ULWQS Atmospheric Deposition Loading Recommendation

Mechanistic water quality models, such as the one currently being developed for Utah Lake by the University of Utah, are often very sensitive to the boundary conditions assumed during model calibration. There is considerable variation in the available estimates of atmospheric nutrient deposition to Utah Lake. Some estimates are two orders of magnitude higher than others, likely due to the inclusion of emerging adult chironomids from Utah Lake in the field measurements of nutrient inputs to Utah Lake. To date, the most thoroughly documented analysis of atmospheric deposition of nutrients to Utah Lake is Brahney (2019). This analysis estimates that the mean atmospheric phosphorus loading to Utah Lake is 5.0 tons/year (range of 1.9 to 8.1 tons P/year), with a mean biologically available phosphorus load of 2.5 tons/year (range of 1.0 to 4.0 tons/year). This analysis also estimates that atmospheric nitrogen loading to Utah Lake likely falls into the range of 153 to 288 tons N/year, with 170 tons N in 2017.

Although the true atmospheric nutrient deposition to Utah Lake is not known at this time, for the sake of model calibration the Utah Lake Water Quality Study Independent Science Panel recommends that the values above, broken out by species and transformed to a daily rate, be applied as follows:

- The atmospheric N and P loading coefficients presented in this memo should be applied to Utah Lake as steady-state variables;
- The following loading coefficients should be used as WASP model inputs:
  - Nitrate[1] – 0.21 mg-N/m^2-day
  - Ammonia[2] – 0.35 mg-NH$_3$/m^2-day
  - Organic Nitrogen[3] – 0.74 mg-N/m^2-day
  - Orthophosphate[4] – 0.009 mg-P/m^2-day
  - Organic phosphate[5] – 0.012 mg-P/m^2-day

The Science Panel will incorporate new atmospheric nutrient input information into the Utah Lake mass balance, mechanistic models, and other relevant analyses as it becomes available.

Brahney, J. 2019. Estimating total and bioavailable nutrient loading to Utah Lake from the atmosphere. White Paper prepared for the Utah Lake Water Quality Study.

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[1] Wet deposition + aerosol deposition (page 20) = (65 mg-N/m2-year + 10 mg-N/m2-year) * (1 year/365.25 days)
[2] Wet + aerosol deposition (page 20) = (120 mg-N/m^2-year + 7 mg-N/m^2-year) * (1 year/365.25 days)
[3] Organic N = Total N - Nitrate - Ammonia
[4] Wet deposition (page 16) + (mean TP* % water solute-dry (page14)) = (2.9 mg P m^2-year +(13.3 mg P/ m^2-year*0.035) * (1 year/365.25 days))
[5] Mean TP * Fraction of Organic P to TP (0.34) = (13.3 mg P/ m^2-year*0.34) * (1 year/365.25 days))