PFAS in landfills

ECOS STEP Meeting

July 29, 2020

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REPUBLIC SERVICES

About Republic Services

Republic Services is an industry leader in U.S. recycling and non-hazardous solid waste disposal. We stand for customer-focused simple solutions, reliability and environmental responsibility.

Sustainability is core to our mission:

- Climate Leadership: first U.S. recycling and solid waste services provider to have emissions reduction target approved by Science-Based Targets initiative
- Sustainability Recognition: named to the North American and World Dow Jones Sustainability Indices for a fourth consecutive year, the CDP Climate A List, Barron's 100 Most Sustainable Companies list, Ethisphere's World's Most Ethical Companies list, and Forbes Best Employers for Women list
- Circular Economy: goal to increase recovery of key materials by 40 percent on a combined basis by 2030 (2017 baseline)
- Regenerative Landfills: Goal to increase biogas sent to beneficial reuse by 50 percent by 2030 (2017 baseline)

BARRON'S 2019 100 Most Sustainable Companies

2019 WORLD'S MOST ETHICAL COMPANIES® WWW.ETHISPHERE.COM

CDP DISCLOSURE INSIGHT ACTION A LIST 2019 CLIMATE

41 STATES AND PUERTO RICO

36,000 EMPLOYEES

79 RECYCLING CENTERS PROCESSING OVER **6M** TONS OF RECYCLABLES ANNUALLY

189 ACTIVE, MODERN LANDFILLS

16,000 TRUCKS, 20% POWERED BY NATURAL GAS

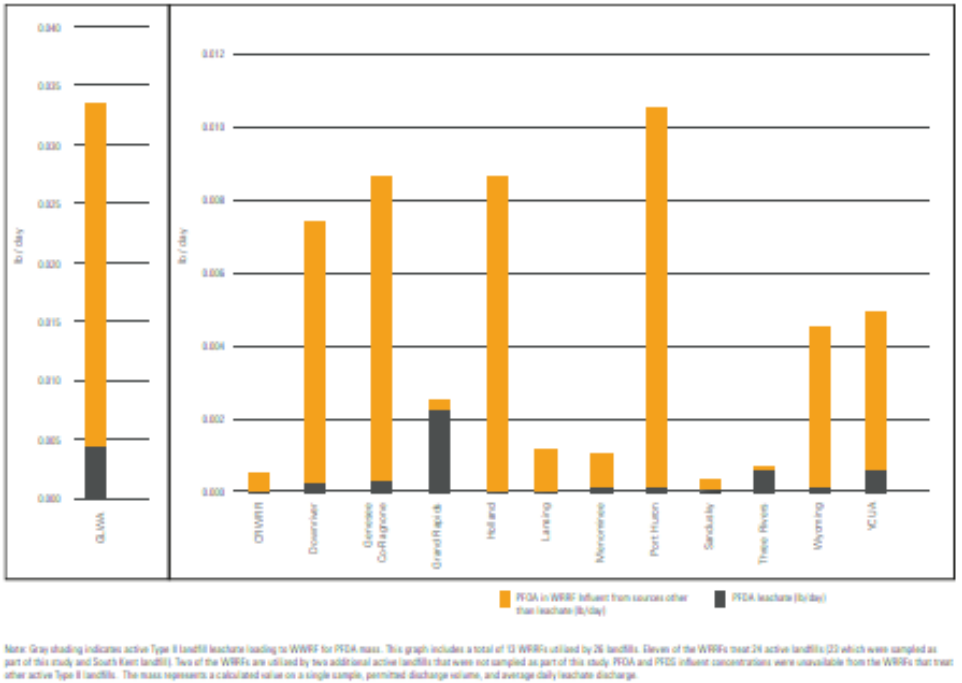
Key Features of Subtitle D (MSW) Landfills

Landfills successfully protect groundwater by using liners and leachate collection systems. The regulations that standardized landfill design have been in place for nearly 30 years.

PFAS in Landfill Leachate

- Modern landfills are well monitored, therefore many studies already exist to quantify PFAS
- PFAS comes from existing sources within material coming to landfill, not created by landfilling
- Rainwater infiltrating landfill will leach non-sequestered PFAS
- The goal is to identify the true "upstream" sources of PFAS, not just stop at easily identified downstream locations

Figure 4-2A
PFOA Mass: Influent Leachate vs. Overall WRRF Influent



Note: Gray shading indicates active Type II landfill leachate loading to WWRF for PFOA mass. This graph includes a total of 13 WRRFs utilized by 26 landfills. Eleven of the WRRFs treat 24 active landfills (23 which were sampled as part of this study and South Kent landfill). Two of the WRRFs are utilized by two additional active landfills that were not sampled as part of this study. PFOA and PFOS influent concentrations were unavailable from the WRRFs that treat other active Type II landfills. The mass represents a calculated value on a single sample, permitted discharge volume, and average daily leachate discharge.

The MWRA sampled leachate at 32 landfills across Michigan, and compared leachate PFAS "load" against total PFAS loading in receiving POTWs

Landfills are well designed and thoroughly monitored "Receivers" of PFAS

Leachate Treatment Challenges for PFAS

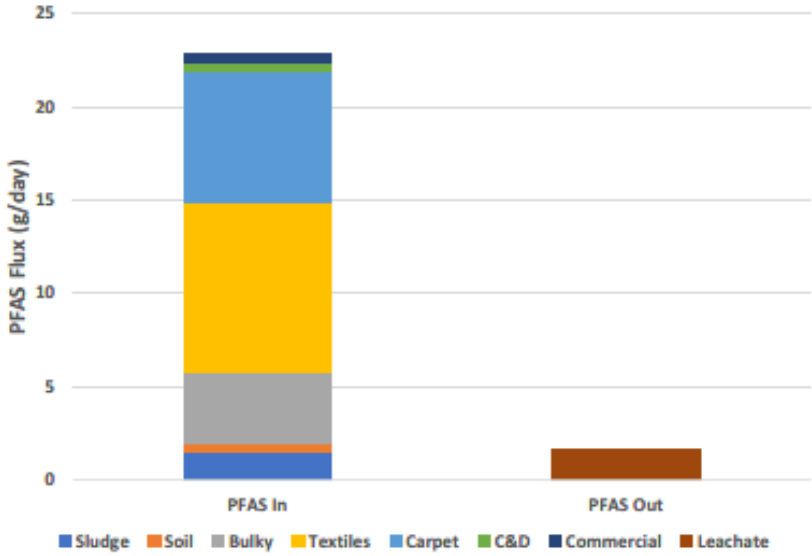
- The current PFAS treatment technologies have been developed around contaminated water
  - Activated Carbon, Ion Exchange, Reverse Osmosis
  - Designed for low concentrations
  - Sensitive to other materials in the matrix (ex: iron)
  - Non-destructive to PFAS
- Leachate has significant matrix of organic material (ex: BOD, etc.)
- Any treatment of leachate requires significant initial treatment steps prior to implementation of any polishing steps to treat PFAS

Pretreatment of landfill leachate to address part-per-trillion level contaminants is impractical, due to the broad matrix of material

Managing PFAS in a Landfill

- Due to the challenges of leachate treatment for PFAS, landfill operators may choose to regulate leachate loading by limiting inbound waste sources
- Conversely, initial studies suggest landfills provide an effective sequestration option for PFAS
- Alternate strategies, including alternative cover or capping of cells with higher concentrations may provide an effective alternative management option

Exhibit ES-2 – Estimated Total PFAS Mass Flux In and Out of the Landfill



The 2019 study PFAS Waste Source Testing Report, NEWSVT by Sanborn, Head & Associates examined the mass-balance of 24 PFAS compounds into a Vermont landfill

Landfill leachate is not a typical industrial discharge to a POTW, but a potential management option for the non-liquid fraction of PFAS

Conclusions

- Modern landfills are well-monitored “receivers” of PFAS, which comes from many of the wastes which enter the facility
- Modern landfills are lined, providing an effective protection to groundwater
- Landfill leachate is collected and treated, and will contain the non-sequestered portion of PFAS leached to infiltrated rainwater which passes through the landfill
- Leachate pre-treatment prior to POTW discharge is typically challenging, unlike other conventional industrial discharges
- Significant leachate pre-treatment requirements may discourage landfills from accepting PFAS wastes

Reference Documents

- Michigan Waste & Recycling Association, March 2019, *Statewide Study on Landfill Leachate PFOA and PFOS Impact on Water Resource Recovery Facility Influent*, Technical Report (www.michiganwasteandrecyclingassociation.com)
- Sanborn, Head & Associates, Inc., October 2019, PFAS Waste Source Testing Report, New England Waste Services of Vermont, Inc. (www.dec.vermont.gov/pfas)
- Weston & Sampson, January 2020, Poly- and Perfluoroalkyl Substances at Wastewater Treatment Facilities and Landfill Leachate, 2019 Summary Report (www.dec.vermont.gov/pfas)
- Environmental Research & Education Foundation, August 2019, *Summit on PFAS in Leachate*, Conference (www.erefdn.org)
- Groundwater and leachate sample results for ~190 landfills under California State Water Resources Control Board available on Board website (www.waterboards.ca.gov/pfas/)
- North Carolina MWRA Chapter Leachate Study to be published shortly