

Environmental Context

The Lower Umatilla Basin Groundwater Management Area (LUBGWMA) Nitrate Crisis

Site Justification for PAWD Pilot Deployment | February 2026

1. The Contamination Crisis

The Lower Umatilla Basin Groundwater Management Area (LUBGWMA) in northeastern Oregon encompasses approximately 350 square miles of intensively farmed agricultural land in Morrow and Umatilla counties. The region's permeable alluvial soils and shallow water table make the underlying aquifer uniquely vulnerable to nitrogen loading from agricultural operations, concentrated animal feeding operations (CAFOs), and food processing facilities.

Decades of agricultural nitrogen application have driven groundwater nitrate concentrations to levels that constitute a public health emergency. Well-water testing across the LUBGWMA documents concentrations ranging from 10 to 75.5 mg/L NO₃-N. The EPA Maximum Contaminant Level (MCL) for nitrate-nitrogen is 10 mg/L.

Parameter	Value
EPA Maximum Contaminant Level	10 mg/L NO ₃ -N
Documented well concentrations	10 – 75.5 mg/L NO ₃ -N
Peak documented concentration	75.5 mg/L (755% of EPA MCL)
Xylem-referenced peak	63 mg/L (630% of EPA MCL)
Contamination trend	Stable to increasing over 35+ years
Affected population	Thousands of residents on private wells
Current mitigation	Bottled water at household expense
Estimated cost to affected households	\$33,000 – \$55,000/year per 46 households

2. Regulatory Landscape

2.1 Oregon Groundwater Management Area (GWMA)

The LUBGWMA was designated under ORS 468B.180 as one of Oregon's Groundwater Management Areas due to persistent nitrate contamination exceeding the EPA MCL. The designation triggers development of a voluntary action plan coordinated between Oregon DEQ, Oregon Health Authority (OHA), Oregon Department of Agriculture (ODA), and local stakeholders.

The current GWMA Action Plan has been in place for over three decades. Despite administrative effort, monitoring data shows that nitrate concentrations have not meaningfully declined across the Basin. The 2026 Nitrate Reduction Plan Annual Report documents continued exceedances across a wide geographic area, with some monitoring wells showing increasing trends.

2.2 Federal Framework

- Safe Drinking Water Act (SDWA): EPA MCL of 10 mg/L NO₃-N applies to public water systems. Private domestic wells are not regulated under SDWA but residents are exposed to the same contaminated aquifer.
- Clean Water Act Section 319: Funds nonpoint source pollution reduction implementation. Oregon DEQ administers EPA pass-through grants for on-the-ground projects. LUBGWMA nitrate is an explicit priority.
- Columbia River Basin Restoration Program (Section 123): EPA Region 10 funds projects reducing nutrient loading to the Columbia River system. Agricultural nitrate from the LUBGWMA is a documented contributor.
- Environmental Justice: Communities relying on bottled water due to contaminated wells meet federal environmental justice criteria for disadvantaged populations bearing disproportionate environmental burden.

2.3 The Implementation Gap

The central failure is not a lack of regulation but a lack of deployment. Existing best management practices (BMPs) focus on source reduction — nutrient management plans, irrigation efficiency, cover crops, and fertilizer application timing. These practices address future loading but do not remediate the legacy nitrate already saturating the aquifer, nor do they reduce concentrations in wells that residents are drinking from today.

No scalable, deployable treatment technology currently operates in the LUBGWMA to directly reduce nitrate concentrations in extracted groundwater before it reaches households.

3. Nitrate Source Analysis

Source Category	Mechanism	Contribution
Row crop agriculture	Fertilizer application exceeding crop uptake; leaching through permeable soils	Primary
Concentrated animal feeding (CAFOs)	Manure application and lagoon leakage	Significant
Food processing facilities	Process wastewater land application	Contributing
Onsite septic systems	Domestic wastewater percolation	Minor (localized)
Natural background	Geological nitrogen in arid alluvial soils	Minimal (~1–2 mg/L)

The dominant mechanism is diffuse agricultural loading across the Basin's highly permeable soils. The shallow water table (often <50 feet) provides minimal filtration or denitrification between the surface and the aquifer. Once nitrogen enters the groundwater as nitrate, it is mobile, persistent, and migrates with groundwater flow.

4. Downstream Watershed Impact

The LUBGWMA aquifer discharges to the Columbia River system through baseflow and irrigation return flows. Nitrogen loading from the Basin contributes to the broader nutrient budget of the Columbia, which EPA has documented as driving algal blooms, eutrophication, dissolved oxygen depletion, and harm to ESA-listed salmonid populations.

Every kilogram of nitrate removed from LUBGWMA groundwater before it enters surface drainage is a kilogram that does not reach the Columbia River. At design throughput, a single PAWD unit removes approximately 387 kg of nitrate per year. A 25-unit deployment would remove nearly 10 metric tons annually — measurable at the watershed scale.

5. Why LUBGWMA for Pilot Deployment

- **Severity:** Documented concentrations up to 755% of EPA MCL — the most acute nitrate crisis in the Pacific Northwest
- **Duration:** 35+ years of failed voluntary administrative response demonstrates that source reduction alone is insufficient
- **Scale:** Thousands of affected residents currently dependent on bottled water — a tangible, measurable baseline for impact
- **Regulatory alignment:** Explicit Oregon DEQ and EPA Region 10 priority area with active interagency coordination
- **Thermal resource:** Proximate data center infrastructure in the Columbia Basin corridor provides waste heat for EMERALD NEXUS coupling
- **Transferability:** Results from LUBGWMA are directly applicable to similar agricultural nitrate crises in Yakima Valley (WA), Central Valley (CA), and other western GWMA
- **Community readiness:** Morrow County Clean Water Consortium actively pursuing solutions with committed funding for future projects

6. PAWD as Direct Response

PAWD addresses the LUBGWMA crisis by providing what has been missing for 35 years: a deployable, modular treatment technology that directly reduces nitrate concentrations in extracted groundwater to safe levels before it reaches households. The system converts contaminated well water (10–75.5 mg/L NO₃-N) to sensor-verified safe water (≤5 mg/L) through biological denitrification accelerated by industrial waste heat.

The Fail-Closed discharge protocol ensures that no treated water is released until industrial-grade YSI/Xylem optical sensors independently verify qualification. This replaces the statistical uncertainty of periodic grab sampling with batch-level verified safety — a standard of assurance that matches the severity of the crisis.

PAWD Performance Metric	Value
Daily treatment volume	~14,000 gallons (~53,000 liters)
Annual nitrate removal	~387 kg NO ₃ ⁻ per unit
Households served	~46 households (~149 people) per unit
Discharge quality	≤5 mg/L NO ₃ -N (sensor-verified)
Design discharge target	2–3 mg/L (approaching natural background)
Bottled water cost eliminated	\$33,000–\$55,000/year per 46 households
Scale projection (25 units)	~3,725 people served, ~9,675 kg/year removed

7. Data Sources

- Oregon DEQ: LUBGWMA Nitrate Reduction Plan and Annual Reports
- Oregon Health Authority: Drinking Water Source Protection assessments
- EPA Region 10: Columbia River Basin nutrient loading studies
- USGS: Groundwater quality monitoring data for Morrow and Umatilla counties
- Morrow County Clean Water Consortium: Stakeholder reports and funding commitments
- PAWDWater Environmental Impact Estimate (internal, February 2026)
- PAWDWater Technical Prospectus v2 (February 2026)
- Whitney Equipment Company Quote #47006 (YSI sensor package specification)

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