Biosolids and PFAS: Maintaining Management Options is Critical to Communities and Sustainability | June 2022

An increasingly urbanized and populous nation requires effective and efficient systems for managing municipal waste streams – systems that safeguard human health and the environment and advance sustainability. As Americans carry out their daily lives, more than 15,000 publicly owned treatment works ("POTWs") nationwide[1] are one of these key systems, providing critical anchor infrastructure services treating 34 billion gallons of wastewater daily.[2] The wastewater treatment cycle is essential to protecting public health, advancing water quality, and bolstering vibrant communities, and is a true benefit of a modern society.

As part of the municipal wastewater treatment process, liquids are separated from solids. The solids are treated and result in a semisolid product referred to as biosolids.[3] Wastewater agencies manage these biosolids through three primary approaches – land application, landfilling, and incineration. Each of these options is critical to municipalities across the country, has undergone decades of scientific study, and is governed by a robust set of federal, and often additional state, regulations, as described below.

The biosolids field is a dynamic one, with municipal wastewater utilities being a driving force behind innovative policy development, essential partnerships with governments at all levels, and community engagement. Recently, however, some states are making premature policy choices concerning biosolids management due to the significant scientific uncertainty – and, at times, public confusion and fear - surrounding a suite of emerging contaminants known as per- and polyfluoroalkyl substances, or PFAS.[4]

PFAS have been designed by scientists not to break down in the environment, which is why they are often called "forever chemicals." PFAS are in countless commercial, consumer, and industrial products[5] and are acknowledged by the U.S. Environmental Protection Agency ("EPA") to be widely present in the environment.[6] Due to their prevalence and evolving concerns around the risks they may pose to human health and the environment, EPA in 2021 published its most recent PFAS Strategic Roadmap, which committed the Agency to an integrated approach focusing on investigating, restricting, and remediating PFAS contamination.[7]

PFAS enter public wastewater treatment systems through industrial, commercial, and domestic sources. Activities ranging from washing PFAS-treated pots and pans to putting out fires with certain foams can all introduce PFAS into the water supply. Because of this ubiquity in the environment, it is likely that PFAS can be found in trace or even higher levels in municipal biosolids. Understanding more about how they are transported and what risk they may pose to public health and the environment is critical.

Public clean water agencies are proactively engaged in advancing the national discussion and understanding of PFAS, but they are also deeply committed to their primary responsibility of providing sustainable, affordable clean water to communities nationwide. This necessarily entails the management of biosolids, and neither the federal government nor the states should limit municipal management options prior to undertaking scientific rigor and honest, comprehensive policy assessments.

Curtailing biosolids management options in a vacuum, without adequate consideration of risk, sustainability, treatment or destruction technology, or available alternative management options, poses a serious threat to the economic and environmental sustainability of local communities and could upend decades of well-established municipal practices. Identifying solutions will not be nearly as easy as identifying potential concerns, but reason and practicality dictate that it must be done before responses are taken that tie the hands of municipalities and create even more intractable problems.

PFAS in Biosolids

When thinking of PFAS in biosolids, it is important to start with one key fact: PFAS presence in biosolids is the inevitable byproduct of widespread continued manufacture, use, and disposal of PFAS chemicals in upstream sources. Over 650 PFAS chemicals are used in commerce today—a number that continues to expand as industry develops new chemicals.[8] PFAS are used in varying degrees in everyday commercial products like non-stick cookware, stain resistant clothing and other fabrics, cosmetics, firefighting foams and construction products. PFAS are also commonly used in electronics, automotive, and aerospace manufacturing.

All of these uses contribute to PFAS going down the drain and into wastewater treatment plants. Once PFAS-bearing waste is discharged into wastewater streams, the onus falls on wastewater treatment facilities – obligate receivers of PFAS chemicals – to then grapple with the contamination. Currently, public wastewater utilities do not and cannot treat for PFAS, in large part due to the sheer volume of water they handle. PFAS chemicals therefore pass through the treatment works and remain in biosolids.[9]

The primary method employed by wastewater agencies to proactively restrict industrial pollutants that may interfere or pass through the treatment works is the Clean Water Act (“CWA”) pretreatment program. This program helps stop chemicals from disrupting the treatment system itself or from getting into biosolids.[10] POTWs also partner with their local communities to advance important pollution prevention programs, such as pharmaceutical takeback programs and household chemical waste collections. All of these activities lower the types and volume of pollutants entering treatment plants, and by extension, reaching biosolids.

The pretreatment program will undoubtedly play a major role in addressing PFAS contamination going forward. EPA’s PFAS Strategic Roadmap calls on the Agency to “require pretreatment programs to include source control and best management practices to protect wastewater treatment plant discharges and biosolid applications.”[11] Importantly, however, while the pretreatment program can help limit PFAS reaching biosolids from industrial sources, it cannot be used to address domestic sources of PFAS contamination.

EPA also regularly assesses pollutant trends in biosolids,and is in fact mandated by the CWA to identify new pollutants in biosolids including through regular literature reviews.[12] After identifying new pollutants in biosolids, EPA undergoes a problem formulation to understand fate and transport pathways of the chemical and its risk to public health and the environment. If risk is found, EPA begins a regulatory process outlined by the CWA to regulate and set standards. However, simply because EPA embarks down a risk assessment does not predetermine that a risk will be found. For example, EPA has assessed many chemicals, including dioxins and furans, that are extremely toxic to public health but are not found in biosolids in concentrations sufficient to warrant regulatory standards.

In EPA's most recent review of pollutants in biosolids, EPA identified eight PFAS in biosolids, and is undergoing a problem formulation process which:

> *"... will serve as the basis for determining whether regulation of PFOA and PFOS in biosolids is appropriate. If EPA determines that a regulation is appropriate, biosolids standards would improve the protection of public health and wildlife health from health effects resulting from exposure to biosolids containing PFOA and PFOS."*[13]

The outcome of EPA's review will underscore critical regulatory and policy decisions with respect to biosolids management options. While it undertakes this PFAS assessment, however, it is key for EPA to communicate its support for existing, well-regulated biosolids management options to the public, policy makers, and the regulated community.

EXISTING FEDERAL REQUIREMENTS ADVANCE SOUND BIOSOLIDS MANAGEMENT

Any biosolids management policy decisions must be made in the context of EPA's robust existing regulatory regime under 40 C.F.R. Part 503.[14] The comprehensive Part 503 regulations are focused on ensuring that biosolids are handled in a manner that is protective of human health and the environment, no matter which management option is chosen.[15]

Clean water agencies that manage biosolids through incineration utilize sewage sludge incinerators ("SSI"), which are subject to a range of requirements, from pollutant-specific limits to operating requirements and endangered species protections. Under the CWA, SSIs must meet risk-based pollutant limits for metals, hydrocarbon standards and management practices, and monitoring, recordkeeping, and reporting requirements.[16] SSIs are also covered under the Clean Air Act ("CAA"), particularly Section 129, which sets numerical emissions standards for certain pollutants and requires operator training, among other requirements.[17]

Municipalities can also choose to landfill biosolids in a monofill (a landfill that only accepts biosolids) under the CWA Part 503 regulations or co-dispose them in a municipal solid waste landfill under 40 C.F.R. Part 258. The 503 regulations mandate specific metal limits;[18] and both the monofill and co-disposal regulations require runoff and leachate collection/disposal;[19] pathogen reduction and vector attraction reduction;[20] and monitoring and recordkeeping.[21] A variety of other requirements also apply under these programs, including those pertaining to species protection, flood prevention, siting criteria, restrictions on access, grazing and growing, and groundwater protection.[22]

Finally, most clean water agencies manage biosolids through sustainable land application. Biosolids land application has been consistently heralded as an incredible example of resource recovery, as well as a dynamic field of innovation and improvement related to the creation of new biosolids products and uses. In fact, more than 60% of biosolids generated in the U.S. are land applied,[23] with wastewater agencies choosing land application for the sustainability of the practice as well as its many co-benefits.

Land applied biosolids are subject to stringent regulations. They can contain only limited concentrations of certain metals under the CWA Part 503 program,[24] must meet either Class A or Class B requirements for pathogen reduction, and are subject to requirements for vector attraction reduction. Land applied biosolids are organized by EPA into classes protective of public health and the environment,[25] and can be distributed in either bag or bulk depending on their type and pathogen class with appropriate labeling.[26] See Tables 1 and 2 at Appendix A.

Restrictions on the planting and harvesting of food crops, animal grazing, and public access apply to Class B biosolids.[27] And both Class A and B biosolids may be subject to management practices[28] depending on the type of biosolid and pathogen class, including packaging and location of application limitations.[29] Additionally, as with the other biosolids management options, wastewater utilities regularly monitor the pollutants in land applied biosolids.[30]

RETAINING CURRENT BIOSOLIDS MANAGEMENT OPTIONS IS ESSENTIAL

There are compelling national and local policy reasons to ensure that a full range of biosolids management options remain available to wastewater agencies. From a scientific point of view, EPA and researchers are learning about ways to mitigate PFAS in biosolids and the initial findings are promising. As the science becomes more certain and EPA's work continues, wastewater agencies are considering proactive source control approaches. They are also involved in the national policy dialogue to ensure that sources ultimately found to cause PFAS contamination are held accountable.

From a practical perspective, biosolids offer several social and environmental benefits. They are rich in nitrogen and low in phosphorous, which translates to reduced environmental impact when compared to synthetic fertilizers.[31] Indeed, studies have repeatedly demonstrated that amending soils with biosolids can improve crop yields and vegetative growth, enhance soil water holding capacity, and increase carbon and nitrogen storage in soil.[32] Moreover, recent data shows that soils amended with biosolids act as carbon sinks,[33] suggesting that biosolid land application may have a role to play in helping to reduce atmospheric carbon and avoiding depleting the remaining global carbon budget.

There is even more reason to reuse and tap into the benefits of biosolids considering shrinking landfill capacity across the country. As of 2021, there is on average approximately 15 years of remaining landfill capacity in municipal solid waste landfills in all regions of the United States,[34] with the northeast estimated to have only eight years of landfill capacity left.[35] For many utilities, landfilling may already be the only feasible option for biosolids management, or it may become so should either land application or incineration become less available. Beneficial reuse, where possible, can help alleviate this landfill capacity pressure nationwide.

Incineration capability in the U.S. is likewise not increasing and has, in fact, always been limited based on certain geographic and economic factors.[36] For utilities using incineration, however, switching to land application can be an expensive or infeasible option, as it requires digestion equipment incineration utilities do not have, as well as nearby land which may be lacking.

Utilities therefore need access to all three biosolids management approaches. Nevertheless, the mere presence of PFAS in biosolids, even at trace levels, is causing some state regulators and, at times, the public to react in fear and prematurely limit local options. For example, the State of Maine[37] recently banned the land application of biosolids, regardless of PFAS concentration, before undertaking any effort to understand the magnitude and depth of PFAS contamination in the state, let alone the true sources of PFAS contamination. In fact, industrial sludges, which are not subject to CWA or state regulations, are often the true sources of contamination, but can be confused with municipal biosolids. This might have been a key underlying factor in Maine.

In another case, Massachusetts recently proposed a bill establishing a moratorium on procuring new structures or modifying existing uses or structures that may generate PFAS emissions. If passed, the bill would effectively halt the construction of new SSIs or any improvements needed for existing SSIs in the state, though the legislature failed to adequately consider the ramifications of doing so.[38] And several other states have taken varying levels of action regarding biosolids which, due to the uncertainties over risk, have included ambiguous and at times conflicting requirements. See Appendix B.

Hasty and ill-informed reactions to a complicated and nuanced scientific issue will have dire consequences for not only clean water utilities, but also critical local, state, and federal environmental goals. For example, removal of land application as a biosolids management option would necessitate increased transportation of heavy solids, adding to air quality and nuisance issues in communities, including those that did not generate the biosolids in the first place. Some communities with limited biosolids management options are already having to transport them vast distances, including internationally to Canada – this is not a hypothetical result.[39]

Such transportation in turn raises serious environmental justice concerns. Should a disadvantaged community subject to less stringent regulatory oversight bear the burden of a state that simply does not want potential PFAS in its own backyard?

Similarly, if biosolids are solely landfilled because of prohibitions on land application and increasingly limited incineration options, the increased generation of leachate will require further treatment at wastewater treatment plants in an unending cycle. And there are growing concerns around current and future landfill capacity and stability related to the potential increased placement of high-liquid material.

Land application moratoriums, even temporary and localized ones, can also have ripple effects on how clean water utilities secure contracts with biosolids management companies, according to a comprehensive study in 2021 by NACWA and other water treatment groups.[40] For example, Pima County, Arizona biosolids management costs doubled during a land application moratorium of less than a year between 2019 and 2020, when biosolids were required to be landfilled.[41] The ban was ultimately lifted after a key study[42] found that the low PFAS concentrations in the biosolids posed essentially no risk due to the fact that there were few industrial dischargers to the wastewater plant and no migration of PFAS into deep groundwater aquifers. But thousands of other wastewater treatment plants throughout the country are still at risk of losing critical biosolids management options due to similarly rushed and poorly grounded policy decisions.

Any PFAS policies developed for municipal biosolids that are disconnected from time-tested scientific information and methodologies – such as documented adverse health or environmental impacts at the levels of PFAS present, exposure assessments, concentration limits, or other considerations – will unduly limit management options for biosolids.

Biosolids are an unavoidable byproduct of wastewater treatment, and wastewater treatment is a cornerstone of public health, disease prevention, and environmental progress. An extensive regulatory regime applies to the management of municipal biosolids to ensure their appropriateness for land application, incineration, or landfilling, and utilities not just in the U.S. but around the world have been successfully managing biosolids with these methods for decades.

Should the science demonstrate the need to regulate PFAS in municipal biosolids, utilities stand ready to do their part to continue their public stewardship, but there must be a practical path forward towards eliminating PFAS from constant reintroduction into treatment works while continuing the time-tested, sustained and needed options for biosolids management. Recent studies show promise in identifying ways to reduce the mobility of PFAS in biosolids. The clean water community remains committed to contributing to these efforts to help address the problem, should source control and pollution prevention efforts fall short.

NEXT STEPS

Addressing the risks posed by PFAS requires getting a grasp on where PFAS are found, in what concentrations, and where they are coming from. The CWA and EPA's regulations have structures in place to identify and mitigate emergent chemicals like PFAS, and it is incumbent on policy makers to turn to those structures in lieu of harmful, rash decision-making.

Understanding the industrial and commercial sources coming into a treatment system is a must; absent any cohesive action to substantially curb the manufacture, use, and disposal of PFAS, states and communities will still have a PFAS problem even if they limit the management options for biosolids out of fear of PFAS contamination.

Appropriate implementation of the CWA's industrial pretreatment program and congressional funding will also help public clean water agencies further mitigate PFAS concerns. And the federal government should be using every statutory tool at its disposal to eliminate non-essential PFAS uses to reduce and mitigate PFAS in everyday consumer goods. A comprehensive program that incorporates product stewardship which prevents the constant introduction of these chemicals into the environment is essential in reducing exposure to the public. Focusing on clean-up after the fact without a program of reducing PFAS production and introduction will not protect public health or the environment.

Michigan's long-term PFAS monitoring efforts and interim biosolids strategy provide an example of how tracing industrial sources of PFAS contamination in wastewater streams can be done while continuing the land application of biosolids.[43] Colorado likewise provides an example of how, once sources have been identified, states can work with industry and municipal wastewater utilities to initiate and develop mechanisms for PFAS source reduction.

Additionally, PFAS policies that do not close the door on innovation are needed. For example, incorporating pyrolysis and gasification into the biosolid management toolkit in the future can enhance the reusability and safety of biosolids. Pyrolysis and gasification decompose substances at elevated temperatures with reduced airflow, which lowers the size and cost of air pollution control equipment. EPA studies of pyrolysis and gasification have shown positive findings regarding PFAS minimization.[44] Pyrolysis and gasification can also produce hydrogen-rich synthetic gases ("syngas"), a valuable source of clean energy.[45]

CONCLUSION

Curtailing biosolids management options in a vacuum, without consideration of risk, sustainability, treatment technology and available alternatives, poses serious economic and environmental risks to municipalities nationwide. Rather than taking options off the table, it is essential to preserve all three primary biosolids management approaches while continuing to look for new, innovative practices that could provide public wastewater agencies with more options as they sustainably manage the nation's biosolids production and provide clean water for communities across the country.

Appendix A

Table 1. Types of biosolids and corresponding requirements

Biosolid Type	Pathogen Class and Distribution	Pollutant Limit Standard	Pathogen Reduction	Vector Attraction Reduction
Pollutant Concentration (PC) Biosolid	A Bulk Only	Pollutant Concentration, 503.13(b)(3)	Any Class A option	Option 9 or 10, 503.33(b)(9), (10)
	B Bulk Only	Pollutant Concentration, 503.13(b)(3)	Any Class B option	Any option 1–10, 503.33(b)(1)–(10)
Cumulative Pollutant Loading Rate (CPLR) Biosolid	A Bulk Only	Cumulative Pollutant Loading Rate, 503.13(b)(2)	Any Class A option	Any option 1–10, 503.33(b)(1)–(10)
	B Bulk Only	Cumulative Pollutant Loading Rate, 503.13(b)(2)	Any Class B option	Any option 1–10, 503.33(b)(1)–(10)
Annual Pollutant Loading Rate (APLR) Biosolid	A Bag Only	Annual Pollutant Loading Rate, 503.13(b)(4)	Any Class A option	Any option 1–8, 503.33(b)(1)–(8)

Table 2. Types of biosolids and corresponding site restrictions and required management practices

Biosolid Type	Pathogen Class and Distribution	Site Restrictions	Management Practice Requirements
Pollutant Concentration (PC) Biosolid	A Bulk Only	NO	YES
	B Bulk Only	YES	YES
Cumulative Pollutant Loading Rate (CPLR) Biosolid	A Bulk Only	NO	YES
	B Bulk Only	YES	YES
Annual Pollutant Loading Rate (APLR) Biosolid	A Bag Only	NO	YES

Appendix B: Select State Actions on PFAS and Biosolids

Florida: Testing. In 2021, the Florida Department of Environmental Protection (FDEP) adopted a Per- and Polyfluoroalkyl Substances Dynamic Plan which prioritizes testing at biosolid disposal facilities for potential PFAS contamination. The plan states that while EPA is working on PFAS testing and programs, the state will be working on ways to more effectively detect/address PFAS contamination from biosolids but offers no specifics.[46]

Michigan: Select Land Application Prohibition. Michigan's Department of Environment, Great Lakes, and Energy (EGLE) released in April 2022 an updated Interim Strategy[47] for PFAS in biosolids, building on its 2018 Industrial Pretreatment Program (IPP) PFAS Initiative,[48] which works with wastewater treatment plants to identify, reduce, and monitor sources of PFOS. The goal is to reduce PFOS concentrations in treated wastewater.

As a result of its wastewater treatment initiative, Michigan claims that most of its sampled public wastewater treatment plants saw reductions of 90 to 99% in PFOS wastewater concentrations.[49] The updated Interim Strategy also prohibits land application of biosolids containing more than 125 ppb of PFOS, which is a more stringent threshold from EGLE's original 150 ppb limit from 2021. Any wastewater treatment plants that exceed this threshold are barred from land applying until they develop long-term pretreatment and source reduction measures and can consistently show that their wastewaters are testing below 125 ppb.

While this PFOS threshold is based on the Michigan's long-term PFOS monitoring efforts at several wastewater treatment plants, the State reports that it is not a "risk-based number."[50] Rather, Michigan chose the number simply because its studies indicated that 150 ppb (the original 2021 threshold) was the "break-point" between general contamination and industrial contamination.[51] It is unclear whether Michigan has engaged in further studies to determine the significance of this "break-point" on public health and environmental protection. As a policy matter, PFOS-related restrictions on biosolid land application should be based on thorough risk analyses and not hasty line drawing.

Minnesota: Studying. In 2019 the Minnesota Pollution Control Agency (MPCA) requested $1.4 million from the state legislature to "evaluate and characterize" PFAS concentrations in land-applied biosolids[52] as part of its "PFAS Blueprint."[53] MPCA received approval for its request in 2020, and funding for the initiative is effective from July 2021 to June 2024.[54]

North Carolina: Studying. In November 2020, North Carolina awarded $101,792 to UNC Charlotte to study whether biosolids land application contributes to PFAS occurrence in surface water, groundwater, and soil statewide.[55] The 2019 Session of the General Assembly of North Carolina introduced House Bill 1108, which directs the Department of Environmental Quality to study the presence of PFAS in land applied biosolids and the likely categories of sources for any PFAS detected.[56] House Bill 1108 did not pass and was reintroduced in 2021 as House Bill 502 with largely identical provisions.

Wisconsin: Select Land Application Discouraged. The Wisconsin legislature in 2021 introduced the CLEAR Act, which would establish a municipal grant program that would provide funding for investigating potential PFAS contamination and reducing or eliminating existing PFAS pollution. Listed among those eligible to apply for municipal grants are parties who have previously applied biosolids to land under a water pollution permit.[57] The CLEAR Act failed to pass in March 2022 pursuant to a state senate joint resolution.

Echoing Michigan's 2021 policy, Wisconsin's Department of Natural Resources (WDNR) states that biosolids containing more than 150 ug/kg of PFAS should not be land applied, and that future water pollution/discharge permits are likely to include language prohibiting land application of biosolids containing more than 150 ug/kg of PFAS.[58] However, it is unclear whether WDNR relied on scientific studies or conducted thorough risk assessments to arrive at its 150 ug/kg threshold.

Vermont: Testing Before Application. Vermont requires all biosolids intended for land application to be tested for PFAS prior to application.[59] Moreover, exceptional quality biosolids must be accompanied with a label stating that the product may contain PFAS.[60] In 2022, the Vermont State Legislature introduced House Bill 650, which proposes a ban on biosolids land application if the biosolids are found to be contaminated with PFAS or microplastics.[61] A sibling bill from 2022, House Bill 710, would prohibit landfills from accepting solid wastes and biosolids, if the material contains PFAS.[62]

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[1] EPA, *PFAS Treatment in Biosolids: State of the Science,* (Sept. 23, 2020), https://www.epa.gov/sites/default/files/2020-10/documents/r1-pfas_webinar_day_2_session_6_mills_final.pdf (last visited June 1, 2022).

[2] EPA, *The Sources and Solutions: Wastewater*, https://www.epa.gov/nutrientpollution/sources-and-solutions-wastewater (last visited June 1, 2022).

[3] Over four million dry metric tons of biosolids are produced annually. EPA, *Basic Information About Biosolids*, https://www.epa.gov/biosolids/basic-information-about-biosolids (last visited June 1, 2022).

[4] Interstate Technology Regulatory Council, *History and Use of Per- and Polyfluoroalkyl Substances (PFAS)* (Apr. 2020), https://pfas-1.itrcweb.org/fact_sheets_page/PFAS_Fact_Sheet_History_and_Use_April2020.pdf.

[5] EPA, *PFAS Explained,* https://www.epa.gov/pfas/pfas-explained (last visited June 25, 2022).

[6] EPA, *Our Current Understanding of the Human Health and Environmental Risks of PFAS*, https://www.epa.gov/pfas/our-current-understanding-human-health-and-environmental-risks-pfas (last visited June 27, 2022). In addition to PFAS in the environment, nearly all (97-99%) Americans have some quantity of PFAS in their blood—although most below levels of concern based on current public health research. *See* U.S. Centers for Diseases Control and Prevention, *National Report on Human Exposure to Environmental Chemicals* (2018); CDC, *PFAS in the U.S. Population* (2017).

[7] EPA, *PFAS Strategic Roadmap: EPA's Commitment to Action 2021-2024, (2021)* at 5, https://www.epa.gov/system/files/documents/2021-10/pfas-roadmap_final-508.pdf (last visited June 25, 2022).

[8] P. Rizzuto, *White House Unveils Multiagency Plan to Cut PFAS Pollution,* (Oct. 21, 2021), (https://news.bloomberglaw.com/environment-and-energy/white-house-unveils-multiagency-plan-to-cut-pfas-pollution (citing 650 PFAS in commerce per EPA); Nat'l Inst. Of Env't Health Sci., Perfluoroalkyl and Polyfluoroalkyl Substances (PFAS), https://www.niehs.nih.gov/health/topics/agents/pfc/index.cfm (last visited June 17, 2022).

[9] EPA, *PFAS Treatment in Drinking Water and Wastewater – State of the Science,* (2020) at 38, https://www.epa.gov/sites/default/files/2020-09/documents/r1-pfas_webinar_day_1_session_3_speth.pdf

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(last visited June 27, 2022); N. Bolan et al., *Remediation of Poly- and Perfluoroalkyl Substances (PFAS) Contaminated Soils – To Mobilize or to Immobilize or to Degrade?*, 401 J. HAZARDOUS MATERIALS (Sept. 9, 2020) at 4.

[10] EPA, *National Pretreatment Program,* https://www.epa.gov/npdes/national-pretreatment-program (last visited June 25, 2022).

[11] *See PFAS Strategic Roadmap: EPA's Commitment to Action 2021-2024, (2021)* at 14.

[12] *See* CWA § 405(d)(2).

[13] *PFAS Strategic Roadmap: EPA's Commitment to Action 2021-2024, (2021)* at 26.

[14] First enacted in February 1993, the Part 503 regulations have been regularly updated and strengthened. Key dates include 1994, 1995, 1999, 2004, 2007, and 2015.

[15] *See* CWA § 405(d). Under Section 405(d)(1) EPA establishes numeric limits and management practices to protect public health and environment from anticipated adverse effects of chemical and microbial pollutants during use or disposal of sewage.

[16] 40 C.F.R. § 503.43.

[17] 40 C.F.R. Part 60 Subparts MMMM and LLLL.

[18] 40 C.F.R. § 503.23.

[19] 40 C.F.R. § 503.24; 40 C.F.R. § 258.26.

[20] 40 C.F.R. § 503.25; 40 C.F.R. §§ 258.22(a), (b).

[21] 40 C.F.R. §§ 503.26, 503.27; 40 C.F.R. § 258.29.

[22] *See, e.g.,* 40 C.F.R. § 503.24(l), (o)(1); 40 C.F.R. § 258.12(a)(2)(iii); 40 C.F.R. § 258.12(a).

[23] K. Kumar, L. Hundal, R. Bastian, B. Davis, WEF, *Land Application of Biosolids: Human Health Risk Assessment Related to Microconstituents,* (2017) at 1, https://www.wef.org/globalassets/assets-wef/3---resources/topics/a-n/biosolids/technical-resources/wef-fact-sheet-microconstituents-v25-aug-2017.pdf (last visited June 27, 2022).

[24] 40 C.F.R. Part 503, Subpart B.

[25] *Id.* The categories are: Pollutant Concentration Biosolid; Cumulative Pollutant Loading Rate Biosolid; or Annual Pollutant Loading Rate Biosolid.

[26] EPA, *A Plain English Guide to the EPA Part 503 Biosolids Rule*, (1994) at 35, https://www.epa.gov/sites/default/files/2018-12/documents/plain-english-guide-part503-biosolids-rule.pdf (last visited June 27, 2022). *See* 40 C.F.R. § 503.12(f)–(h) (enumerating requirements for notice and provision of necessary information when giving prepared biosolids away for land application); 40 C.F.R. § 503.14(e) (listing the kind of information that should be included in the required label).

[27] 40 C.F.R. §503.32(b)(1)(ii) (iterating general requirement for meeting Class B site restrictions, 40 C.F.R. § 503.32(b)(5) (enumerating the different types of Class B site restrictions).

[28] 40 C.F.R. § 503.14 (enumerating the different management practices that may be required).

[29] *See* 40 C.F.R. § 503.14(a)–(d).

[30] 40 C.F.R. § 503.16(a).

[31] S. Brown et al., *Municipal Biosolids: A Resource for Sustainable Communities*, 14 CURRENT OPINION IN ENV'T SCI. & HEALTH 56, 56–57 (2020); see also M. Badzmierowski and G. Evanylo, *Nutrient Content, Value, and Management of Biosolids,* (2018) at 1, https://www.virginiabiosolids.com/wp-content/uploads/2018/10/VBC_NutrientContent.pdf (last visited June 27, 2022).

[32] Brown et al. at 56-57*.*

[33] *Id.*

[34] J. Thompson & R. Watson, *Time is Running Out: The U.S. Landfill Capacity Crisis*, Solid Waste Env't Excellence Protocol, https://sweepstandard.org/time-is-running-out-the-u-s-landfill-capacity-crisis/ (last visited June 3, 2022).

[35] K. Musulin, *U.S. Landfill Capacity to Drop 15% Over Next 5 Years*, Waste Dive, (May 8, 2018), https://www.wastedive.com/news/us-landfill-capacity-decrease-SWEEP/523027/ (last visited June 25, 2022).

[36] In 2013, there were 218 SSIs in the U.S. See, e.g., https://earthjustice.org/our_work/cases/2013/cleaning-up-sewage-sludge-incinerators. The North East Biosolids & Residuals Association cites 204 SSIs. https://www.nebiosolids.org/incineration-thermal-conversion#:~:text=%E2%80%9CEPA%20estimates%20that%20there%20are,operating%20in%20the%20United%20States (last visited June 27, 2022).

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[37] 38 M.R.S. § 1306 enacted by P.L. 2022, c. 641.

[38] S2655, Mass. 2021-22, 192nd Gen. Ct., https://fastdemocracy.com/bill-search/ma/192nd/bills/MAB00048021/.

[39] E.A. Crunden, *For Waste Industry, PFAS Disposal Leads to Controversy, Regulation, Mounting Costs,* Society for Environmental Journalists, (November 18, 2020), https://www.sej.org/publications/features/waste-industry-pfas-disposal-leads-controversy-regulation-mounting-costs (Concord, N.H. opted to send biosolids to Canada).

[40] NACWA et al*., Cost Analysis of the Impacts on Municipal Utilities and Biosolids Management to Address PFAS Contamination,* (Oct. 2020, rev. Jan. 2021), https://www.wef.org/globalassets/assets-wef/3---resources/topics/a-n/biosolids/technical-resources/cost-analysis-of-pfas-on-biosolids---final---rev-1-2021.pdf.

[41] *Id*. at Section 3.5.

[42] Pima County Wastewater Reclamation et al., *PFAS in Biosolids A Southern Arizona Case Study, (Oct. 2020),* https://online.fliphtml5.com/vjxoz/hpqy/#p=1 (last visited June 25, 2022).

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