Affects of Land Use on Nutrient Loading in the Lake Trafford Watershed

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INTRODUCTION

Nutrient loading refers to the amount of nutrients seeping into our waterways in a given time period. Although nutrient loading is a natural process, it has been amplified by anthropogenic sources of runoff, which cause catastrophic events in the given ecosystem. Common issues associated with high nutrient loading are eutrophication and red tide (John Anderson et al., 2005).

Different land uses have been shown to have different levels of overall nutrient loss from their system (Young et al., 1995). For example, agricultural fields will contain a lot more nitrogen and phosphorus in their runoff than preserve land due to the fertilizer used.

Lake Trafford has dealt with many instances of eutrophication, which has not only been detrimental to the ecosystem itself, but those that rely on it for their main source of income. The lake has already been dredged once to rid it of the excess nutrients and organic matter.

Because of these factors, this experiment looks at how different dominant land use types shift the overall level of nutrients in Lake Trafford through time. The results can help to guide management decisions and show the community how they can mitigate further losses.

RESEARCH OBJECTIVE

The objective for this experiment is to determine whether or not shifting the dominant land use type in the watershed effects the overall nutrient levels through time in Lake Trafford. Another aim is to determine whether the main type of agriculture (industrial or sustainable) plays a role as well.

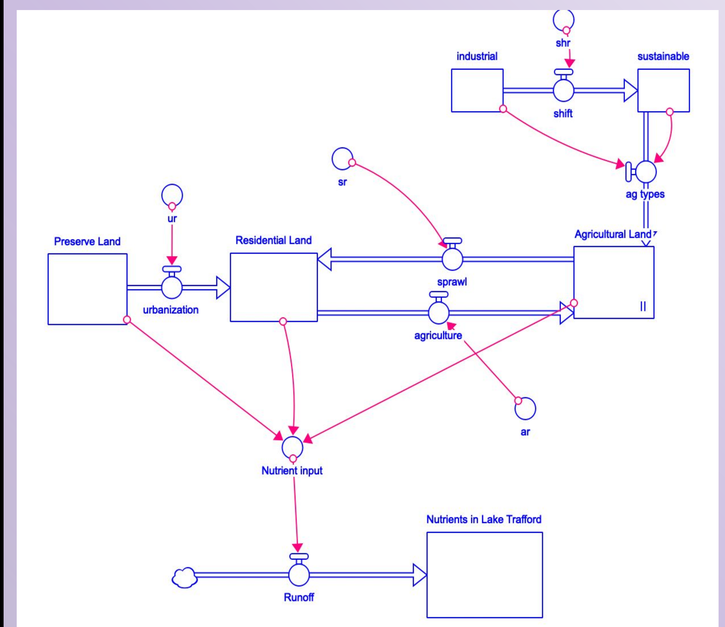
MODELING APPROACH

This experiment was run for a duration of 50 years with a time step of one. The nutrients in Lake Trafford stock has an initial value of 0 for simplification and was not manipulated. Preserve land, residential, and agricultural land had initial values of 1539, 1746, and 6527, respectively. These values are the number of acres that the land use type is accounted for in the watershed. For the nutrient input converter, the numbers of all the land use types were added and multiplied by different magnitudes to suggest higher levels of nutrient runoff. Preserve was multiplied by 1, residential by 2, and agriculture by 4.

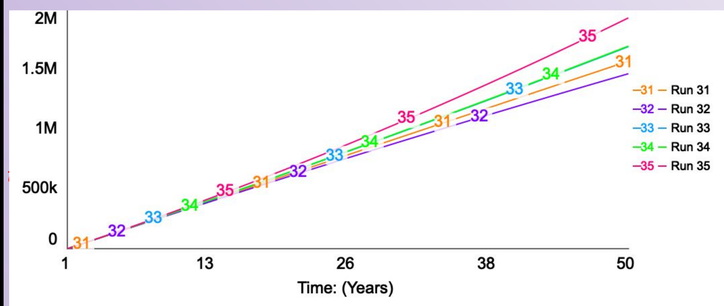
Flows were added between some of the land use stocks to suggest shifts and land use. The convertors attached to those flows are what has been manipulated in this experiment. UR stands for urbanization rate, SR for sprawl rate, and AR for agriculture rate.

Agriculture land has further been broken down into sustainable and industrial agriculture, with initial values of 227 and 6300, respectively. The rate that industrial agriculture shifts to sustainable (represented by SHR) will be manipulated as well.

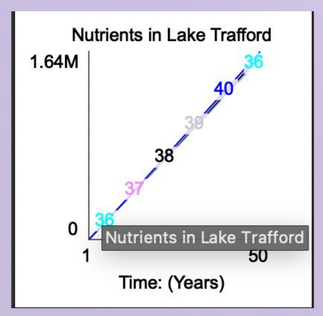
CONCEPTUAL MODEL



SIMULATION RESULTS

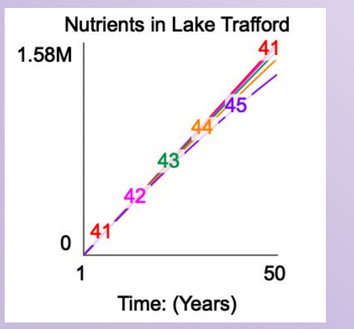


Changing AR from 1 to 10 to 25 to 50 to 100



Changing UR from 1 to 10 to 25 to 50 to 100

SIMULATION RESULTS



Hanging SR from 1 to 10 to 25 to 50 to 100

DISCUSSION

The experiment showed that shifts in the rate of change between the different land use types did have an overall affect on the nutrients in Lake Trafford. Urbanization rate seemed to affect the end number the least, as most of numbers were very close. Changing the agriculture rate seemed to have the biggest impact. When it was shifted to 100, overall nutrients in Lake Trafford nearly reached 2 million.

Surprisingly, shifting from industrial to sustainable agriculture did not seem to have much of an effect on the levels at all. The numbers stayed the same, despite changing SHR. This could point to human error or simply that the dominant agriculture type has little affect on the landscape.

For future experiments, it might be best to break the overall conceptual model into smaller pieces, then place it back together as a whole. This would allow for less variability and more reliability in the model, as only one factor is affecting the nutrient levels.

LITERATURE CITED

John Anderson, N., Jeppesen, E., & Sondergaard, M. (2005). Ecological effects of reduced nutrient loading (oligotrophication) on lakes: An introduction. *Freshwater Biology*, *50*(10), 1589–1593. https://doi.org/10.1111/j.1365-2427.2005.01433.x

Young, W. J., Marston, F. M., & Davis, J. R. (1995). *Nutrient Exports and Land Use in Australian Catchments*. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.525.4304&rep=rep1&type=pdf

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