECCC, n.d.-b). Nova Scotia's seven municipal solid waste disposal sites, also known as landfill facilities, reside in four of the seven regions (i.e., Region 2, Region 3, Region 4, Region 6) (ECCC, n.d.-b). Each of the landfills and their locations can be seen in Figure 5, although the West Hants landfill has been renamed the GFL facility (ECCC, n.d.-b).

Figure 5:

Solid waste management regions and landfill locations.

Note. Reprinted from "2017 Waste Audit Report," by Divert NS, 2018,

https://divertns.ca/sites/default/files/researchreportsfiles/2021-09/WasteAudit2017.pdf. Copyright

2021 by Divert NS.

2.4 SUP Regulations Impacting Nova Scotia

2.4.1 Canada's Single-use Plastics Prohibition Regulation

On June 22, 2022, the Government of Canada published the *Single-use Plastics*

Prohibition Regulations (SUPPR), through Environment and Climate Change Canada (ECCC)

(ECCC, 2022d, p.6). SUPPR announced the prohibition, manufacturing, import and sale of six

types of SUP items, aiming to prevent and target Canada's plastic pollution (ECCC, 2022d, p.6).

The six SUP items to be eliminated and restricted are made entirely or partially from plastic, and

are categorized as checkout bags, cutlery, foodservice ware, ring carriers, stir sticks and straws

(ECCC, 2022d, p.6). As per SUPPR, the following are prohibition guidelines for the six SUP

categories (ECCC, 2022d):

- Checkout bags are bags used to carry purchases from businesses and restaurants. These bags are not a fabric material. They also break or tear easily when carrying 10 kg over 53 metres, 100 times, or washed extensively.

- Cutlery refer to plastic forks, knives, spoons, sporks, and chopsticks that typically contain PE or PS, or change form after 100 dishwasher runs. These items are most often provided with take-out food, in grocery stores, and institutional settings.

- Foodservice ware items are designed for food and beverages that are ready to be consumed. These items contain PS foam, PVC and are in the form of clamshell containers, lidded containers, boxes, cups, plates, or bowls. They are typically seen at restaurants, fast-food locations, and grocery stores for takeout and to-go meals.

- Ring carriers refer to deformable rings or bands that surround beverage containers to keep them together. These are typically the rings that surround six-pack canned beverages, such as pop or beer cans.

- Stir sticks are designed to stir or mix drinks and prevent spilling from to-go cup lids. These are commonly seen in coffee-shops, restaurants, and grocery stores.

- Straws refer to plastic in the shape of drinking straws that contain PS or PE, and that change form after 100 dishwasher runs. These are received in nearly any fast-food drink cup, provided at restaurants, sold grocery stores, and are attached to juice boxes/pouches.

SUPPR was developed through scientific evidence and review of the occurrence and impacts of plastic pollution (ECCC, 2022d, p.6). They were created through consultations with a combination industry, jurisdictions, civil society organizations and Canadians (ECCC, 2022d, p.6). This communication and input from a variety of stakeholders allowed for different perspectives and opinions to be raised on the topic. In unison with SUPPR, a factsheet (seen in

Figure 6 and Figure 7) was created for the public, describing the prohibited items, addressing

accessibility concerns, indicating the dates of implementation, and providing additional resources

(ECCC, 2022a). While many Canadians are under the impression that each category under

SUPPR are to be implemented in unison, the dates differ. Table 1 shows the complete

breakdown of implementation dates for each SUP category, in accordance with SUPPR.

Figure 6:

Page one of the SUPPR Fact Sheet.

Note. Reprinted from "Single-use Plastics Prohibition Regulations Fact Sheet," by ECCC, 2022,

https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/reduce-

plastic-waste/single-use-plastic-factsheet.html.

Figure 7:

Page two of the SUPPR Fact Sheet.

Note. Reprinted from "Single-use Plastics Prohibition Regulations Fact Sheet," by ECCC, 2022,

https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/reduce-

plastic-waste/single-use-plastic-factsheet.html.

Table 1:

Dates the Single-use Plastics Prohibition Regulations come into effect (Adapted from: ECCC, 2022d).

Item	Manufacture & Import	Sale	Export
Checkout bags	2022, December 20	2023, December 20	2025, December 20
Cutlery	2022, December 20	2023, December 20	2025, December 20
Foodservice wares	2022, December 20	2023, December 20	2025, December 20
Ring carriers	2023, June 20	2024, June 20	2025, December 20
Stir sticks	2022, December 20	2023, December 20	2025, December 20
Straws*	2022, December 20	2023, December 20	2025, December 20

Flexible straws packaged together with a beverage container are allotted exceptions to the straw regulations. After the Exportation effect of SUP straws, all export of flexible straws is required to adhere to the conditions in section B.6.4 in ECCC's Technical Guidelines.

*Flexible Straws	2022, December 20	2024, June 20	2025, December 20

2.4.2 Plastic Bags Reduction Act, Bill No. 152

In September of 2019, the Honourable Gordon Wilson, Nova Scotia's Minister of Environment, introduced the *Plastic Bags Reduction Act, Bill 152* (Wilson, 2019). *Bill No. 152* was introduced as an act to reduce the use of plastic bags and other single-use items (Nova Scotia Legislature, n.d.). After receiving assent, or approval, from the Lieutenant Governor in October 2019, the Act came into effect in October 2020 (Wilson, 2019). This Act was the first major SUP ban in Nova Scotia. The roll-out of the *Plastic Bags Reduction Act* preceded SUPPR, allowing Nova Scotian's and businesses time to transition (Ryan, 2020). Rather than implementing regulations of all six SUP categories at once, it allowed Nova Scotians to adapt to

one small change first. It allowed communities to learn new shopping habits and transition away

from a reliance on SUP checkout bags. Months later, in 2021, Nova Scotians explained that the

transition had been smooth (Foussekis, 2021). In an interview, the owner of TJ's Grocery in

Halifax thought the transition was so smooth due to a large enough transition time to allow the

community to move through the stages (Foussekis, 2021). Furthermore, according to a

representative for the Department of Environment, most Nova Scotians had been complying with

the ban (Foussekis, 2021).

The generally positive response towards the *Plastic Bag Reduction Act* demonstrates that

Nova Scotians have been in favour of the minor inconvenience of removing SUP checkout bags,

in favour of the environmental benefits it provides. This acceptance towards change furthers a

more encouraging and welcoming atmosphere for further SUP elimination.

3.1 Context of Research

The aim of this research was to explore Nova Scotia's SUP waste data through properly managed and mismanaged sources, creating a vast waste data set relating to the six categories of SUPs included in SUPPR. Through data collection and analysis, this research will gain information and insight to assist in answering the research question: How does the amount of single-use plastic waste discarded in Nova Scotia compare pre- and post-announcement of the *Single-use Plastics Prohibition Regulations?*

3.2 Research Design

3.2.1 Research Type & Research Strategy

Quantitative research is the primary research method for this study. In its simplest description, quantitative research collects numerical data and analyses it through mathematical based methods to interpret and answer the research question (Creswell, 2009, p.17). Mathematically based methods refer to converting data into numerical form and analyzing it through ways such as statistics (Sukamolson, 2007, p.2). This study will rely on quantitative methods to gather and quantify data prior to its analysis. A quantitative analysis will be required to establish generalizable facts, patterns, themes, and conclusions with the collected data.

In alignment with quantitative research, this study will focus on deductive reasoning. Deductive reasoning makes logical conclusions based on the information at hand (Johnson-Laird, 2009). The deductive reasoning will be conducted through basic word analysis of the numerical data.

3.2.2 Postpositivist Worldview

Postpositivism is an overarching worldview where causes determine effects or outcomes (Creswell, 2009, p. 25). Its intent is to reduce the ideas into a small, discrete set of ideas to test and the knowledge that comes from this worldview is based on observation of the objective reality (Creswell, 2009, p. 25). Postpositivism has several key assumptions that influences the work, such as the idea that truth can never be fully established, and research aims to develop relevant, true statements that explains the situation or relationships of interest (Philips & Burbules, 2000). Furthermore, data, evidence and rational considerations shape knowledge, and remaining objective is essential to the research (Philips & Burbules, 2000). These assumptions will remain true throughout this research to establish unbiased and relevant data and theories.

Postpositivism often begins with theory, then collects data before making the necessary revisions to the theory (Creswell, 2009, p. 25). In this study, we are to start with a research question, collect data relating to said question, explore the results, and then discuss the findings. To collect and examine data in a non-biased form that is relevant to the study, maintaining a postpositivist lens on the study will be important.

3.2.3 Secondary Data Collection

This study focuses on secondary data, rather than primary data, to gather relevant and detailed information. The research will examine what has already been collected and tracked in Nova Scotia (i.e., municipalities in Nova Scotia, waste monitoring programs, cleanup groups, reports) rather than conducting research that results in new data (e.g., surveys and interviews). Due to the focus on secondary data, this research will not involve direct public participation.

Secondary data will also allow the data to be obtained through a variety of forms (e.g., itemized collection lists, reports, overall quantities). The secondary data collection for this research was selected based on the following criteria:

(1) Secondary data is in relation to the six categories of SUP items included in SUPPR: checkout bags, cutlery, foodservice wares, ring carriers, stir sticks and straws. These categories will be compared against quantities of the total MSW, total weight, and the total plastic collected. All other waste data is irrelevant to this study and will not be included for analysis.

(2) SUP waste data is collected and gathered solely in Nova Scotia.

(3) Data will be collected from properly managed avenues in the seven waste regions in Nova Scotia: Cape Breton, Eastern, Northern, HRM, Valley, South Shore and Western. This will include the recycling and sorting facilities to determine what is landing there, as well as quantities in relation to other waste items.

(4) Data will be collected from mismanaged waste sources. This will include litter audits and litter cleanups to determine what isn't going through the proper avenues in Nova Scotia.

(5) The secondary data collected will date from January 2017 – December 2022. This range allows the data to date back five years prior to the announcement of SUPPR, as well as collect what has been tracked since.

This criterion was determined to ensure that all the data is kept within the scope of the project. This also ensures that data from multiple avenues and sources within Nova Scotia are considered.

3.2.4 *Managed Waste Data Sources*

The data utilized from secondary sources for managed MSW aims to include information retrieved from reports and waste regions directly. Divert NS was used to obtain reports and contact information for representatives of each waste region.

The following are the contacts and reports that were found, relevant to managed SUP waste data:

(1) Regional Waste Educators

Contacts for the regional coordinators were obtained on Divert's 'Local Waste Educators' page (Divert NS, n.d.-b). This page is used as a resource to find experts about the waste systems, specific to each municipality (Divert NS, n.d.-b). Using the emails linked on this page, each educator will be contacted via email to request any public MSW data they can provide pertaining to SUPPR.

(2) Andrew Philopoulos – Director of Solid Waste Resources, Transportation and Public Works (HRM)

Dr. Tony R. Walker provided Andrew Philopoulos' contact information. Andrew Philopoulos will be contacted for information using the email template in Appendix A.

(3) Divert NS 2017 Waste Audit Report

The *Divert NS 2017 Waste Audit Report* was conducted by four individuals to identify and quantify the materials entering provincial landfills (Divert NS, 2018). The report, published in 2018, separates material gathered from each landfill by location (i.e., Eastern, Northern, HRM and South Shore) and material origin (i.e., provincial-wide waste, residential waste, and industrial, commercial and institutional [ICI] waste) (Divert NS, 2018). The waste is then broken into seven further subcategories of fibres, organics,

plastics, textiles, construction and demolition (C&D), special care waste (SCW), and

other (Divert NS, 2018). From this report, the only sub-categories relevant to this

research will be the 'plastics' and 'other' categories.

In cases where the sources are to be contacted via email, requesting further public data,

an email template will be used. The email template, as seen in Appendix A, will determine if the

full publicly available data is available online, or if the sources provide more upon request. The

use of the email template ensures cohesive and appropriate requests between all sources.

3.2.5 Secondary Data Sources – Mismanaged Waste

The mismanaged plastic waste (MPW) data utilized from secondary sources will

incorporate a variety of programs, organizations, cleanup groups, and citizen science. All groups

included in this research were found through a series of Google searches, using keywords such

as: 'NS litter cleanup group', 'NS cleanup group', 'NS litter data', 'litter data', 'NS litter

cleanup' and 'NS waste data'. Additional sources were found through social media (i.e.,

hashtags, tagged posts, 'explore page' on Instagram).

The following are the reports, groups and organizations that were found relevant to

mismanaged SUP waste data:

(1) Divert NS

Divert NS is a not-for-profit corporation that works to improve waste

diversion solutions in Nova Scotia (Divert NS, n.d.-a). Divert works to improve

recycling through a combination of stewardship, education, and offers community

resources on their website such as sorting guides and research reports (Divert NS,

2022a).

Divert's mismanaged SUP data will be gathered from their public reports, in particular the *Nova Scotia Roadside Litter Audit*. This audit, published in 2021, was conducted in collaboration with Dillon Consulting Limited to provide an overview of Nova Scotia's litter at pre-selected site locations (Divert NS, 2021). This litter audit took place just over the span of a month, from June 14 – July 15, 2021.

(2) Nova Scotia Adopt-A-Highway (AAH) & the Great Nova Scotia Pick-Me-Up (PMU)

Nova Scotia Adopt-A-Highway is a program that allows community members to work together to keep their communities clean by providing free supplies and acting as the liaison between community, Public Works, and the waste regions (AAH, 2023b). There are two programs with different levels of commitment (AAH, 2023c). AAH allows community members to 'adopt' a roadway, agreeing to clean their roadway twice a year for three years (AAH, 2023c). PMU allows anyone to register a one-time cleanup in any location (AAH, 2023c).

AAH and PMU publish Annual Reports and newsletters called 'LITTERature' (AAH, 2023a). Although data can be gathered from these, the programs will be contacted via email to determine if the full data records are publicly available. These full data sets, should they be publicly available, will allow for a more comprehensive analysis of the data.

(3) PADI Aware

PADI Aware is a project organized by the Professional Association of Diving Instructors (PADI) to engage divers and activists around the world (PADI, 2022). The goal of project AWARE® is to bring together those passionate about the ocean in

global volunteer work to further conservation efforts (PADI, 2022). Using citizen science, PADI Aware tracks the ocean debris gathered from global dives and includes it on their Dive Against Debris® map (PADI, 2023).

The data from project AWARE will be collected from the Dive Against Debris map. Although the map shows global totals, the scope will be narrowed to Nova Scotian dives. These individual data points on the map for Nova Scotia will each be examined to track the date, municipality, and items found.

(4) Trashformers

The Trashformers are a litter clean-up team that works in Cape Breton, Nova Scotia (ACAP, n.d.). The Trashformers work in partnership between CBRM Solid Waste and ACAP Cape Breton to clean the municipality during summer months (ACAP, n.d.). The Trashformers track the data gathered from each of their cleanups and provide visual representations of their findings to the public (ACAP, n.d.).

Similarly, as with AAH & PMU, although data can be extrapolated from their public graphs, the group will be contacted via email (see Appendix A) to determine if the full data records are publicly available.

(5) Litterati

Litterati is an app that encourages individuals across the world to participate in cleaning their communities (Litterati, n.d.). The app works by allowing users to compete against one-another in challenges and leaderboards, centered around cleaning litter from their communities (Litterati, n.d.). As users clean, they photograph and tag the pieces of litter they gathered (Halifax, n.d.). This data allows Litterati, and those in charge of the challenge, to track and categorize the data

collected during challenges (Litterati, 2022). By this method of tracking, Litterati, governments and communities can determine how much litter is being found, where, and what it is, to take preventative action (Litterati, 2022).

The Litterati data used for this research stems from the HRM. The HRM launched the Litterati App in Nova Scotia and began with the CLEANHRM challenge (Halifax, n.d.) in April 2022 (Halifax Recycles, 2022). While the challenge is public and some data can be gathered from viewing the challenge through the app (e.g., the total amount of litter, number of participants), the representative for HRM's Litterati will be contacted via email to determine if there are more detailed public records.

In cases where the organizations and groups are to be contacted via email to request further public data, an email template will be used. The email template, as seen in Appendix A, will determine if the full publicly available data is available online, or if the sources provide more upon request. The use of the email template ensures cohesive and appropriate requests between all sources.

3.2.6 Data Compilation

All secondary data collected will be compiled into two separate groups – managed SUP waste data and mismanaged SUP waste data. The data will then be separated into further tables to demonstrate what data was received from each source.

The data for each grouping will be organized by the following:

(1) Category of SUP item: the tables will separate the data gathered for each SUP category featured in SUPPR (i.e., checkout bags, cutlery, foodservice ware, ring carriers, stir sticks and straws).

(2) Waste Regions: When possible, the data gathered will be sorted per waste region.

(3) Yearly Findings: The data will be separated according to the year it was gathered.. The yearly range will span the calendar year from January 1 – December 31 of each year (e.g., January 1, 2017 – December 31, 2017) to maintain consistency. In cases where data was gathered in under a year, it will be categorized within that year (e.g., January 2017 – March 2017 will be categorized under 2017). If data is tracked during the fiscal year, tracking ranges outside of the calendar year, such as from April 1 – March 31 (e.g., April 1, 2017 – March 31, 2018) (Business Development bank of Canada, n.d.). In these cases, the data will be sorted within the year most of the tracking was completed (i.e., F201718 will become 2017).

(4) Yearly waste weight: The total waste weight for each year will be examined for each data set. All waste weight will be converted to kilograms (kg), if not already tracked in this measurement. This will be done to align with the Standard International (SI) System of Units base unit of mass (Bureau International, 2022, p.131)

3.2.7 Data Analysis

After compiling and categorizing all the secondary data gathered, this research will analyze the findings. The analysis will examine the data to clearly determine themes, differences, patterns, and similarities in the SUP waste gathered from managed and mismanaged waste disposal methods.

The analysis seeks to address to following:

(1) What are the key findings for managed SUP waste in Nova Scotia?

(2) What are the limitations with the managed SUP waste data?

(3) What are the key findings for mismanaged SUP waste in Nova Scotia?

(4) What are the limitations with the mismanaged SUP waste data?

(5) Can changes in the data be attributed to SUPPR or the *Plastic Bags Reduction*

Act?

(6) Does the examination of this data provide any future recommendations?

The aim is for the analysis to provide the important context as to how SUPPR has impacted the SUP waste in Nova Scotia.

Chapter 4: Results

Results from this study include an analysis and comparison of a variety of publicly available SUP waste data in Nova Scotia, from a combination of sources. The data is analyzed through the six categories of SUPs featured in SUPPR – checkout bags, cutlery, ring carriers, stir sticks, foodservice wares, and straws. This data is then compared against the total waste, total weights, and total plastics tracked. The data is compiled through a combination of provincial waste regions, organizations, and citizen science:

(1) Managed Waste

    a. Local Waste Region Educators

    b. Andrew Philopoulos, Director of Solid Waste Resources, Transportation and Public Works (HRM)

    c. Landfill Waste Audit, Divert NS

(2) Mismanaged Waste

    a. Divert NS

    b. Nova Scotia Adopt-A-Highway & Great Nova Scotia Pick-Me-Up Program

    c. PADI Aware

    d. Trashformers

    e. Litterati

The data was gathered from public reports, websites, and publicly available data supplied by the sources directly. In instances where the full data set was supplied by an individual source they were contacted using the email template in Appendix A.

The data is presented visually in graphs and figures throughout this chapter. The data is both compiled and broken down by source. This allows easy viewing and comparison of the data

collected. The full data tables can be found in Appendix B and Appendix C for further examination of all the data collected.

4.1 Managed Waste

The managed waste data for this report was sourced through three avenues. The first source was through the local waste educators for each of waste regions in Nova Scotia. The second was through Andrew Philopoulos with the HRM. The third source of data was from the *Divert NS 2017 Waste Audit Report*.

4.1.1 Local Waste Region Educators

Nova Scotia's waste regions were all contacted via email to determine what public data they could provide in relation to SUPs. The local waste educators for each region were sourced from Divert NS's Resource page, and were then emailed using the template in Appendix A. This request was sent to see if they keep public records of the plastic data they receive through each waste regions depot.

All the educators were friendly and responded rapidly. However, there was no public data pertinent to this study collected through the depots, or any other outlet other than those already gathered. According to the educators, this is because the waste regions track waste material according to their composition, rather than the type of item and weight of items that enters their systems (C. McClare, personal communication, January 12, 2023; B. Rioux, personal communication, January 9, 2023; A. Garrett, personal communication, January 9, 2023).

4.1.2. Andrew Philopoulos, Director of Solid Waste Resources, Transportation and Public Works (HRM)

Andrew Philopoulos was contacted via email, using the email template from Appendix A. Mr. Philopoulos did not have any further data specific to the six SUP items included in the

SUPPR, as they track item composition instead of the type of item (A. Philopoulos, personal communication, December 19, 2022). Andrew instead directed the research to the Divert NS 2017 Waste Audit Report for the most recent provincial landfill waste audit data (A. Philopoulos, personal communication, December 19, 2022).

4.1.3 Landfill Waste Audit, Divert NS

The managed waste data is compiled from the *Divert NS 2017 Waste Audit Report*. Data from the report was extracted when relevant to the six SUP categories into *Table 2* and *Table 3*. Out of the six categories, the only categories it addresses within its categorization of waste were checkout bags and foodservice wares.

Figure 8:

Nova Scotia's managed waste (source: Divert NS, 2018).
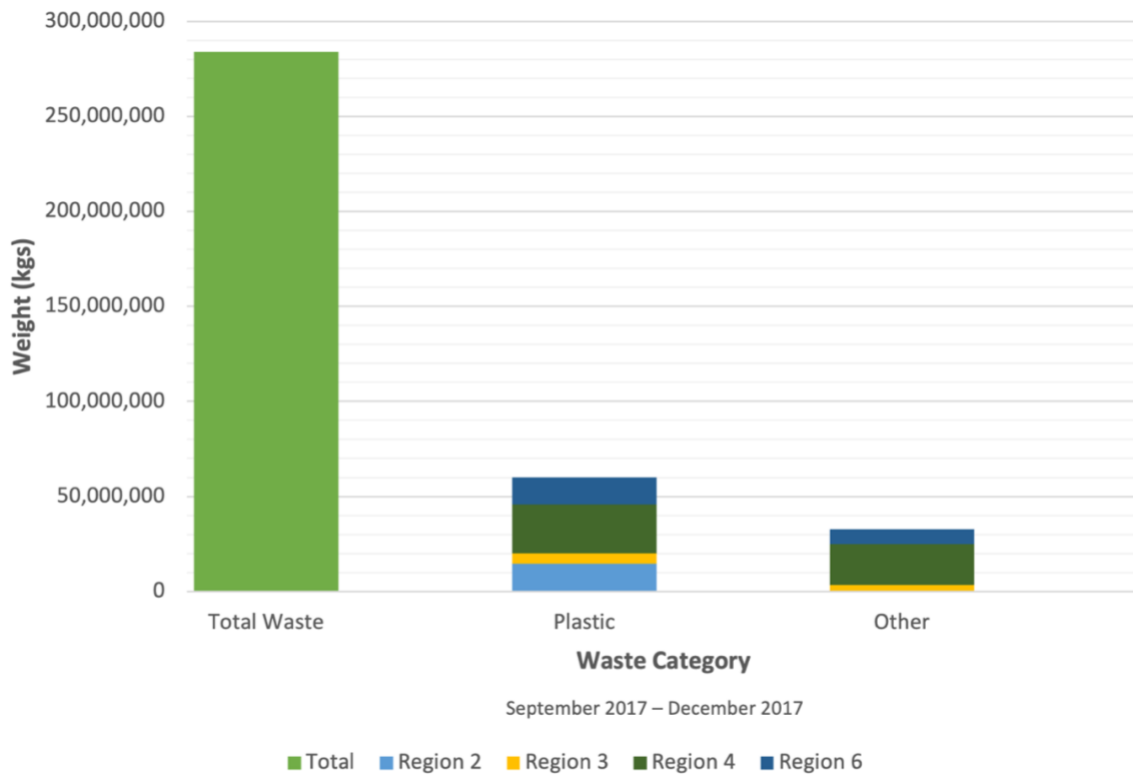
As shown in Figure 8, Divert's audit accumulated a total of 284,171,000 kg of waste

weight (Divert NS, 2018). Out of this total weight, the plastics category made up a total of

59,258,000 kg (21%), of which plastic checkout bags accounted for 2,429,578 kg (Divert NS,

2018). Additionally, the 'Other' category totaled 38,910,000 kg (13.7%) of the total waste, of

which foodservice wares accounted for 8,015,460 kg (Divert, 2018).

Figure 9 breaks down this information further, separating the information by source and

location. The four bars on the left demonstrate the waste from residential sources, and what

quantities were found in which waste region. The four bars on the right depict the waste

stemming from ICI and what quantity comes from each region. As shown in Figure 9, most of

the waste comes from Region 2 and Region 4.

Figure 9:

Nova Scotia's waste by origin (source: Divert NS, 2018).
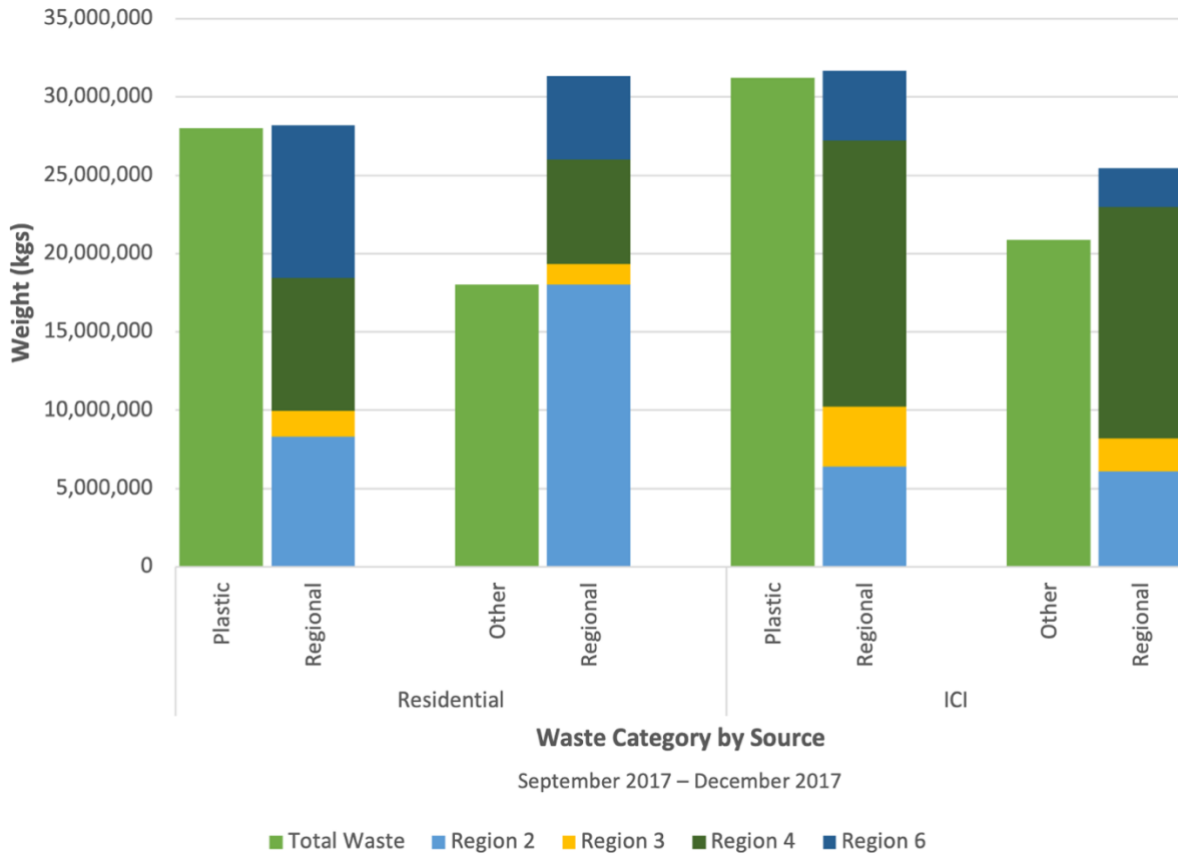
4.2 Mismanaged Waste

The mismanaged waste data for this report was obtained through several sources. All the data gathered from Divert NS, AAH and PMU, PADI Aware, Trashformers and Litterati were compiled into Table 4 and Table 5 in Appendix C. The data is visually represented in Figure 10 and Figure 11.

As shown in Figure 10, the quantities of reported waste have changed significantly since 2017. In 2017 no items were reported, meaning weight was the only way to track the data. The weight of all MSW gathered in 2017 totaled 49,588 kg (Divert NS, 2021; AAH & PMU, 2022;

PADI Aware, 2023; Trashformers, 2023; & Litterati, 2023). Throughout the years the amount of

waste, MPW and weight of MPW reported has fluctuated, with a significant decrease in 2020.

2022 saw 122,556 items reported through the five organizations/programs, which to-date has

been the most reported items (Divert NS, 2021; AAH & PMU, 2022; PADI Aware, 2023;

Trashformers, 2023; & Litterati, 2023). 2022 also more than doubled the previous years' total

weight in reported items, accounting for the largest reported weight at 181,397 kg (Divert NS,

2021; AAH & PMU, 2022; PADI Aware, 2023; Trashformers, 2023; & Litterati, 2023). This is in line

with the significant increase in total reported items.

Figure 10:

Nova Scotia's mismanged SUP waste data (sources: Divert NS, 2021; AAH, 2022; PADI Aware, 2023;

Trashformers, 2023; & Litterati, 2023).
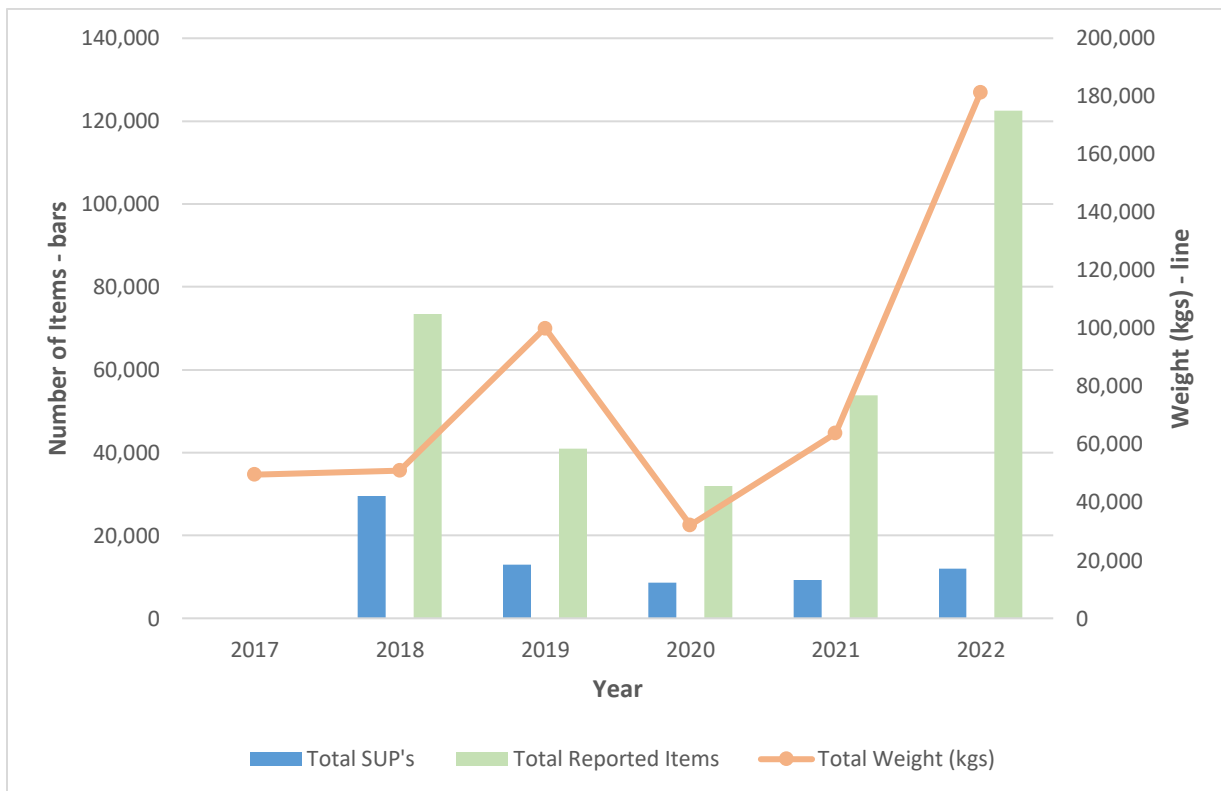
Figure 11 depicts the trends in reported SUP items from 2017 – 2022 throughout the province.
2017 starts with no reported SUP items before seeing a significant increase in reporting the
following year. Foodservice wares and straws were the two categories that were most reported
over the years (see Table 4). In comparison, stir sticks and ring carriers were drastically lower in
the number of items reported for their categories, never reaching more than two items reported
each year (see Table 4). Checkout bags was the only category that saw a nearly consistent
reduction, going from 11,711 bags in 2018 to 2,455 bags reported in 2022 (see Table 4).

Figure 11:

Nova Scotia's SUP item trends (sources: Divert NS, 2021; AAH, 2022; PADI Aware, 2023; Trashformers,
2023; & Litterati, 2023).
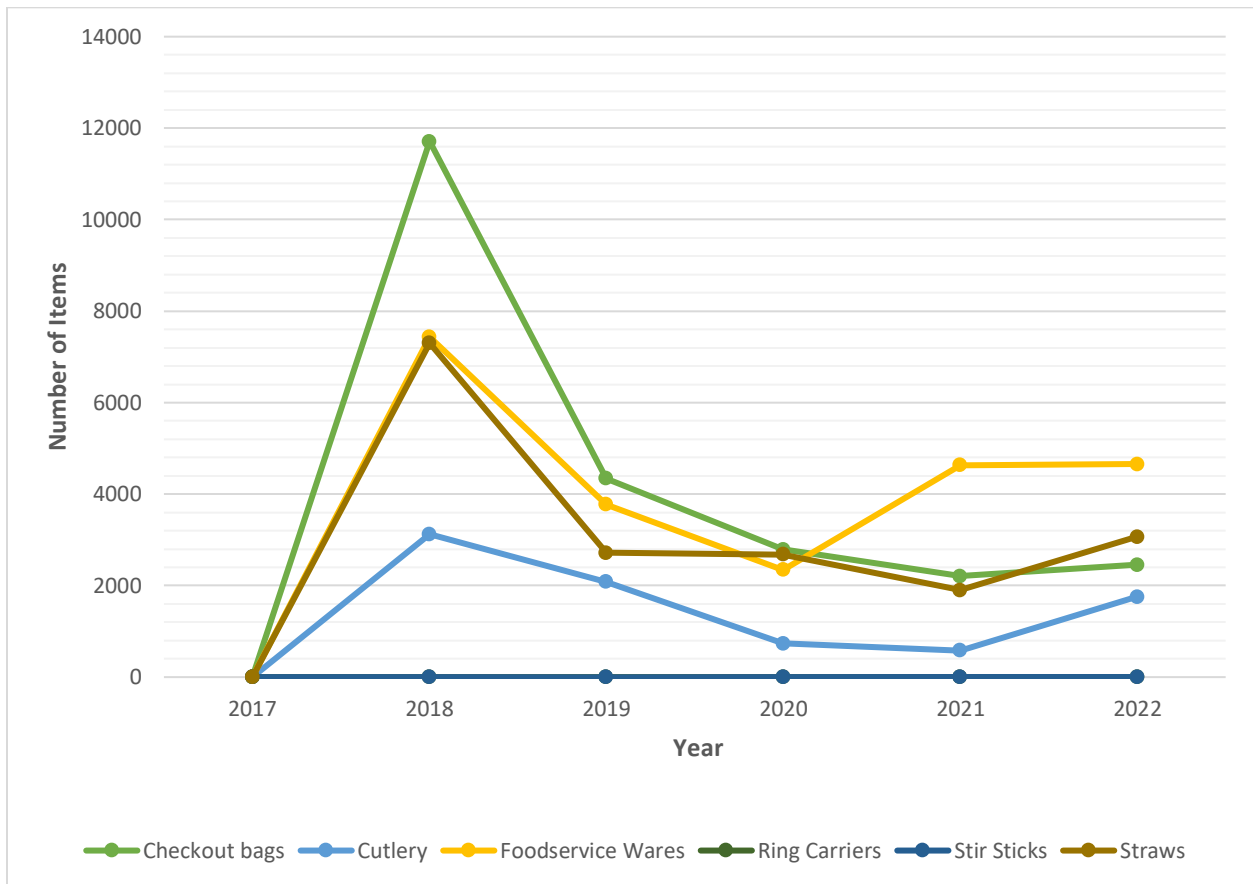
4.2.1 Divert NS

Divert NS was contacted using Appendix A's email template to determine if they had any additional public data that may not have been included in their reports. It was determined that all pertinent data and information to this research is in the public reports on their website (K. Bremner, personal communication, January 9, 2023).

The data examined was extracted from the *Divert NS Nova Scotia Roadside Litter Audits, 2021 Results* report. The full data gathered from this report is listed in Table 6 (Appendix C). The relevant data collected from this audit is summarized in Figure 12. Of 2,844 pieces of litter gathered, 127 items were checkout bags, 21 were foodservice wares, 54 were straws and 15 were plastic cutlery (Divert NS, 2021).

Figure 12:

SUPs collected during NS roadside litter audit (source: Divert NS, 2021).
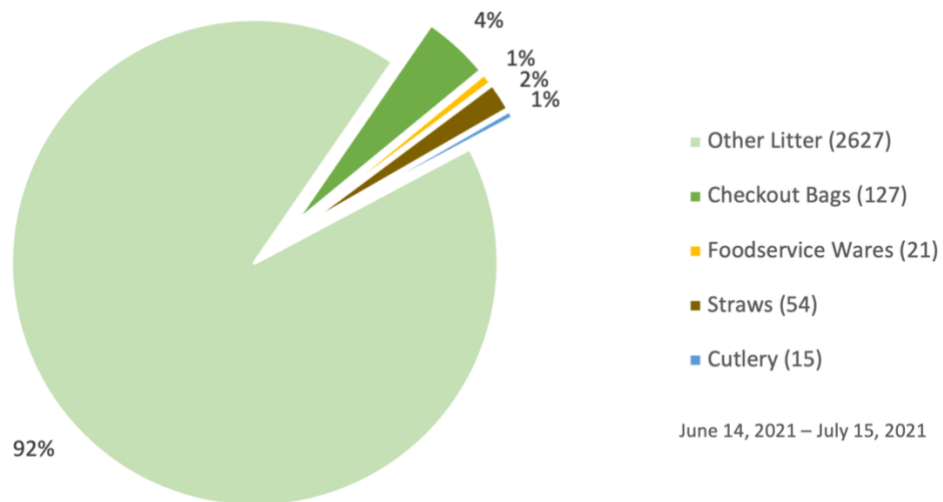
4.2.2 Nova Scotia Adopt-A-Highway & Great Nova Scotia Pick-Me-Up Program

AAH and PMU were contacted via email, using the email template in Appendix A. The programs provided their comprehensive data spreadsheets for each year. The data pertinent to this research can be found in Table 7 in Appendix C. Data was able to be gathered from 2017 – 2022 from the two programs. AAH and PMU track their data through the April 1 – March 31 fiscal year, the data was adjusted to fit under the starting year of that fiscal year. This meant that F201718 became 2017.

As shown in Figure 13, 2017 – 2018 saw litter tracking done through weight only (AAH, 2022). However, the following years the program tracked the items collected, which averaged around 400 items reported each year (AAH, 2022). The total weight of items collected during cleanups was yearly, with 2019 nearly doubling the previous year's total weight at 94,535 kg (AAH, 2022). 2020 saw a significant decrease in reported weight, hitting the lowest weight at 27,510 kg before, increasing exponentially until 2022 (AAH, 2022). 2022 was a record year for the programs, tracking a total of 69,948 items at 173,856 kg (AAH, 2022).

Figure 13:

AAH and PMU litter program totals (source: AAH, 2022).

Figure 14 depicts the number of SUP items reported from the program cleanups, separated by category. As visible through the bars, the number of SUP items increased drastically from previous years by 2019 (AAH, 2022). Between 2019 – 2021, the highest number of SUP items per category never reached 50 (AAH, 2022); however, 2022 saw record numbers for all four of the categories, ranging from 798 – 2,383 items each (AAH, 2022). Ring carriers and stir sticks were never reported in the data (AAH, 2022).

Figure 14:

SUP litter tracked by AAH & PMU programs (source: AAH, 2022).
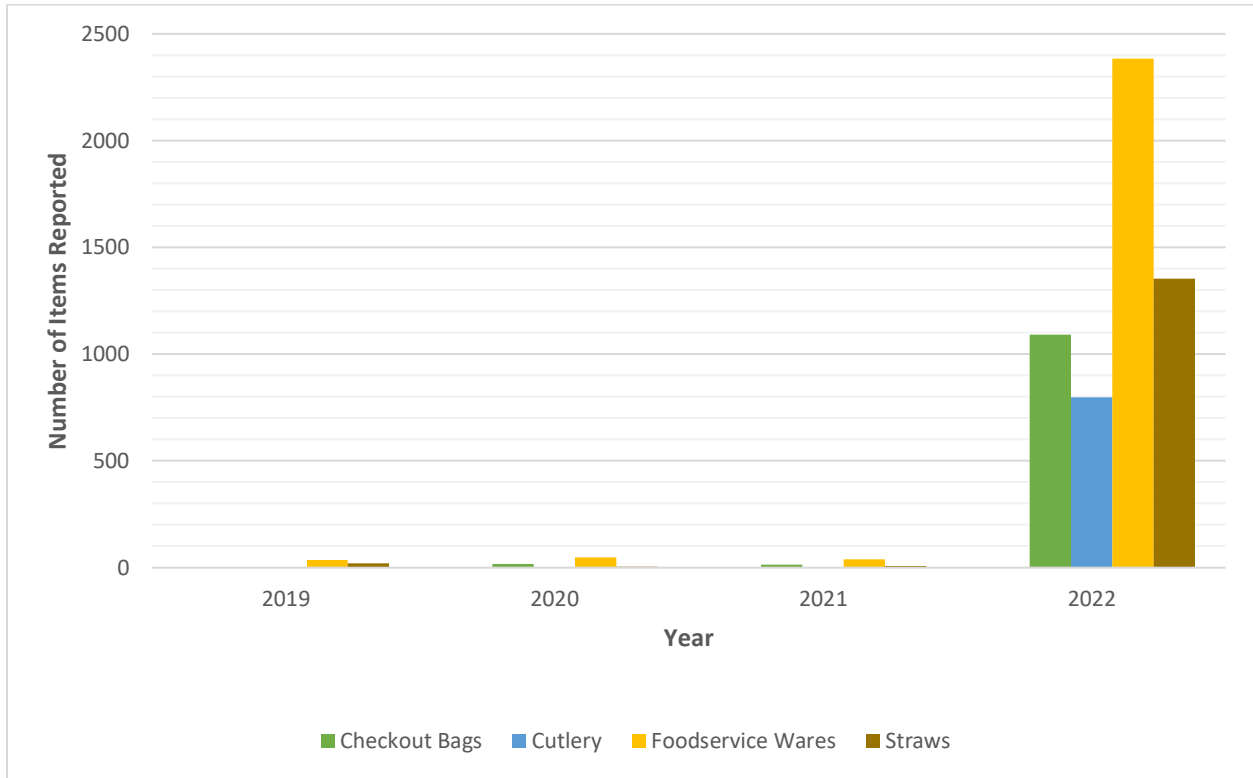
4.2.3 PADI Aware

Project Aware's public dive records contain data from three Nova Scotia waste regions (PADI Aware, 2023). The data relevant to this study ranged from January 2018 – December 2022, and can be found in Table 8 in Appendix C.

Figure 15 shows the yearly totals collected in Nova Scotia from project Aware's dives. As seen by the elements of this graph, the data collected reached its largest weight in 2019 at 253 kg, while its largest number of items (1,203 items) found was in 2020 (PADI Aware, 2023). Although 2021 gathered nearly half the previous years' total items during their dives, they found the largest number of plastics (306 plastic items), accounting for nearly half of all retrieved items for that year (PADI Aware, 2023). Since then, there has been a drastic decrease in items found.

In 2022, 181 items were found during dives, of which 82 were plastics, with a total weight at 11 kg (PADI Aware, 2023).

Figure 15:

Project Aware's yearly Nova Scotian findings (source: PADI Aware, 2023).
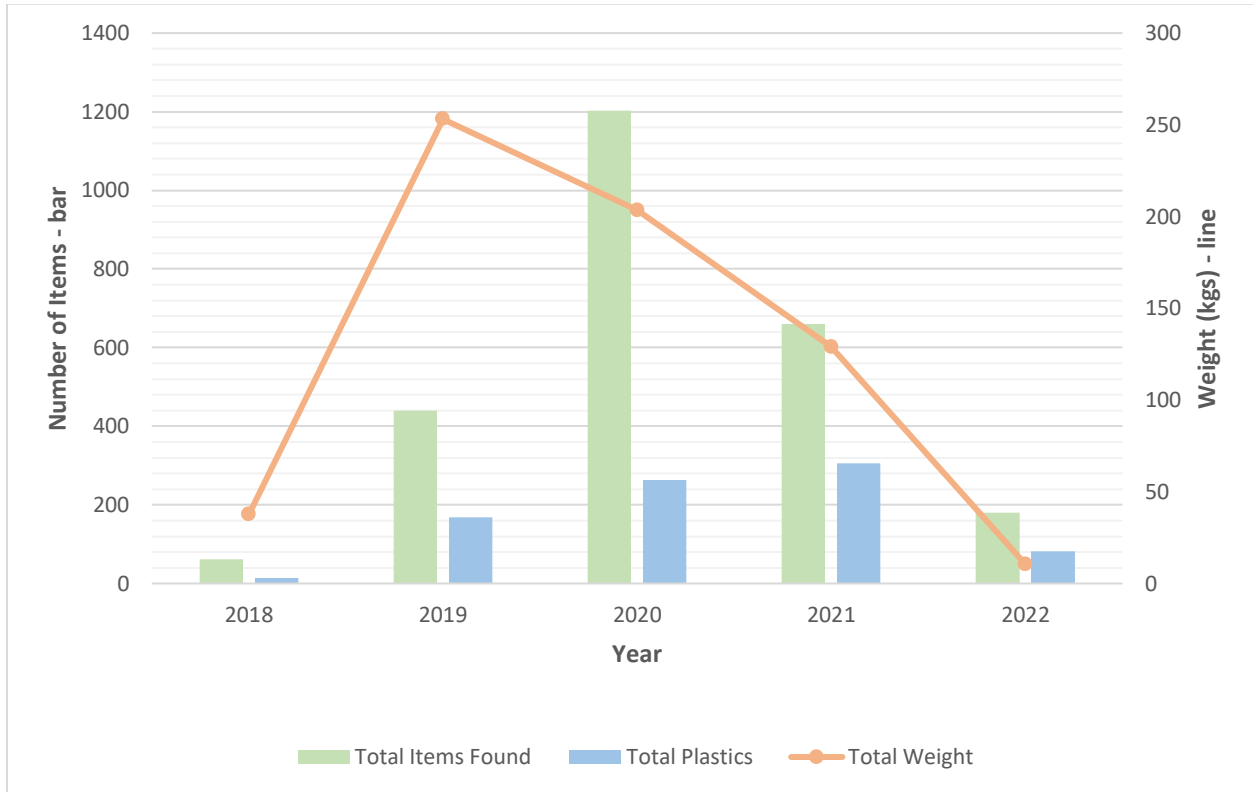
Figure 16 shows the comparison between all the plastic items retrieved from Aware's dives, versus each of the SUP categories found. As seen in the graph, the portion of total plastics that SUP items made was relatively small. Out of the six categories of SUP items, no stir sticks or ring carriers were reported (PADI Aware, 2023). Checkout bags were found the most frequently, with the largest quantity of 19 gathered in 2021 (PADI Aware, 2023).

Figure 16:

SUPs retrieved during Nova Scotian dives (source: PADI Aware, 2023).
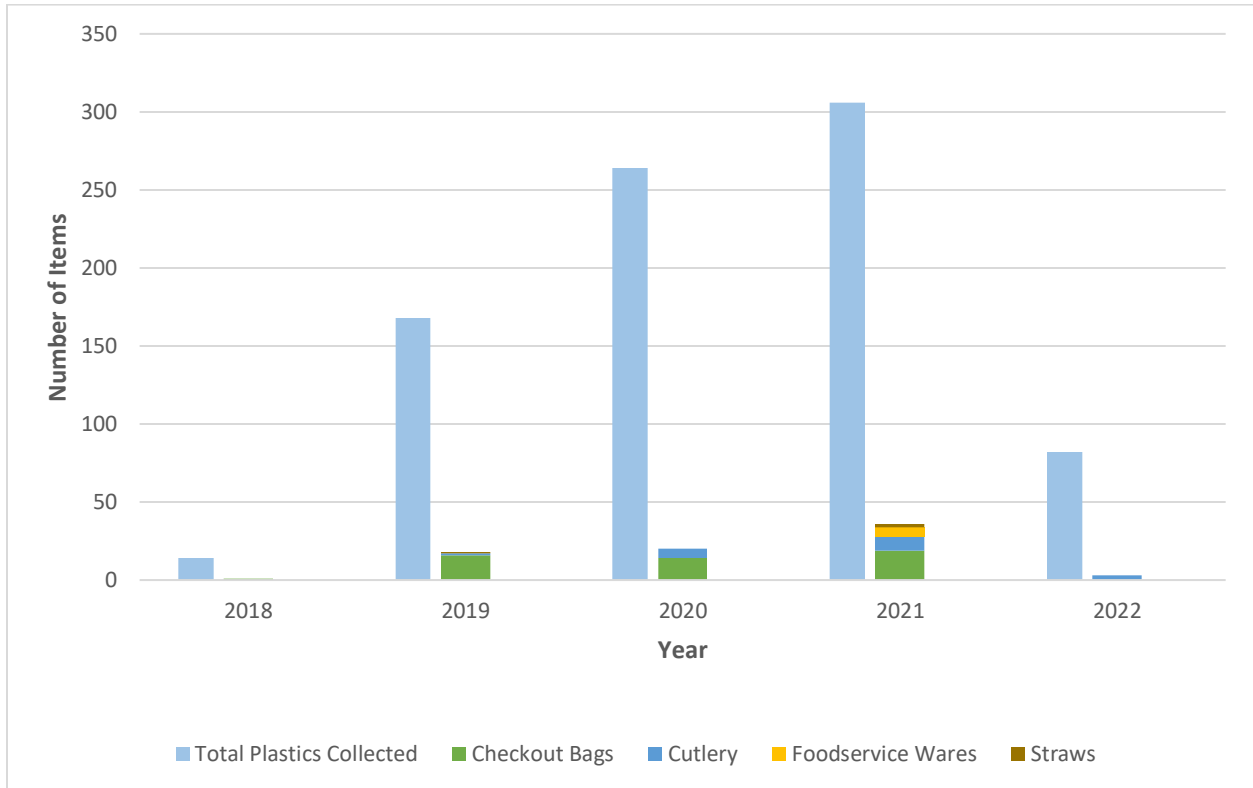
4.2.4 Trashformers

The Trashformers website contains detailed graphs and figures representing the data they collect. However, they were also contacted using the email template in Appendix A to see if they were able to provide more detailed information of their collected items.

A full data sheet detailing their cleanup findings from 2018 was provided by a representative from Trashformers (Trashformers, 2023). The data relevant to this study from Trashformers can be found in Table 9 in Appendix C.

Figure 17 shows the SUP items collected from Trashformers' cleanups in comparison to their total findings. Their data did not contain any ring carriers, or stir sticks collected in their data. Their 2018 cleanups resulted in the most litter collected, as well as the most SUP items

(Trashformers, 2023). In 2018, the collected a total of 73,411 items, 7300 of which were straws, 7,435 foodservice wares, and 3,123 cutlery items (Trashformers, 2023). Relative to this, there has been a decrease each year, with the fewest items found in 2020 (Trashformers, 2023). As of 2022, the quantity of plastic straws, cutlery and foodservice wares have seen a relative decrease, while the weight saw an all-time high of 7,530 kg (Trashformers, 2023).

Figure 17:

Cape Breton SUP litter collected by Trashformers (source: Trashformers, 2023).
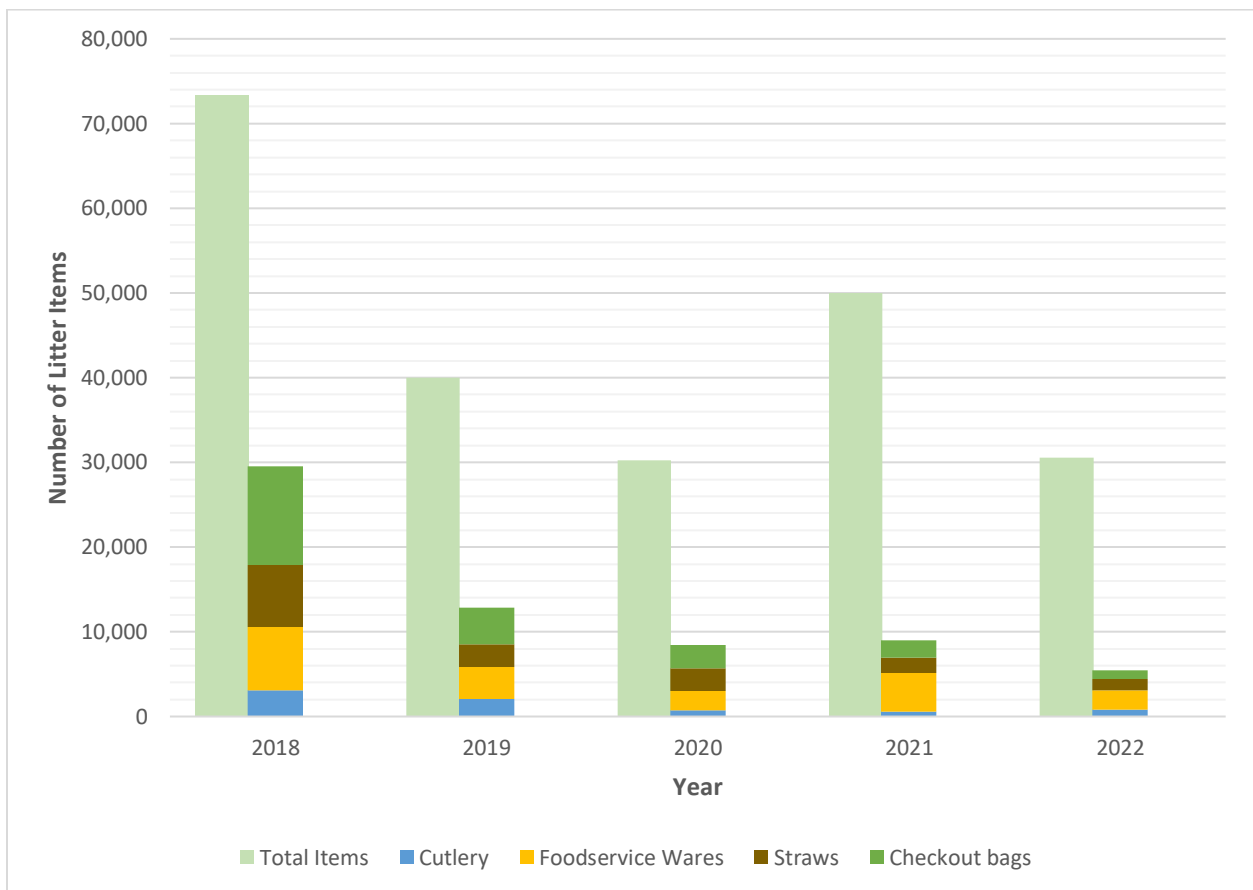
4.2.5 Litterati

Waste Resource Education Officers from the HRM were contacted with the email template in Appendix A. They were asked if their new initiative, Litterati, had released any public data from the first eight months of the app's use. While they hadn't yet made the comprehensive data public, they were excited to share the information as a means of initiating its public launch. The SUP-related data provided by the HRM is listed in Table 10 in Appendix C.

Figure 18 demonstrates how the SUP categories related to the rest of the litter collected through their campaigns. Out of 21,880 total pieces of litter collected by users, a little over 40% was plastic waste (Litterati, 2023). Straws and checkout bags were the most common items collected, both tallying over 300 individual items (Litterati, 2023).

Figure 18:

SUPs collected through Litterati's CLEANHRM challenge (source: Litterati, 2023).
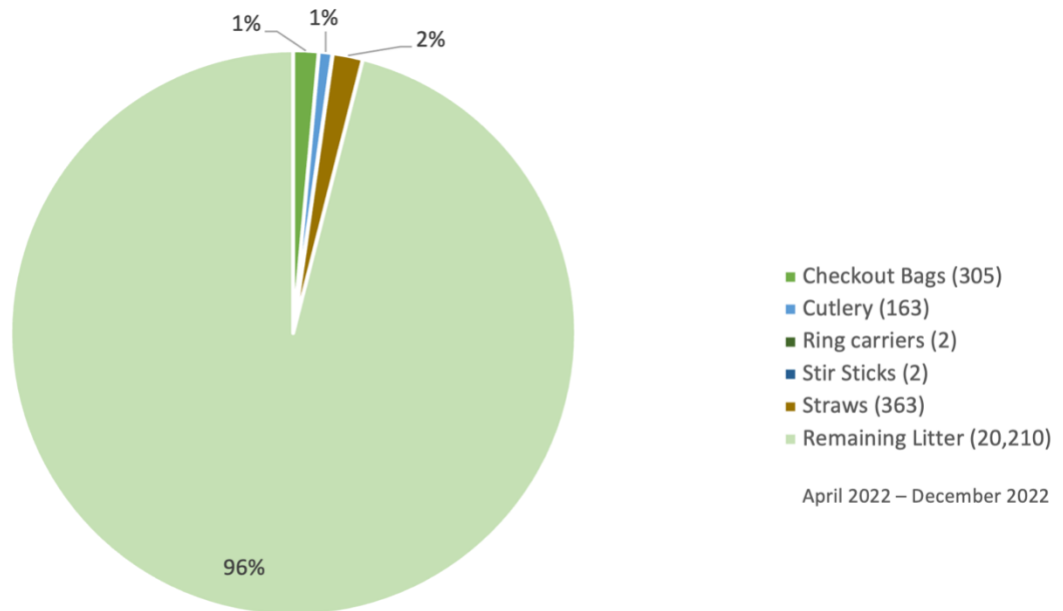
Chapter 5: Discussion

The aim of the data analysis was to determine the following:

(1) What are the key findings for managed SUP waste in Nova Scotia?

(2) What are the limitations with the managed SUP waste data?

(3) What are the key findings for mismanaged SUP waste in Nova Scotia?

(4) What are the limitations with the mismanaged SUP waste data?

(5) Can changes in the data be attributed to SUPPR or the *Plastic Bags Reduction Act*?

(6) Does the examination of this data provide any future recommendations?

Following the secondary data presented in Chapter 4, this chapter will situate the findings within broader literature and context of the SUPPR and the *Plastic Bags Reduction Act*. It will discuss insights this research might offer involved stakeholders (such as organizations, municipalities, and the Government of Nova Scotia) aiming to reduce our SUP waste. Finally, this chapter will identify potential limitations with the data collected during this study and conclude with recommendations for future research.

5.1 Limitations with the Managed SUP Waste Results

Throughout this research, several key limitations were discovered in the data for managed SUP waste. This subsection will discuss what those limitations are and how it impacts the results.

5.1.1 Gaps in Managed Waste Tracking

As seen in Chapter 4, section 4.1, very little properly managed SUP waste data was gathered. The only data able to be used in Table 2 and Table 3 was from the *Divert NS 2017 Landfill Waste Audit Report*. The local waste region educators and director were unable to

provide any data relating directly to SUPPR. As detailed by the regional waste educator contacts, the waste regions track items via their material composition (e.g., PVC plastics), not by item category (e.g., plastic cutlery) (C. McClare, personal communication, January 12, 2023; B. Rioux, personal communication, January 9, 2023; A. Garrett, personal communication, January 9, 2023). While tracking plastic composition can be useful for other studies, it fails to provide SUP data, and data relating to SUPPR or the *Plastic Bags Reduction Act*. This means that the actual quantity of SUPs entering managed waste systems is likely much higher. However, the extent to which this missing tracking information would skew the results cannot be determined.

Additionally, this research is unable to determine how much SUP waste comes from each waste region. The *Divert NS 2017 Waste Audit Report* tracks the waste gathered at each of their landfills. These landfills, as seen in Figure 5, reside in all NS waste regions except for CBRM, Valley and Western (Divert NS, 2018). While the approximate location of the waste is tracked via landfills, it does not explain which regions the waste originated from. As there are no landfills in CBRM, Valley and Western (ECCC, n.d.-b), their waste would have been transported for another region for analysing at the landfill. While the origin of managed SUP waste is not vital for this study, it will inhibit future inquiries seeking to determine if, or how, different municipal waste regulations impact the amount and types of SUP waste at landfills.

This depicts a gap in the tracking process for the waste regions. With the current SWRM tracking systems, information is not able to be collected about SUP items entering the facilities (e.g., how many SUP items, what type of SUP items), nor about regional information (e.g., which region most of the waste stems from). As Schnurr et al. (2018) stated, "Future research should include standardization of monitoring and data collection methods for characterizing plastics (p. 167). If the province wishes to determine how the province is using SUPs and where

they are ending up, the SWRM tracking systems for waste require updating. Improved tracking regarding the items entering SWRM systems is vital to determine the effectiveness of SUPPR in Nova Scotia.

5.1.2 Limited Data Availability

There exists a large gap in managed SUP waste data for Nova Scotia, resulting in a limited data set. Due to the lack SUP item tracking in Nova Scotia's SWRM systems, the data used for the managed waste category is solely derived from one source. The managed SUP waste data accumulated in Table 2 and Table 3 relies solely on data retrieved from the 2017 Divert *Landfill Waste Audit Report*. This does not provide good representation of Nova Scotia's managed SUP waste.

Due to the data only coming from the landfill audit, the type of data tracked is also very limited. The current tracking methods, as described in section 5.1.1, only allow for observation of two out of six SUP categories: checkout bags and foodservice wares. This means themes are unable to be drawn for the other four SUP categories featured in SUPPR. This is problematic for future analyses and comparison of the six SUP categories within SUPPR, as a lack of historic data prevents complete analysis. Any future discussions pertaining to the six SUP categories will be unable to discuss how plastic straws, ring carriers, stir sticks and cutlery totals compare to those of 2017 within the Nova Scotia landfills.

Without further relevant data retrieved from the SWRM system, there can be no conclusions drawn regarding if: 1) Nova Scotia has decreased its reliance and use of SUPs; 2) If Nova Scotia's proper waste management systems adequately contain and collect SUP waste; and 3) If the SUPPR or *Plastic Bags Reduction Act* has seen positive or negative impacts for Nova Scotia's SUP waste within SWRM systems.

5.1.3 Inability to Determine Key Themes

The lack of available managed SUP data in Nova Scotia means this study is unable to properly determine key themes for the managed data. Due to the size of the managed SUP waste data set (see Table 2 and Table 3), the data set is too small to be used in an analysis. The data cannot be analyzed to determine trends or discrepancies between years, as it only contains data for 2017 (Divert NS, 2018). Additionally, the data cannot compare data for the six SUP categories against each other, as it only contains data for checkout bags and foodservice wares (Divert NS, 2018).

The size of the managed SUP waste data set makes it difficult to situate within the context of SUPPR and the *Plastic Bags Reduction Act*. The limited data is unable to identify the impact SUPPR has had on Nova Scotia's managed SUP waste data, as the data is five years prior to its announcement. No deductions can be made as to: 1) Whether the amount of SUP waste entering landfills has increased or decreased since 2017; 2) Whether the amount of SUP waste in SWRM systems can be attributed to a year's events (e.g., economy changes, pandemic), and 3) Whether the total quantity or weights of SUPs entering SWRM systems have fluctuated. It does not allow the research to determine how Nova Scotia's SUP data has evolved, if at all, over the past six years. To do so, a more extensive data set is required.

5.1.4 Discrepancies with Data Calculations

A significant restraint that limits the reliability of the data sourced from the *Divert NS 2017 Landfill Waste Audit Report* is the inaccuracy of data sums and breakdowns within the report. While the report breaks down the total waste gathered from each SWRM region by category and weight (Divert NS, 2018), the weights at times are inaccurate. In many cases, the weight attributed to the category or location break down does not equal the weight sum

originally described (Divert NS, 2018). Any explanation for this discrepancy is missing from Diverts Report.

The clearest example of the discrepancies with data calculations is on page 24 of the *Divert NS 2017 Landfill Waste Audit Report*. On this page, the total weight of the 'other' category for the Guysborough landfill is described as totalling 10,590 tonnes (Divert NS, 2018). However, when broken down by origin, it claims that the waste from residential sources totalled 18,018 tonnes, while the waste from ICI sources totalled 6,114 tonnes (Divert NS, 2018). This cannot be possible, as the Residential and ICI waste add up to 24,132 tonnes, rather than 10,590 tonnes. Furthermore, it is not an error of accidentally mislabelling a weight total, as the ICI weight (6,114 tonnes) combined with the total landfill weight (10,590 tonnes) equate to 16,704 tonnes, which is not the weight attributed to residential waste (18,018 tonnes). The report lacks any explanation for the calculation errors. This inaccuracy in the data harms the reliability of the weights used within the report.

Due to the discrepancy with the data calculations in the *Divert NS 2017 Landfill Waste Audit Report,* the data included in Table 2, Table 3, and section 4.1.3, are imprecise. The managed SUP data set in this research used the incorrect weights gathered from Divert's report, knowing it is a limitation. The reason it was still included was to provide an approximate idea as to how much SUP waste is gathered in Nova Scotia within a year. While it provides an idea for the SUPs that entered the landfill in 2017, the research does not claim the data to be completely accurate. The discrepancy in Diverts' calculations prevents confidence in the data, as well as the ability to conduct a comprehensive analysis on the properly managed waste data.

5.1.5 Short Data Collection Time Frame

The data gathered for *Divert NS' 2017 Landfill Waste Audit Report* had a short collection time frame. The collection time for the waste included in the report only ran from September 2017 – December 2017 (Divert NS, 2018). This duration length means that waste was only collected from the waste regions for four out of the twelve months. This means that the totals used do not represent the full year's SUP waste data.

5.2 Key Themes for Mismanaged SUP Waste

The data collected for mismanaged SUP waste in Nova Scotia was compiled through a variety of sources. This allowed an extensive data set to be created relating to Nova Scotia's SUP items. This discussion will address the key themes and limitations associated with this data.

5.2.1 Yearly Trends in the Mismanaged SUP Waste Data

The mismanaged SUP waste data has seen significant changes over the past six years. Table 4 and Table 5 depict the total findings and trends in the data gathered.

In 2017, the only available data was the weight of all mismanaged waste from AAH & PMU and Trashformers (see Table 4). The weight was of all litter gathered, not just SUP items. From 2017 – 2018, the total weight of all mismanaged MSW gathered in Nova Scotia only increased slightly, by around 2,000 kg (see Table 4 and Figure 10). 2018 was the first year that saw any reporting of SUPs (see Table 4).

2019 saw an interesting change in the data, as the total mismanaged MSW weight nearly doubled (see Table 4). Despite this significant weight increase, the total number of items collected, and SUPs decreased (see Table 4). 2020 saw a drastic decrease in total weight, overall items and SUP items reportedly gathered from cleanups and dives (see Table 4). This drop in items and weight reported will be discussed later in section 5.2.3.

After 2020, the quantities reported slowly rose again (see Table 4). 2022 was a record year for the total mismanaged MSW items and weight (see Table 4). The weight of all items gathered nearly doubled from 2021 to 2022, increasing from 63,877 kg to 181,397 kg (see Table 4). The total number of MSW items reported more than doubled from 2021 to 2022, going from 53,848 items to 122,556 items (see Table 4). The total number of SUP items reported also saw an increase of over 3,000 items (see Table 4).

While initially this information appears to indicate that Nova Scotia's SUP waste situation is worsening through mismanaged sources, this is not true. While there has been an increase in reported SUP items, the proportion of SUP items to total waste has decreased. As shown in Table 5, the percentage of SUP items to reported MSW items has decreased steadily since 2018. However, 2021 to 2022 experienced the largest decrease of SUPs relative to total waste. This was a decrease of 7%, from 17% to 10% (see Table 5). This finding is significant. It shows that although the amounts of waste being reported through mismanaged sources has increased, the proportion of MSW that SUP items contribute has decreased significantly. This means that the reported increase in Nova Scotia's mismanaged waste is not currently due to SUPs.

This finding is important. However, due to the scope of this study, this research is unable to delve further into what is causing the increase in waste, if it is not SUP items. Nevertheless, this is a positive indicator that Nova Scotia is reducing its reliance on SUPs, or disposing of them properly.

5.2.2 Trends for the Six SUP Categories

Using the data collected for mismanaged SUP waste, trends can be drawn from each of the six categories. Although the SUP data in Nova Scotia was tracked from 2017 – 2022, 2017

lacks any itemized data (see Table 4). Therefore, the comparison of each category, as seen in Figure 11, begins in 2018.

Throughout the timeline, foodservice wares, cutlery, and straws followed similar trends to one another. 2018 saw the largest quantities of foodservices wares, cutlery and straws reported in a single year (see Table 4). In contrast, 2019 saw a substantial drop in the reported quantity of these three categories (see Table 4). Every year since 2018, the number of items reported for foodservice wares, cutlery and straws has decreased relative to their starting point (see Table 4). Despite this, these categories have been highest reported items every year, other than checkout bags (see Table 4).

The checkout bags category was the only SUP category to see completely unique trends. Checkout bags was the only category that saw a nearly consistent reduction, going from 11,711 bags in 2018 to 2,455 bags reported in 2022 (see *Table 4*). As mentioned in Chapter 2, the *Plastics Bag Reduction Act* was implemented in October 2020 for Nova Scotia (Wilson, 2019).

In contrast to the above trends, ring carriers and stir sticks were consistently under-represented in the mismanaged SUP waste data (see Table 4). No items from either of these two categories were reported in 2017, 2018 or 2020 (see Table 4). From 2017 until 2022, neither category saw more than 2 items reported a year (see Table 4).

5.3 Limitations with Mismanaged SUP Waste Data

While compiling the data from the mismanaged waste sources (Divert NS, AAH & PMU, PADI Aware, Trashformers, and Litterati), several key limitations were identified for the mismanaged SUP waste data. Throughout this subsection we will discuss what those limitations are and how it impacts the ability to interpret the data.

5.3.1 Reliance on Citizen-Science

The mismanaged data sources are reliant on citizen-science for data tracking. Citizen science is a valuable tool for improving environmental awareness, social movements, knowledge, and action about towards their initiatives (Ammendolia & Walker, 2022). To gain reliable data from citizen science, participants require clear guidelines for recording their findings, and access additional resources on the subject (Ammendolia & Walker, 2022). Due to the method in which mismanaged MSW sources gather their data (i.e., public participation through litter cleanups, dives, and illegal dump sites), incorporating clear and accessible tracking systems are important for encouraging community involvement.

Despite the benefits, depending on citizen science does produce some challenges. Often, community members are working in their spare time to help keep their communities clean, beautiful, and safe (UN Environment Programme, 2018). Using clear and lenient guidelines for participants gathering mismanaged MSW data ensures more people can contribute but can also hinder the reliability of the data. Due to public involvement, participants may lack knowledge about the work they are doing, and the tracking guidelines may be misunderstood. However, if organizations and groups seeking data were to become strict and implement rigid guidelines, it would likely deter participation. This work largely relies on honesty from community members when reporting items, the amount gathered, how much the items weigh, and how they categorize the litter.

5.3.2 Significant Drop in Data

The mismanaged waste saw a significant drop in the data reported data for 2020. This slowly began to rise again in 2021, but 2020's total weight nearly halved the previous years' reported weight (see Table 4).

We can assume that this decrease in data is due to the COVID-19 pandemic that put Nova Scotia into lockdown (Roth, 2021). The pandemic halted gatherings and socializing with anyone outside of your household (Roth, 2021). While Nova Scotian's were encouraged to get outside to pass the time, there was still widespread fear of catching the virus and much uncertainty as to how it spread (Koffman et al., 2020). It was a common theme globally that the COVID-19 pandemic hindered the ability to collect waste data (Ammendolia & Walker, 2022).

Due to these circumstances, it is difficult to determine if COVID-19 is the main reason for the decrease in reporting. While people were unable to gather in groups, they were encouraged to go outside, where they would more likely be confronted with litter. Additionally, due to the lockdown, Nova Scotians would have the opportunity to perform clean-ups more often than normal. However, due to the lack of knowledge as to how the virus spread (Koffman et al., 2020) there could have been a larger fear of collecting waste disposed by others for fear of contracting COVID-19. Additionally, with Nova Scotians spending more time at home, there may have been less opportunity to dispose of waste improperly, and an increase in proper disposal through their household waste collection.

Another factor of note is that Nova Scotia's *Plastic Bag Reduction Act* was announced in September 2019, and came into effect in October 2020 (Wilson, 2019). The implementation of this act likely contributed to a decrease in checkout bags being reported. Less production and use of SUP checkout bags would mean there is less opportunity for the disposal of the bags, improper or not.

While it seems likely that the prevalence of COVID-19 could be the cause for the drop in reported data, we are unable to say for certain. If we want to determine whether COVID-19 was the main cause for the decrease in data, future studies are needed.

5.3.3 Inconsistent Tracking of Mismanaged Data

A further limitation with the mismanaged SUP waste data is that there is inconsistent tracking of the reported items. The organizations that the mismanaged data was retrieved from follow their own personal guidelines. This means that the tracking systems between each group varies, and there is no uniformity to their methods of tracking the waste.

Divert NS, when conducting their roadside litter audit, went out themselves to gather the litter (Divert, 2021). As they conducted the audit themselves, they would have been able to easily follow their own tracking system and guidelines to ensure the most accurate results.

Other organizations (e.g., AAH & PMU, PADI Aware and Litterati) rely on volunteers to provide the data from their cleanups. This results in inconsistent data tracking between cleanups. Some individuals report the total number of an item found (e.g., that they collected 11 forks), while others simply document that they found items from a certain category (e.g., forks were found). This difference results in some cleanups reporting very high numbers of SUP items, as they are very thorough in their tracking, while others have low quantities from simply noting items from a category were found. While there is nothing wrong with only indicating that items from a specific category were found, it creates difficulty when combined with more thorough data tracking processes. This results in incomplete and inaccurate totals because true quantity of SUP items gathered from a category cannot be determined.

Additionally, some cleanups track the total weight of items found, while others don't. Litterati and Divert NS did not track the total weight of items found, while AAH and PMU tracked the weight when it was reported to them (see Table 4). This means the total MSW weight used for the mismanaged compilation is lacking data from at least two of the sources entirely,

and missing portions from a third. In any case, using the total MSW waste weight gathered is not very useful to this study, as the SUP weight cannot be extracted from the total weight.

Furthermore, examining waste weight is not a good form of tracking how much SUP was found. SUP cutlery, checkout bags, straws, foodservice wares, ring carriers and stir sticks do not weigh a lot in comparison to other items. The total weight of items gathered can include any number of heavier items (e.g., household and construction garbage). This means that the weight used cannot provide any additional information to assist in accurately depicting how much SUP waste was retrieved.

5.3.4 Inconsistent Categorization of SUP Data

A large limitation with the mismanaged SUP waste data is that there is inconsistent categorization of the reported items. The way in which data is categorized by the organizations plays a large role in its ability to be properly analyzed and interpreted. This is a problem at the organizational level that is only realized once compiling the data with other organizations to interpret the findings.

Within the data sourced from AAH & PMU, PADI Aware and Litterati, the categorization of waste gathered begins with the community members who are participating in clean-ups. As mentioned in section 5.3.1, the organizations rely on citizens to label and categorize the items they find. This creates difficulties with the reliability of data, as the responsibility of categorizing the type of items (and their composition) is placed on community members. While they are the ones to see the waste in-person, it leaves the item classification open to interpretation, based on what the participant determines it to be. For example, PADI Aware's data tracked both 'plastic bags' and 'trash bags' (PADI Aware, 2023). The 'plastic bags' were determined to fall under the category of a SUP checkout bag, which trash bags do

not. However, this relies on the individual who gathered the item to properly differentiate the

type of bag they collected. This could be skewed if the individual tracking did not pay attention

to how they categorized the item, quickly summarized what they found, or if there is knowledge

or language barriers surrounding the difference between a trash bag and a plastic retail bag.

However, this becomes a larger issue when the data is reported to the organizations and

are further compiled into categories. The organizations can compile two items of the same

category, but that are made of different composition. After compilation, the organizations are

unable to separate the data by their composition (e.g., paper and wax fast-food wrappers vs.

plastic foodservice wares) because they can fit in the same general category for the

organizations. Another example of this is seen with Trashformers data. While they categorize the

type of item (e.g., cutlery), they do not differentiate items by material (e.g., plastic cutlery vs.

bamboo cutlery vs. metal cutlery) (Trashformers, 2023).

This is a problem with every SUP category included in the results, as there is no way to

determine if the items are only SUPs, not other plastic material, or a combination of the two.

While this form of categorization is useful to maintain easy item organization, it removes details

from the data.

5.3.5 Miscellaneous Plastic

The inconsistent categorization of data from the mismanaged waste sources resulted in

significant amount of unidentified or miscellaneous data reported. This includes plastic data that

was unidentified or summarized as miscellaneous by the community members who retrieved it,

or were simply identified as 'plastic'. The miscellaneous plastic category is quite large from each

data source and can include SUP items that were missed during litter collection. Miscellaneous

plastic was seen in the *Divert NS 2021 Roadside Litter Waste Audit* (Divert NS, 2021), as well as

in PADI Aware and AAH & PMU's data (PADI Aware, 2023; AAH, 2022). Similarly, Litterati noted a large quantity of 'plastic material' that was not broken down further by item (Litterati, 2023).

This must be considered when observing the results section. If the items labelled as miscellaneous plastic were identified, each of the SUP categories could be much larger. This is significant when considering that stir sticks and ring carriers, both of which were underreported, could easily be lumped together as miscellaneous or unidentified due to their smaller nature and thinner composition.

5.3.6 Yearly Data Tracking

Another limitation with the mismanaged waste occurs with the yearly data tracking of the organizations. Trashformers and PADI Aware categorize their data within each year's calendar year (i.e., data tracked from January 1, 2018 – December 31, 2018, is labelled as 2018). However, AAH & PMU, Litterati, and Divert NS tracked their data slightly differently.

The *Divert NS 2021 Nova Scotia Roadside Litter Audit* categorized their data for 2021. However, it should be noted that the data gathered for the report was only gathered between June 14 – July 15, 2021 (Divert NS, 2021). Similarly, the data used for Litterati's 2022 CLEANHRM challenge was collected between April – December 2022 (Litterati, n.d.).

The AAH & PMU data is tracked differently through their organizations. AAH & PMU track their cleanup data within fiscal years, from April 1 – March 31 of each year (AAH, 2022). As their cleanup seasons typically run from April – November each year, the first half of the fiscal year's date was used to represent which year was attributed to each year (e.g., F201920 indicates that the data spans April 1, 2019 – March 31, 2020; this means that F201920 would change to 2019). However, it should be noted that their data attributed to each year cannot be

claimed as completely accurate, as there could be cleanups residing outside the standard cleanup season.

5.4 Recommendations

After analyzing the data's key themes and limitations for properly managed and mismanaged sources, several recommendations can be suggested to improve the SUP waste situation in Nova Scotia. The following are two main recommendations that resulted from this research.

5.4.1 Improve tracking within Properly Managed Sources

The lack of properly managed waste data significantly hinders the ability to determine with any certainty how effective SUPPR is. Without knowing the trends and quantities of SUP that have entered Nova Scotia's landfills and sorting facilities outside of 2017, there can be no proper comparison with the data received from mismanaged sources.

The data received from mismanaged waste sources can be used to determine that relevant to the total MSW waste gathered, SUPs have decreased significantly. However, without a full properly managed waste data, spanning several years, the research lacks the ability to provide further context. If a full managed waste data set was available, a comparison could be drawn between managed and mismanaged SUP waste to deduce reasoning and external causes for the trends and themes. For example, if the managed SUP waste had continued to increase over the years, while mismanaged SUP waste decreased, it could indicate that public knowledge and waste management systems have improved. However, if managed SUP waste had decreased since 2017, as did the mismanaged SUP waste, it could indicate that there is less SUP waste being used and/or disposed of in general.

Due to the lack of SUPs information within properly managed sources, more information is needed to fully understand what the smaller portion of mismanaged SUPs means for Nova Scotia. The best way to gain this context and information, as well as gain relevant SUP data from properly managed sources, is to improve the tracking systems within the provincial waste management systems. The current systems focus on the composition of items entering their locations (C. McClare, personal communication, January 12, 2023; B. Rioux, personal communication, January 9, 2023; A. Garrett, personal communication, January 9, 2023; A. Philopoulos, personal communication, December 19, 2022). This form of tracking does not benefit studies and research pertaining to the impact of SUPPR, as item composition does not indicate whether an item belongs to one of the six SUP categories.

Updating the tracking systems within the waste management system will require a way to obtain SUP data relevant to the six categories, without inhibiting the work being done at the landfills, depots, and sorting facilities. To properly do this, involving the use of a consulting firm (e.g., Dillon Consulting) may be beneficial. A consulting firm would have the opportunity and resources to collaborate with SWRM regions and employees to determine the effectiveness of their current practices, while also involving other knowledgeable stakeholders.

If the Government of Canada, or Government of Nova Scotia, wish to determine the effectiveness of SUPPR within Nova Scotia, the existing waste tracking methods require updating.

5.4.1 Conduct Further Studies

Determining the impact of SUPPR necessitates further study and research. At this moment in time, the research is unable to determine if the announcement and implementation of SUPPR, or the *Plastics Bag Reduction Act,* has proved effective. The research has also been

unable to determine reasoning behind key themes. This is largely due to a lack of managed SUP waste data and inconsistent categorization of data through mismanaged sources.

The hope is that over the next five years, Nova Scotia will continue to experience less disturbance from the COVID-19 pandemic and increased interest in SUPPR. Should Nova Scotia maintain its interest in SUPPR and similar bans, hopefully more SUP data will become available. Increased data availability from both properly managed and mismanaged SUP waste sources is needed to make an informed analysis and decision about the effectiveness, or ineffectiveness, of SUPPR. Should there be an increased in relevant data tracked and recorded through the previously mentioned sources (Nova Scotia Landfills, Waste Region Educators, Divert NS, AAH & PMU, Trashformers, PADI Aware, and Litterati), a more conclusive decision will be reached.

It is recommended that research be conducted concerning to the following:

(1) What caused the decrease in SUP data reported from properly managed waste sources? Was it due to the COVID-19 pandemic? Or was it due to the accumulation of multiple factors during a significant lifestyle change for all of Nova Scotia?

(2) How can we better improve SUP tracking within the Nova Scotia SWRM regions? Is it possible to find a solution that allows for better and more relevant data tracking pertaining to SUPPR, without impacting the workload of those employed there?

(3) How has the SUP waste data changed in the five years after this study? Has tracking improved and become more cohesive among all sources? Has the percentage of SUPs within total MSW gathered, continued to decrease alongside the implementation of SUPPR?

(4) Was SUPPR effective immediately? Or was it a gradual shift?

(5) Did the implementation of SUPPR alter the end-of-life cycle for our waste? Did

SUPPR result in more SUPs being improperly discarded of, or were they discarded of

through the proper SWRM sources? Was there a decrease in SUP reporting through

both managed and mismanaged sources, or only one?

Chapter 6: Conclusion

A definitive conclusion cannot be made at this time about the effectiveness of SUPPR within Nova Scotia. Due to a lack of properly managed data from Nova Scotia's SWRM regions, and inconsistencies with SUP categorization, comparison cannot be drawn between managed and mismanaged waste sources. Despite this, the data collected from both properly managed and mismanaged sources provides important insight into the state of Nova Scotia's SUP waste.

Through the managed SUP waste data, there is a lack of waste tracking relevant to SUPPR and SUP items. Although there are periodic audits conducted on Nova Scotia's landfills, these audits are conducted by outside parties. Furthermore, the current waste tracking systems within SWRM regions does not track the category of SUPs entering their facilities.

The mismanaged SUP waste data does allow key themes to be drawn. Firstly, the quantity of total MSW waste, and weight of MSW gathered, has continued to increase since 2017. In contrast to these findings, the amount of SUPs accounting for the total MSW waste has steadily decreased each year. Lastly, stir sticks and ring carriers are significantly underreported. Despite these apparent themes, reasoning as to why they have arisen within the data are not evident.

After conducting this research, two key recommendations are suggested:

(1) Improve SUP tracking systems within Nova Scotia's SWRM systems.

(2) Conduct further studies on Nova Scotia's SUP waste over the next five years to better determine the effectiveness of SUPPR.

To properly establish the context and impact of the SUPPR on Nova Scotia's managed and mismanaged waste, continued monitoring and research is required.

Appendix

A: Data Request Email template

Hello,

My name is Kali Hines, and I am a current Honours student at Dalhousie University. I am taking a double major in Environment, Society and Sustainability (ESS) and Spanish.

For my thesis, I am examining the *Single-use Plastics Prohibition Regulation* by the federal government. To explore the impacts and context within Nova Scotia, I am looking to gather and examine data since 2017, 5 years prior to the ban announcement, until now. I hope that examining the data will provide evidence for the benefits or challenges of the federal ban. I am focusing on the following six categories of single-use plastics: checkout bags, takeout ware, ring carriers, stir sticks, straws, and cutlery.

I was wondering if you have any publicly available records you can give me access to surrounding waste in Nova Scotia. This may include what has been found or collected, quantities, weight, percentages, and who has contributed to this data. Any information you can provide would be greatly appreciated.

Thank you for taking the time to read this. I look forward to hearing from you.

Kali Hines

Dalhousie University | ESS & Spanish

Appendix B: Data for Managed and Mismanaged Waste

Table 2:

Nova Scotia's 2017 provincially managed waste, separated by region (source: Divert NS, 2018).

	Combined		Residential		ICI	
Category	Weight (kg)	%	Weight (kg)	%	Weight (kg)	%
Total Waste	284,171,000	100	126,443,000	44.5	157,729,000	55.5
Plastic	59,258,000	21.0	28,018,000	22.8	31,241,000	19.8
Region 2	14,702,000		8,291,000		6,411,000	
Region 3	5,457,000		1,662,000		3,795,000	
Region 4	25,497,000		8,471,000		17,026,000	
Region 6	14,216,000		9,782,000		4,434,000	
Other	38,910,000	13.7	18,018,000	14.3	20,892,000	13.2
Region 2	10,590		18,018,000		6,114,000	
Region 3	3,413,000		1,328,000		2,085,000	
Region 4	21,443,000		6,674,000		14,769,000	
Region 6	7,820,000		5,337,000		2,482,000	

Table 3:

Nova Scotia's 2017 managed SUP waste, compared to category (source: Divert NS, 2018).

Waste Category	Weight (kg)	% of category
Plastic	59,258,000.00	
Plastic Film	2,429,578.00	4.1
Other	38,910,000.00	
Disposable Cups	7,392,900.00	19.0
Polystyrene	622,560.00	1.6

Table 4:

Nova Scotia's mismanaged SUP waste data (sources: Divert NS, 2021; AAH, 2022; PADI Aware, 2023;

Trashformers, 2023; & Litterati, 2023).

Item	2017	2018	2019	2020	2021	2022
SUP Items						
Checkout bags		11,711	4,344	2,789	2,207	2,455
Cutlery		3,123	2,080	736	584	1,758
Foodservice Wares		7,435	3,772	2,344	4,631	4,656
Ring carriers						2
Stir Sticks			1		2	2
Straws		7,300	2,714	2,681	1,903	3,066
Miscellaneous Plastic		13	207	274	521	7995
Totals						
SUP Items		29,569	12,911	8,550	9,327	11,939
Waste Items		73,473	40,923	31,897	53,848	122,556
Weight (kg)	49,588	50,925	100,088	32,154	63,877	181,397

Table 5:

The number of SUPs to total waste (sources: Divert NS, 2021; AAH, 2022; PADI Aware, 2023;

Trashformers, 2023; & Litterati, 2023).

	2017	2018	2019	2020	2021	2022
Totals						
SUP Items		29,569	12,911	8,550	9,327	11,939
Waste Items		73,473	40,923	31,897	53,848	122,556
% of SUPs within Total Waste		40	32	27	17	10

Appendix C: Data by Source

Table 6:

Divert NS 2021 Roadside Litter Waste Audit data *(source: Divert NS, 2021).*

Litter Categories	# of items
Total Waste Items	2844
SUP Items	
Checkout Bags	127
Branded	32
Unbranded	95
Foodservice Wares	21
Polystyrene Fast-Food Plates	2
Polystyrene cups	11
Polystyrene Clamshells	4
Polystyrene Trays	4
Straws	54
Cutlery	15
Miscellaneous Plastic	246

Table 7:

Nova Scotia Adopt-A-Highway and Great Nova Scotia Pick-Me-Up SUP data (Source: AAH, 2022).

Item			Year*			
	2017	2018	2019	2020	2021	2022
SUP Items						
Checkout Bags				17	14	1090
Cutlery			2			798
Foodservice wares			35	48	38	2383
Ring carriers						
Stir Sticks						
Straws			21	4	8	1,355
Miscellaneous Plastic			57	30	5	319
Totals						
Waste Items			472	415	321	69,948
Weight (kg)	44,378	44,377	94,535	27,510	56,998	173,856
# of Cleanups	128	128	557	495	1,080	1,756

*Yearly data is tracked via Fiscal Year (April 1 – March 31); However, the programs are only open from April – December each year, so for continuity purposed fiscal year was changed to the year the cleanup data is from (i.e., F201718 became 2017, as all the data is from April 2017 – December 1, 2017).

Table 8:

Project Aware's Nova Scotia SUP dive data from January 2018 – December 2022 (source: PADI Aware, 2023).

Item	2018	2019	2020	2021	2022
Region 4 Dives	5	8	21	14	5
Miscellaneous Plastics	14	168	259	306	82
SUP Items					
Checkout Bags	1	16	14	19	
Cutlery		1	6	9	3
Foodservice wares				6	
Stir Sticks		1		2	
Region 6 Dives			3	2	
Miscellaneous Plastic					
Region 7 Dives			4	1	1
Miscellaneous Plastic			5		
Totals					
# of Dives	5	8	28	17	6
Waste Items	62	439	1203	660	181
Miscellaneous Plastic	13	150	244	270	79
Weight (kg)	38	253	204	129	11

Table 9:

Trashformers SUP data (source: Trashformers, 2023).

				Year		
Item	2017	2018	2019	2020	2021	2022
SUP Items						
Checkout Bags		11,710	4,328	2,758	2,047	1,060
Cutlery		3123	2077	730	560	794
Foodservice wares		7435	3737	2296	4566	2273
Ring carriers						
Stir Sticks						
Straws		7300	2693	2677	1841	1348
Totals						
Waste Items		73,411	40,012	30,279	50,023	30,547
# of Bags Filled	1037	1636	1141	344	524	391
Weight (kg)	5210	6510	5300	4440	6750	7530

Table 10:

Litterati tracked data from April 2022 – December 2022 (source: Litterati, 2023).

Item	#	%
SUP Items		
Checkout Bags	305	1.57
Cutlery	163	0.84
Ring carriers	2	0.01
Stir Sticks	2	0.01
Straws	363	1.87
Miscellaneous Plastic	7,597	
Totals		
Waste Items	21,880	
# of Participants	47	

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