

- Projected PFAS loading increases associated with Expansion II waste streams
- Mass flux estimates to receiving wastewater treatment plants
- Uncertainty analysis for PFAS variability under different hydrologic conditions

Without a mass-balance, DEP cannot determine whether the proposed treatment system is appropriately sized or whether downstream discharges will meet Maine's PFAS reduction goals.

2. I believe that Leachate characterization should include full analytical speciation and matrix interference evaluation

Given the complexity of landfill leachate, PFAS treatment performance depends heavily on matrix chemistry. I believe that the application should include:

- Comprehensive PFAS analyte list (≥ 40 compounds), not just the "Sum of Six"
- Co-contaminant profiles (COD, BOD, ammonia, TSS, surfactants, metals)
- Matrix interference assessment for foam fractionation, IX, and GAC
- Seasonal and storm-event sampling to capture variability
- Colloidal and particulate-bound PFAS fractionation

Short-chain PFAS (e.g., PFBA, PFBS, PFHxA) are more mobile and more difficult to remove; their concentrations must be explicitly quantified.

3. I believe that Pilot-scale PFAS treatment data should be provided with engineering rigor

Foam fractionation is promising for landfill leachate, but DEP needs pilot-scale data that meet engineering QA/QC standards. The application should include:

- Influent and effluent PFAS concentrations for each analyte
- Removal efficiencies for long-chain and short-chain PFAS
- Hydraulic loading rates and air-to-water ratios
- Breakthrough curves for polishing media (IX or GAC)
- Energy demand and operational constraints
- Scaling, fouling, and surfactant-related performance impacts
- Mass-balance closure ($\geq 90\%$) for PFAS entering and leaving the system

I believe that the DEP cannot evaluate treatment reliability without these data.

4. I believe that residuals management is a critical missing component of the application

All PFAS treatment technologies generate a high-strength PFAS residual. I believe that the application should include:

- Expected PFAS concentrations in foam fractionation concentrate

- Volume projections for residuals under peak and average flows
- Storage and secondary containment design
- Transport and disposal pathways
- Evaluation of in-state vs. out-of-state destruction options
- Demonstration that residuals will not be re-introduced into Maine's waste stream

Residuals often contain PFAS at concentrations orders of magnitude higher than raw leachate; their management is a primary environmental risk. Where will the final residuals be disposed of?

5. I believe that PFAS fate-and-transport analysis is required for current and future leachate disposal

Until PFAS treatment is operational, JRL leachate continues to be sent to wastewater treatment plants that do not remove PFAS, resulting in direct discharge to the Penobscot River. Because the Penobscot Nation's reservation islands, trust lands, and traditional use areas are located downstream of these discharge points, the Nation experiences unique and disproportionate exposure to PFAS relative to non-tribal communities. I believe that a complete application should therefore include:

- Mass loading estimates of PFAS to receiving WWTPs, including seasonal variability and high-flow conditions
- Effluent PFAS concentrations based on pass-through assumptions consistent with EPA's 2022 WWTP PFAS study
- Downstream fate-and-transport modeling (surface water, sediment, porewater, and biota) using tools such as EPA WASP or MIKE 11
- Bioaccumulation and trophic transfer analysis for fish, waterfowl, and aquatic plants harvested by the Penobscot Nation
- Cumulative impact assessment for Penobscot Nation communities, including interactions with existing contaminant burdens (e.g., mercury, dioxins, legacy industrial discharges)

Compliance with Maine's environmental equity obligations under 06-096 CMR 400 §4(E) mandates assessment of disproportionate environmental burdens on tribal communities. The Penobscot Nation relies on the river for subsistence fishing, waterfowl hunting, gathering of river plants, and ceremonial uses, PFAS contamination directly threatens food sovereignty, cultural continuity, and human health in ways not experienced by non-tribal populations. These pathways must be explicitly modeled and quantified. An environmental equity analysis must also consider that PFAS bioaccumulation in fish and waterfowl represents a long-term, intergenerational exposure pathway, and that the Nation already bears cumulative contaminant burdens from upstream industrial sources.

For these reasons, I believe that the DEP cannot evaluate the environmental or cultural impacts of the proposed expansion without a Penobscot Nation–specific PFAS exposure and environmental equity assessment that integrates hydrology, toxicology, cultural use patterns, and cumulative impacts.

6. I believe that the DEP should establish a numeric PFAS performance standard for treated leachate

To ensure the treatment system is protective, DEP should require a numeric performance standard such as:

- Sum of Six < 20 ng/L, consistent with Maine’s drinking-water MCL, or
- A technology-based effluent limit derived from pilot performance

Without a numeric standard, DEP cannot determine whether the system meets the intent of the PBD conditions.

Conclusion

For the reasons above, I respectfully request that DEP require the applicant to provide:

1. A complete PFAS mass-balance and speciation analysis
2. Full leachate characterization with matrix interference evaluation
3. Pilot-scale PFAS treatment data meeting engineering QA/QC standards
4. A detailed PFAS residuals-management plan
5. A PFAS fate-and-transport analysis for current and future leachate pathways
6. A numeric PFAS performance standard for treated leachate

Thank you for your careful review of this application.

I believe that these elements are essential for a scientifically defensible and environmentally protective decision. I have attached a regulatory-citation appendix:

Appendix A – Regulatory and Technical Citations (PFAS & Leachate)

Appendix A – Regulatory and Technical Citations (PFAS & Leachate)

A1. Maine statutes and rules

- **06-096 CMR Chapter 400 – Solid Waste Management Rules, General Provisions**
 - §4(D) – Protection of public health and the environment; requires adequate control of leachate and contaminants.
 - §4(E) – Environmental justice and disproportionate impact considerations.
 - §9 – Design and operation standards, including containment and secondary containment for liquids and residuals.
- **06-096 CMR Chapter 401 – Solid Waste Siting**
 - §5 – Hydrogeologic and surface-water impact assessment requirements.
 - §6 – Leachate collection, management, and discharge considerations.
- **06-096 CMR Chapter 405 – Landfill Standards**
 - §6(A) – Leachate collection and treatment system design and performance.
 - §6(C) – Monitoring requirements, including frequency and analyte suites.
 - §7 – Corrective action and response to releases.

A2. PFAS analytical methods

- **EPA Method 1633 (Draft)** – *Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS*
 - Basis for ≥ 40 -analyte PFAS suites in leachate and effluent.
- **EPA Method 537.1 / 533** – *Determination of Selected PFAS in Drinking Water by SPE and LC-MS/MS*
 - Legacy methods; relevant for comparison and QA/QC but less comprehensive than 1633.
- **EPA 200.7 / 200.8** – *Trace elements in water and wastes by ICP-AES / ICP-MS*
 - For metals that may affect treatment performance (e.g., fouling, co-precipitation).

A3. QA/QC and testing standards

- **ASTM D2777** – *Standard Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water*

- Basis for method performance, detection limits, and precision in PFAS analyses.
- **ASTM D5903 / D5810** – *Practices for Sampling Wastewater / Groundwater Monitoring Wells*
 - Relevant to leachate and groundwater sampling protocols.
- **ASTM D6586** – *Standard Practice for Comparison of Field Methods for Determining Hydraulic Conductivity in Saturated Porous Media*
 - Applicable to leachate collection system performance and hydraulic loading.
- **ASTM D3860** – *Standard Practice for Determination of Adsorptive Capacity of Activated Carbon by Aqueous Phase Isotherm Technique*
 - Relevant to GAC polishing design and breakthrough analysis.

A4. PFAS treatment and fate

- **EPA Technical Brief: “PFAS Treatment in Drinking Water and Wastewater”**
 - Summarizes performance of GAC, IX, RO, and emerging destruction technologies.
- **EPA PFAS Strategic Roadmap (2021–2024)**
 - Policy context for PFAS reduction and treatment expectations.
- **EPA WWTP PFAS Study (2022)**
 - Evidence for PFAS pass-through in conventional wastewater treatment plants.
- **EPA WASP (Water Quality Analysis Simulation Program)**
 - Recommended tool for surface-water fate-and-transport modeling.