# Adding Nitrogen Flux to Dam Removal Discussions

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March 2019

## *The implications of dam removals on nitrogen flux*

*Since the late 20th century, researchers have valued lakes, ponds and reservoirs for their ability to retain nitrogen (N). By retaining N, they prevent its downstream discharge into coastal waters where it could contribute to cultural eutrophication which degrades estuarine habitats and causes hypoxia (loss of oxygen). Dams often create reservoirs that may retain nitrogen. Through the Future of Dam project, we explored the implications of dam removals on nitrogen flux from New England watersheds (Gold et al. 2016). To our knowledge, this was the first exercise that introduced nitrogen flux as a dam trade-off.*

## Nitrogen flux as a trade-off

There are numerous trade-offs to be weighed with every dam removal decision. Potential benefits include improved migratory fish passage and reduced safety hazards while potential costs encompass loss of values, such as water supply storage, flood control, recreational opportunities, sediment retention or economic opportunities with hydropower. We proposed and illustrated an ecological classification based on a potential function of dams – the retention and removal of nitrate-nitrogen from coastal waters. We used a geospatial approach based on widely-available data that had been developed previously in our lab (Kellogg et al. 2010) to evaluate the potential for New England reservoirs to serve as locations of N removal. In our model key parameters were:

- Reservoir surface area – the larger the reservoir, the longer it may retain water

*Reservoir behind the Potter Hill Dam in Westerly, RI. Photo by Kelly Addy.*

- Stream flow rates – slower flow rates into the reservoir and in the channel will also allow more retention time
- Watershed surface area – the larger the watershed, the greater potential for watershed N to run into the reservoir

- Nitrogen inputs from different land uses – different land uses contribute different amounts of N; watersheds with large areas of forest will likely have less N export than watersheds dominated by agriculture or suburban/urban areas
- Nitrogen inputs to a reservoir from wastewater treatment plants

We highlighted the reservoirs that increased the water retention time to allow more time for biological transformations of the N. We coupled that with estimated N loading from watersheds to each reservoir based on models and assumptions about different land use and wastewater treatment in New England. From these data, we were able to estimate the % of N could be removed from each dammed reservoir.

We identified approximately 2,200 dams with reservoirs in New England had potential benefits for N removal. Across these dams, safety concerns ranged between 28% to 44% based on the size of the river. Only 3% of these N removal dams were classified as high value for fish passage. Of course, site-specific analyses are warranted to improve N delivery estimates and examine alternatives that retain the reservoir while enhancing fish passage and safety.

Part of the impetus for the project was to establish a New England Dam Database – all the needed parameters plus a host of others (link to that research brief). These geospatial data have contributed to several ongoing studies including the recent tradeoff analyses published in the Proceedings of National Academy of Sciences (Roy et al. 2018).

## Researchers


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## Additional Resources


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## Funding


Support for this research is provided by the National Science Foundation's Research Infrastructure Improvement NSF #IIA-1539071.