

Towards a Waste-Free Arctic

March 2021



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Towards a Waste-Free Arctic

Acknowledgements

The initial inspiration for this report came from a 2018 workshop on marine plastics in advance of the G7 meetings hosted by Canada. This event brought together 60 experts from industry, local and national governments, scientists and conservation groups. While much has changed in the world since then, the flow of plastic and other pollutants into the marine environment has continued to increase and remains a serious threat to the health of our ocean. Thanks to all of the participants who continue to work on these issues and demonstrate leadership in addressing marine pollution across Canada and around the world.

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CREDITS

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Executive Summary

Despite the fact that waste – and plastic waste in particular – is increasingly seen as a pressing environmental problem,¹ waste management is often overlooked in high-level discussions about Arctic policy and development. For the communities of Inuit Nunangat, many of which continue to engage in subsistence hunting and fishing, this issue is not only about unequal access to the waste management infrastructure that southern Canadians take for granted; it is a critical part of reconciliation with Inuit communities.

Inuit have called the Arctic home for millennia and make up almost 90 per cent of the population in this region. Until relatively recently, Inuit followed a seasonal pattern of harvesting and travel. Homes, clothing, tools and modes of transportation were all made with natural materials. Waste accumulation has greatly increased with colonization, including the centralized settlement of communities, industrial development and a growing reliance on resources from the south, without the concomitant investment in waste management and reduction systems.

While some information exists on waste management in the Canadian Arctic, there has not yet been an attempt to generate a comprehensive overview of waste management throughout the communities of Inuit Nunangat. This report provides a survey of waste and waste management based on community- and regional-level data on waste accumulation, waste composition, past and ongoing waste management systems and initiatives, and existing policy and regulatory frameworks. The report also proposes steps that can be taken towards waste-free Arctic communities, underscoring the centrality of understanding, supporting and empowering the ongoing efforts of communities, Indigenous institutions and all levels of government.

The report finds that Inuit communities do not accumulate more waste than communities in other parts of Canada. However, they are faced with managing similar quantities of waste with inferior infrastructure, limited services and programming, extremely poor access to eco-alternatives and fewer economic, educational and capacity resources to develop lasting solutions. The burden of managing waste has been placed on communities across Inuit Nunangat for the better part of 70 years with limited investments in infrastructure and training. There is no overarching policy framework for waste management; the latest Arctic Policy Framework, released in September 2019, does not address waste management.

Numerous local initiatives across a range of waste diversion and reduction programs have been started in Inuit Nunangat, but the lack of a comprehensive plan or the resources required to ensure success means that many of these initiatives are short-lived. It should be noted, however, that the communities of Inuit Nunangat were among the first in Canada to adopt plastic bag bans. This report includes suggestions for how the private sector, civil society and all levels of government can make lasting progress. It also provides examples of tangible and affordable eco-alternatives to many existing sources of waste – and plastic pollution in particular – that can directly benefit local communities.

In the predominantly Indigenous communities of the Canadian Arctic, community-level waste management is a matter of equity, inclusivity and responsibility. Waste must be addressed within the context of colonialism, health, food security, economic development and diversification, with a view towards providing opportunities for innovation, education and, ultimately, global leadership on a complex issue.

Foreword

Inuit culture is rooted in a 'circular economy,' where our prosperity is dependent on our wise and equitable use of renewable resources. Our knowledge of a minimal-to-zero-waste life is part of the living memory of our elders. In the recent past, our local environment, including the animals and plants that continue to contribute significantly to our food security, met all of our food, shelter, heat, energy, cultural, technological, and transportation needs. In essence, our harvesting economies and the principles that shape them, including the equitable sharing of our resources, lie at the core of our societal values, cultural identity, and the sustainability of our communities. The solutions we are seeking to the local waste management issues we now face embrace holistic and sustainable approaches that achieve multiple outcomes, just as the economies of our ancestors did. This report highlights that the challenges Inuit face related to effective landfill and wastewater management in our communities are distinct from the challenges experienced in Southern Canada. Efforts to address these challenges require a framework specific to Inuit Nunangat, and this report outlines why it is high time such a framework was built by and for Inuit.

Like most communities around the world, we have become increasingly dependent on goods and services flown or shipped from thousands of miles away. We have also worked tirelessly for decades to advocate for legal and regulatory changes at international and national levels to address the impacts on our health and environment of the long range transport of pollutants and plastics originating in countries thousands of miles away. However, unlike most southern Canadians, we have faced chronic, large and growing municipal infrastructure gaps for decades, and limited say in the investments and decision-making about how to tackle the growing impacts of accumulating waste in our communities. The gaps in municipal-level capacity to address needed upgrades to entirely inadequate waste management and infrastructure deficits in our 51 communities have direct impacts on the health of our families.

Our local solid waste landfills and wastewater lagoons are increasingly ill-equipped to handle the volume and toxicity of the waste they store. Many of our communities are running out of space to address infrastructure deficits, including much-needed housing, and cannot accommodate landfills with larger and larger footprints. Innovative solutions are needed to decrease the size of our landfills and wastewater lagoons, and to greatly reduce the risk that climate change impacts, including permafrost melt and coastal erosion, pose to the integrity of the landfills and sewage lagoons in our remote and largely marine coastal communities.

Our local leaders are pursuing promising and holistic initiatives. I can describe only a handful here, but many Canadians would be surprised to learn, for example, that my home community of Nain—the most northern community in Nunatsiavut—was the first municipality to ban the sale of plastic bags more than 10 years ago. This move contributed to provincial discussions on the need for comprehensive extended producer responsibility policies where companies account for the full life cycle of their products and their packaging. In Inukjuak, Nunavik, the Unaaq Men's Association matches local youth with elders and experienced hunters to learn how to salvage, recycle and repair equipment, and learn traditional skills that strengthen our local economies and the leadership potential of our youth. In Arviat, Nunavut, the Aqqiumavvik Society supports locally-driven, multi-pronged approaches to strengthening youth involvement in our local food production, harvesting economy, environmental monitoring, and sustainability planning. In the Inuvialuit Settlement Region (ISR), the growing unreliability and food wastage caused by traditional, below-ground freezer storage is being proactively addressed by installing industrial community freezers with solar panels in each community. Through this initiative, the ISR is creating renewable energy generation capacity, solar installation training opportunities, and supporting Inuit food sharing practices that are thousands of years old. And finally, Cambridge Bay, Nunavut is exploring the potential of converting household waste into heat that could be recovered by the local district heating system through a high temperature incineration plant. The local municipal council is actively learning from the now almost 25 year experience of Utqiagvik, Alaska, which has drastically reduced the noxious emissions from open landfill burning, a common practice in our communities, and reduced its landfill volume by almost half.

We currently have little to no direct decision-making involvement in the recycling, reduction or diversion of the paper, cardboard, plastics, hazardous materials and e-waste filling our landfills, threatening our freshwater supplies and locally harvested foods, and directly affecting our local air quality. I do see tremendous hope in the promising solutions that our communities are pursuing. However, work at a local level requires policy support on many fronts to ensure strategic waste management infrastructure and training investments are made. These supports will not only make our communities healthier places to live and increase the resilience of our economies, but also honour our values and history. It is innovative thinking that has allowed us to thrive as a people and it is the same resourcefulness that will allow us to meet zero-waste goals with direct, positive outcomes for the health of our communities.

Natan Obed
President, Inuit Tapiriit Kanatami



Introduction

What is the Canadian Arctic going to look like in 20 years? This question is often posed in relation to the impacts of climate change. However, as communities grow and develop, this question can also be posed in terms of the impact of waste.

Like climate change, waste – including plastic pollution – is a global problem requiring innovative and imaginative solutions. Within Canada, our ability to manage waste varies significantly, with the Arctic communities that make up Inuit Nunangat having access to fewer resources and programs to address waste management than communities in the south. Historically, Canada's Arctic was relatively free of waste; however, recent data show that debris now litters beaches and coastlines, that microplastics are accumulating under sea ice, and that sources of Inuit country food are increasingly contaminated.

Waste is also similar to climate change in that its effect on Arctic communities is disproportionately large given their contribution to the problem. Much of the waste in the Arctic is not created at the community level or even within the Arctic itself. Extractive industries in the North produce large quantities of waste that are captured and stored with varying degrees of effectiveness, while many dangerous contaminants in Arctic ecosystems originate from agricultural and industrial activities farther south. Ocean currents convey plastic from elsewhere around the globe to the Arctic, where it washes ashore or is trapped in sea ice. And for decades, colonial government policies have encouraged the growth of static, southern-style communities while failing to create or fund the infrastructure necessary to support them. This report therefore recognizes that an undue burden should not be placed on Inuit communities and that achieving a waste-free Arctic will require national and international co-operation.



What Is “Waste”?

The Basel Convention, an international agreement on transboundary waste management, defines “wastes” as “substances or objects which are disposed of or are intended to be disposed of or are required to be disposed of by the provisions of national law.” Waste management at the community level typically deals with municipal solid waste, or MSW, which the federal government refers to as “recyclables and compostable materials, as well as garbage from homes, businesses, institutions, and construction and demolition sites” (Environment and Climate Change Canada, 2018).

However, the available reports about waste accumulation in Northern communities sometimes include additional composition categories not usually found in MSW estimates and do not use a consistent nomenclature to describe waste composition (see Appendix B for a detailed breakdown of data sources by region). Thus, although this report focuses on waste management at the municipal level, it uses the term “community waste” rather than “MSW” to describe the waste accumulated within northern communities. Figures presented here for community waste may not be directly comparable to other MSW figures in the literature, especially those for regions with detailed data collection on waste composition.

However, our report largely focuses on waste management at the community level. According to a 2019 report by the Arctic Council’s Sustainable Development Working Group, which examined waste management in remote Arctic communities, municipal waste management practices can present health risks including “smoke inhalation, direct contact with waste, surface water contamination, and environmental degradation primarily emanat[ing] from the landfill and/or other community-level facilities and practices” (Sustainable Development Working Group, 2019, p. 9). Furthermore, improperly managed waste can attract animals, which is not only bad for the animals – some of which are harvested – but also increases the risk of adverse human-wildlife interactions. Understanding and reforming waste management within communities is therefore key to addressing interrelated issues of health, food security and sustainability.

Over the last five years, Canada has prioritized being part of a global solution to the waste problem. In 2018, Canada signed the G7 Ocean Plastics Charter, an international agreement to reduce plastic waste in the marine environment. That same year, the Canadian Council of Ministers of the Environment (CCME) set a Canada-wide goal to reduce per capita waste measurements by 50 per cent by 2040. Canada currently plans to eliminate harmful single-use plastics by 2021. But before Canada can credibly be a leader abroad and at home, we must work to address our own waste problem across *all* regions of our country. As a nation that is still struggling to address inequalities between regions and peoples, Canada’s leadership in this space could be impactful. In order to achieve this, however, we must invest in inclusive and equitable solutions while engaging the full spectrum of stakeholders and rights-holders.



This report presents an overview of community waste accumulation and management throughout Inuit Nunangat and of their current waste management systems. Based on the findings, it provides steps that could be taken towards waste-free Arctic communities predicated on the following guiding principles:

1. Fully and formally include Inuit in the design and implementation of legislation, regulations and policies related to waste management in their lands
2. Develop and adhere to world-leading standards in waste management
3. Establish and uphold the integral relationship among environmental protection, human well-being, and economic prosperity

Successful integration of these principles in the design and implementation of a zero-waste strategy for the Arctic should do the following:

1. Empower the political geography of Inuit Nunangat while respecting regional diversity
2. Reduce our environmental footprint while simultaneously improving our shared economic prosperity (see graphic on next page)
3. Draw on and build upon environmental best practices from within Inuit Nunangat and other regions and countries around the world, with a view towards tangible solutions to waste accumulation.

Reconciliation between Aboriginal and non-Aboriginal Canadians, from an Aboriginal perspective, also requires reconciliation with the natural world. If human beings resolve problems between themselves but continue to destroy the natural world, then reconciliation remains incomplete... **reconciliation will never occur unless we are also reconciled with the earth.**

(Truth and Reconciliation Commission, 2015, p. 18)

Why Should We Care about Community Waste and Waste Management in the Arctic?

Community-level waste management is perhaps an unlikely but effective lens through which to assess Canada's stated goals vis-a-vis conservation, reconciliation and development in the Arctic. Understanding what happens to waste is critical to discussions around the health of the environment, harvesting, food security, ecosystem monitoring and science in the North. It is well documented that the Arctic environment is sensitive to disturbances, that infrastructure across the North is insufficient and outdated, and that solutions which rely on economies of scale are limiting. In addition, the increasing impacts of climate change are likely to affect current waste management strategies and dumps in particular.

Most reports about economic and infrastructure development in the North are premised on these observations, yet they rarely include tangible steps that can be taken to remedy the situation. This report proposes that the long-standing and continued absence of action on waste management in the Arctic must be addressed as part of reducing ongoing inequality for Indigenous communities across Canada. The ethical, environmental and economic consequences of inaction are ultimately greater than the price of action.

The analysis focuses on the predominantly coastal communities of Inuit Nunangat – the four regions that make up the Inuit homeland in what is now Canada. Where they are relevant and useful, comparisons are drawn from other countries. To inform this report, all available published materials related to municipal waste and waste management in Inuit Nunangat were reviewed, with a particular focus on plastic waste, given its growing presence in the marine environment.

Municipal waste profiles were developed for each of the communities, and a database on each community and region was assembled from publicly available information as well as information received via request. This information underpins the analysis presented in this report, with the intention that the data presented here become part of the public architecture for action on this critical issue.



Defining the Circular Economy

The “circular economy” is a term used to describe a holistic, systematic approach for dematerializing product and service delivery systems, retaining the embodied energy and materials in products through reuse, recovering material resources as inputs into subsequent production cycles, and eliminating waste (namely, greenhouse gases, toxic discharges and solid waste).

A circular economy approach is based on two key principles: reducing our environmental footprint while simultaneously improving our shared economic prosperity.

The report has two main parts:

Part One, Community Waste Management in Inuit Nunangat, describes and analyzes the conditions and challenges of waste management based on the community waste profiles we developed for each region. Specifically, this section describes waste quantities, accumulation and composition at the regional and community levels. It explains how community waste is governed across the four regions, summarizing the common features and challenges of waste management in Inuit Nunangat. An inventory of contemporary waste diversion initiatives and programs across Inuit Nunangat is provided, followed by a discussion of the analysis and a summary of observations of waste management in the Arctic.

Building on this foundation, **Part Two, Towards Waste-Free Arctic Communities**, offers suggestions for positive steps aimed at the different levels and types of governments, the private sector and civil society.

“The simple fact is that Arctic strategies throughout my lifetime have rarely matched or addressed the magnitude of the basic gaps between what exists in the Arctic and what other Canadians take for granted. **Closing these gaps is what northerners, across the Arctic, wanted to speak to me about as an urgent priority.**”

Mary Simon, Interim Report on the Shared Arctic Leadership Model

Inuit Nunangat

Inuit Nunangat comprises four regions: the Inuvialuit Settlement Region (northern Northwest Territories), Nunavut, Nunavik (northern Quebec), and Nunatsiavut (northern Labrador). It includes 51 communities and encompasses about 35 per cent of Canada's land mass and 50 per cent of its coastline. According to the 2016 census, the total population of Inuit Nunangat is 56,585. Overall, Inuit constitute approximately 84 per cent of the total population and make up the majority in nearly every community. Across Inuit Nunangat, the population is significantly younger than the Canadian average, and it is one of the fastest-growing in Canada.

The governance structure of each of the four regions is outlined in four constitutionally protected land claims agreements. In each region, Inuit have extensive surface, subsurface, onshore and offshore rights, associated with decision-making roles and responsibilities in the comanagement of their respective lands and waters with the Canadian federal government and the relevant provincial and territorial governments.

In addition to the various bodies created under their respective land claims agreements, Inuit have also developed political organizations to assert their rights within Canada and on the international stage.

Inuit Tapiriit Kanatami (ITK), formerly Inuit Tapirisat of Canada, was founded in 1971 and is the national representational organization protecting and advancing Inuit rights and interests in Canada. ITK has representatives from all four Inuit Nunangat regions.

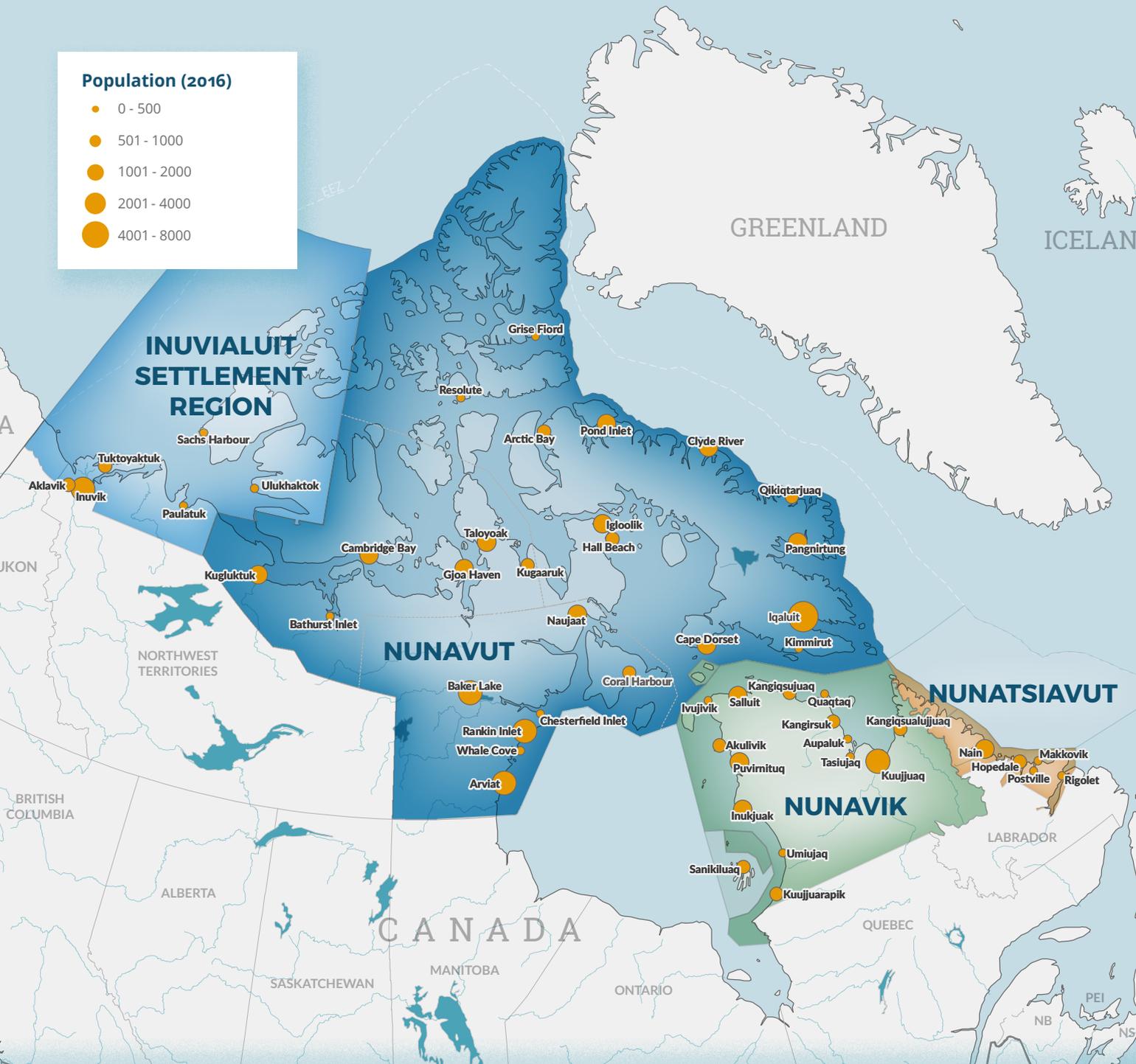
Inuit Circumpolar Council (ICC) was founded in 1977 and is an international organization representing 160,000 Inuit of Alaska, Canada, Greenland and Chukotka (Russia). ICC holds Consultative Status II at the United Nations. ICC-Canada is led by a board of directors comprising the elected leaders of the four land claims settlement regions: Inuvialuit, Nunatsiavut, Nunavik and Nunavut.

In 2017, the Inuit-Crown Partnership Committee was created with the signing of the Inuit Nunangat Declaration on Inuit-Crown Partnership. The committee is founded on the principle that an equal partnership between Inuit and the Crown is essential to the reconciliation process. The committee is co-chaired by the prime minister and the president of Inuit Tapiriit Kanatami. Members include federal cabinet ministers and the elected leaders of the Nunatsiavut government, Nunavut Tunngavik Inc., Inuvialuit Regional Corporation and Makivik Corporation. The committee is engaged in pressing matters related to Inuit prosperity, including social, economic and environmental issues.

In 2018, the Department of Fisheries and Oceans and the Canadian Coast Guard announced the creation of a new region focused specifically on the Arctic. This new region includes all four regions of Inuit Nunangat – a first for a federal department.

Population (2016)

- 0 - 500
- 501 - 1000
- 1001 - 2000
- 2001 - 4000
- 4001 - 8000



Pathways for Plastic into the Arctic

Globally, the quantity of ocean plastic is predicted to increase. The world is on track to produce 26 billion tonnes of plastic by 2050, most of which will not break down for more than 1,000 years (Gulgielmi, 2017). When it does, it will break down into micro- and nanoplastics, which will in turn enter the food chain (see **Appendix A.1** for a summary of plastics classification). Currently, less than 3 per cent of the world's ocean plastics are present in the Arctic Ocean, but this, too, is expected to increase (Cózar et al., 2017).

The scientific literature first reported the presence of microplastics in the Arctic marine environment in the mid-2000s. Experts hypothesize that the vast majority of microplastics originate elsewhere, transported by **ocean currents**, in **river run-off**, and in **melting sea ice** (see **Appendix A.2** for a more detailed explanation of the pathways for plastic into Canadian Arctic waters).





Plastics in Arctic coastal waters may also come from local sources such as dumps. In Canada, approximately 9 per cent of plastic is recycled, while three million tonnes are thrown out (Environment and Climate Change Canada, 2019). Of all waste in Canada, including plastic, metals, paper and organics, approximately 30 per cent is recycled, while in the North, the rate is estimated to be between 0 per cent and 5 per cent. Most Arctic communities have only very basic waste management infrastructure, allowing plastic waste to travel from dump to sea via wind, waves and even erosion. As Inuit Nunangat communities continue to grow and to increasingly import packaged goods, it is vital to improve waste management to prevent plastic and other waste from entering local waters.

Risk to Humans and the Environment from Plastic in Arctic Waters

The amount of plastic in our oceans is reaching unprecedented volumes, and plastic is found all over the world. The risks to the safety and health of wildlife, and ultimately humans, in the Arctic resulting from marine plastics are still under investigation. Plastic waste can harm wildlife through both physical entanglement and ingestion. Larger items of plastic, such as derelict fishing gear, pose a risk to larger marine mammals if they become entangled or impaled (Cózar et al., 2017). Smaller plastic items pose a risk to a much wider range of species through ingestion. Lost nets and traps also continue to catch fish; this “ghost fishing” poses a risk to commercially valuable species and incidentally caught species.

Some plastic can leach contaminants harmful to organisms and may thus contaminate the food chain (Guo et al., 2019). Inuit populations in Canada are already exposed to some of the highest levels of environmental contaminants (Parajuli et al., 2018). Inuit continue to practise wildlife harvesting across their homelands, and marine species such as seal, char, and beluga are critically important to Inuit health and well-being. If plastics can carry legacy contaminants, such as persistent organic pollutants (also called POPs), which are then ingested by these animals and, in turn, by humans, there could be human health and food security implications.

“We know that the health of Inuit Nunangat is inextricably linked to the health of Inuit. Protecting Inuit Nunangat, the Inuit homeland, is an intrinsic part of the Inuit way life.”

- Natan Obed, June 21, 2019

How Is Waste Managed across Inuit Nunangat?

In Canada, waste management is a shared responsibility among the federal, provincial/territorial and municipal governments. In Inuit Nunangat, there is an additional component of governance. Modern treaties – or comprehensive land claims agreements – signed between 1976 and 2002 across the Canadian Arctic establish the constitutional context within which decisions are made and public policies are created across the four regions. Each of the four **modern treaties** contains provisions for environmental protection, conservation and Inuit well-being. The parties to these treaties (federal, provincial/territorial and Indigenous governments) all have responsibilities to uphold the provisions in the treaties. The land claims agreements also establish joint management boards and agencies that oversee various aspects of land use and resource development, some of which are pertinent to waste management.

The **federal government** has a number of relevant pieces of legislation pertaining to environmental protection and the transportation and management of polluting or hazardous materials. These include the Canadian Environmental Protection Act, the Transportation of Dangerous Goods Act, the Fisheries Act, the Arctic Waters Pollution Prevention Act, the National Fire Code, and the Explosives Act. The government of Canada may also set national waste management targets or national regulatory standards, for example, with respect to extended producer responsibility (EPR) (Government of Canada, 2018). Finally, the federal government has committed to banning single-use plastics and working with the private sector to introduce EPR, making producers of waste responsible for its reuse and recovery (Government of Canada, 2019).

Each **provincial and territorial government** has its own legislation and regulations regarding environmental protection, water resources, municipalities, public health and sanitation, and so on. Moreover, the relevant departments (such as Health, Environment, Local Government) also have departmental guidelines regarding waste disposal, transportation of hazardous materials and so on that ensure adherence of all parties to existing legislation and regulations. All the provinces and territories except for Nunavut have a waste management strategy that provides a vision for improving waste management, including plans for investments in infrastructure, plans for waste diversion and, in some cases, a vision for a circular economy approach.

Provincial and territorial legislation and regulations provide the framework within which EPR programs are created and implemented in each jurisdiction. Currently, there are EPR programs in the N.W.T., Nunatsiavut and Nunavik (CCME, 2014). In Nunatsiavut, EPR programs are overseen by the province's Multi-Materials Stewardship Board, a Crown agency that is responsible for waste diversion programs in Newfoundland and Labrador, including beverage container and tire recycling.

Finally, **municipal governments** are responsible for managing and operating solid waste management facilities. Each community government is empowered to pass bylaws regarding waste collection and disposal, including the creation and implementation of local recycling programs. Because of the limited revenue-raising capabilities of local governments across Inuit Nunangat, however, most local governments receive the bulk of their funding from the provincial or territorial government and thus have limited capacity to develop their own programming.





PART I:

Community Waste Management in Inuit Nunangat

Inuit have called the Arctic home for millennia. In small family groups, Inuit followed an annual cycle of harvesting and travel calibrated to the seasons. Homes, clothing, tools and modes of transportation were all made with natural materials.

European whalers, explorers, missionaries, and traders began arriving in the Inuit homelands between the 17th and 19th centuries, depending on the region, introducing new materials and thus importing waste. European influences gradually but persistently deepened, and in the postwar years of the 20th century, the government of Canada established permanent settlements across the Canadian Arctic. The vast majority of the communities that now make up Inuit Nunangat were created during this time, sometimes but not always at existing trading posts or missions.

Over the next several decades, the rapidly growing settlements accommodated increasing populations as families moved off the land. This was coupled with the ever-expanding scope of the Canadian state in providing basic infrastructure such as housing, airports, public works, health centres, schools and administrative buildings. Construction projects – and thus increasing amounts of imported waste – were regular features of community life. By the mid-1980s, nearly all of the communities had been incorporated as municipalities, which became responsible for managing local waste. Most of the dumps that are still operating today across Inuit Nunangat were created during this period and are now far exceeding their intended lifespans.

This section summarizes the findings from an analysis of waste data derived from communities across Inuit Nunangat. Community waste profiles were developed for each of the communities, comprising population data, information about the regional regulatory and policy frameworks, local waste management systems and estimates of waste metrics, including the quantities of waste accumulated by Inuit Nunangat communities, the different types of waste present in Arctic dumps and an inventory and analysis of contemporary community waste diversion initiatives across the four regions.

How Much Waste and What Types?

Based on estimates provided in regional reports, this study calculates the amount of waste that has accumulated (in cubic metres [m³]) in each Inuit Nunangat community over the last 25 years. Figure 1 summarizes the community-level data, and Figure 2 shows average community waste accumulation for the same period.

Waste Accumulation

Annual waste accumulation varied significantly by community, driven primarily by community population size. The regional capitals of **Iqaluit (Nunavut)**, **Kuujuuaq (Nunavik)**, **Inuvik (Inuvialuit Settlement Region – ISR)** and **Nain (Nunatsiavut)**, accumulated the highest volume of waste in their respective regions.

How does this compare to Canada overall? Canada is the leading producer of garbage among its peers in Western Europe and the United States, accumulating over 34 million tonnes of municipal waste per year (based on 2012 levels) (Conference Board of Canada, 2019). This translates to about 9.6 m³ per capita annually (see **Appendix B: Methodology** for an explanation of our calculations).

This means that while Inuit Nunangat communities do not seem to be accumulating substantially greater volumes of waste than their southern counterparts, they **are** tasked with managing similar quantities of waste with inferior infrastructure, limited services and programming, extremely limited access to eco-alternatives and fewer resources to develop solutions.

Figure 1: Inuit Nunangat Waste Accumulation (m³) over 25 Years

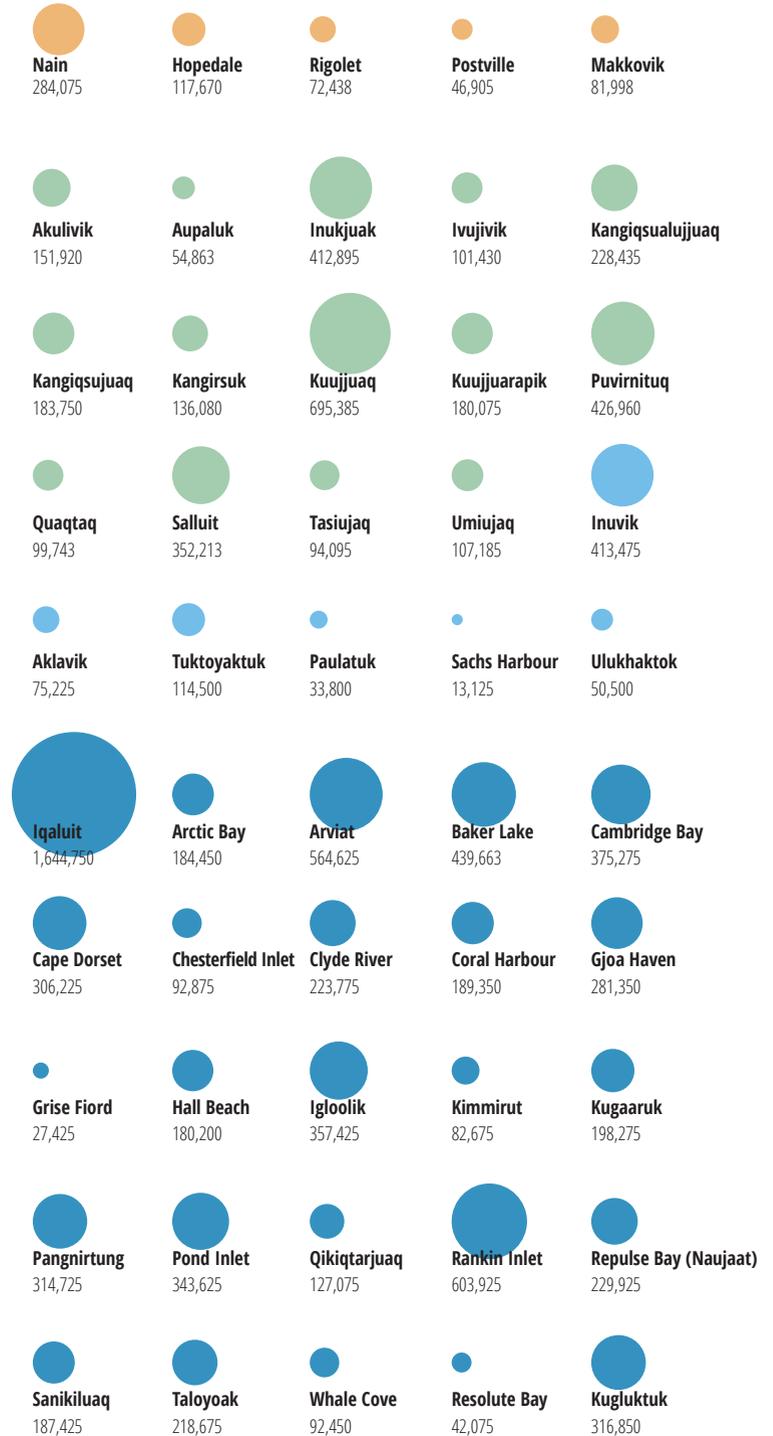
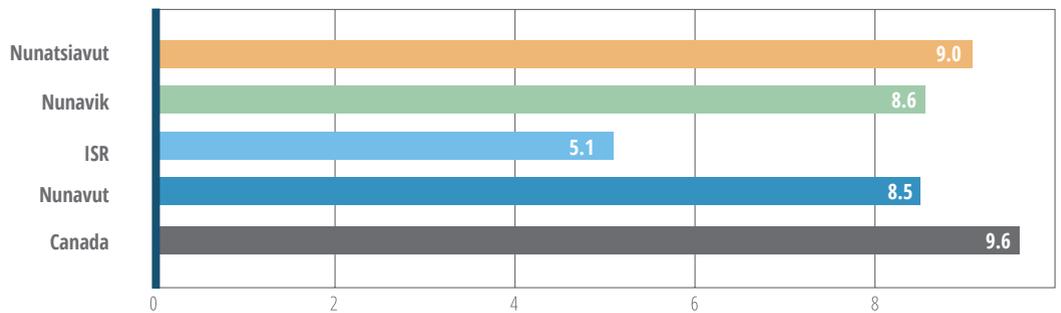


Figure 2: Average Waste Accumulation (m³) by Region



Figure 3: Average Annual Per Capita Waste Generation (m³)



Box 1: The Iqaluit Dump Fire

On May 20, 2014, the dump in Iqaluit burst into flames. Sparked by chemical processes within the vast deposit of unsorted waste, it burned for four months, releasing plumes of noxious smoke. Although the original plan had been to let the fire burn itself out – a process that would have taken up to three years – it was eventually put out by firefighters at an estimated cost of \$2.2 million.

The dump fire in Iqaluit exemplifies many of the challenges regarding solid waste management in the North. Like most dumps in the Arctic, Iqaluit’s dump had long outlived its intended lifespan: constructed in 1995, it was meant to last only until 2000. The lack of waste sorting also meant that organics, electronics and hazardous materials all went to the

same place, and there was no system to prevent the buildup of methane created by decomposition. These conditions, combined with the volume of waste, had caused numerous dump fires in the past, but none as severe as the one in 2014.

While Iqaluit was spending a similar amount as southern cities on waste management per capita, its unique challenges required a greater investment. In July 2018, the city announced a new waste management plan that involves closing the old site and creating a new waste transfer station that aims to reduce landfill waste by 44 per cent through recycling of tires and scrap metal, among other waste diversion initiatives. The new facilities, which are currently under construction, are funded jointly by the municipality and the federal government.



Waste Composition

Understanding waste composition in a given dump or region is important not only for managing existing waste but also for the prioritization of planning decisions around waste reduction and waste prevention. Unfortunately, access to reliable and up-to-date information about the composition of waste in Inuit Nunangat communities is extremely limited relative to other jurisdictions in Canada. Most other jurisdictions, for example, report on the quantity of waste generated per household per week, and because they have more sophisticated waste collection systems, they can report in more detail on waste composition and trends over time. By contrast, all the data used in this report are estimates based on ad hoc surveys and site visits (see **Appendix B** for a comprehensive overview of our methodology). One of the recommendations in this report calls for a more concerted effort to collect waste and waste diversion data.

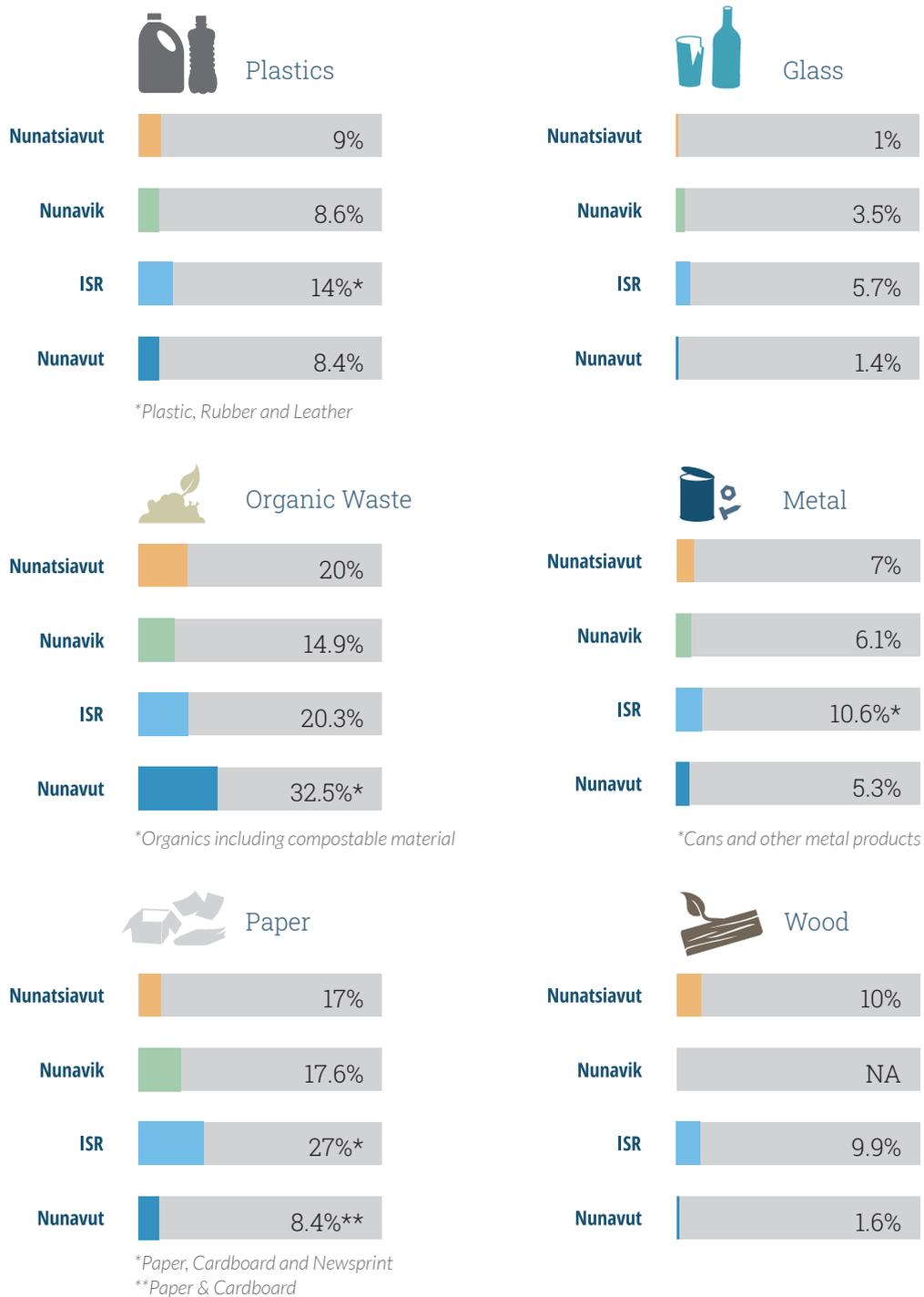
Based on the data, some cautious comparisons can be made regarding waste composition among the four Inuit Nunangat regions. Waste composition profiles for each region appear in **Figure 4**.

Overall, paper products and organic materials make up the largest proportions of waste in Inuit Nunangat dumps. Cardboard and paper account for about one-fifth to one-quarter of total waste; however, there are currently no programs aimed at recycling or reducing paper or cardboard in Northern Canada (see page 30 for information about a recent cardboard recycling initiative in Western Greenland that may serve as inspiration for Inuit Nunangat communities).

It is well documented that Canada, in general, has some of the highest levels of food waste in the world (Mancini and Vellani, 2016). Across Inuit Nunangat, organic materials account for 20-42 per cent of total waste, and, although there have been some efforts in recent years to divert organic waste (see “Waste Diversion Programs: A Regional Inventory and Analysis” below), other forms of waste have taken priority.

The percentage of plastic waste in Inuit Nunangat dumps varies slightly and *may* be highest in the ISR communities (14 per cent), compared with Nunatsiavut (9 per cent), Nunavik (8.6 per cent), and Nunavut (8.4 per cent).² Unfortunately, we do not have the data to compare Northern communities with a national Canadian average; however, these proportions are markedly higher than those in other circumpolar regions. Western Greenland – a region with similar social and economic characteristics, as well as similar infrastructure challenges – reports just 2.4 per cent plastic waste per capita. More in-depth comparative research is needed to explain this difference. Gathering information at the community level requires exhaustive research, so monitoring any improvements in waste management will require a common reporting mechanism.

Figure 4: Waste Composition as a Percentage of Total Waste, by Region



Box 2: Common Infrastructure and Practices

- Limited or no waste separation
- Open-air burning of domestic waste
- Minimal separation of bulky waste from municipal waste
- Limited hazardous waste management
- Limited or no facility operations and maintenance
- Facility typically not designed or constructed to acceptable engineering standards
- Facility often not fenced and proper signage damaged or non-existent

Box 3: Common Waste Management Challenges

- Remoteness of communities/issues with transport
- Low or inconsistent amounts of materials
- Lack of data on quantities of materials
- Lack of storage facilities
- Capital costs/access to funding
- Staffing of facilities
- Proper handling of materials
- Segregation of recoverable materials
- Public involvement
- Lack of experience with waste recovery programs

Common Features of Waste Management across Inuit Nunangat

Communities across Inuit Nunangat share similar infrastructure and face similar challenges with respect to waste management, summarized in Boxes 2 and 3.

All the communities we studied (except for the largest regional centres) share similar infrastructure challenges. Across the board, waste management infrastructure in Inuit Nunangat is outdated,³ in terms of both equipment and techniques, posing significant risks to the human and natural environments. Each community studied has a dump near it and at least one piece of heavy equipment used to transport solid waste. The ability to sort waste into different zones and the infrastructure to manage bulky and hazardous waste (including electronic waste) vary by community but are generally limited. There are no incinerators in the Canadian Arctic, and except for three Nunavut communities, all use open-air burning.⁴ In most communities, water is supplied and wastewater collected regularly by truck. Wastewater is then transported to lagoons or settling ponds.

The current issues surrounding waste management practices and infrastructure will likely become more severe in the future, which may further damage human and environmental health. Increased coastal erosion, rising sea levels and melting permafrost due to climate change will leave coastal dumps vulnerable and increase the probability that waste will enter the ecosystem. Winds are also expected to increase with climate change, dispersing waste from open dumps across land and water. Meanwhile, as the Arctic becomes ice-free for longer periods, a rise in tourism – particularly via large cruise ships – could place an additional burden on existing waste management systems.

Waste Diversion Programs: A Regional Inventory and Analysis

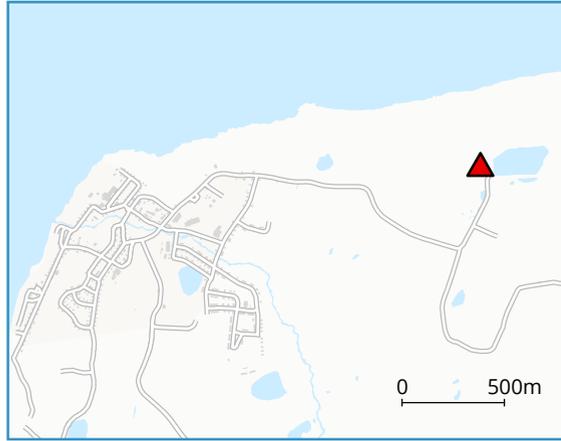
Except for Iqaluit and Cambridge Bay⁵ in Nunavut, there are no household recycling programs in any Inuit Nunangat community; however, pilot recycling programs in various forms are or have been reported in most communities since the mid-2000s. Figure 5 provides an inventory of waste diversion initiatives across Inuit Nunangat during 2009-19, by region. The inventory includes programs and initiatives by government, industry and the not-for-profit sector.

In what follows, we describe the types of programs that we found, highlighting a few examples of specific initiatives. It is important to note that in some cases, the initiatives described may no longer be active or may have always been relatively informal. At the end of this section, we discuss some of the challenges that Arctic communities face with respect to implementing waste diversion initiatives.

Figure 5: Waste Diversion Program Inventory, by Region (since 2009)

								
Program Type		Beverage Containers	Electronics Recycling	Single-Use Plastic Bags or Plastic Bag Ban	End-of-Life Vehicle	Household Hazardous Materials	Organic Waste	Used Tires
Region	Inuvialuit Settlement Region							
	Nunavut							
	Nunavik							
	Nunatsiavut							

Figure 6: From Landfills to Sea:
 Distance from waste management locations to shoreline. Map data:
 Open Street Map Contributors (2020)

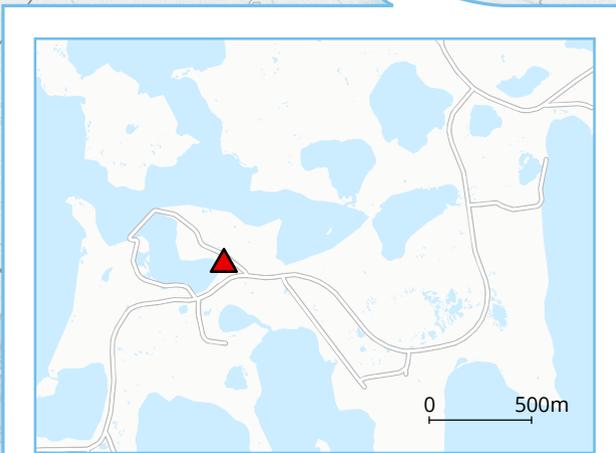


Pond Inlet

Population 1,617

Tons of plastic waste per year: 28,865KG

Distance from landfill to water: **430M**



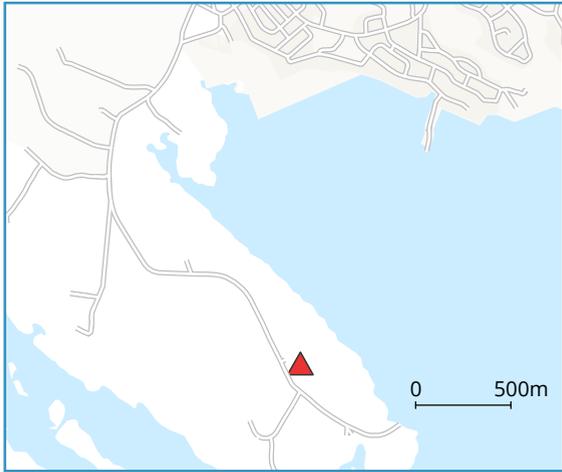
Tuktoyaktuk

Population: 898

Tons of plastic waste per year: 16,030KG

Distance from landfill to water: **266M**





Iqaluit

Population: 7,740

Tons of plastic waste per year: 138,159KG

Distance from landfill to water: **244M**

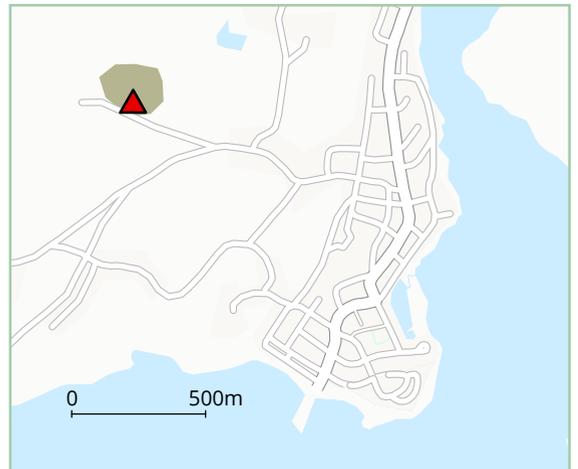


Nain

Population: 1,125

Tons of plastic waste per year: 25,567KG

Distance from landfill to water: **70M**



Inukjuak

Population: 1,757

Tons of plastic waste per year: 35,509KG

Distance from landfill to water: **933M**





Beverage Container Programs

Beverage container programs exist in some form in all regions of Inuit Nunangat; however, not all the programs are run or funded by the regional or territorial government. For example, in Nunavut between 2007 and 2010, the territorial government piloted a recycling program in three communities, which included a beverage container component. In 2010, it decided not to continue the program, citing dubious cost-effectiveness and a lack of tangible benefits (Government of Nunavut, n.d.). The following year, Arctic Co-operatives Ltd., one of two major retailers in the territory, announced it was partnering with The Co-operators Group Ltd. to launch an aluminum recycling program in 23 communities across Nunavut (The Co-operators, 2011). The program is simple: Arctic Co-operatives Ltd. provides recycling bins at each of its stores and then uses its supply system to ship the cans south. The program is partially funded through another waste management program – charging customers for the use of single-use plastic bags. Between 2011 and 2013, 19 shipping containers filled with aluminum cans were shipped out of Nunavut, amounting to approximately 750,000 cans (Varga, 2013). There is also one business owner in Iqaluit who runs an independent can and bottle recycling depot (Varga, 2014b).

By contrast, a territorial beverage container program has existed in the N.W.T. since 2005. The N.W.T. beverage container program has a network of community depots operated by businesses, schools, community governments and individuals. The depots collect beverage containers, pay refundable deposits to N.W.T. residents and send beverage containers to regional processing centres in Yellowknife, Hay River and Inuvik. The containers are then sorted, baled, and sent to processing facilities in the south. The N.W.T. program seems to be the most comprehensive in terms of the number of communities involved and the types of containers included in the program.⁶

In Nunavik, two types of beverage container programs exist. First, like the Arctic Co-operatives Ltd. program in Nunavut, the Fédération des coopératives du Nouveau-Québec (FCNQ) stores in each Nunavik community offer compacting services for aluminum beverage containers. Collected cans are shipped south once a year through FCNQ networks. The Newiq'vi General Store in Kuujuaq also collects plastic bottles in special bags supplied by Boissons Gazeuses Environnement, a Quebec-based non-profit created by the soft drink industry to administer the deposit and return of soft drink containers. It is estimated that roughly 20 per cent of cans are shipped out of Kuujuaq by local retailers. Second, RECYC-QUÉBEC, the provincial recycling body, manages the single-use beer and soft drink container deposit program. The program requires bottlers, brewers, retailers and consumers to collect or pay a deposit on single-use containers, which is then recovered when the empty containers are returned. This program exists throughout Quebec.

In Newfoundland and Labrador, the Multi-Materials Stewardship Board (MMSB) – a Crown agency of the provincial government – is responsible for the beverage container recovery program, established in 1997. The MMSB has partnered with six schools in Nunatsiavut to collect beverage containers in the region. MMSB provides a shipping container in each community to store the cans and bottles and covers the expense of shipping the beverage containers by sea to a depot in Happy Valley-Goose Bay once or twice per year, where they are counted. Local schools raise a small amount of money from MMSB for participating in the program (Aivek Stantec Consulting, 2017).



Electronics Recycling Programs

In the N.W.T., an electronics recycling program was launched in 2016, building on the existing network of recycling depots established for the territory's beverage container program. The program has reportedly collected more than 100 tonnes of electronics for recycling (Government of the Northwest Territories, 2017).

Nunavut has no formal EPR programs for electronic waste and no formal electronics recycling programs, although individual communities have spearheaded their own ad hoc electronic waste diversion efforts over the years (Rogers, 2014b).

In 2015, the Kativik Regional Government (KRG) launched a three-community pilot program (in Kuujuaq, Salluit and Kuujuaapik) in which local depots were set up near community dumps for end-of-life electronics. The plan was to roll out the program across Nunavik by 2018; it is not clear whether this has happened. In addition to the KRG program, the Electronic Products Recycling Association (EPRA), which operates regulated electronics recycling programs in nine Canadian provinces, including Quebec, has a presence in a few Nunavik communities. In each community, a participating individual or business is authorized to collect end-of-life electronics on behalf of the EPRA. Under Quebec's EPR program, Nunavimmiut pay a fee on certain items, such as electronics, that contain hazardous materials, to help pay for their safe disposal.

In Nunatsiavut, end-of-life electronics are collected at schools and shipped in the same containers used for the beverage container recycling program. Electronics are then shipped from Happy Valley-Goose Bay to a recycling facility. According to a 2017 report by Aivek Stantec Consulting, the volume of electronics collected for recycling in Nunatsiavut communities remains small.

It is also worth noting that the Canadian Wireless Telecommunications Association operates a mobile phone recycling program in every province and territory except for Nunavut (Government of Canada, 2019).

Did you know?

Nain was the first municipality in Canada to ban plastic bags. Today, four of Nunatsiavut's five communities have banned plastic bags. (Aivek Stantec Consulting, 2017)

Single-Use Plastic Bag Programs and/or Bans

In 2010, the N.W.T. became the first Canadian province or territory to implement regulations targeting single-use retail bags. The program began with a 25-cent charge for each single-use bag from every N.W.T. grocery store, and later expanded to include all N.W.T. stores. In total, 128 retailers participate in the program, and N.W.T. residents have reduced their use of single-use retail bags by an estimated 72 per cent since the start of the program. In the ISR, the community of Tuktoyaktuk has banned single-use plastic bags, and citizens in other communities in the region have demanded action by retailers and governments in their towns (Scott, 2019).

The North West Company, a major northern retailer, has implemented a plastic bag reduction program under its Greener Tomorrow Initiative in the N.W.T., Nunavut and Nunavik. Under this program, Northmart customers in Nunavut and Nunavik are charged 25 cents per plastic bag. To kick-start the program in 2011, Northmart provided each household with two reusable shopping bags. A portion of the plastic bag fees has been reinvested into the Nunavut and Nunavik communities for initiatives such as community cleanups, youth programs, school breakfast programs, beautification projects and scholarships.

Two Nunavut communities – Kimmirut and Iqaluit – have passed bylaws banning single-use plastic bags. (Pucci, 2019).

In 2008, Kuujjuaq passed a bylaw banning single-use plastic shopping bags, which is still in place today. The Kativik Environmental Advisory Committee funded the production and distribution of reusable grocery bags bearing the committee's logo to all Nunavik communities, encouraging them to pass similar bylaws. To the best of our knowledge, Kuujjuaq remains the only community in Nunavik with a single-use plastic bag ban.

Meanwhile, four out of five communities in Nunatsiavut (Rigolet, Makkovik, Hopedale and Nain) have instituted plastic bag bans. Nain was, in fact, the first municipality in Canada to ban plastic bags.



End-of-Life Vehicle Programs

End-of-Life Vehicle (ELV) programs currently operate in 11 communities across Nunavut (three), Nunavik (three), and Nunatsiavut (five).⁷ Tundra Take-Back was founded by Scout, a Toronto-based not-for-profit organization, with funding from Environment Canada and in-kind support from 15 private sector partners working in the North. It launched in Nunavut in 2014 as a skills development program aimed at improving capacity within local communities to clean up metal dumps and ensure that they do not pollute the environment. At first, the program focused on recycling and extracting ELVs as well as some provincially regulated EPR products including tires, batteries and used oil. Since then, the program has expanded in both size and scope to include other types of waste such as appliances (so-called “white goods”), heavy equipment and other hazardous materials.⁸



Household Hazardous Materials

Household hazardous materials are identified across Inuit Nunangat as a significant environmental and health concern, particularly given the nearness of dumps to both communities and coastlines; however, regions and communities vary in their approaches and capacity to collect and manage decades of accumulated waste in Arctic dumps.

While there are few initiatives in place to manage household hazardous waste in the ISR, the government of the N.W.T. undertook a municipal hazardous waste inventory in all six ISR communities as a step to addressing the challenges there (KBL Environmental Ltd., 2013). In the meantime, as an ongoing stop-gap measure, the government of the N.W.T. holds one-day collection events for different types of hazardous waste products; however, in the ISR, these events are held only on an ad hoc basis. In the N.W.T., where there is widespread burning of oil, primarily by industry, some operators backhaul used lubricating oil to the south. In Inuvik, local contractors collect lead-acid batteries from the Inuvik dump for transport to a transfer station in Yellowknife and then further south (Sonnevera, 2015).

In Nunavut, household hazardous waste such as batteries and used oil are typically (but not always) segregated at community dumps; however, there are no government programs in place for the treatment or recycling of these materials. In the private sector, Qikiqtaaluk Environmental Inc. (QE) operates a licensed transfer station in Iqaluit, receiving hazardous waste for a fee. The company primarily collects and backhauls commercial hazardous waste,

including lead-acid batteries and waste lubricating oil that is too contaminated to burn. QE also crushes fluorescent bulbs and ships out the residual material (Sonnevera, 2015).

In Nunavik there are two main hazardous materials programs for batteries (household and vehicle) and waste lubricating oil. KRG has a relationship with the Montreal-based recycling company Newalta Corporation. Nunavik communities pay to backhaul batteries to Montreal and are reimbursed at market value. More recently, in 2014, the Société de gestion des huiles usagées (SOGHU) helped to set up a used oil depot in Kuujjuaq. SOGHU supplies the containment system and covers shipping and processing costs. It is not clear whether or how used oil is transported from other Nunavik communities to Kuujjuaq for shipment.

In some Nunatsiavut communities, paint, used oil, and batteries are collected and transported south. Permanent paint collection depots, facilitated through the B.C.-based not-for-profit Product Care Recycling, have been set up in Nain, Makkovik and Postville,⁹ while Hopedale and Rigolet have one-day-collection events. Nain also has a depot for the collection of used oil and batteries. Hydro Newfoundland collects and backhauls used oil from Hopedale and Postville; there are no used oil depots in Rigolet or Makkovik (Aivek Stantec Consulting, 2017).



Organic Waste Recycling

There are no regionwide household organic waste recycling programs in Inuit Nunangat, although there are or have been local greenhouse projects in three of the four regions and at least one independently run composting initiative in Iqaluit in the last decade.¹⁰

The municipality of Kuujuaq in Nunavik launched its greenhouse project with support from the KRG (ITK, n.d.). The project includes a community greenhouse and a supporting composting initiative. The Inuvik community greenhouse goes one step further and for a small fee collects household organic waste for use at the greenhouse (Inuvik Community Greenhouse, n.d.). In Iqaluit, Nunavut, the Greenhouse Society operates a community greenhouse and a composting site near the city's dump to generate soil for the greenhouse.

A recent report on waste management in Nunatsiavut indicates that composting is of potential interest in the region; a composting program is included in their proposed waste management action plan for 2019 (Aivek Stantec Consulting, 2017).

Used Tire Programs

In Nunavik, RECYC-QUÉBEC has been collecting tires in Nunavik since 2005. While communities are responsible for loading containers and coordinating shipping, program costs are reclaimed through a rebate paid by RECYC-QUÉBEC (Sonnevera, 2015).

In the N.W.T., in the absence of a territorywide program for tires, most communities stockpile tires at their dumps. A pilot tire-shredding project was undertaken in 2014 to aid in the management of historic stockpiles; however, none of the ISR communities were included in this project.

There is currently no tire collection or recycling in Nunavut¹¹ or Nunatsiavut.



Summary

Based on the review of existing and past waste management programs and initiatives, several overarching observations can be made:

- 1. Waste management is an issue of concern for communities in Inuit Nunangat.** It is clear from the waste diversion program inventory that there have been many attempts over the last 10 years to address the volume of waste that has accumulated in Inuit Nunangat communities. It is also clear that citizens, governments and businesses alike recognize the waste management problems that Arctic communities are facing.
- 2. Local solutions must be coupled with capacity-building and education.** There is a strong emphasis on “made in the North” solutions coupled with a general skepticism about solutions to similar challenges designed elsewhere. At the same time, all available regional waste management reports document the need for adequate training for policy-makers and municipal employees, as well as general public education around waste management and waste prevention. Balancing investments in learning from elsewhere with investments in innovation based in Inuit Nunangat will be critical.
- 3. A coherent and comprehensive waste management vision is needed to ensure community initiatives are better supported.** The inventory and analysis indicates that there have been many one-off, short-lived, and ad hoc waste diversion initiatives across Inuit Nunangat over the last decade. While a few of these abandoned initiatives have been evaluated (such as the two-year Nunavut household recycling program piloted in three communities) it appears that there has been no comprehensive study of waste diversion initiatives across the North. Undoubtedly, economies of scale and limited resources play heavily into decisions about the viability of these programs; however, there is no thorough understanding of why so many of these promising initiatives were not successful or were not deemed to be successful by decision-makers. There is little publicly available information, and the criteria against which these pilot programs are evaluated is not publicly documented. One reason that they are not taken up may be that in the absence of a larger, more coherent waste management vision, these pilot projects and short-term initiatives are unable to attach themselves to a set of strategic objectives and thus are more easily dismissed.
- 4. Multistakeholder and multipurpose programs can deliver success in waste management.** The analysis presented here suggests that successful waste management programs and initiatives involve participation by and collaboration among government, industry and third-sector actors. The Tundra Take-Back program is an example of both multistakeholder involvement and a multipurpose program; it does more than manage waste. It provides skills development and public education in addition to promoting and facilitating waste management system development.

Inspiration from Elsewhere

Greenland faces many of the same waste management challenges as Inuit Nunangat. Nonetheless, 99 per cent of plastic and glass bottles used in Western Greenland are returned to recycling plants (European Environment Agency, 2011).

Greenland has invested in a waste volume reduction program through a partnership with Mil-tek, a company that designs and manufactures waste compactors to reduce the volume of waste, making it easier and cheaper to transport. Pilot projects in three communities in 2014-15 were very successful. The compactors are low-tech, are suitable for the climate, and require no fuel or electricity to operate. This system also encourages proper sorting of waste, which increases its usefulness for recycling (Mil-tek, 2015).

Sweden recycles almost 100 per cent of all household waste. In 2016, the country converted 2.3 million tonnes of household waste (about 50 per cent of total waste) into energy. In 2018, Sweden established a special advisory group to help make the circular economy a key component of government policy (Hinde, 2019). Sweden has a dedicated waste management association that works to “facilitate circular activity” with members from all sectors (Avfall Sverige, n.d.).

Alaska has developed the Solid Waste Alaska Taskforce, a multi-agency initiative formed in 2014 to help Indigenous communities across the state build sustainable solid waste programs. The taskforce members work together to develop programming and share information to facilitate cross-community and cross-agency learning and co-operation (Solid Waste Alaska Taskforce, n.d.).

Whitehorse and **Yellowknife** have “swap shops” and a number of thrift stores. In Nunavut there are consignment stores in **Iqaluit** and **Baker Lake**.

PART II:

Towards Waste-Free Arctic Communities

As the Inuit homeland, the Arctic remains a place where people depend heavily on the local environment for food and well-being. At the same time, it is where the least amount of investment has been made in waste management. It is one of the last places we can start to do things right. Policy, practice and investment are needed now to move towards a waste-free Arctic.

Rationale

The analysis of municipal waste management in Inuit Nunangat reveals a strong desire across all scales and sectors for action in this important area of social, cultural and economic life in the North, even though potential solutions are challenged by insufficient infrastructure and economies of scale. While there have been many efforts, there remains a need to frame these into a more comprehensive vision that encompasses multiple actors. The burden of managing waste has been left to communities across Inuit Nunangat for the better part of 70 years, with limited investments in infrastructure and training.

Reconciliation through action on the environment in the Arctic is intimately bound up with health, food security, economic development and diversification, opportunities for innovation and education, and, ultimately, global leadership on a complex issue (TRC, 2015). Municipal waste management is both an environmental and an economic problem that is linked directly to climate change. In the predominantly Indigenous communities of the Canadian Arctic, waste management is also a matter of equity, inclusivity and responsibility.

While the Arctic presents certain challenges that make waste management more expensive, the United Nations Environment Programme has estimated that, through harm to public health and the environment, poor waste management practices can cost five to 10 times more than properly treating waste in the first place. Addressing municipal waste management challenges across Inuit Nunangat offers an opportunity to redress the inequities that have existed in this region while advancing beneficial programs with cross-cutting social and economic effects such as support for harvesting, replacing disposable products with less expensive eco-alternatives, and local training and employment in waste diversion.

Successful realization of this vision will require commitments from public and Indigenous governments, businesses, civil society and citizens. It is clear from the community and regional waste management reports reviewed that there is a strong desire for change and leadership in this area, and our inventory of waste diversion initiatives shows that community-level initiatives are common in Inuit Nunangat. But in the absence of sustained support and leadership by governments and industry, these efforts cannot result in the transformative changes that are needed, nor will they aid in abating ongoing inequities between northern Indigenous communities and the rest of Canada.

What Can Governments Do?

While municipal governments are responsible for the day-to-day operations of waste management in their respective cities and towns, government leadership and intervention *at all levels* is essential for reducing waste in the Arctic. This includes both public and Indigenous governments. It is notable that the Arctic Policy Framework does not mention waste management, despite broad-based community efforts to address one of the most visible environmental issues facing the North. Through its efforts during the 2018 G7 Presidency, Canada led on the establishment of the Oceans Plastics Charter and as such has a responsibility to make progress on its implementation (Government of Canada, 2018). Furthermore, the CCME, which includes federal, territorial and provincial representatives, has agreed to a 50 per cent waste reduction target for 2040. An upcoming federal ban on single-use plastics provides a further impetus to collaborate on waste reduction measures. Here, we make some specific suggestions for government action on waste and waste management in Inuit Nunangat.

Global Governance

Marine plastics have been the subject of numerous international reports, communication efforts and commitments. The UN Sustainable Development Goals, while non-binding, provide a framework, as well as targets and timelines, for national efforts and co-ordination of global efforts to reduce ocean plastics (UN, 2015). These include the following targets:

- By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil to minimize their adverse impacts on human health and the environment (target 12.4).
- By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse (target 12.5).
- By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution (target 14.1).

Canada should continue to advance the full implementation of the SDGs and use platforms such as the G7 and G20 to ensure that developed countries are advancing plastic reductions strategies to reduce global sources that ultimately affect the Arctic. Without international action, stemming the tide of plastic in the Arctic will not be possible.

Federal Government and Inuit Nunangat

Joint Inuit-Crown action is needed to make critical changes to the regulatory and legal framework regarding waste in Canada. Law and policy reforms and program initiatives towards achieving a waste-free Arctic at the nation-to-nation level could include the following:

- Create legislation that enshrines the right to a healthy environment for all Canadians, including a baseline level of waste management services.
- Create an environmental goals and sustainable prosperity law or equivalent, with associated targets and policies linking waste reduction with economic opportunity. Goals and targets could include the following, some of which could be achieved without overarching legislation:
 - A target for waste reduction across the Arctic in line with that set by CCME (50 per cent by 2040)
 - EPR in the Arctic and other return-of-waste initiatives, consistent with those anticipated in other regions of Canada (CCME, 2009)
 - A funded, centralized, shared, standardized and publicly available reporting system, mandating regular data collection on a community level and annual reporting requirements
 - Regulations for businesses, with funding earmarked for emerging small and Indigenous-owned businesses, to promote circularity and waste reduction
 - A target percentage of energy to be created through low-emission waste-to-energy initiatives and directly linked to renewables
- Invest in infrastructure and other capacity requirements to ensure that waste management systems are equal across the country.
- Promote and invest in Arctic food production through support for harvesting, greenhouses, local production and other initiatives.
- Invest in research and development to promote innovative waste-free solutions specific to the Arctic, with a focus on efforts based within communities.

Provincial and Territorial Governments

Given that waste management and a circular economy will require collaboration among all levels of government, the provincial and territorial governments must be involved in the regulatory frameworks as well as infrastructure to achieve a waste-free Arctic. Currently, not all the provinces and territories have waste management legislation. For example, Nunavut does not. The N.W.T. is currently developing a Waste Management Resource Strategy (Government of the Northwest Territories, 2018). Recommendations for regional governments within Inuit Nunangat include the following:

- Create new or update existing provincial/territorial legislation in support of implementing the Oceans Plastics Charter (see recommendation above regarding an environmental goals and sustainable prosperity act).
- Adopt a whole-of-government approach to zero waste by amending government practices through procurement, operations and incentives to reduce waste in all government departments.
- Develop and enhance household recycling programs in each region.
- Create regional waste management strategies with region-specific programs that:
 - Replicate best practices that already exist within Inuit Nunangat and elsewhere;
 - Encourage cross-community and intra-regional learning and knowledge sharing;
 - Provide incentives and funding for communities to develop local programming keyed to regional strategic objectives;
 - Incentivize the private sector operating in the region to reduce waste through partnership and regulation where needed, including reductions in single-use plastics, food waste and supply chain management; and
 - Revamp and properly fund harvester support programs and other food-related initiatives that promote Arctic food production and contribute to community well-being.

Municipal Governments

Municipal governments play a critical role in waste management in Arctic communities. Despite the well-documented infrastructure challenges that all Inuit Nunangat municipalities grapple with every day, many municipalities have taken action at the local level.

The recommendations below build on existing initiatives, with the goal of communities learning from each other. All municipalities should do the following:

- Following the lead of several communities, pass bylaws banning plastic bags and other single-use plastic items.
- Create and promote waste reduction through targeted public awareness campaigns that offer incentives for lower-cost and lower-waste alternatives (such as laundry strips, reusable feminine hygiene products, waste compactors similar to those used in Greenland, reusable grocery bags, etc.).
- Establish waste reduction working groups within municipal associations to promote cross-community learning and to ensure that best practices are shared. This could include the following:
 - Required waste reduction courses for hamlet councillors and senior administrative staff as well as economic development staff
 - Training programs through municipal training organizations related to waste management for municipal employees (including senior administrative officers, community economic development officers and waste management staff)
 - Training for small appliance repair, perhaps in partnership with the colleges or with non-governmental organizations (NGOs)
 - Promoting the development of swap shops for residents to share and exchange usable goods¹²
- Establish green-business-model workshops for potential entrepreneurs and existing businesses.

What Can the Private Sector Do?

The private sector has a significant role to play in reducing municipal waste. There are many current examples of successful practices in more southern regions. These can serve as inspiration for businesses operating in the North. Recommendations for practices that the private sector could either bring from the south to the North or innovate first in the North include the following:

- Explore options for waste to be used in development of new products (such as fishing nets, organic material and compost, etc.).
- Reform grocery store delivery, bulk purchasing, and new methods of food production.
- Implement voluntary EPR in advance of the regulatory process.
- Ensure that waste and recyclables are returned to the south through the efficient use of existing transportation infrastructure (e.g., planes, barges, and ships should be picking up waste as well as delivering products).
- Support and promote green alternatives, including but not limited to the following:
 - Food packaging
 - Feminine hygiene products
 - Laundry detergent and filtration
 - Infant care (a list of specific products and initiatives appears in **Appendix C**)

What Can Civil Society Do?

For government and private sector initiatives to succeed, civil society must be engaged and willing to make behavioural changes. Many of the initiatives in place in Inuit Nunangat were started by environmental NGOs based largely in the south in partnership with individual communities. Over the long term, efforts must be rooted in Arctic communities and Indigenous self-government. Such efforts may include the following:

- Ensure that waste is included as an overarching theme in all civil society projects related to Arctic Ocean health and community projects and that ENGO projects do not contribute to further waste in the Arctic.
- Create a hub of all existing projects and initiatives in the Arctic that are advancing waste reduction and bring together a community of practice.
- Create a shared funding base for community-led initiatives on waste reduction.¹³
- Bring together researchers working on waste in the Arctic to inform data collection mechanisms, collaborate across Indigenous-supported research projects and act as experts in policy reform.
- Work with food security initiatives, including Nutrition North, to ensure that waste reduction is part of an overall food security strategy, particularly given the fact that country food can be jeopardized by increased plastic pollution in both marine and terrestrial environments.
- Advocate for waste innovation across all levels of government.



Green Alternatives Can Lead to Cost Savings, Even in the Arctic

Switching to green alternatives for common personal and household items can result in cost reductions to families, particularly in the Arctic, where prices are significantly higher than the national averages. Here, we show a calculation for an everyday household item that generates significant waste: laundry detergent.

Laundry Detergent

According to a 2017 post on Feeding My Family, a Facebook group raising awareness about the high cost of living in Northern Canada, a 1.47-litre plastic jug of laundry detergent (enough for about 32 loads) costs \$34.99. The price partly reflects the weight of this product, which must be shipped North on the annual sealift or flown in by plane. Ultimately, all these large plastic jugs end up in a community dump where they remain in the absence of a recycling program.

Assuming a household average of 384 loads per year, requiring about one jug of detergent each month (Northern households are typically larger than the national average, so this estimate may be low), the annual estimated cost of doing laundry using detergent from a plastic jug in an Arctic community is \$419.88.

Switching to an eco-friendly alternative could save a Northern household over \$200 each year.

TruEarth is a Canadian startup that produces laundry strips and auto-ships them monthly to households across the country. One package of laundry strips costs \$12.95 (including shipping) and contains 32 loads worth of detergent (the typical household needs about one package per month). The annual cost of using detergent strips, therefore, is just \$155.40. Moreover, unlike the conventional product in bulky plastic jugs, detergent strips are virtually weightless, are made without harmful chemicals, and do not contribute large amounts of plastic to community dumps.

Comparative cost breakdown summary

384 loads per year = about 32 loads per month ($32 \times 12 = 384$)

Plastic Jug: \$34.99 for 32 loads (or 1 jug per month) = $\$34.99 \times 12 =$ **\$419.88**

Strips: \$12.95 for 32 loads (or 1 pack per month) = $\$12.95 \times 12 =$ **\$155.40**



Conclusion

Our analysis shows that communities in Inuit Nunangat are accumulating the same levels of waste per capita as other areas of Canada, but without the same levels of investment or resources in managing that waste. As the impacts of waste continue to grow, addressing municipal waste management must be incorporated into policy frameworks aimed at reconciliation and environmental protection both in the North and elsewhere in Canada.

While programs have been started across the waste management stream – including but not limited to organic waste diversion, plastic bag bans, vehicle scrappage projects and toxic waste recycling – maintaining these programs has proven difficult. There is a desire for community-based solutions embedded in local control; however, these would benefit from an overarching policy framework, a common reporting system and investment in education and capacity. Balancing the desire for local or community control with the need for big-picture leadership and visioning around this important issue is a key challenge.

Opportunities exist to incorporate waste management, reduction and diversion into economic opportunities and to view these opportunities as multipurpose initiatives, addressing challenges to employment, health, food security and environmental protection.

Through a vision and shared strategy for waste management in Inuit Nunangat, resources now deployed in traditional waste management could be redirected to find value in these resources. Ensuring that private sector commitments to EPR are also in place in the Arctic would be a step in harmonizing such initiatives across all of Canada. Given that waste accumulation has a much shorter history in Inuit Nunangat than in the rest of Canada, there are opportunities to learn from mistakes and implement new initiatives in the Arctic first.

Endnotes

- 1 For examples of concerns by residents of Inuit Nunangat, see Arktis Solutions. (2011). *Report on Current State of Solid Waste Management and Facilities in Nunavut and Cost-Benefit Analysis of Selected Solid Waste Management Approaches*. Retrieved from: <https://assembly.nu.ca/library/GNedocs/2011/000359-e.pdf>; and Aivek Stantec Consulting Ltd. (2017). *Solid Waste Management Study – Northern Labrador Region: A Sustainable Waste Management Strategy for Nunatsiavut*.
- 2 Direct comparisons for regional waste composition are cautious, as a standard waste characterization methodology does not exist in Canada. For example, in the ISR and in Nunavut, plastic is grouped in with other materials rather than forming its own category; it is thus impossible to know the exact proportion of plastic waste in those regions.
- 3 A 2014 CCME report notes: “Approximately half of all communities in Nunavut are operating historical dump facilities that were not initially designed by an engineer, and there are no supporting engineering designs or operation and maintenance plans for the facility.” Canadian Council of Ministers of the Environment. (2014). *Progress Report on the Canada-Wide Action Plan for Extended Producer Responsibility*, 91. Retrieved from: <https://www.ccme.ca/files/Resources/waste/extended/CAP-EPR%20Progress%20Report.pdf>.
- 4 Some communities, such as Rigolet and Makkovik in Nunatsiavut, restrict burning to winter months only (Aivek Stantec Consulting, 2017).
- 5 This program was established by the mayor of Cambridge Bay in 2015. The main feature of the program was supplying each household with a recycling bin that would be collected at regular intervals along with garbage. The current status of the program was not known at the time of writing. For more information, see: Peter Varga. (2014a). “Cambridge Bay lays groundwork for new waste management plan.” *Nunatsiaq News* 4 February 2014. Retrieved from: https://nunatsiaq.com/stories/article/65674cambridge_bay_lays_groundwork_for_new_waste_management_plan/.
- 6 For a list of the types of containers included, see: Government of the Northwest Territories. (n.d.) Beverage Container Program. Retrieved from: <https://www.enr.gov.nt.ca/en/services/beverage-container-program>.
- 7 In the mid-2000s, the government of Nunavut launched an ELV pilot program in Iqaluit and one in Rankin Inlet, but these do not seem to have continued beyond a few years. It is important to note that there are a number of federal regulatory requirements associated with ELV recycling because of the hazardous materials they carry; therefore, it would be quite a large undertaking to set up a full-scale program that adheres to all the rules and regulations. For more information see: Dillon Consulting Limited. (2011). *End-of-Life Vehicle Hazardous Materials Recovery Program Manual*. (Iqaluit: Department of Environment). Retrieved from: https://www.gov.nu.ca/sites/default/files/final_-_elv_program_manual_-_jan_10_2011_0%20%281%29.pdf.
- 8 To learn more about Tundra Take-Back, visit: <https://tundratakeback.ca/about-the-programs/>.
- 9 To learn more about ProductCare Recycling, visit: <https://www.productcare.org/recycling-locator/#location=Nain%2C+NL%2C+Canada&product=>.
- 10 Between 2004 and 2013, an Iqaluit resident ran a non-profit composting program with 100 households in the city. To learn more about the venture, visit: <http://findingtruenorth.ca/blog/composting-in-iqaluit>.
- 11 In 2019, the Nunavut Impact Review Board heard public comments on the proposed new waste management site for the City of Iqaluit. One of the features of the proposed waste transfer station is a scrap-tire-shredding operation, which would see tires shipped south for recycling or reused in the territory for other purposes. See NIRB File No. 13UN034 for more information. Retrieved from: <http://www.nirb.ca/project/125346>.
- 12 These already exist in Yellowknife, Whitehorse, and Iqaluit, and informally on community Facebook pages across Inuit Nunangat.
- 13 A possible model for a community-led waste reduction funding program might be the Climate Change and Health Adaptation Program. See Abele and Gladstone (2018) for an analysis and impact evaluation of this program. Frances Abele and Joshua Gladstone. (2018). *Health Canada Climate Change Health Adaptation Program Synthesis Report and Impact Analysis*. Retrieved from: http://www.climatetelling.info/uploads/2/5/6/1/25611440/cchap_final_report.pdf.
- 14 Vertical mixing is the upward and downward movement of water occurring as a result of temperature differences between layers of water.
- 15 38-234 particles/m³ of sea ice.
- 16 This was calculated using the lowest estimate of particles (38 m³).
- 17 The world’s top 20 polluting rivers account for 67 per cent of the global total input of plastics into the ocean every year (Lebreton et al., 2017).
- 18 Kent, R., et al. (2003). *Guidelines for the Planning, Design, Operations and Maintenance Of Modified Landfill Sites in the NWT*. FSC Project No. 2001-1330.

Bibliography

- Abele, F., & Gladstone, J. (2018). *Health Canada Climate Change Health Adaptation Program Synthesis Report and Impact Analysis*. Retrieved from: http://www.climatetelling.info/uploads/2/5/6/1/25611440/cchap_final_report.pdf.
- Aivek Stantec Consulting Ltd. (2017). *Solid Waste Management Study – Northern Labrador Region: A Sustainable Waste Management Strategy for Nunatsiavut*. (Andrea Hoyt, personal communication, January 16, 2019).
- Aksenov, Y., et al. (2016). Arctic pathways of Pacific water: Arctic Ocean model intercomparison experiments. *Journal of Geophysical Research: Oceans*, 121(1), 27–59. <https://doi.org/10.1002/2015JC011299>
- Alimi, O.S., Budarz, J.F., Hernandez, L.M., & Tufenkji, M. (2018). Microplastics and Nanoplastics in Aquatic Environments: Aggregation, Deposition, and Enhanced Contaminant Transport. *Environmental Science & Technology*, 52(4), 1704-1724.
- Arktis Solutions. (2011). *Report on Current State of Solid Waste Management and Facilities in Nunavut and Cost-Benefit Analysis of Selected Solid Waste Management Approaches*. Retrieved from: <https://assembly.nu.ca/library/GNedocs/2011/000359-e.pdf>.
- Avfall Sverige. (n.d.). Avfall Sverige – the Swedish Waste Management Association. Retrieved from: <https://www.avfallsverige.se/in-english/>.
- Butler, Kiera. (2016). “Stop using plastic tampon applicators!” *Mother Jones*, March/April. Retrieved from: <https://www.motherjones.com/environment/2016/03/plastic-tampon-applicator-beach-pollution/>.
- Cairns, S., Ogden, M., & McFatridge, S. (2018). *Getting to a Circular Economy: A Primer for Canadian Policy Makers*. Smart Prosperity Institute. Retrieved from: <https://institute.smartprosperity.ca/sites/default/files/spipolicybrief-circulareconomy.pdf>.
- Canadian Council of Ministers of the Environment (CCME). (2009). *Canada-Wide Action Plan for Extended Producer Responsibility*. Retrieved from: https://www.ccme.ca/files/current_priorities/waste/pn_1499_epr_cap_e.pdf.
- Canadian Council of Ministers of the Environment (CCME). (2014). *Progress Report on the Canada-Wide Action Plan for Extended Producer Responsibility*. Retrieved from: <https://www.ccme.ca/files/Resources/waste/extended/CAP-EPR%20Progress%20Report.pdf>.
- Canadian Council of Ministers of the Environment (CCME). (2018). *Strategy on Zero Plastic Waste*. Retrieved from: <https://www.ccme.ca/files/Resources/waste/plastics/STRATEGY%20ON%20ZERO%20PLASTIC%20WASTE.pdf>.
- Cantin, P., Bury, D., & Vaillancourt, P. (2012). *Inventory and Feasibility Assessment of Electronic Waste Recovery in the Northwest Territories: Final Report*. Retrieved from: www.dessau.com
- CBC News. (2015a). Makkovik, Postville to eliminate plastic shopping bags. August 3. Retrieved from: <https://www.cbc.ca/news/canada/newfoundland-labrador/makkovik-postville-to-eliminate-plastic-shopping-bags-1.3172343>.
- CBC News. (2015b). Recycling program removes wrecks from Nain, Hopedale. October 4. Retrieved from: <https://www.cbc.ca/news/canada/newfoundland-labrador/recycling-program-removes-wrecks-from-nain-hopedale-1.3252516>.
- City of Whitehorse. (n.d.). Reuse Information and Resources. Retrieved from: <https://www.whitehorse.ca/departments/environmental-sustainability/waste-diversion/additional-information/reuse>.
- Conference Board of Canada. (2018). *Waste Generation*. Retrieved from: <https://www.conferenceboard.ca/hcp/provincial/environment/waste.aspx>.
- Conference Board of Canada. (2019). *Municipal Waste Generation Calculator*. Retrieved from: <https://www.conferenceboard.ca/hcp/Details/Environment/municipal-waste-generation.aspx>.
- The Co-operators. (2011). The Co-operators partners with Arctic Co-operatives to bring recycling to Nunavut. *Newsroom*, May 26. Retrieved from: <http://newsreleases.cooperators.ca/index.php?s=5651&item=40276>.
- Cózar, A., Echevarría, F., González-Gordillo, J. I., Irigoien, X., Ubeda, B., Hernández-León, S., & C. M. Duarte. (2014). Plastic debris in the open ocean. *Proceedings of the National Academy of Sciences of the United States of America*, 111(28), 10239–10244. <https://doi.org/10.1073/pnas.1314705111>
- Cózar, A., et al. (2017). The Arctic Ocean as a dead end for floating plastics in the North Atlantic branch of the Thermohaline Circulation. *Science Advances*, 3(4), 1–9. <https://doi.org/10.1126/sciadv.1600582>
- Curry, N. (n.d.). *Waste Management and Waste-to-Energy Opportunities in the Canadian High Arctic*. Retrieved from: http://www.akruralenergy.org/2016/2016_REC_Waste_Management_and_Waste-to-Energy_Opportunities_in_the_Canadian_High_Arctic-Nathan_Curry.pdf.
- The Danish-Greenlandic Environmental Cooperation. (2019). *The Protection of Nature and the Environment in Greenland*. Retrieved from: https://www2.mst.dk/udgiv/publications/2001/87-7944-977-8/html/kap03_eng.htm.
- Dawley, D. (2013). *Municipal Hazardous Waste Inventory Beaufort Delta/Arctic Pilot Project*. Retrieved from: https://www.enr.gov.nt.ca/sites/enr/files/haz_waste_inventory_report.pdf.
- Dillon Consulting Ltd. (2009). *Hamlet of Aklavik – Solid Waste Site Evaluation Final Report*. Retrieved from: https://www.inuvwb.ca/sites/default/files/documents/0570_solid_waste_site_evaluation_-_090310.pdf.
- Dillon Consulting Ltd. (2010). *Evaluation of Recycling Pilot Projects: Final Report*. Retrieved from: <https://www.gov.nu.ca/sites/default/files/Evaluation%20of%20Recycling%20Pilot%20Projects%20-%20Final%20Report%20-%20March%20202010.pdf>.
- Doyle, M. J., Watson, W., Bowlin, N. M., & Sheavly, S. B. (2011). Plastic particles in coastal pelagic ecosystems of the Northeast Pacific Ocean. *Marine Environmental Research*, 71(1), 41–52. <https://doi.org/10.1016/j.marenvres.2010.10.001>

- Eisted, R., & Christensen, T. H. (2011a). Characterization of household waste in Greenland. *Waste Management*, 31(7), 1461–1466. <https://doi.org/10.1016/j.wasman.2011.02.018>
- Eisted, R., & Christensen, T. H. (2011b). Waste management in Greenland: Current situation and challenges. *Waste Management and Research*, 29(10), 1064–1070. <https://doi.org/10.1177/0734242X10395421>
- Eisted, R., & Christensen, T. H. (2013). Environmental assessment of waste management in Greenland: Current practice and potential future developments. *Waste Management and Research*, 31(5), 502–509. <https://doi.org/10.1177/0734242X13482175>
- Ellen Macarthur Foundation. (2014a). *Towards the Circular Economy: Accelerating the Scale-up across Global Supply Chain* (Vol. 3). Retrieved from: http://www3.weforum.org/docs/WEF_ENV_TowardsCircularEconomy_Report_2014.pdf.
- Ellen Macarthur Foundation. (2014b). *The New Plastics Economy: Rethinking the Future of Plastics*. <https://doi.org/10.4324/9780203965450>
- Emery, W. J., Fowler, C. W., & Maslanik, J. A. (1997). Satellite-derived maps of Arctic and Antarctic sea ice motion: 1988–1994. *Geophysical Research Letters*, 24(8), 897–900.
- Environment and Climate Change Canada. (2017). *Solid Waste Management for Northern and Remote Communities: Planning and Technical Guidance Document*. Government of Canada. Retrieved from: http://publications.gc.ca/collections/collection_2017/eccc/En14-263-2016-eng.pdf.
- Environment and Climate Change Canada. (2018). *Municipal solid waste: A shared responsibility*. November 26. Retrieved from: <https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/municipal-solid/shared-responsibility.html>.
- Environment and Climate Change Canada. (2019). *Economic Study of the Canadian Plastics Industry, Markets and Waste: Summary Report*. Government of Canada.
- Environment and Natural Resources. (2014). *Waste Reduction and Recovery Program 2012–2013 Annual Report*. Government of the Northwest Territories. Retrieved from: https://www.enr.gov.nt.ca/sites/enr/files/waste_reduction_and_recovery_program_2012-13_annual_report_final_-_february_2014.pdf.
- Eriksen, M., et al. (2014). Plastic pollution in the world's oceans: More than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. *PLoS ONE*, 9(12), 1–15. <https://doi.org/10.1371/journal.pone.0111913>
- Exp Services Inc. (2014a). *City of Iqaluit Solid Waste Management Draft Plan*. Retrieved from: <http://iqaluitwasteproject.files.wordpress.com/2013/12/draft-solid-waste-management-plan-english-2013.pdf>.
- Exp Services Inc. (2014b). *Nunavut Solid Waste Management Plan*. Retrieved from: <http://www.cgs.gov.nu.ca/rfp/Past%20Documents%20Sanikiluaq/Nunavut%20Solid%20Waste%20Management%20Plan.pdf>.
- European Environment Agency. (2011). New film on waste management in Greenland. October 13. Retrieved from: <https://www.eea.europa.eu/highlights/new-film-on-waste-management>
- George, Jane. (2018a). Arctic Council eyes action plan to reduce Arctic marine litter, microplastics. *Nunatsiq News*, August 30. Retrieved from: http://nunatsiq.com/stories/article/65674arctic_council_eyes_action_plan_to_reduce_marine_litter_microplastics/.
- George, Jane. (2018b). Group wants to lower cost of tampons and sanitary pads for Northern women. *Nunatsiq News*, March 18. Retrieved from: https://nunatsiq.com/stories/article/65674flo_collective_wants_to_lower_tampon_and_pad_costs_for_northern_women/.
- GESAMP. (2015). *Sources, Fate and Effects of Microplastics in the Marine Environment: A Global Assessment*. International Maritime Organization. Retrieved from: www.imo.org.
- Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances*, 3(7), 1–5. <https://doi.org/10.1126/sciadv.1700782>
- Giroux, L., Giroux Environmental Consulting, Duncan Bury Consulting, Rene Drolet Consulting Services, & Ecoworks Consulting. (2014). *State of Waste Management in Canada*. Canadian Council of Ministers of Environment. Retrieved from: https://www.ccme.ca/files/Resources/wst_mgmt/State_Waste_Mgmt_in_Canada_April_2015_revised.pdf.
- Golder Associates Ltd. (2016). *Study of NWT Waste Management Systems: Landfill Site Risk Factors, Waste Generation and Management Costs in the NWT* (Vol. 2). Retrieved from: https://www.enr.gov.nt.ca/sites/enr/files/resources/golder_report_volume_2_nwt_waste_study_final_with_disclaimer_dec2016.pdf.
- Golder Associates Ltd. (2018). *Waste Management in the Northwest Territories*. 2018 Swana Northern Lights Conference. Retrieved from: <https://swananorthernlights.org/wp-content/uploads/2017/05/Paul-Dewaele-NWT-Presentation-SWANA-Edmonton-2018-Draft-LPH-002-1.pdf>.
- Goldhar, C., Sheldon, T., & Bell, T. (2013). *SakKijanginnatuk Nunalik: Understanding the Risks and Developing Best Practices for Sustainable Communities in Nunatsiavut*. Retrieved from: <https://www.turnbackthetide.ca/files/resources/Understanding-the-Risks-Report.pdf>.
- Government of Canada. (2005). *Land Claims Agreement between the Inuit of Labrador and Her Majesty the Queen in Right of Newfoundland and Labrador and Her Majesty the Queen in Right of Canada*, S.C. 2005, c. 27. Retrieved from: <https://laws-lois.justice.gc.ca/eng/acts/l-4.3/page-1.html>.
- Government of Canada. (2018). *Oceans Plastics Charter*. Retrieved from: https://www.canada.ca/content/dam/eccc/documents/pdf/pollution-waste/ocean-plastics/Ocean%20Plastics%20Charter_EN.pdf.
- Government of Canada. (2019). *Overview of Extended Producer Responsibility in Canada*. Retrieved from: <https://www.canada.ca/en/environment-climate-change/services/managing-reducing-waste/overview-extended-producer-responsibility/inventory-recycling-programs.html>.

- Government of Newfoundland and Labrador. (2014). *Solid Waste Management Strategy: Performance Monitoring Report*. Retrieved from: https://www.mae.gov.nl.ca/waste_management/WM_Report.pdf.
- Government of Newfoundland and Labrador. (2018). *Plastic Shopping Bag Management in Newfoundland and Labrador: Status and Options*. Retrieved from: https://www.mae.gov.nl.ca/env_protection/waste/guidancedocs/Plastic_Bag.pdf.
- Government of the Northwest Territories. (2016). *Waste Reduction and Recovery Program 2015–2016*. Retrieved from: https://www.enr.gov.nt.ca/sites/enr/files/128-wrrp_ar_press.pdf.
- Government of the Northwest Territories. (2017). *Developing a Waste Resource Management Strategy*. Retrieved from: https://www.enr.gov.nt.ca/sites/enr/files/resources/final_pdf_env_wrrp_discussion_paper_for_development_of_waste_resource_management_strategy_november_2017.pdf.
- Government of the Northwest Territories. (2018). *Waste Resource Management Strategy*. Retrieved from: <https://www.enr.gov.nt.ca/en/services/waste-reduction-and-recycling/waste-resource-management-strategy>.
- Government of the Northwest Territories. (n.d.). *Beverage Container Program*. Retrieved from: <https://www.enr.gov.nt.ca/en/services/beverage-container-program>.
- Government of Nunavut. (2014). *Solid Waste Operation and Maintenance Plan*. Retrieved from: <http://www.cgs.gov.nu.ca/rfp/Past%20Documents%20Sanikiluaq/Solidwaste%20Operation%20and%20Maintenance%20Plan%20for%20Hamlet%20of%20Sanikiluaq%202014-ILAE.pdf>.
- Government of Nunavut. (n.d.). *Solid Waste Management in Nunavut: A Background*. Retrieved from: <https://www.gov.nu.ca/sites/default/files/Solid%20Waste%20Management%20in%20Nunavut.pdf>.
- Gulgielmi, Georgia. (2017). In the next 30 years, we'll make four times more plastic waste than we ever have. *Science*, July 19. Retrieved from: <https://www.sciencemag.org/news/2017/07/next-30-years-we-ll-make-four-times-more-plastic-waste-we-ever-have>.
- Guo, Y., Chen, L., Wu, J., Hua, J., Yang, L., Wang, Q., & Zhou, B. (2019). Parental co-exposure to bisphenol A and nano-TiO₂ causes thyroid endocrine disruption and developmental neurotoxicity in zebrafish offspring. *Science of the Total Environment*, 650, 557–565.
- Gurman, Elissa. (2017). How much do Canadian women actually spend on tampons and pads each year? *Chatelaine*, 7 July. Retrieved from: <https://www.chatelaine.com/living/how-much-do-periods-cost/>.
- Hallanger, I. G., & Gabrielsen, G. W. (2018). *Plastic in the European Arctic*. Norwegian Polar Institute. Retrieved from: <https://data.npolar.no/publication/586ecfcc-676c-4cd1-b552-2aa43241f3e0>.
- Hinde, D. (2019). The Swedish Recycling Revolution. Retrieved from: <https://sweden.se/nature/the-swedish-recycling-revolution>.
- Inuit Tapiriit Kanatami (ITK). (n.d.). *Kuujuaq Greenhouse*. Retrieved from: <https://www.itk.ca/nuluqaq-mapping-project/initiative/kuujuaq-greenhouse/>.
- Inuvialuit Regional Corporation. (2016). *Inuvialuit Regional Corporation: Strategic Plan 2016 to 2019*. Retrieved from: <https://www.irc.inuvialuit.com/system/files/Strategic%20Plan%202016%20-%202019.pdf>.
- Inuvik Community Greenhouse. (n.d.). *Convenient Compost Collection in Inuvik*. Retrieved from: <https://www.inuvikgreenhouse.com/2017/10/31/convenient-compost-collection-in-inuvik/>
- Jambeck, J., et al. (2015). Plastic waste inputs from land into the ocean. *Science*, 347(6223), 768–771. <https://doi.org/10.1017/CBO9781107415386.010>
- Kanhai, L. D. K., Gårdfeldt, K., Lyashevskaya, O., Hassellöv, M., Thompson, R. C., & O'Connor, I. (2018). Microplastics in sub-surface waters of the Arctic Central Basin. *Marine Pollution Bulletin*, 130, 8–18. <https://doi.org/10.1016/j.marpolbul.2018.03.011>
- KBL Environmental Ltd. (2013). *Municipal Hazardous Waste Inventory Beaufort Delta / Arctic Pilot Project*. Government of the Northwest Territories Department of Environment. Retrieved from: <https://www.enr.gov.nt.ca/en/services/managing-hazardous-waste>.
- Keske, C., Mills, M., Tanguay, L., & Dicker, J. (2018). Waste management in Labrador and northern communities: Opportunities and challenges. *The Northern Review*, 47, 79–112. <https://doi.org/10.22584/nr47.2018.005>
- Lebreton, L. C. M., et al. (2017). River plastic emissions to the world's oceans. *Nature Communications*, 8(15611). <https://doi.org/10.1038/ncomms15611>
- Lewis, E. (2018). Circular economy. In *Sustainspeak: A Guide to Sustainable Design Terms*. Routledge. <https://doi.org/10.4324/9781315270326-38>
- Lusher, A. L., Burke, A., O'Connor, I., & Officer, R. (2014). Microplastic pollution in the Northeast Atlantic Ocean: Validated and opportunistic sampling. *Marine Pollution Bulletin*, 88(1–2), 325–333. <https://doi.org/10.1016/j.marpolbul.2014.08.023>
- Lusher, A. L., Tirelli, V., O'Connor, I., & Officer, R. (2015). Microplastics in Arctic polar waters: The first reported values of particles in surface and sub-surface samples. *Scientific Reports*, 5, article 14947. <https://doi.org/10.1038/srep14947>
- Maclellan, G. (2013). *Electronic Products Recycling Association: Product Stewardship Plan*. Electronic Products Recycling Association. Retrieved from: https://www.recyclemyelectronics.ca/nl/wp-content/uploads/2017/09/EPRA_Stewardship_Plan_NL_2013.pdf.

- Mancini, M., & Vellani, N. (2016). A \$31B problem: How Canada sucks at reducing food waste. CBC News, October 26. Retrieved from: <https://www.cbc.ca/radio/thecurrent/the-current-for-april-5-2018-1.4605392/how-bad-is-canada-s-food-waste-problem-among-the-world-s-worst-report-finds-1.4606012>; <https://www.cbc.ca/news/business/canada-food-waste-1.3813965>.
- McCarthy, J., & Sanchez, E. (2016). These Countries Are the Best and Worst Recyclers in the World. Global Citizen. Retrieved from: <https://www.globalcitizen.org/en/content/best-and-worst-recyclers-in-the-world/>.
- Mil-tek. (2015). Miltek in Greenland: Helping residents to minimize their waste. News Archive April 17. Retrieved from: <https://www.miltekusa.com/news/mil-tek-news-archive/miltek-in-greenland-helping-residents-to-minimize-their-waste?PID=28709>.
- Mil-tek. (2019). Air-powered balers and compactors for cardboard and plastic waste. Retrieved from: <http://www.miltek.ca/AIR-POWERED-BALERS.aspx?ID=19023>.
- Morgana, S. et al. (2018). Microplastics in the Arctic: A case study with sub-surface water and fish samples off Northeast Greenland. *Environmental Pollution*, 242(B), 1078–1086. DOI: [10.1016/j.envpol.2018.08.001](https://doi.org/10.1016/j.envpol.2018.08.001)
- Multi-Materials Stewardship Board. (2015). *Guiding our province to a greener future*. Retrieved from: https://mmsb.nl.ca/wp-content/uploads/2014/05/2011-2012-Annual-Report_.pdf.
- Municipality of Baker Lake. (2013). Baker Lake Community Plan: Schedule 1 By-law No. 218.
- Municipality of Pangnirtung. (2018). Municipal Services. Retrieved from: <http://www.peterborough.ca/AssetFactory.aspx?did=9719>.
- Municipality of Pangnirtung. (n.d.). *Hamlet of Pangnirtung: Waste Management Options*. Retrieved from: <https://www.nunavuteda.com/sites/default/files/WasteManagement-Pangnirtung.pdf>.
- National Aboriginal Economic Development Board. (2014). *Study on Addressing the Infrastructure Needs of Northern Aboriginal Communities*. Retrieved from: <http://www.naedb-cndea.com/reports/northern-infrastructure-report.pdf>.
- The North West Company. (2013). *Canada's Oldest Retailer Reduces Plastic Bag Usage in Nunavut and Nunavik by 67%*. News release, April 16. Retrieved from: <https://www.northwest.ca/uploads/documents/mr-2013-04-16.pdf>.
- Nuna Burnside Engineering and Environmental Ltd. (2010). *Solid Waste Management Report: Hamlet of Arviat*. Retrieved from: [ftp://ftp.nwb-oen.ca/registry/3%20MUNICIPAL/3A/3AM%20-%20Municipality/3AM-ARV1016/3%20TECH/4%20WASTE%20DISP%20\(D\)/D14%20Solid%20Waste%20Management%20Report/101231%203AM-ARV1015%20SWM%20Report-ILAE.pdf](ftp://ftp.nwb-oen.ca/registry/3%20MUNICIPAL/3A/3AM%20-%20Municipality/3AM-ARV1016/3%20TECH/4%20WASTE%20DISP%20(D)/D14%20Solid%20Waste%20Management%20Report/101231%203AM-ARV1015%20SWM%20Report-ILAE.pdf).
- N.W.T. Bureau of Statistics. (2013). *Aklavik Infrastructure Profile*. Retrieved from: https://www.statsnwt.ca/community-data/Infrastructure%20PDF/Aklavik_In.pdf.
- Obbard, R. W. (2017). Microplastics in polar regions: The role of long-range transport. *Current Opinion in Environmental Science & Health*, 1, 24–29. <https://doi.org/10.1016/j.coesh.2017.10.004>
- Obbard, R. W., Sadri, S., Wong, Y. Q., Khitun, A. A., Baker, I., & Richard, C. (2014). Global warming releases microplastic legacy frozen in Arctic sea ice. *Earth's Future*, 2, 315–320. <https://doi.org/10.1002/2014EF000240>. Abstract
- The Ocean Conservancy. (2015). *Stemming the Tide: Land-Based Strategies for a Plastic-Free Ocean*. Retrieved from: <https://oceanconservancy.org/wp-content/uploads/2017/04/full-report-stemming-the.pdf>.
- Oceans North Conservation Society, WWF-Canada, & Ducks Unlimited Canada. (2018). *Canada's Arctic Marine Atlas*. Retrieved from: <https://oceansnorth.org/wp-content/uploads/2018/09/Canadas-Arctic-Marine-Atlas.pdf>.
- Parajuli, R. P., Goodrich, J. M., Chan, L. H., Ayotte, P., Lemire, M., Hegele, R. A., & Basu, N. (2018). Genetic polymorphisms are associated with exposure biomarkers for metals and persistent organic pollutants among Inuit from the Inuvialuit Settlement Region, Canada. *Science of the Total Environment*, 634, 569–578.
- Peeken, I. et al. (2018). Arctic sea ice is an important temporal sink and means of transport for microplastic. *Nature Communications*, 9(1), 1–12. <https://doi.org/10.1038/s41467-018-03825-5>
- Product Care Association of Canada. (2017). *Newfoundland and Labrador Paint Stewardship Program 2016 Annual Report*. Retrieved from: <https://www.productcare.org/app/uploads/2018/12/NL-2017-Paint-annual-Report.pdf>.
- Pucci, Michelle. (2019). Iqaluit city council moves to ban single-use plastic bags. CBC News, July 3. Retrieved from: <https://www.cbc.ca/news/canada/north/iqaluit-plastic-bag-ban-1.5198438>.
- Qikiqtaaluk Environmental. (n.d.). Retrieved from: <http://qenv.ca/>.
- Rabble. (n.d.). Abluqta Society starts food bank and thrift store in Baker Lake Nunavut. Rabble. Retrieved from: <http://rabble.ca/toolkit/rabblepedia/abluqta-society-starts-food-bank-and-thrift-store-baker-lake-nunavut>.
- Renewable Resources Environment Lands and Parks Department. (n.d.). *Nunavik Residual Materials Management Plan: Executive Summary*. Kativik. Retrieved from: http://www.krg.ca/images/stories/docs/Environment/PGMR_Eng.pdf.
- Rogers, S. (2014a). Nunavik ramps up recycling, waste management projects. *Nunatsiaq News*, December 16. Retrieved from: http://nunatsiaq.com/stories/article/65674nunavik_ramps_up_recycling_waste_management_projects
- Rogers, S. (2014b). From landfills to local environment – How to curb Nunavut's toxic waste. *Nunatsiaq News*, May 12. Retrieved from: https://nunatsiaq.com/stories/article/65674from_landfills_to_local_environment_how_to_stop_the_flow_of_nunavuts_t/.

- Rogers, S. (2015). KRG says yes to Nunavik's waste management plan. *Nunatsiaq News*, March 2. Retrieved from: http://nunatsiaq.com/stories/article/65674krg_oks_nunaviks_waste_management_plan/
- Scott, Mackenzie. (2019). Inuvik youth take aim at Northmart's plastic use. *CBC News*, 4 April. Retrieved from: <https://www.cbc.ca/news/canada/northmart-youth-plastic-climate-action-inuvik-1.5085235>.
- Scout Environmental. (2016). *Protecting the Land: A Practical Guide to ELV and Sustainable Waste Management in Nunatsiavut*. Retrieved from: <https://tundratakeback.ca/wp-content/uploads/2018/06/Protecting-the-Land-A-Practical-Guide-to-ELV-Recycling-in-the-North.pdf>.
- Scout Environmental. (2018). *Tundra Take-Back Nunatsiavut*.
- Sebillé, E. et al. (2012). Origin, dynamics and evolution of ocean garbage patches from observed surface drifters. *Environmental Research Letters*, 7, 1–6. <http://dx.doi.org/10.1088/1748-9326/7/4/044040>
- Solid Waste Alaska Taskforce. (n.d.). Retrieved from: <http://www.907swat.org/>.
- Song, G. (2016). Lessons from Dumpcano: Governance issues in solid waste management in Nunavut. *Arctic Yearbook*, 249–270.
- Sonnevera International Corp. (2015). *Summary of Targeted Materials for Extended Producer Responsibility in the North*. Retrieved from: <https://www.ccme.ca/files/Resources/waste/extended/EPR%20in%20North%20sonnevera%20intl%201.0.pdf>.
- Sustainable Development Working Group. (2019). *Best Waste Management Practices for Small and Remote Arctic Communities*. Arctic Council. Retrieved from: https://oaarchive.arctic-council.org/bitstream/handle/11374/2387/SDWG-REPORT_BEST_WASTE_PRACTICES_SMALL_COMMUNITIES-14-February-2019.pdf.
- Tekman, M. B., Krumpfen, T., & Bergmann, M. (2017). Marine litter on deep Arctic seafloor continues to increase and spreads to the North at the HAUSGARTEN observatory. *Deep-Sea Research Part I: Oceanographic Research Papers*, 120, 88–99. <https://doi.org/10.1016/j.dsr.2016.12.011>
- Thompson, R.C., et al. (2004). Lost at sea: Where is all the plastic? *Science*, 304, 838. DOI: [10.1126/science.1094559](https://doi.org/10.1126/science.1094559)
- Tremblay, D. (2017). *Watching Our Waste-Line: Used Electronics, Tires and Organics*. The Gordon Foundation. Retrieved from: http://gordonfoundation.ca/app/uploads/2017/05/TGF_ResearchPapers_Individual_Tremblay_digital.pdf.
- Trevaill, A. M., Kühn, S., & Gabrielsen, G. W. (2015). *The State of Marine Microplastic Pollution in the Arctic*. Norwegian Polar Institute. Retrieved from: <https://data.npolar.no/publication/9f028b7c-1c2f-48e1-9542-7d834094e9f7>.
- Truth and Reconciliation Commission of Canada (TRC). (2015). *Honouring the Truth, Reconciling for the Future: Summary of the Final Report of the Truth and Reconciliation Commission of Canada*. Retrieved from: http://nctr.ca/assets/reports/Final%20Reports/Executive_Summary_English_Web.pdf.
- United Nations. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. Retrieved from: <https://sdgs.un.org/sites/default/files/publications/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf>
- Varga, Peter. (2013). Arctic Co-ops recycling turns empty pop cans into cash. *Nunatsiaq News*, May 29. Retrieved from: https://nunatsiaq.com/stories/article/65674arctic_co-ops_recycling_turns_empty_pop_cans_into_cash/.
- Varga, Peter. (2014a). Cambridge Bay lays groundwork for new waste management plan. *Nunatsiaq News* February 4. Retrieved from: https://nunatsiaq.com/stories/article/65674cambridge_bay_lays_groundwork_for_new_waste_management_plan/.
- Varga, Peter. (2014b). Iqaluit entrepreneur keeps empty cans and bottles flowing out of Iqaluit. *Nunatsiaq News*, April 25. Retrieved from: https://www.nunatsiaqonline.ca/stories/article/65674iqaluit_entrepreneur_keeps_empty_cans_and_bottles_flow_out_of_iqalu/.
- Wang, Q., Myers, P. G., Hu, X., & Bush, A. B. G. (2012). Flow constraints on pathways through the Canadian Arctic archipelago. *Atmosphere – Ocean*, 50(3), 373–385. <https://doi.org/10.1080/07055900.2012.704348>
- Weaver, F. (2013). *Finnish families get to grips with trash*. Finland Promotion Board. Retrieved from: <https://finland.fi/life-society/finnish-families-get-to-grips-with-trash/>.
- Zahara, A. R. D. (2015). *The Governance of Waste in Iqaluit, Nunavut*. (Master's thesis, Queen's University, Kingston, Ontario, Canada).



APPENDICES

Appendix A: Plastics in the Canadian Arctic

A.1: Classification of Ocean Plastics

Macroplastics	Microplastics	Nanoplastics
> 5mm in diameter	< 5mm in diameter	< 100 nanometres
Fishing gear Bottles Floating debris	Two sub-types: 1. Purposely manufactured to be small: cosmetic microbeads, micro-fibers for textiles, and pellets AKA “nurdles.” (Morgana et al., 2018) 2. Fragmented microplastics: begin as macroplastics and then are broken down; coastal environments accelerate fragmentation through sand abrasion, wave action, and photo-degradation. (Thompson, 2004)	Even more difficult to detect than microplastics, given their incredibly small size. Once plastics reach nanoscale size, they can continue to be transported undetected through water, soil and air. (Alimi et al., 2018)

A.2: Pathways for Plastic into Canadian Arctic Waters

Research shows that microplastics and floating plastic debris are present in the Arctic Ocean's water column, on its sea floor, and in the sea ice. By looking at disintegrated pieces of plastic found in Arctic waters, researchers have determined that most plastics found in the offshore region are **not local**, while those found in inshore areas are typically local. Research shows that marine plastic waste is transported to coastal communities by ocean currents, by river run-off, and in melting sea ice (for example, Cózar et al., 2017; Lusher et al., 2015; Sebille et al., 2012). Unfortunately, a limiting factor to fully understanding the transport and distribution of plastics in the Arctic is the lack of data for the northern polar region, particularly for Canadian Arctic waters. This section explores the possible trajectories plastics might take to arrive in the study area, the likelihood of this occurrence, and estimates of total external inputs.

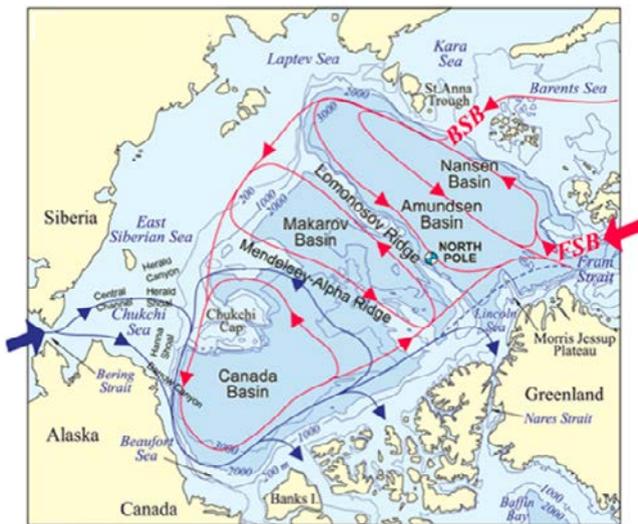
Ocean Currents

Plastics are transported by ocean currents from distant sources below the Arctic Circle to the Arctic Ocean. Map A.1 shows the main pathways for plastics, which include the Bering Strait (Pacific waters), the Fram Strait and the Barents Sea (Atlantic waters). Plastics appear to accumulate between Eastern Greenland and the Barents Sea, indicating that the Atlantic Current and other currents based in the Arctic Ocean aid in the deposition of plastics into this area.

And, although there does not seem to be significant evidence to suggest this is happening now, currents through the archipelago and the structure of the archipelago may force debris to accumulate in specific areas, or, in other words, to create garbage patches.

Plastics are also distributed into the subsurface waters of the Arctic Ocean through vertical mixing,¹⁴ and even deposited onto the ocean floor, which is a known sink for plastics (see, for example, Tekman et al., 2017).

Map A.1 Ocean Currents



Source: Aksenov et al. (2016). (Note: Blue arrows show Pacific Water circulation after McLaughlin et al. [2002]. Red arrows mark Atlantic Water pathways with the Fram Strait Branch [FSB] and Barents Sea Branches [BSB] of the Atlantic flow.)

Sea Ice

Sea ice can transport and deposit microplastics locally and throughout the Arctic Ocean. One study found that the concentration of microplastic particles in Arctic Ocean samples was significantly higher¹⁵ than values found in the North Atlantic or the North Pacific Gyre (Obbard et al., 2014). The authors of this study speculated that, like the ocean floor, sea ice is a major sink for microplastics, estimating that if all the sea ice were to melt at once, over a trillion particles would be released into the Arctic Ocean surface waters.¹⁶ Their hypothesis was confirmed by a more recent study, which showed that sea ice does serve as a temporary sink for microplastics (Peeken et al., 2018).

River Run-Off

While little is known about river run-off as a specific pathway, we do know that it has the **potential** to carry plastics into Arctic waters, similar to what has been documented at lower latitudes (see, for example, Lebreton et al., 2017). Major river systems contribute a significant amount of river run-off to the Mackenzie Basin and the Canadian Archipelago, suggesting that contaminated run-off from these rivers poses a risk to Arctic waters.¹⁷ Some research suggests that fresh coastal waters actually dilute polluted waters (Lusher et al., 2014), and that the presence of fresh water seems to correlate with a decline in the presence of plastic debris in surface water (Lusher et al., 2015). Change in the salinity or temperature of oceanic waters wrought by the introduction of fresh water may influence the placement and distribution of plastic debris in the water column (Lusher et al., 2015).

It is also important to note that plastic and other forms of waste are derived from growing industries, for example from fisheries, mining and shipping.

Appendix B: Methodology

Waste profiles were developed to provide an analysis of waste accumulated within northern coastal communities across all of Inuit Nunangat. To develop the profiles, information was collected on community populations (based on the Statistics Canada 2016 population census), local waste management systems (based on various reports and available resources), and estimates of waste metrics (based on various reports and available resources).

To find or derive per capita waste estimates for all of Inuit Nunangat, either at the regional level or for each community, a search was conducted online to gather all the best available sources of information at the time. The research took place from July 2018–February 2019. The search was conducted primarily on search engines, as well as through academic publication platforms. “Best available” was determined based on multiple criteria: (1) whether the resources reported on waste management in the regions, (2) whether the resources were the most recent resource available, (3) whether the resources were published and/or accepted by the region, (4) whether the resources reported on waste management and were comparable to the regions, and (5) whether the resources were the finest resolution, regionally and/or locally.

The resource search varied for each region, and attempts were made to access and/or gather best available information from the government directly via personal communication with government staff at the time.

Once the best available information at the time was identified, based on the criteria above, the resource was reviewed to identify local waste management systems and estimates of waste metrics. For some regions, waste estimates were already calculated for annual waste generation, while for others the calculation was done based on a suggested waste generation rate. The data found in the available reports and resources, as well as the figures calculated for the purpose of this study, are explained in detail for each region below.

For Nunatsiavut:

- The Aivek Stantec Consulting 2017 report titled *Solid Waste Management Study – Northern Labrador Region: A Sustainable Waste Management Strategy for Nunatsiavut* was received via personal communication with government staff at the time.
- The report included waste quantity estimates which were based on “all Inuit Community Governments (IGCs) in 2016, in tons” found in Tables 3-5, 3-10 and 3-11 of the report. These estimates included residential, industrial-commercial-institutional, construction and bulky waste. Not included within the estimates was hazardous waste or a recyclables category.
- The report included composition values which were compiled from local estimates and the existing literature, including studies from northern regions, remote communities and Indigenous communities.
- The report’s calculations for estimated values were based on a conversion factor of 0.099 tonnes/cubic metre for uncompacted waste and selected waste generation ratio of kg/person/year.
- Based on the report’s estimated waste values, provided in kg/person/year, we calculated estimated per capita rates per community, based on the population from the 2016 census from Statistics Canada.
- We then generated a waste accumulation value – an idea of the amount of waste which had piled up throughout these communities’ development – by multiplying this rate over 25 years (based on the most recent population data from the 2016 census profile).
 - For example, Rigolet, Nunatsiavut
 - Table 3-5 of the report
 - Rigolet’s total waste generation in tonnes by community of 286 tonnes was divided by the conversion factor of 0.099 tonnes/m³ = 2,888.8888
 - 2,888.888 tonnes/m³ was then divided by the population from the 2016 census (305)
 - 2,888.888 m³/305 people = 9.5 m³/cap/year
 - 9.5 m³/cap/year × 305 people × 25 years = 72,438 m³ accumulation
- The plastic percentage rate, which was estimated in the Aivek report, was then applied to the 25-year accumulation value for all communities, and this gave the amount of accumulated plastics.
 - For example, Rigolet, Nunatsiavut
 - 72,438 × 9% = 6,519 m³ of plastic

For Nunavik:

- The Kativik Renewable Resources report titled *Nunavik Residual Materials Management Plan* was found online.
- The report included waste quantity estimates which were based on municipal, industrial-commercial-institutional and construction-renovation-demolition sources in both tonnes and cubic metres, found in Table 10 of the report.
- The report included composition values, which were based on three studies, as no characterization studies had been conducted in the region; references for their composition estimation can be found on pages 28 and 37 of the report.
- The report calculations for estimated values were based on a conversion factor of 0.099 tonnes/cubic metre for uncompacted waste – this was used in our calculations. However, estimated values were provided in cubic metres as well.
- Based on the report's total estimated annual waste values, provided in both tonnes and cubic metres, we calculated estimated per capita rates for each community, based on the population estimates in Table 10 of the report.
- We then generated a waste accumulation value – an idea of the amount of waste which had piled up throughout these communities' development – by multiplying this rate over 25 years (based on the most recent population data from the 2016 census profile).
 - For example, Akulivik, Nunavik:
 - Table 10 of the report
 - Akulivik's "total estimated annual quantities of residual materials by sector and village" (5,255 m³) was divided by the population provided in the table (548)
 - 5,255 m³/548 people = 9.6 m³/cap/year
 - 9.6 m³/cap/year × 633 people × 25 years = 151,920 m³ accumulation
- The plastic percentage rate, which was estimated in the Kativik report, was then applied to the 25-year accumulation value for all communities, and this gave the amount of accumulated plastics.
 - For example, Akulivik, Nunavik:
 - 151,920 m³ × 8.6% = 13,065 m³ of plastic

For Inuvialuit Settlement Region:

- The Johnson et al. 2017 report titled *Aklavik, NWT – Solid Waste Planning Study* was found online.
- This report included a waste quantity estimate calculation based on the standard N.W.T. waste generation rate of 0.014 m³/person/day.
- Using this waste generation rate, we calculated estimated per capita rates per community, based on the 2016 population census.
- We then generated a waste accumulation value – an idea of the amount of waste which had piled up throughout these communities' development – by multiplying this rate over 25 years (based on the most recent population data from the 2016 census profile).
 - For example, Inuvik, Inuvialuit Settlement Region:
 - Page 7, Table 3.2 of the report
 - We used the Inuvik waste generation rate of 0.014 m³/person/day to calculate estimated per capita rates for the individual communities
 - 0.014 m³/per/day × 365 days = 5.1 m³/cap/year
 - 5.1 m³/cap/year × 3,243 people × 25 years = 413,483 m³ accumulation
- The report included no composition values or characterization of the waste estimation. Therefore, additional reports were used for estimating what percentage of waste is made up of plastics at the regional level.
- The best available information at the time for estimating what percentage of waste is plastic was then found from two reports:
 - AECOM 2018. Hamlet of Tuktoyaktuk, *Solid Waste Disposal Facilities Operation and Maintenance Plan*. September 2018.
 - Dillon Consulting Ltd 2016. Hamlet of Ulukhaktok, NT, *Solid Waste Facility Operation and Maintenance Plan*. March 2016.
- From these two reports only an estimated rate of plastics could be found, which included both rubber and leather. It should therefore be considered a potential over-estimation.
- This estimated plastics percentage rate was then applied to the 25-year accumulation value for all communities, and this gave the estimated amount of accumulated plastics.
 - For example, Inuvik, Inuvialuit Settlement Region:
 - 413,483 × 14% = 57,888 m³ of plastics

For Nunavut:

- The Arktis Solutions 2011 report titled “Report on Current State of Solid Waste Management and Facilities in Nunavut and Cost-Benefit Analysis of Selected Solid Waste Management Approaches” was found online.
- This report included waste quantity estimates, found in Table 2.3b of the report, based on the reported number of garbage truck trips per day and garbage truck volume. The study estimated the average annual garbage volume per capita to be 8.5 m³/person/year, noting that this value is about 55 per cent higher than the value of 0.014 m³/person/day reported in relevant literature.
- We then generated a waste accumulation value – an idea of the amount of waste which has piled up throughout these communities’ development – by multiplying this rate over 25 years (based on the most recent population data from the 2016 census profile).
 - For example, Kimmirut, Nunavut:
 - Table 2.3b of the report
 - The report’s estimated annual deposited volume for Kimmirut (7,488 m³) was divided by the population provided in the table (449)
 - $7,488 \text{ m}^3 / 449 = 16.7 \text{ m}^3/\text{cap}/\text{year}$
 - The report provided this calculation for 14 communities and then they took the average per capita rate of 8.5 m³/cap/year
 - $8.5 \text{ m}^3/\text{cap}/\text{year} \times 389 \text{ people} \times 25 \text{ years} = 82,663 \text{ m}^3$ accumulation
- The report included composition estimates in which waste composition was approximated into three broad categories: municipal solid waste, bulky waste and hazardous waste. The report provided an estimate of the volume of each, as an audit to verify the composition and quantity had not been completed; the approximations were derived from “applicable studies and literature reported data.”
- The best available information at the time for estimating the percentage of plastic waste was then found in two reports:
 - The Canadian Council of Ministers of the Environment 2016. Summary of Targeted Materials for Extended Producer Responsibility in the North. (<https://www.ccme.ca/files/Resources/waste/extended/EPR%20in%20North%20sonnevera%20intl%201.0.pdf>)
 - Government of Nunavut 2014. Nunavut Solid Waste Management Plan. October 24, 2014
- From these reports an estimated rate of plastics could be found.
- This estimated plastic percentage rate was then applied to the 25-year accumulation value for all communities, and this gave the amount of accumulated plastics.
 - For example, Kimmirut, Nunavut:
 - $82,663 \text{ m}^3 \times 8.4\% = 6,944 \text{ m}^3$ of plastics

For Canada:

- The Conference Board of Canada 2015 report titled *Waste Generation, Canada and Provinces* was found online.
- This report included estimated waste generation for all of Canada based on the population in 2012.
- In order to calculate estimated waste per capita, in m³/cap/year, we converted the estimated waste generation value (720 kg) into tonnes.
 - $720 \text{ kg} / 1,000 = 0.72 \text{ tonnes}/\text{cap}/\text{year}$
- We then took the 0.72 tonnes/cap/year and applied the uncompacted waste conversion factor (tonnes/0.099) to calculate an estimated per capita in m³/cap/year.
 - $0.72 \text{ tonnes} / 0.099 = 7.3 \text{ m}^3/\text{cap}/\text{year}$
- We then generated a waste accumulation value – an idea of the amount of waste which has piled up over the past 25 years in the country – by multiplying this rate over 25 years (based on the most recent population data from the 2016 census profile).
 - $7.3 \text{ m}^3/\text{cap}/\text{year} \times 35,158,304.00 \times 25 = 6,416,390,480.00 \text{ m}^3$ accumulation
- There were no available resources which estimated composition of waste generation for Canada; therefore, calculating an estimated plastics accumulation was not possible.

It is important to note that it was not easy to find data on waste, and that only estimates could be derived for Inuit Nunangat, with various levels of resolution. The available resources relied on an N.W.T. study which uses the calculation of 0.015 kg/person/day¹⁸ based on a reference to “MACA (1986),” which can no longer be found or accessed; given that most of the data for Inuit Nunangat (three out of four regions) continue to rely on this calculation, which is now over 30 years old, it is likely time to review whether it is still a valid calculation.

While we used the available data to derive waste accumulation estimates for each community, we recognize that there is considerable uncertainty in such estimates, and that community-to-community or even region-to-region comparison may be inappropriate. Each region and report approached the composition estimates and classification of waste differently. Most studies included additional composition categories not typically found in MSW estimates, and there was no consistent nomenclature used across the available resources – hence the terminology used within each report or resource was used when describing the methodology for that specific report or resource. Another issue is that the terms “tonnes” and “tons” are sometimes used interchangeably in the literature. For the purposes of this report and in line with Canadian spelling, we have consistently used “tonne” to refer to a metric ton. The lack of reliable, comparable data indicates a need for improved efforts to document waste streams in the North so that the effectiveness of waste reduction strategies can be monitored.

For this report, the key message is that northern communities, like communities throughout Canada, must manage large volumes of waste, creating problems with health, land management, the environment, aesthetics and quality of life. Waste reduction and waste management strategies are thus urgently needed.

Appendix C: Green or Eco-Friendly Alternatives

The number of green or eco-friendly product alternatives available to consumers is increasing all the time. Here we include a list of products, with websites where they are available or that provide more information, that may be of particular interest to families, communities, retailers, governments and businesses across Inuit Nunangat.

- Reusable utensils for travel:
https://www.amazon.ca/Sunwinc-Silverware-Portable-Stainless-Chopsticks/dp/B07PYTG3GP/ref=sr_1_6
- Reusable kitchenware for travel:
<https://www.amazon.ca/GSI-Outdoors-Cascadian-Person-Tableset/dp/B001LF3IBQ/r>
- Reusable bags:
<https://www.icegreen.ca/products/reusable-bags/>
- Washing bag:
<http://guppyfriend.com/en/>
- The Cora Ball:
<https://coraball.com/>
- Filtrrol 160 washing filter:
<https://www.septicsafe.com/washing-machine-filter/>
- Lint LUV-R washing filter:
<http://www.environmentalenhancements.com/>
- Xeros Technologies:
<https://www.xerostech.com/technology#xfiltra>
- Waste-to-energy incinerator:
<https://ecosolutions.com/green-clean/>
- Portable trash compactor:
<https://www.bestproducts.com/appliances/large-appliances/g328/best-trash-compactors/>
- Solar energy:
<http://aea.nt.ca/saving-energy/generation>
- Wind energy:
<https://www.windside.com/>
- Hydroponic greenhouses:
<https://sucseed.ca/>
- Waterless toilets:
<https://www.businessinsider.com/bill-gates-waterless-toilet-2016-11>

Appendix D: Waste Database

Region	Community Name	Population	Waste Accumulation (m ³)	Percentage Plastic	Plastics Accumulation (m ³)
Nunatsiavut	Nain	1,125	284,075	9.0%	25,567
	Hopedale	574	117,675	9.0%	10,591
	Rigolet	305	72,450	9.0%	6,521
	Postville	177	46,900	9.0%	4,221
	Makkovik	377	82,000	9.0%	7,380
Nunavik	Akulivik	633	151,920	8.6%	13,065
	Aupaluk	209	54,863	8.6%	4,718
	Inukjuak	1,757	412,895	8.6%	35,509
	Ivujivik	414	101,430	8.6%	8,723
	Kangiqsualujjuaq	942	228,435	8.6%	19,645
	Kangiqsujuaq	750	183,750	8.6%	15,803
	Kangirsuk	567	136,080	8.6%	11,703
	Kuujuaq	2,754	695,385	8.6%	59,803
	Kuujuarapik	686	180,075	8.6%	15,486
	Puvirnituq	1,779	426,960	8.6%	36,719
	Quaqtaq	403	99,743	8.6%	8,578
	Salluit	1,483	352,213	8.6%	30,290
	Tasiujaq	369	94,095	8.6%	8,092
	Umiujaq	442	107,185	8.6%	9,218
Inuvialuit	Inuvik	3,243	413,475	14.0%	57,887
	Aklavik	590	75,225	14.0%	10,532
	Tuktoyaktuk	898	114,500	14.0%	16,030
	Paulatuk	265	33,800	14.0%	4,732
	Sachs Harbour	103	13,125	14.0%	1,838
	Ulukhaktok	396	50,500	14.0%	7,070
Nunavut	Iqaluit	7,740	1,644,750	8.4%	138,159
	Arctic Bay	868	184,450	8.4%	15,494
	Arviat	2,657	564,625	8.4%	47,429
	Baker Lake	2,069	439,663	8.4%	36,932
	Cambridge Bay	1,766	375,275	8.4%	31,523
	Cape Dorset	1,441	306,225	8.4%	25,723
	Chesterfield Inlet	437	92,875	8.4%	7,802
	Clyde River	1,053	223,775	8.4%	18,797
	Coral Harbour	891	189,350	8.4%	15,905
	Gjoa Haven	1,324	281,350	8.4%	23,633
	Grise Fiord	129	27,425	8.4%	2,304
	Hall Beach	848	180,200	8.4%	15,137
	Igloolik	1,682	357,425	8.4%	30,024
	Kimmirut	389	82,675	8.4%	6,945
	Kugaaruk	933	198,275	8.4%	16,655
	Pangnirtung	1,481	314,725	8.4%	26,437
	Pond Inlet	1,617	343,625	8.4%	28,865
	Qikiqtarjuaq	598	127,075	8.4%	10,674
	Rankin Inlet	2,842	603,925	8.4%	50,730
	Repulse Bay (Naujaat)	1,082	229,925	8.4%	19,314
Sanikiluaq	882	187,425	8.4%	15,744	
Taloyoak	1,029	218,675	8.4%	18,369	
Whale Cove	435	92,450	8.4%	7,766	
Resolute Bay	198	42,075	8.4%	3,534	
Kugluktuk	1,491	316,850	8.4%	26,615	

Region	Community Name	Community Population	Average Number of Years Since Establishment/Incorporation	Estimated Annual 'Total Waste' Generation (m ³)	Estimated 'Total Waste' Accumulation (m ³)
Nunatsiavut	Nain	1,125	25	11,363	284,075
	Hopedale	574	25	4,707	117,675
	Rigolet	305	25	2,898	72,450
	Postville	177	25	1,876	46,900
	Makkovik	377	25	3,280	82,000
Nunavik	Akulivik	633	25	6,077	151,925
	Aupaluk	209	25	2,195	54,875
	Inukjuak	1,757	25	16,516	412,900
	Ivujivik	414	25	4,057	101,425
	Kangiqsualujjuaq	942	25	9,137	228,425
	Kangiqsujuaq	750	25	7,350	183,750
	Kangirsuk	567	25	5,443	136,075
	Kuujuaq	2,754	25	27,815	695,375
	Kuujuarapik	686	25	7,203	180,075
	Puvirnituq	1,779	25	17,078	426,950
	Quaqtaq	403	25	3,990	99,750
	Salluit	1,483	25	14,089	352,225
	Tasiujaq	369	25	3,764	94,100
	Umiujaq	442	25	4,287	107,175
Inuvialuit Settlement Region	Inuvik	3,243	25	16,539	413,475
	Aklavik	590	25	3,009	75,225
	Tuktoyaktuk	898	25	4,580	114,500
	Paulatuk	265	25	1,352	33,800
	Sachs Harbour	103	25	525	13,125
Nunavut	Ulukhaktok	396	25	2,020	50,500
	Iqaluit	7,740	25	65,790	1,644,750
	Arctic Bay	868	25	7,378	184,450
	Arviat	2,657	25	22,585	564,625
	Baker Lake	2,069	25	17,587	439,663
	Cambridge Bay	1,766	25	15,011	375,275
	Cape Dorset	1,441	25	12,249	306,225
	Chesterfield Inlet	437	25	3,715	92,875
	Clyde River	1,053	25	8,951	223,775
	Coral Harbour	891	25	7,574	189,350
	Gjoa Haven	1,324	25	11,254	281,350
	Grise Fiord	129	25	1,097	27,425
	Hall Beach	848	25	7,208	180,200
	Igloolik	1,682	25	14,297	357,425
	Kimmirut	389	25	3,307	82,675
	Kugaaruk	933	25	7,931	198,275
	Pangnirtung	1,481	25	12,589	314,725
	Pond Inlet	1,617	25	13,745	343,625
	Qikiqtarjuaq	598	25	5,083	127,075
	Rankin Inlet	2,842	25	24,157	603,925
	Repulse Bay (Naujaat)	1,082	25	9,197	229,925
	Sanikiluaq	882	25	7,497	187,425
	Taloyoak	1,029	25	8,747	218,675
	Whale Cove	435	25	3,698	92,450
	Resolute Bay	198	25	1,683	42,075
Kugluktuk	1,491	25	12,674	316,850	

Percentage Plastic	Plastics Accumulation (m ³)	Waste Generation Per Capita	Average
9.0%	25,567	10.1	9.4
9.0%	10,591	8.2	
9.0%	6,521	9.5	
9.0%	4,221	10.6	
9.0%	7,380	8.7	
8.6%	13,066	9.6	
8.6%	4,719	10.5	
8.6%	35,509	9.4	
8.6%	8,723	9.8	
8.6%	19,645	9.7	
8.6%	15,803	9.8	9.9
8.6%	11,702	9.6	
8.6%	59,802	10.1	
8.6%	15,486	10.5	
8.6%	36,718	9.6	
8.6%	8,579	9.9	
8.6%	30,291	9.5	
8.6%	8,093	10.2	
8.6%	9,217	9.7	
14.0%	57,887	5.1	
14.0%	10,532	5.1	
14.0%	16,030	5.1	
14.0%	4,732	5.1	
14.0%	1,838	5.1	
14.0%	7,070	5.1	
8.4%	138,159	8.5	8.5
8.4%	15,494	8.5	
8.4%	47,429	8.5	
8.4%	36,932	8.5	
8.4%	31,523	8.5	
8.4%	25,723	8.5	
8.4%	7,802	8.5	
8.4%	18,797	8.5	
8.4%	15,905	8.5	
8.4%	23,633	8.5	
8.4%	2,304	8.5	
8.4%	15,137	8.5	
8.4%	30,024	8.5	
8.4%	6,945	8.5	
8.4%	16,655	8.5	
8.4%	26,437	8.5	
8.4%	28,865	8.5	
8.4%	10,674	8.5	
8.4%	50,730	8.5	
8.4%	19,314	8.5	
8.4%	15,744	8.5	
8.4%	18,369	8.5	
8.4%	7,766	8.5	
8.4%	3,534	8.5	
8.4%	26,615	8.5	

Sources

Nunatsiavut

Aivek Consulting Ltd. (2017). Solid Waste Management Study – Northern Labrador Region: A Sustainable Waste Management Strategy for Nunatsiavut. (Andrea Hoyt, personal communication, January 16, 2019).

Nunavik

Renewable Resources Environment Lands and Parks Department. (n.d.). Nunavik Residual Materials Management Plan Executive summary. Kativik. Retrieved from http://www.krg.ca/images/stories/docs/Environment/PGMR_Eng.pdf.

Inuvialuit Settlement Region

Johnson, Davignon and Behrens 2017. Aklavik, NWT Solid Waste Planning Study. Retrieved from https://issuu.com/cryofront/docs/170410_csce_aklavik_solid_waste.

AECOM 2018. Hamlet of Tuktoyaktuk, Solid Waste Disposal Facilities Operation and Maintenance Plan. September 2018.

Dillon Consulting Ltd 2016. Hamlet of Ulukhaktok, NT, Solid Waste Facility Operation and Maintenance Plan. March 2016.

Nunavut

Arktis Solutions. (2011). Report on Current State of Solid Waste Management and Facilities in Nunavut and Cost-Benefit Analysis of Selected Solid Waste Management Approaches. Retrieved from <https://assembly.nu.ca/library/GNedocs/2011/000359-e.pdf>;

The Canadian Council of Ministers of the Environment 2016. Summary of Targeted Materials for Extended Producer Responsibility in the North. Retrieved from <https://www.ccm.ca/files/Resources/waste/extended/EPR%20in%20North%20sonnevera%20int%201.0.pdf>.

Government of Nunavut 2014. Nunavut Solid Waste Management Plan. October 24, 2014.

All Regions

Government of Canada 2019. Statistics Canada Census Profile, 2016 Census. Retrieved from <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E>.





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