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Report Summary:
Future Options and Associated Costs for Management of Massachusetts Wastewater Sludge

PFAS and Residuals Technology and Management Study (Sludge Study), Part 2

Background

Per- and polyfluoroalkyl substances (PFAS) are a group of thousands of chemicals with many uses, including use in waterproof fabrics and firefighting foams. They have been linked to a variety of health issues, including increased cancer risk. These chemicals are widely used and do not break down easily due to their chemical composition. They therefore are found throughout the environment, including soil, water, air, food, and wastewater. Current wastewater treatment is not able to remove PFAS, so the PFAS that enter the treatment plants remain in the plant's effluent and wastewater treatment residue, known as sludge.

Massachusetts produced 166,000 dry tons of wastewater sludge in 2023 (based on Part 1 of this sludge study). This is equivalent to over 600 truck loads per week, including 9000-gallon tanker trucks and 30-yard dumpster trucks. Wastewater treatment plants manage their sludge through incineration, land application (where sludge is used as a fertilizer and soil amendment), and landfilling. Management of this sludge is growing more challenging as PFAS have been found to have numerous negative health and environmental impacts. Additionally, current management options all result in some risk of PFAS exposure to the environment. Capacity for managing sludge through conventional methods is decreasing due to aging incinerators, land application restrictions, and landfill capacity/closures. Some of these changes are already known, and account for a 7% capacity decrease by 2028. An additional 45% of Massachusetts sludge has a high risk of market disruption by 2028, including potential regulatory changes.

Report Overview

Part 2 of the PFAS and Residuals Technology and Management Study **(Sludge Study) analyzes how the Commonwealth can manage the PFAS in wastewater sludge and effluent. The study considers technological opportunities and constraints, and evaluates financial implications.**

Key conclusions of the report are:

- Conventional sludge management capacities (incineration, land application, and landfilling) will likely decrease, both within and outside of Massachusetts.
- There are options to improve sludge management, including expansion of conventional sludge management capacities, additional sludge volume reduction, new PFAS treatment facilities, and source reduction of PFAS before wastewater enters treatment plants.
- Wastewater treatment plant operators, regulators, and legislators can take action related to sludge management and PFAS.

These conclusions are based on detailed analysis in the report, summarized here:

> Management of Massachusetts sludge and septage is complex, involving multiple treatment technologies across many facilities and states. The sludge management landscape is actively changing, including due to PFAS concerns. Possible disruptions in sludge management include aging incinerators, land application restrictions, and landfill closures. **More than 50% of Massachusetts sludge is managed through means which will be at risk or no longer available by 2028.**
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> PFAS make conventional sludge management methods more challenging. Methods to manage PFAS in wastewater effluent and sludge include removing PFAS from wastewater effluent, reducing sludge volume to enable better management of sludge, and destroying PFAS in sludge. While some technologies are not yet commercially viable, they are expected to provide significant benefits in PFAS destruction, transportation logistics, and disposal capacity conservation. At present, costs for such technologies range considerably. Also, the needs of individual treatment facilities vary – some can make substantial PFAS reductions through industrial pretreatment, while others may need to employ other methods.

The full Sludge Study Part 2 report, as well as materials from a January 31, 2025 public presentation of the report are available at: Residuals & Biosolids | Mass.gov.

Key Take-Aways

Table 1: Massachusetts Sludge Management Scenarios 1-6

This table summarizes the Massachusetts impact of potential sludge management restrictions.

Category	Land Application		Landfill		Incineration	
Scenario	**1: Land application restrictions in Massachusetts**	**2: Regional/national land application restrictions with regional impact**	**3: Landfill restrictions in Massachusetts**	**4: Regional/national landfill restrictions with regional impact**	**5: Incineration capacity reduction in Massachusetts**	**6: Regional/national incineration restrictions with regional impact**
Plants Affected	20	17	1	10	10	44
Dry Tons Affected per Year	15,974	10,931	919	11,372	17,988	23,730
Annual Sludge Management Cost Increase **	+$18M initially (+15%)	+$11M initially (+9%)	+5M initially (+4%)	+$10M initially (+9%)	+$23M initially (+19%)	+$14M initially (+12%)
Estimated Capital Cost	-	-	-	-	+$6M/year annualized ($77.8M total)	+$21M/year annualized ($273.2M total)

*Scenarios are not mutually exclusive.

** Percentages listed in the table are out of current annual costs of $118.8M/year. After the first year, all scenarios have a further +6.2% per year increase in sludge management costs

Table 2: Massachusetts Sludge Management Scenarios 7-10

This table summarizes the Massachusetts impact of potential PFAS and sludge management solutions.

Category	**New capacity, innovation, legislative & funding solutions**			
Scenario	**7: Additional sludge disposal capacity becomes available**	**8: Additional sludge reduction capacity becomes available**	**9: New sludge PFAS treatment capacity becomes available**	**10: Source reduction to reduce PFAS at wastewater treatment plants**
Plants Affected	127			
Dry Tons Affected per Year	171,000			
Annual Sludge Management Cost Increase	3.1%	3.1%	3.1%	3.1%
Estimated Capital Cost	+$51M/year annualized ($650M total)	+$106M/year annualized ($1.36B total)	+$99M/year annualized ($1.26B total)	-
Estimated O&M Costs	+$15M	+$72M	+$29M	-
Annual Net Cost **	-$30M (-25%) *Net savings*	+$83M (+70%)	+$31M (+26%)	-$96M (-80%) *Net savings*

*Scenarios are not mutually exclusive.

** Percentages listed in the table are out of current annual costs of $118.8M/year. Net costs consider $96M/year savings from a stabilized sludge market

Table 3: Options for Wastewater Treatment Plants, Legislators and Regulators

This table summarizes actions that could improve Massachusetts sludge management, including PFAS.

Options	Timeline (years)	Potential to increase sludge management capacity	Potential to reduce PFAS	Relative cost	Comments
Wastewater Treatment Plants					
Conduct industrial pretreatment for PFAS source reduction	0-2	**Low**	**Low, Med, or High**	**Low**	Efficacy depends on proportion of PFAS load from industry
Pilot test promising PFAS reduction technologies	2-5	**Low**	**Low**	**Low**	Pilots can help determine the performance of new technologies
Reduce sludge volume	2-5	**High**	**Low**	**High**	Producing less sludge with more potential outlets reduces market risks
Consider commitments to regional facilities	5-10	**High**	**Low or High**	**Low**	PFAS reduction depends on technology
Legislators and Regulators					
Limit biosolids land application	0-2	**Low**	**Medium**	**Low**	Can build off the tiered approach of most other states. Compliance could be costly.
Promote PFAS treatment technologies	0-2	**Medium**	**Medium**	**Low**	PFAS treatment technologies typically also greatly reduce sludge volume
Control PFAS sources – consumer products and manufacturing	2-5	**Low or Medium**	**Medium or High**	**Medium**	Office of Technical Assistance can assist industries
Support volume reduction and PFAS treatment projects	2-5	**High**	**High**	**High**	Funding needed for installations; regulatory certainty needed for pilots
Promote regional facilities	5-10	**High**	**Low or High**	**High**	PFAS reduction varies by technology; regulatory certainty and funding needed