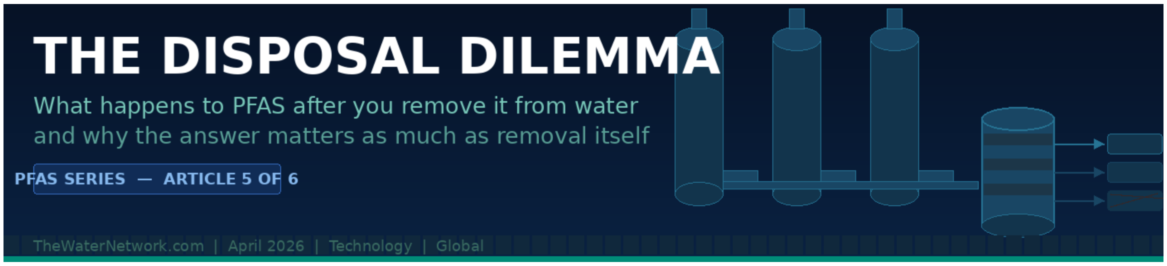

PFAS SERIES — ARTICLE 5 OF 6

The Disposal Dilemma

What happens to PFAS after you remove it — and why the answer matters as much as removal itself

Water utilities around the world are installing PFAS treatment systems. Granular activated carbon, ion exchange resins, reverse osmosis membranes — these technologies work. They can reduce PFAS concentrations in drinking water to below the most stringent limits currently in force anywhere in the world.

But there is a question that comes immediately after "how do we remove it?" and it is asked far less frequently. That question is: where does the PFAS go?

The uncomfortable answer is that most PFAS treatment systems do not destroy PFAS. They concentrate it. The contaminant moves from water into spent carbon, from treated effluent into membrane reject streams, from intake to output — but it does not disappear. And a treatment system that moves PFAS from drinking water into a landfill is not a solution. It is a deferral.

> ***Removal without destruction is not remediation. It is relocation. The question is not whether PFAS can be removed from water. The question is whether it can be permanently eliminated.***

Figure 1: The PFAS Disposal Chain

From treatment technology to end state — the four stages every water professional needs to understand

① TREATMENT TECHNOLOGY GAC · Ion Exchange · RO	② WASTE STREAM Spent media / Concentrate	③ MANAGEMENT PATHWAY Reactivation / Destruction	④ END STATE Reuse or Permanent Disposal
Removes PFAS from water — but creates a new waste stream	**PFAS is now concentrated in spent carbon, brine or reject**	**Each pathway has different costs, risks and regulatory status**	**Goal: permanent destruction — not moving PFAS elsewhere**

Source: Barr Engineering, Water Environment Research 2025, Revive Environmental 2025 · TheWaterNetwork.com / AquaSPE 2026

Figure 1: PFAS removal creates new waste streams at each stage. The goal is permanent destruction, not relocation.

The three waste streams

Every PFAS treatment technology produces a waste stream. Understanding what that stream is — and what legitimate pathways exist for managing it — is as important as selecting the treatment technology itself.

Figure 3: The Three Waste Streams — What You Need to Manage

Each treatment technology creates a different disposal challenge

SPENT GAC & ION EXCHANGE RESIN

Most widely used treatment media

- PFAS now trapped in solid media
- Thermal reactivation: >99.9% DRE
- GAC RENEW solvent method: 4+ cycles
- Landfill risk: PFOA leaches 10-100x more than PFOS — alkaline conditions

RO / NANOFILTRATION CONCENTRATE

Membrane systems reject PFAS into 15-25% reject stream

- PFAS concentrated 4-10x in reject
- Reject must be treated — not just disposed
- SCWO or EOx effective on concentrate
- Volume reduction before destruction reduces cost significantly

LANDFILL LEACHATE

Often overlooked — highest PFAS concentrations anywhere

- Can exceed 200,000 ng/L PFAS
- Conventional treatment ineffective
- Foam fractionation + SCWO chain showing best results in 2026
- A regulatory time bomb as landfill PFAS rules tighten

Sources: Barr Engineering Water Environment Research 2025, EST 2025, Waste Advantage Magazine 2026 · TheWaterNetwork.com / AquaSPE 2026

Figure 3: The three main PFAS waste streams and their management challenges. Landfill leachate is the most concentrated and most overlooked.

Spent granular activated carbon (GAC)

GAC is the most widely deployed PFAS treatment technology globally. When it reaches the end of its service life — typically when PFAS begins breaking through into treated water — it must be either reactivated or disposed of. The critical issue is what happens to the PFAS it has adsorbed.

Thermal reactivation — the established approach for large-scale users, operates at temperatures above 900°C. At these temperatures, >99.9% PFAS destruction removal efficiency has been demonstrated in full-scale potable water reactivation facilities. No targeted PFAS were detected on reactivated GAC at the temperatures and operating conditions tested. Reactivated GAC performs comparably to virgin carbon.

Landfill disposal — a common but problematic option for smaller utilities without access to reactivation infrastructure. Research shows PFOA leaches from spent GAC at one to two orders of magnitude more than PFOS under alkaline leaching conditions, creating a secondary contamination pathway. As PFAS-in-landfill regulation tightens, landfill disposal of spent GAC carries growing liability.

Emerging regeneration methods — solvent-based GAC regeneration (commercialised as GAC RENEW by Revive Environmental) is transitioning from pilot to commercial scale in 2026. Large-scale capacity for potable-use GAC is available in the Midwest and New England US from Q1/Q2 2026, with west coast expansion planned for 2027. Four regeneration cycles have been demonstrated with maintained PFAS removal performance.

Reverse osmosis and nanofiltration concentrate

Membrane systems are highly effective at PFAS removal — but they concentrate PFAS rather than destroy it. Typically 15–25% of the treated volume becomes reject water containing PFAS at concentrations 4–10 times higher than the influent. This concentrate must itself be treated.

Volume reduction before destruction is critical: the smaller the volume that needs destruction treatment, the more economically viable the destruction step becomes. Combining membrane concentration with downstream SCWO or electrochemical oxidation is emerging as a viable treatment train for high-concentration waste streams.

Ion exchange regenerant and still bottoms

Regenerable ion exchange (IXR) systems generate a PFAS-laden brine during regeneration cycles. This concentrated regenerant — which can contain high levels of salt, NOM, and nitrate — presents destruction challenges because matrix constituents can slow PFAS degradation kinetics in some systems. Full-scale data from 26 consecutive IXR regeneration cycles show no PFAS buildup or deterioration of the resin, confirming the approach's long-term viability. The regenerant stream itself is typically managed through incineration or emerging destruction methods.

Figure 2: PFAS Waste Management — Technology Comparison 2026

Key options for handling spent media and PFAS concentrate — status and capability

TECHNOLOGY	HOW IT WORKS	PFAS RANGE	SCALE	STATUS
Thermal Reactivation (GAC)	High-temp kiln >900°C destroys PFAS	Long-chain PFAS >99.9% DRE	Commercial (full scale)	Proven
Supercritical Water Oxidation (SCWO)	374°C / 22 MPa — complete mineralisation	Long + short-chain >99.99% DRE	Commercial (limited scale)	Proven
Hydrothermal Alkaline Treatment (HALT)	Heat + NaOH ~350°C, 16.5 MPa	Long + short-chain >97% degradation	Pilot / early commercial	Emerging
Electrochemical Oxidation (EOx)	Electric current generates oxidants	Long-chain; limited short-chain	Commercial (modular)	Proven
Solvent Regeneration (GAC RENEW)	Solvent strips PFAS then destroys extract	Long-chain PFAS 4+ regeneration cycles	Pilot to commercial 2026	Emerging
Incineration (high-temp)	Combustion at >1100°C	Broad — if temp adequate	Commercial	Concern
Landfill Disposal (spent GAC)	Containment — no destruction	PFAS retained; leaching risk	Commercial (common)	Concern

Sources: Barr Engineering 2025, Aclarity 2024, Revive Environmental 2025, 374Water, Aquagga, Cleantech Group 2025, Remediation Journal 2025

Figure 2: Technology comparison for PFAS waste management. DRE = destruction removal efficiency. TRL = technology readiness level.

The destruction imperative

The distinction between removal and destruction is not semantic. It has direct regulatory and liability implications.

Thermal reactivation at above 900°C destroys PFAS at rates exceeding 99.9% in full-scale facilities. Supercritical water oxidation (SCWO) — operating above 374°C and 22 MPa — completely mineralises PFAS to water, carbon dioxide, and inorganic salts, with no hazardous by-products. SCWO is considered a clean technology precisely because it does not generate secondary waste. When PFAS-laden waste is delivered as a concentrated stream, SCWO destruction efficiencies exceed 99.99%.

Electrochemical oxidation (EOx) is the most commercially deployed destruction technology, integrated into ion exchange resin systems at full scale at defence and industrial sites globally. It operates at ambient temperatures, does not require combustion, and is available in modular formats. Its limitation is selectivity — it is less effective for short-chain PFAS than for long-chain compounds.

Hydrothermal alkaline treatment (HALT), commercialised by Aquagga, sits between SCWO and EOx in terms of efficiency and treatment volume. It uses subcritical water amended with strong base

(350°C, 16.5 MPa, NaOH) and has been demonstrated at pilot scale for spent GAC regeneration, achieving near-complete (>97%) reduction in measured PFAS concentrations with retention of GAC surface area and adsorption capacity.

> ***Incineration at inadequate temperatures is not a valid PFAS destruction pathway. At temperatures below 1100°C, PFAS compounds can survive combustion or be reformed as products of incomplete destruction. The regulatory direction is toward verified destruction with traceable batch records — not assumed destruction through general waste incineration.***

The landfill leachate problem

One of the most significant and underappreciated PFAS disposal challenges is not associated with water treatment systems at all. It is landfill leachate — the liquid that percolates through municipal waste and emerges at the base of landfills.

Landfill leachate can contain PFAS at concentrations exceeding 200,000 ng/L — orders of magnitude above drinking water limits and far above any other waste stream in the water sector. Conventional leachate treatment systems were not designed for PFAS and pass the compounds through largely untreated.

The most effective treatment chain emerging in 2026 combines foam fractionation to concentrate PFAS from raw leachate, followed by SCWO for destruction. Foam fractionation exploits the surfactant properties of PFAS — many compounds are surface-active and concentrate at air-water interfaces, allowing them to be separated into a small, highly concentrated foam fraction for downstream destruction. SCWO then mineralises this concentrated stream with destruction efficiencies exceeding 99.99%.

For water professionals: municipalities that accept leachate at wastewater treatment plants should assess whether their treatment trains are adequate for the PFAS load. As landfill PFAS regulations tighten in both the US and EU, leachate arriving at WWTPs will increasingly require dedicated pre-treatment before discharge to the receiving water body.

Figure 4: PFAS Destruction Technology Readiness 2026

How commercially ready are the leading destruction options?

TECHNOLOGY	TECHNOLOGY READINESS LEVEL (TRL) — 1 = bench scale, 9 = full commercial	TRL (1–9)
Thermal Reactivation (GAC)		TRL 9
Electrochemical Oxidation (EOx)		TRL 8
Supercritical Water Oxidation		TRL 7
Hydrothermal Alkaline (HALT)		TRL 6
Solvent Regeneration (GAC RENEW)		TRL 5
Non-thermal Plasma		TRL 4
Photocatalysis / UV-ARP		TRL 4
Ball Milling (solid phase)		TRL 3

Sources: Barr Engineering 2025, Aclarity 2024, 374Water, Aquagga, Cleantech Group 2025, npj Clean Water 2025

Figure 4: Technology readiness levels for PFAS destruction options. TRL 9 = full commercial deployment. TRL 1-3 = bench scale only.

What this means for water utilities

The practical implications for utilities investing in PFAS treatment are significant and often underappreciated at the procurement stage.

1. Plan the full disposal chain before selecting treatment technology. The choice of primary treatment technology determines what waste streams you will need to manage. A GAC system requires either a reactivation contract or a robust disposal pathway. A membrane system requires concentrate management. Ion exchange requires regenerant handling. None of these are optional.

2. Require destruction verification, not just disposal contracts. As PFAS liability law develops, utilities that can demonstrate their spent media was destroyed — with traceable batch records — will be in a stronger position than those who can only show it was landfilled. Emerging procurement standards increasingly require verified destruction.

3. Evaluate emerging technologies for 2026–2027 deployment. Large-scale commercial GAC regeneration with verified PFAS destruction is becoming available from Q1/Q2 2026 in the US. Utilities procuring GAC systems now should negotiate regeneration options into their contracts from the outset, not as an afterthought.

4. Assess leachate inputs to WWTPs. If your wastewater treatment plant accepts municipal solid waste landfill leachate, assess the PFAS load that stream represents and whether your system is treating it adequately. This is an emerging regulatory exposure.

5. Track biosolids regulation. Spent treatment media concentrating PFAS often ends up in biosolids streams. The EPA's draft risk assessment on PFOA/PFOS in biosolids (released January

2025) signals that biosolids PFAS regulation is coming. The disposal chain does not end at the water treatment plant boundary.

> ***The PFAS crisis in water has been framed as a treatment problem. It is equally a disposal problem. Every utility investing in PFAS removal technology today needs a credible answer to the question: and then what?***

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