Atmospheric Deposition to Farmington Bay (2021–2024)

What is Atmospheric Deposition?

Atmospheric deposition (AD) is the transfer of nutrients from the atmosphere to a water body, primarily through precipitation. These nutrients, particularly total phosphorus (TP), orthophosphate (OP), and total nitrogen (TN), can contribute to eutrophication and harmful algal blooms.

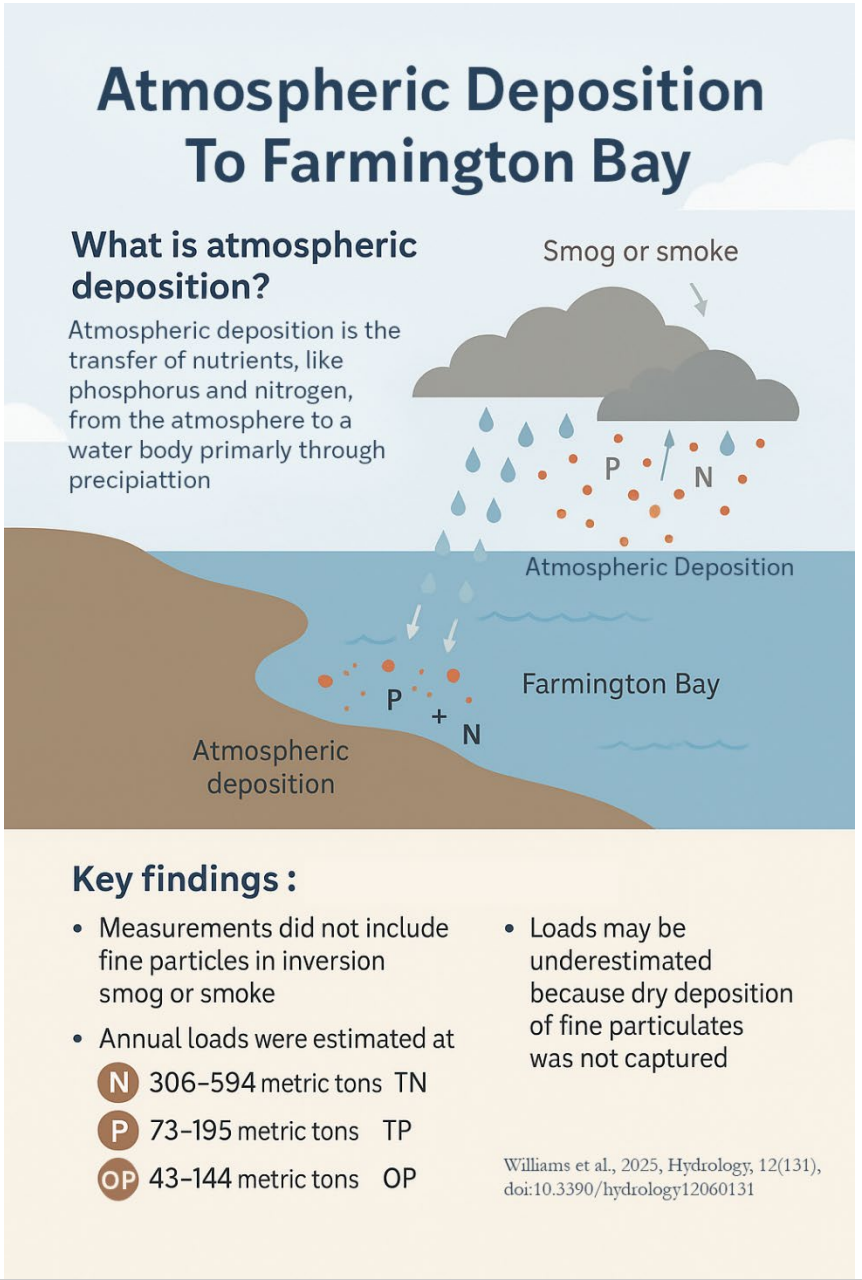
Key Findings for Farmington Bay:

- AD was measured exclusively via *precipitation-based sampling methods* which capture nutrients that fall during rain or snow events.
- *Dry deposition* and *fine particulate matter* (like smog or smoke) were *not captured* using these methods. This means nutrient loads associated with the finest particles—those most common in inversion events or wildfire smoke—were excluded.
- Based on these *precipitation-only* methods, annual loads were estimated as follows:
    - **Total Nitrogen** (TN): 306–594 metric tons/year
    - **Total Phosphorus** (TP): 73–195 metric tons/year
    - **Orthophosphate** (OP): 43–144 metric tons/year

Measurement Approach:

Researchers measured atmospheric deposition (AD) in Farmington Bay from 2021–2024 using the **precipitation-only method**:

- **Precipitation samples** were collected after storm events at seven stations around the Bay.
- **Nutrient concentrations** (total phosphorus [TP], orthophosphate [OP], and total nitrogen [TN]) were measured in these samples.
- **Total nutrient loads** were calculated by multiplying nutrient concentrations by the total precipitation volume over the Bay.



Details:

- A single storm event on 13 April 2023 contributed a major portion of the annual load, highlighting the episodic nature of AD.
- The highest load was in 2023 due to increased rainfall and a large April deposition event.
- Nutrient concentrations were higher near urban areas and lower in more remote parts of the Ray.

Limitations and Implications:

- This method **does not capture dry deposition** (e.g., dust or fine airborne particles like smog or smoke that are captured when they contact the water surface).
- Past studies at Utah Lake suggest precipitation-only methods may **underestimate total nutrient loads by 2 to 3 times**.
- This limitation is especially important in Utah's Wasatch Front region, which experiences periodic inversion events that increase atmospheric fine particulates.
- Nutrient loads deposited onto water bodies tend to be higher than those onto land due to the efficient capture of fine particles by the water surface.

Why It Matters:

Understanding the magnitude and variability of AD is crucial for nutrient budgeting and water quality management in Farmington Bay. While AD has often been overlooked, this study shows it is a significant and episodic nutrient source that must be considered alongside point sources like wastewater discharge.

For more details:

see: Williams et al., 2025, *Hydrology*, 12(131), doi:10.3390/hydrology12060131