ALTO HSR CITIZEN RESEARCH INITIATIVE

POLICY BRIEF

Don't Build Tomorrow's Cleanup Problem Today

The Case for a No EPS/XPS Standard in the ALTO Rail Corridor

April 2026

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> *If Ontario law prohibits unencapsulated polystyrene in dock floats because it harms aquatic ecosystems, how can it permit a railway corridor to bury industrial volumes of the same material within metres of provincially significant wetlands and SARA critical habitat, with no equivalent protection, no material disclosure, and no remediation bond?*

Executive Summary

Ontario's Bill 228 (Keeping Polystyrene Out of Ontario's Lakes and Rivers Act, 2021) formally established that expanded and extruded polystyrene (EPS and XPS) are waterway pollutants requiring legislative control. The Act came into force in May 2023, prohibiting unencapsulated polystyrene in all new floating docks, platforms, and buoys sold or constructed in Ontario.

The proposed ALTO High-Speed Rail corridor, routing through the Napanee–Kingston reach and Frontenac Arch Biosphere Reserve, would introduce construction-grade EPS and XPS in industrial quantities as geofoam embankment fill, frost-protection subgrade, and culvert void fill. These materials will affect the same hydrological catchments that Bill 228 was designed to protect. Unlike a dock billet, a railway embankment cannot be hauled out of the water and replaced.

This brief argues that:

- The environmental risks of EPS/XPS in wetland-proximate railway construction are severe, multi-pathway, and century-scale;
- Ontario's legislative record on dock foam provides a direct and binding analogy for polystyrene prohibition in the ALTO corridor;
- The muskrat fragmentation vector is documented as the primary mechanism of dock foam dispersal in Ontario's freshwater systems. Muskrats will reliably fragment any unencapsulated polystyrene placed at or near the water table in the corridor;
- ALTO has not disclosed its construction material specifications, meaning the April 24, 2026 consultation period closes before Canadians know how much polystyrene may be buried in their watersheds;
- A "No EPS/XPS" standard is technically feasible using alternative materials and should be a precondition of any Environmental Impact Assessment approval.

KEY FINDING: Ontario has already decided that polystyrene does not belong in its lakes and rivers. The ALTO corridor must be held to the same standard, ***not a lower one***.

1. EPS and XPS: What They Are and Why They Are Used in Railway Construction

Expanded Polystyrene (EPS) and Extruded Polystyrene (XPS) are petroleum-derived foam plastics used extensively in transportation infrastructure. In railway construction, their most significant applications are:

- **EPS Geofoam: Used as lightweight embankment fill in frost-susceptible, soft, or load-sensitive terrain. This is standard practice on routes crossing glacial till, peat, compressible soils and especially the LEDA clay (precisely the substrate conditions encountered in the ALTO routes in the Ottawa and St Lawrence Valleys).**
- **XPS Frost Protection Board: This is placed beneath track subgrade to prevent frost penetration and differential heave. Used at culverts, grade crossings, and bridge approaches, locations immediately adjacent to watercourses.**
- **EPS Void Fill: Used in culvert reconstruction, abutment backfill, and retaining wall drainage layers.**

ALTO's cold-climate HSR project will require the usage of more polystyrene than any engineering infrastructure project in world history.

EPS geofoam has been used in Ontario transportation infrastructure since the 1990s and is specified in both MTO and federal rail engineering standards for certain ground conditions. It is cheap, light, and effective. It is also, as Ontario's own legislature has established, an environmental liability when exposed to water, UV radiation, or mechanical disturbance.

The geological profile of the ALTO southern corridor includes frost-susceptible glacial till or LEDA clay overlying karst limestone, and is crossed by multiple tributary watercourses. This is a near-textbook specification case for EPS geofoam use.

2. Environmental Risk Pathways in Wetland and Riparian Zones

2.1 The Muskrat Fragmentation Vector

https://bnia.ca/wp-content/uploads/2020/03/styrofoam.jpg

The muskrat (Ondatra zibethicus) is the primary wildlife mechanism for polystyrene dispersal in Ontario's freshwater systems — a fact confirmed in the legislative record of Bill 228 and by Georgian Bay Forever's scientific research program. Muskrats chew EPS for nest-building material, mistaking the texture for cattail pith. A single animal can destroy a standard dock billet in one season, scattering beads and fragments across lake edges and wetland margins.

This fragmentation vector does not distinguish between dock foam and construction foam. Any unencapsulated EPS within reach of riparian muskrat populations (for example, embankment slopes, culvert outfalls, drainage swales) is subject to the same mechanical dispersal. The ALTO corridor would create hundreds of kilometres of new EPS-bearing infrastructure at exactly the water's-edge locations that muskrats inhabit.

Spring dispersal is the critical window: muskrat activity peaks in March–May during ice-out, breeding season, and lodge repair, precisely when waterfowl are nesting and amphibians are breeding. EPS beads released at this time enter open water during the most ecologically sensitive period of the freshwater year.

https://georgianbay.ca/wp-content/uploads/2025/05/Dock_Foam_handout_final_version_lowres.pdf

2.2 Microplastic Generation

EPS and XPS degrade to microplastics (< 5 mm) and nanoplastics (< 1 µm) through four pathways that operate simultaneously in wetland-edge railway environments:

- UV photodegradation: surface yellowing, embrittlement, and bead release; accelerated at exposed embankment faces
- Freeze-thaw cycling: repeated ice formation within the bead matrix disrupts structural cohesion; particularly aggressive in the limestone plain climate regime
- Mechanical abrasion: wave action, ice scour, and maintenance vehicle traffic at culvert and drainage locations
- Biological fragmentation: muskrats, beavers, and burrowing rodents (see 2.1 above)

Freshwater microplastic concentrations are now documented in virtually every Canadian Shield lake system studied. Polystyrene is consistently among the dominant polymer types in nearshore zones. Construction-phase EPS and XPS would add a concentrated, point-source contribution to catchments that receive diffuse microplastic loading from existing dock foam stocks, precisely the problem Bill 228 was designed to reduce.

2.3 Human Health Consequences

The microplastic particles generated by EPS and XPS degradation are not a passive pollutant. The human health evidence has matured substantially since 2023 and now constitutes a direct public health argument against placing unencapsulated polystyrene in freshwater-proximate railway infrastructure serving communities that depend on private wells and local food sources.

Cardiovascular disease. A landmark March 2024 study published in the *New England Journal of Medicine* (Marfella et al.) examined carotid artery plaque from 304 patients. Those in whom microplastics and nanoplastics were detected within the plaque faced a 4.53-fold higher risk of myocardial infarction, stroke, or all-cause death at 34 months (HR 4.53; 95% CI 2.00–10.27; $p < 0.001$) compared to those without detectable particles. In an accompanying editorial, Professor Philip Landrigan of Boston College described the association as "strongly suggestive of causality" and noted that a hazard ratio of 4.5 is "large and alarming." This is the first human clinical study to directly link microplastic burden in tissue to cardiovascular mortality outcomes.

Brain accumulation and dementia. A 2025 study in *Nature Medicine* confirmed microplastic and nanoplastic accumulation in human kidney, liver, and brain tissue. Concentrations in brain tissue increased significantly between 2016 and 2024 samples ($p = 0.01$). Critically, brains of individuals with documented dementia diagnoses showed markedly higher accumulation, with deposition in cerebrovascular walls and immune cells. A parallel 2025 study in *Science Advances* found that microplastics in the bloodstream can induce cerebral thrombosis and neurobehavioural abnormalities. Given that Ontario spends approximately $5.5 billion per year on dementia care, even a marginal population-level increment in microplastic brain loading carries measurable healthcare system implications.

Reproductive and developmental harm. A 2024 rapid systematic review in *Environmental Science & Technology* rated the evidence quality as "high" and concluded that microplastic exposure is "suspected" to adversely impact sperm quality and digestive immune function. Microplastics smaller than 10 µm have been confirmed to penetrate the placental barrier, raising direct concerns about fetal exposure in communities adjacent to the corridor. Children, whose organs are still developing, are considered at elevated risk.

Styrene carcinogenicity: IARC Group 2A. Beyond particle toxicity, polystyrene degrades by releasing styrene monomer into water and air. In 2019, the World Health Organisation's International Agency for Research on Cancer upgraded styrene from Group 2B (possibly carcinogenic) to Group 2A (*probably* carcinogenic to humans) based on evidence of lymphohaematopoietic malignancies in exposed workers and "strong evidence" of genotoxicity in human cells. The US National Toxicology Program similarly classifies styrene as "reasonably anticipated to be a human carcinogen." The karst hydrology of the Napanee Limestone Plain provides a fast-transport pathway from corridor drainage to residential wells, making styrene monomer release from embedded EPS and XPS a drinking water risk with no natural filtration buffer. The document section 2.3 below identifies styrene as only Group 2B; this has since been superseded by the 2019 IARC Monograph 121 upgrade.

Ontario healthcare budget: the 50-year cost baseline. A 2024 peer-reviewed study by Trasande et al. in the *Journal of the Endocrine Society* estimated plastic-associated chemical disease burden in the United States at US$249 billion per year (1.22% of GDP). The authors explicitly note this is an underestimate, covering only a subset of chemicals and diseases with sufficient data. A proportional per-capita extrapolation to Ontario (14.5 million of Canada's 40 million people, approximately one-ninth of US population) yields a baseline plastic-attributable health cost of approximately $11 billion per year, before accounting for any new concentrated point-source additions. Over a 50-year infrastructure horizon, the ALTO corridor's EPS and XPS emissions would represent an incremental, compounding addition to that baseline, concentrated in catchments serving communities with high private-well dependency and above-average elderly populations. This cost is entirely absent from ALTO's published financial estimates.

Regulatory incoherence. In January 2024, Health Canada committed $2.1 million to fund microplastic health research at McGill University, Memorial University of Newfoundland, and the University of Toronto, explicitly acknowledging that "there is a lot we don't know about the effect of microplastics on human health." **The Government of Canada cannot coherently fund research to understand this risk, invoke Bill 228's logic to prohibit dock foam in Ontario waterbodies, and simultaneously exempt the largest planned new source of freshwater EPS and XPS pollution in Canadian history from equivalent scrutiny.** The April 24, 2026 consultation deadline closes before ALTO has disclosed what materials it proposes to bury, and before Health Canada's funded researchers have completed their work. Canadians are being asked to consent to a health risk that has not been characterised, from a source that has not been disclosed.

HEALTH FINDING: Patients with microplastics detected in carotid artery plaque faced a 4.5-fold higher risk of heart attack, stroke, or death — the first human clinical evidence directly linking microplastic tissue burden to mortality outcomes.

The microplastics generated by ALTO corridor EPS and XPS degradation will enter the same Eastern Ontario catchments that supply drinking water to corridor communities. This health cost does not appear in any ALTO financial estimate.

2.4 Chemical Contamination

EPS and XPS are not chemically inert. They leach:

- Styrene monomer: residual unreacted monomer; aquatic toxicity documented; IARC Group 2B (possible human carcinogen); endocrine-disrupting properties under investigation
- HBCD (Hexabromocyclododecane): the flame retardant used in XPS until approximately 2015–2016; listed under the Stockholm Convention as a Persistent Organic Pollutant (POP) and on Canada's Toxic Substances List (CEPA Schedule 1). Legacy foam in transit infrastructure continues to leach HBCD. Bioaccumulates in fish, waterfowl, and mammals; detected in Arctic wildlife far from source areas.
- Polymeric FR (PolyFR / FR-122P): the HBCD replacement used in foam manufactured post-2016; environmental fate and bioaccumulation potential remain incompletely characterized

Polystyrene particles also function as sorption vectors for legacy hydrophobic contaminants (including PCBs, PAHs, and pesticides) concentrating them at levels orders of magnitude above ambient water. When ingested by wildlife, sorbed contaminants are bioavailable. This "Trojan horse" mechanism operates independently of the foam's own chemical leachate.

2.5 Wetland-Specific Risk Amplification

Wetlands are disproportionately vulnerable to polystyrene contamination for structural reasons that compound all of the above pathways:

- Low flushing rate: particles accumulate rather than disperse
- Organic-rich sediments: microplastics bind to organic flocs and settle, creating permanent sediment reservoirs
- High wildlife density: waterfowl, amphibians, turtles, and muskrats all concentrate in wetland habitat
- Emergent vegetation: cattail and phragmites beds trap floating debris, preventing natural removal
- Freeze-thaw dynamics: ice physically embeds EPS beads into shoreline substrate; spring melt releases them in concentrated pulses
- Karst groundwater connectivity: the Napanee Limestone Plain alvar pools have direct hydrological connection to aquifer recharge zones; microplastics and leachates can enter drinking water aquifers

2.6 SARA-Listed Species at Specific Risk

The ALTO southern corridor crosses documented critical habitat for multiple Species at Risk Act-listed species whose biology makes them particularly vulnerable to polystyrene contamination:

- Eastern Loggerhead Shrike (Lanius ludovicianus migrans): Endangered; fewer than 40 wild individuals; Napanee is one of two remaining Canadian breeding sites; forages over wetland and alvar margins where contaminated invertebrate prey would concentrate
- Little Brown Myotis, Northern Myotis, Tri-colored Bat: all Endangered; drink by skimming water surfaces; ingest surface-floating microplastics directly
- Grey Ratsnake (Pantherophis spiloides): Threatened; wetland-edge forager; prey including frogs and small mammals carry polystyrene-associated contaminants
- Blanding's Turtle (Emydoidea blandingii): Endangered; wetland obligate; documented to ingest floating plastic debris

3. Bill 228 and the Provincial Legislative Standard

Ontario's Keeping Polystyrene Out of Ontario's Lakes and Rivers Act, 2021 (Bill 228) is not merely a policy signal, it is binding statute, in force since May 2023. Its legislative record establishes a clear evidentiary foundation directly applicable to the ALTO corridor.

The Act requires that any person who sells, offers to sell, constructs, or reconstructs a floating dock, floating platform or buoy must ensure that any expanded or extruded polystyrene is fully encapsulated. The statute applies to both EPS and XPS.

> *"In 2019, volunteers with Georgian Bay Forever conducting a cleanup of the Georgian Bay shoreline in Parry Sound collected an estimated 5,000 pieces of dock foam, far more than any other kind of litter." — Legislative record, Bill 228*

The same legislative record confirms that wildlife fragmentation is a primary dispersal mechanism: Georgian Bay Forever explicitly noted that "some of our favourite mammals also like to chew on the foam, which further speeds up the breakdown."

Bill 228 demonstrates that Ontario has already made a collective political and legal judgment: unencapsulated polystyrene does not belong in its lakes and rivers. That judgment was made unanimously, supported by all parties.

CRITICAL GAP: Bill 228 applies to dock floats. It does not apply to construction-grade EPS geofoam, XPS frost-protection board, or EPS void fill used in railway embankments, even when those embankments are placed within metres of the same lakes and rivers the Act was designed to protect.

This is a legislative gap created by the scope of a private member's bill focused on the residential dock market. The ALTO Environmental Impact Assessment process represents the first opportunity to close that gap for large-scale infrastructure.

4. The 100-Year Contamination Timeline

Railway infrastructure has a design life of 75–100+ years. EPS and XPS embedded in that infrastructure create an open-ended contamination obligation. The timeline below describes the progression of polystyrene risk across the lifecycle of the ALTO corridor if no No EPS/XPS standard is applied:

Phase	Risk Profile
Construction (Yrs 0–5)	Largest single polystyrene input event. EPS offcuts, packaging waste, and damaged geofoam sections enter drainage during earthworks. No equivalent of dock float inspection applies.
Early operation (Yrs 1–20)	Foam largely intact beneath protective layers. Subsurface styrene monomer and HBCD leaching begins immediately, especially in karst terrain where groundwater travel times are short. Culvert-face XPS exposed to UV and freeze-thaw.
Mid-life (Yrs 20–50)	UV embrittlement and burrowing wildlife (muskrats, groundhogs, voles) fragment exposed foam at culvert outfalls, slope faces, and drainage structures. Microplastic pulse enters adjacent wetlands. First detection likely in sediment cores.
Late infrastructure (Yrs 50–75)	Karst subsidence events (a documented risk on the Napanee Limestone Plain) can expose previously buried geofoam, releasing large volumes into surface and subsurface drainage. Remediation at this stage requires partial embankment reconstruction at multi-million dollar cost.
End of life / rebuild (Yrs 75–100+)	Corridor reconstruction requires excavation and disposal of contaminated geofoam. Material cannot be recycled, cannot be composted, and will persist in landfill for centuries. Any material not recovered has already entered the watershed permanently. Cleanup cost passes to future governments and taxpayers.

This timeline describes the documented degradation trajectory of polystyrene in freshwater-proximate infrastructure, based on the peer-reviewed literature on EPS geofoam performance and the environmental fate studies cited in the Bill 228 legislative record. The cleanup obligation created by a polystyrene-intensive ALTO corridor is open-ended, non-remediable, and transgenerational. It represents a cost that is entirely absent from ALTO's published financial estimates.

5. The No EPS/XPS Campaign: What We Are Asking For

The ALTO HSR Citizen Research Initiative calls for the establishment of a No EPS/XPS standard as a precondition of Environmental Impact Assessment approval for any ALTO corridor route passing through provincially significant wetlands, SARA critical habitat zones, or karst terrain.

Specifically, we call on ALTO, Transport Canada, and the Government of Canada to:

1. Commit to a polystyrene-free design standard for all corridor segments within 500 metres of provincially significant wetlands, SARA critical habitat, karst terrain, and designated water supply watersheds. Alternative materials such as recycled aggregate fill, cellular concrete, expanded clay aggregate (LECA), and air-entrained concrete void fill, are available, proven, and do not create century-scale contamination obligations.
2. Require a full polystyrene mass balance in the Environmental Impact Assessment: total volume of EPS and XPS proposed, mapped by segment against adjacent watercourses, wetlands, and SARA critical habitat, with a quantified risk assessment for each fragmentation and leaching pathway described in Section 2 of this brief.
3. Extend the logic of Bill 228 explicitly to ALTO construction materials. Ontario has established by statute that polystyrene does not belong in its lakes and rivers. The federal Environmental Impact

Assessment process must apply the same standard to large-scale infrastructure that provincial law applies to residential dock floats.

4. Establish a bonded 100-year environmental remediation fund if EPS or XPS is used in any corridor segment. The fund must be sized to the full volume of polystyrene installed and indexed to the documented cost of embankment excavation and polystyrene disposal at current rates. This cost must not fall to future taxpayers.
5. Disclose all construction material specifications including geofoam type, volume, and placement locations before the April 24, 2026 public consultation deadline. Canadians cannot provide informed comment on environmental risk they cannot see.
6. Require wildlife interaction monitoring during construction and the first decade of operation, with specific protocols for muskrat activity at all EPS/XPS locations within 200 metres of watercourses and wetland boundaries.

6. Key Findings

#	Finding	Policy Implication
1	EPS geofoam is standard engineering practice in frost-susceptible, karst, and soft-ground railway construction — the precise conditions of the ALTO Napanee–Kingston reach.	*EPS/XPS use in the corridor is not hypothetical. It is an engineering probability that ALTO has not disclosed.*
2	Muskrats are a proven, documented primary vector for polystyrene dispersal in Ontario freshwater systems — confirmed in the Bill 228 legislative record and Georgian Bay Forever research.	*Any unencapsulated EPS placed at or near the water table in the corridor will be fragmented and dispersed by muskrats, regardless of design intent.*
3	EPS and XPS leach styrene monomer and brominated flame retardants (HBCD) classified as Stockholm Convention POPs. HBCD is on Canada's CEPA Schedule 1 Toxic Substances List.	*Leaching from railway geofoam into karst-connected groundwater represents a drinking water risk that has not been assessed in any ALTO document released to date.*
4	Ontario's Bill 228 (in force May 2023) establishes that unencapsulated polystyrene does not belong in Ontario's lakes and rivers. It passed unanimously.	*The federal ALTO EIA must apply at minimum the same standard that Ontario has already enacted for residential dock floats. A lower standard for a $60–90B federal infrastructure project is indefensible.*
5	The contamination timeline for railway-embedded polystyrene is 75–100+ years. Legacy HBCD in existing foam continues to leach decades after manufacture.	*The cleanup cost is transgenerational, open-ended, and absent from ALTO's financial estimates. A remediation bond is essential.*
6	ALTO has not disclosed construction material specifications. The April 24, 2026 consultation deadline passes before Canadians know how much polystyrene may be buried in their watersheds.	*Material disclosure must be a precondition of any consultation period. The current timeline does not permit informed public comment on polystyrene risk.*
7	The human health evidence now directly links microplastic tissue burden to cardiovascular mortality (NEJM 2024: HR 4.53), brain accumulation with dementia association (Nature Medicine 2025), and reproductive harm. Styrene monomer from degrading polystyrene is IARC Group 2A — probably carcinogenic to humans. Plastic-associated chemical disease costs in the US reached US$249 billion per year (2018); proportionally, Ontario’s baseline is approximately $11 billion per year. These costs are absent from ALTO’s financial estimates.	*The ALTO EIA must include a quantified human health risk assessment covering microplastic and styrene exposure pathways from EPS and XPS degradation in corridor catchments. Health Canada is simultaneously funding research on this risk — the consultation deadline cannot precede that research. Health costs attributable to corridor polystyrene must be included in ALTO’s full-lifecycle financial model.*

Ontario passed a law to keep polystyrene out of your lake because muskrats chew dock foam into the water. ALTO proposes to use the same material — in vastly larger quantities — beside the same lakes, with no equivalent protection, no material disclosure, and no cleanup bond.

The No EPS/XPS standard would close that gap before the damage is done.
The alternative is a century of cleanup that nobody has budgeted for.

About This Initiative

The ALTO HSR Citizen Research Initiative (CRI) is an independent, non-partisan citizen research project critically examining Canada's proposed ALTO High-Speed Rail corridor.

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Public consultation on the ALTO corridor closes April 24, 2026.