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Nanoscale Measurement for Plastics

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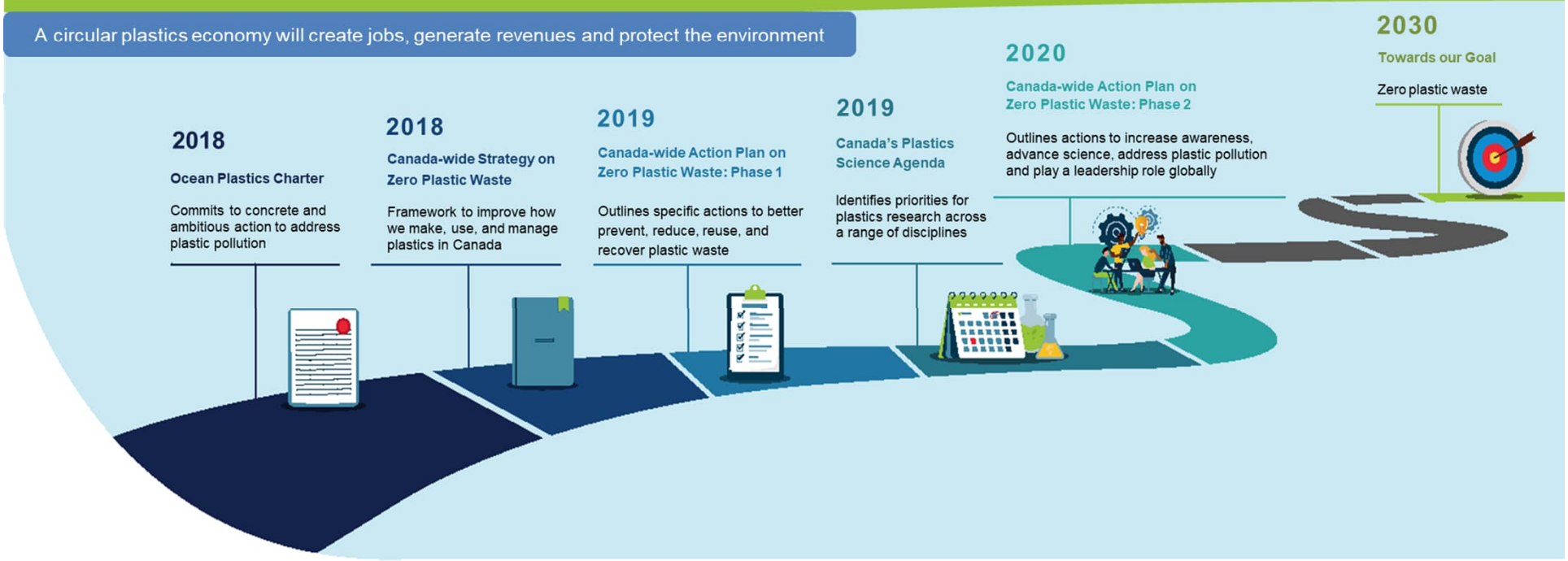
ANSI-NSP Nanotechnology Standards Panel – Standards Needs for Nanoplastics, Virtual, September 10-11, 2024

FRAMEWORK FOR COLLABORATIVE ACTION

Canada is implementing a comprehensive agenda to achieve zero plastic waste and keep plastics in the economy and out of the environment

A circular plastics economy will create jobs, generate revenues and protect the environment



CANADA'S ZERO PLASTIC WASTE AGENDA (CaPSA): FOUNDATION OF EVIDENCE

- Canada is implementing an evidence-based, comprehensive plan to reduce plastic waste and pollution and move towards a circular plastics economy with complementary actions across the plastics lifecycle

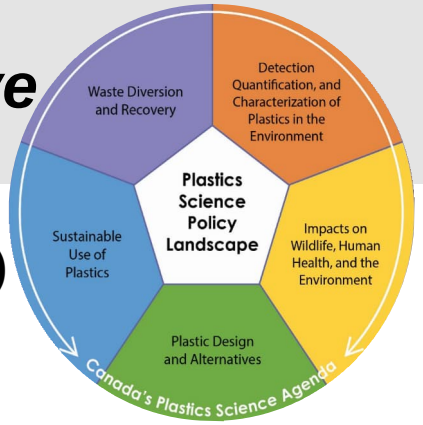
Key Science Inputs		Key Foundational Milestones
• Science summary for microbeads (2015)		Microbeads in Toiletries Regulations (2017)
• Economic study of the Canadian plastic industry, markets and waste (2019) • Domestic and international data and literature	→	Ocean Plastics Charter (2018) Canada-wide Strategy on Zero Plastic Waste (2018) Phase 1 Action Plan (2019) Phase 2 Action Plan (2020)
• Science Symposium and Best Brains Exchange (2018) • Domestic and international data and literature • Policy agenda and needs	→	Canada's Plastics Science Agenda, CaPSA (2019)
• Domestic and international data and literature		Science Assessment of Plastic Pollution (2020)
• Science assessment plastic pollution • Physical flow accounts for plastic material • Domestic and international data and literature, including community science gleaned macro-litter data	→ →	Single-use Plastics Prohibition Regulations (2022)

- Extensive consultations throughout all milestones, bridging policy makers, scientists and other subject matter experts and stakeholders

OVERVIEW OF SCIENCE-POLICY NEEDS

- **WHAT:** Products, composition and associated contaminants in the market, during end-of-life management and in environment
  - Informs potential sectors, product types or contaminants to consider for source-control policy interventions
- **QUANTITY:** Amount of plastics in the economy (material flows), plastic waste generated, diverted and managed, and pollution in the environment
  - Identifies drivers/pressures to inform new actions and helps measure trends and performance over time
- **WHERE:** Identify the key sectors and leakage points, pathways, and fate, including geographic areas of pollution accumulation
  - Identifies additional areas for policy intervention, investments, and mitigation and remediation
  - Data helps to measure trends and results over time
- **WHY:** Determine exposure and effects of plastic pollution to ecosystem and human health, and socio-economic impacts
  - Identifies key risks or exposure points to be targeted through potential actions and supports rationale for evidence-based action
- **PERFORMANCE:** Determine the impacts of existing and planned policies and trends
  - Identifies additional areas for action and supports rationale for evidence-based action
- **ENABLE STRONG SCIENCE:** Strengthen consistent methods, reference data and reporting, domestic capacity, engagement and information exchange, and communicate reliable and robust information to Canadians

NRC Framework for *Zero Plastic Waste Initiative*



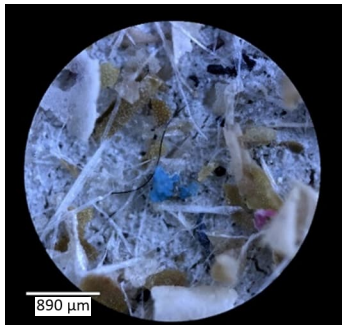
Memorandum to Cabinet file:
Advancing a Circular Plastics Economy for Canada (2022 – 2027)

Marine Microplastics (MPs) & Nanoplastics (NPs)

Impact, Detection, Characterization and Modeling of Marine Micro/nanoplastics

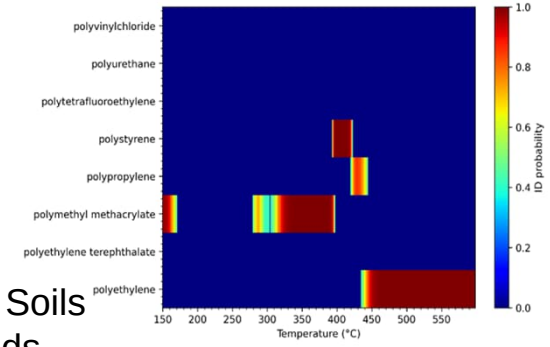
Chemical and Biological Characterization of Marine Life (ACRD)	Initial toxicity testing of micro/nanoplastics in marine organisms	• Establish zebrafish testing protocol • Assess toxicity of various plastic types
Predictive Tools and System, Transport & Fate Modeling (OCRE)	Development and initial validation	• Improve modeling to incorporate various plastic characteristics • Develop decision support tool
Physical-Chemical Characterization (METRO)	**Robust and reproducible methods to extract and separate MPs/NPs**	• **Enable identification, assess morphology and toxicity** • **Standard and reference materials**
In-Situ Technology Development (CEI)	In-situ sensor for environmental monitoring of micro/nanoplastics	• Adapt oil detection prototype for in-situ plastic detection

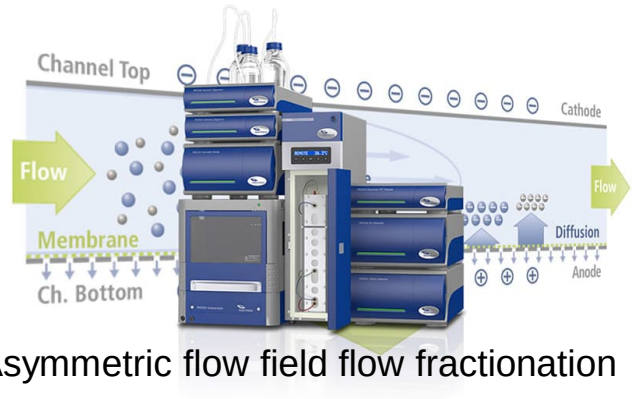
Characterization Methods Development
for Micro/Nanoplastics from Environment



Extraction of microplastics in Field Soils Amended with Municipal Biosolids

ID, Quantify, Machine Learning

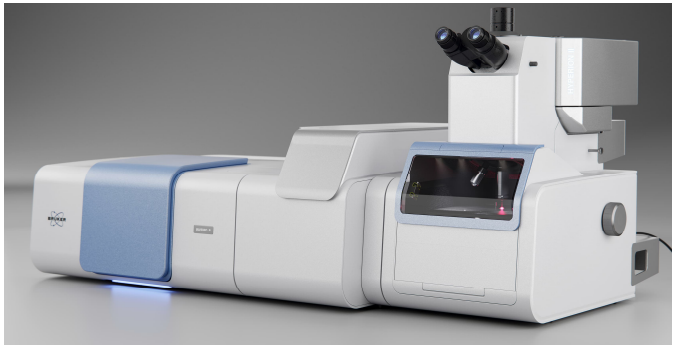




Asymmetric flow field flow fractionation

Density separation

Tangential flow filtration



Combined infrared and quantum cascade laser imaging and spectroscopy

ECCC, AAFC & U Carleton

Sci. Total Environ. **2024**, *907*, 168007.

G&C with *u*Ottawa

J. Environ. Chem. Eng. **2023**, *11*, 110967.

Nanometrology
Science of Measurements at the Nanoscale

- **Quantitative, systematic, and reproducible metrology is fundamental to understanding nanomaterials and micro/nanoplastics.**

- **Develop measurement reference materials and standards to facilitate the adoption and safe use of new nanomaterials and enhance understanding of the impact of micro/nanoplastics.**

- **Developing competency in measurement methods to enhance sensitivity, timescale, and spatial resolution, including the use of multi-modal approaches that combine various contrast mechanisms on a single platform.**

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Thank you for your attention!

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