

WPI

Nutrient Filtration by Riparian Buffers on White Island Pond

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Abstract

High concentrated nutrient runoff is a prominent issue in the cranberry growing industry. White Island Pond, located in Plymouth/Wareham, MA, shows the effects of this runoff. The Massachusetts Department of Environmental Protection identified this pond as impaired in 2009, and a budget



USDA Natural Resources Conservation Service. "The combination of trees, shrubs and grasses in this riparian buffer reduces sediment and other attached pollutants entering the stream." 2011. USDA NRCS Photo Gallery.

and plan was organized to improve the quality of the water. Cranberry bogs were pinpointed as a source of pollution for White Island Pond, and a filtration method was devised and employed. Among the plan of action for this pond, responsibilities were assigned to guarantee that the quality of the water is maintained. Many solutions were researched and riparian buffers were concluded to be the most viable Best Management Practice. It is recommended that Plymouth and Wareham apply this plan through a community service projects.

Background

- Cranberry production is a popular industry in MA due to abundance of water, sandy soil, and level land
- The combination of heavy fertilizer use and annual harvest floods cause the problem of nutrient rich runoff reaching watersheds
 - Phosphorus and nitrogen are needed in cranberry growth but are also limiting growth agents for algae and aquatic plants
 - Cranberry bog runoff causes eutrophication in their watersheds
- White Island Pond was deemed impaired and a recovery plan was formulated by the MassDEP

Objectives

- Understand cranberry bog runoff
- Provide a solution that would reduce the amount of nutrients in White Island Pond
- Analyze solutions for cranberry bog runoff
- Improve water quality and decrease eutrophication

Implementation

Since the town selectmen of Plymouth and Wareham are responsible for implementing Best Managements Practices (BMPs) to repair the pond, riparian buffers would be added as an additional BMP and would be placed through a community service project. In order to measure the success, the tests conducted by the UMass Cranberry Station would be repeated, with samples being collected monthly from March to November and during seasonal bog flows.

Methodology

The initial step was to contact the White Island Pond Conservation Alliance (WIPCA) to inquire about what, if any, solution(s) were already in place to cut down on nutrient concentration. Based on information received from the WIPCA, nonpoint source runoff proved to be the second largest factor in nutrient concentration. During harvest, the water used to release the cranberries from the vines is drained into a reservoir that often overflows with common rains, and the nutrient filled runoff flows into White Island Pond.

Analyzed possible solutions:

- Policy to regulate of fertilizer/pesticide use
- Construct runoff filters on the reservoir's of local cranberry bogs
- Implement a riparian buffer between cranberry bogs and the pond

Contaminant removal efficiencies from references within Castelle et al. (1994) review of U.S. vegetated buffers. (VFS = vegetated filter strip.)

Contaminant	Buffer width	Removal (%)	Slope (%)	Farm type	Buffer type	Reference
Sediment	30.5	90	2			Wong & McCuen (1982)
Sediment	61	95	2			Wong & McCuen (1982)
Sediment	24.4	92			Veg.	Young et al. (1980)
Sediment	22.9	33		dairy	Filter strip	Schellinger & Clausen (1992)
Sediment	61	80			Grassy swale	Horner & Mar (1982)
Sediment	30	75-80			Logging activity	Lynch et al. (1985)
Sediment	9.1	85	7 and 12		Grass VFS	Ghaffarzadeh et al. (1992)
NO3-N, NH4-N, PO4-P	4.6	90%			Grass VFS	Madison et al. (1992)
NO3-N, NH4-N, PO4-P	9.1	96-99.9			Grass VFS	Madison et al. (1992)
Sediment, N, P	9.1	84, 79, 73	11-16		Grass VFS	Dillaha et al. (1989)
Sediment, N, P	4.6	70, 61, 54	11-16		Grass VFS	Dillaha et al. (1989)
NO3-N	10	99.9%			forested	Xu et al. (1992)
N, P	19	89, 80			forested	Shisler et al. (1987)

Table 2: Some New Zealand studies of efficiency.

Contaminant	Buffer width	Removal (%)	Farm type	Buffer type	Reference
Nitrate	c. 3-4m	88-97	pasture	Riparian organic soils - wetland	Cooper 1990
Nitrate	c. 3-4m	0-62	pasture	Riparian mineral soils - wetland	Cooper 1990
Nitrate		-140-91	pasture	streambed	Cooper 1990
Nitrate		32-100%	Waste water treatment	wetland	Cooper 1994
Nitrate	10-13m	67	pasture	Retired pasture	Smith 1989
Dissolved P	10-13m	55	pasture	Retired pasture	Smith 1989
Particulate P, N	10-13m	80, 85	pasture	Retired pasture	Smith 1989
Total Suspended Solids	10-13m	87	pasture	Retired pasture	Smith 1989

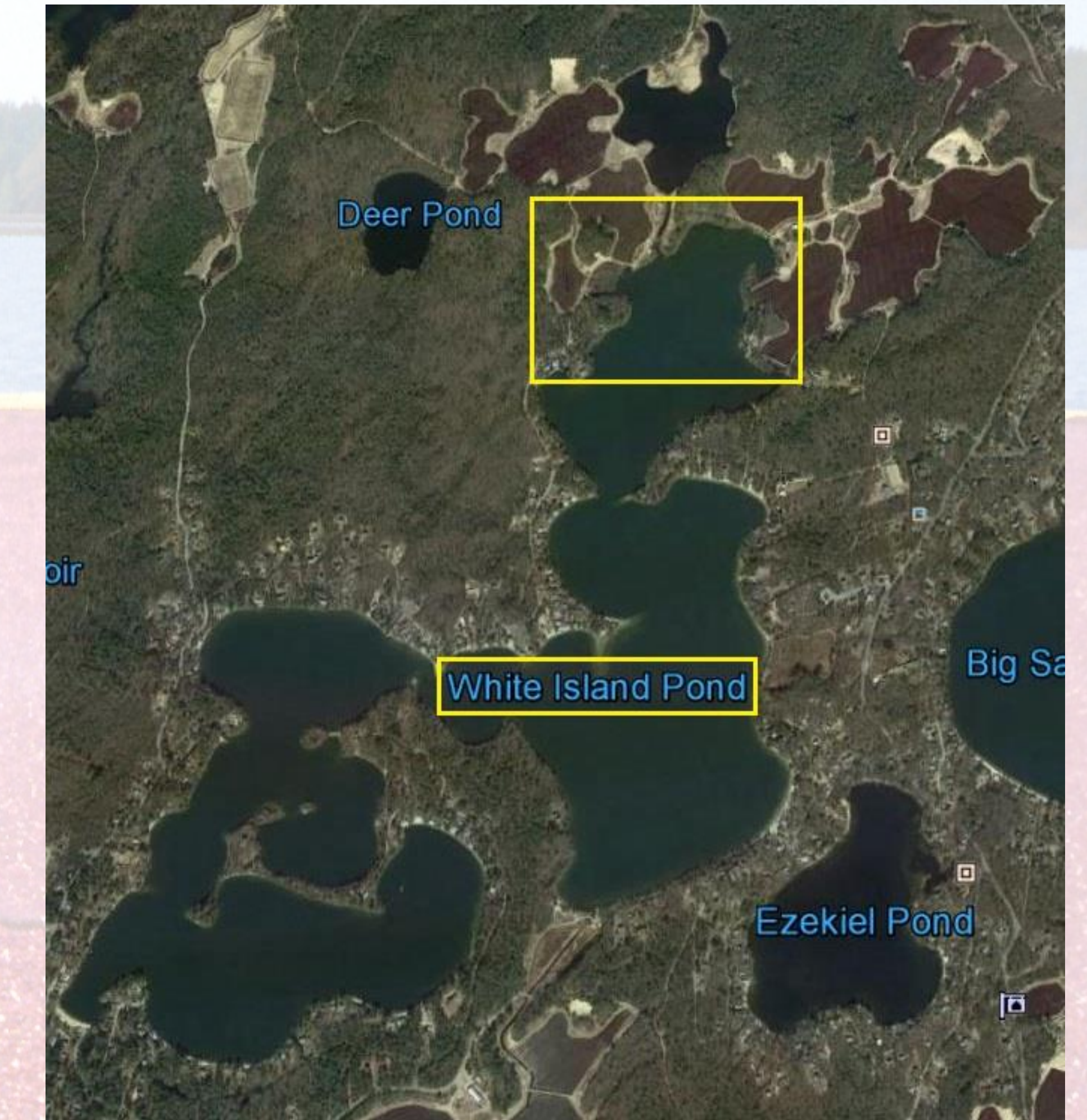
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Results

Implementation of riparian buffers along the edge of White Island Pond will significantly reduce the amount of contaminants that enter the pond by absorbing the nutrients from the soil and using them for their own benefit. These buffers would consist of native plants in a width proportional to the slope of the land. This will cause water quality to increase from the moment of implementation because the runoff that will enter the pond, will be less potent and harmful therefore decreasing eutrophication.

Sustainability, affordability, and practicality were driving factors in the search for a solution and eventually led to the discovery of riparian buffers. Riparian buffers rely solely on the growth of natural vegetation within the area, have a minimal cost that will not be overly taxing to the community or possible investors, can be easily maintained, and are extremely effective in removing high percentages of nutrient runoff.

White Island Pond Plymouth/Wareham, MA



Personally Taken Photograph. "Location of Cranberry Bogs in reference to White Island Pond." 2013. Google Earth Image.

- This project focuses solely on the northern portion of White Island Pond.
- The riparian buffer would be placed within area indicated by the topmost yellow box, on the sections of land between the pond and local cranberry bogs.

Conclusions & Recommendations

- White Island Pond experiences nutrient runoff from nearby cranberry bogs, causing eutrophication in the pond
- Of the three possible solutions, riparian buffers were the most feasible option
- It is recommended to the towns of Plymouth/Wareham and their Selectmen, that riparian buffers be used in addition to current filtration systems and other BMPs to help protect the quality of the pond
- This plan would be implemented through a community service project and upon completion, the water quality would need to be monitored to indicate success

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