The Pioneer Grant Program

The 2016 Pioneer Grant Program aims to reduce nutrient and/or sediment contaminant loads to the Maryland portion of the Chesapeake Bay and Maryland Coastal Bays from any nonpoint source: agriculture, urban or suburban stormwater, air, and septic by seeking proposals that focus on new techniques, information, or programs that increase the rate at which load reductions can occur.

University of Maryland Center for Environmental Science

Determination of Denitrification within Currently Available Floating Wetland Products

2010-2014

Project Track: New Information

Research Question: How effective are commercially available, floating treatment wetland products at remediating nitrogen and phosphorus overloading in storm water retention ponds? These floating wetlands incorporate and compare six specific plant species: Asclepias (milkweed), Decodon (swamp loosestrife), Hibiscus, Iris, Justicia (water willow), and Pontederia (pickerelweed).

Research Results: Decodon and Justicia were shown to sequester the greatest concentration nitrogen and phosphorus among the three test sites compared to Hibiscus and Iris. Results were disseminated to participating homeowners and at two Chesapeake Stormwater Network workshops.

Notable Information: Currently this work and other research data is being evaluated as a possible stormwater BMP. This effort is led by the Chesapeake Stormwater Network.

PROJECT PARTNERS

University of Maryland Center for Environmental Science

Determination of Denitrification within Currently Available Floating Wetland Products

2010-2014

Summary of Project

Objectives: Project objectives included: 1) evaluation of nitrogen and phosphorus uptake of six species of plants using two commercially available floating wetland products: Maryland Aquatic Nurseries (MAN)'s floating wetland (www.floatingwetland.com) and BlueWing Environmental's Biohaven (BH) floating wetland (www.bluewing-env.com); 2) determination of denitrification within ponds and floating treatment wetlands to assess contribution of wetland and baseline pond sediment values; and 3) Combine project data with previous studies and develop BMP's for using plants as nutrient remediation in stormwater ponds and disseminate information to key stakeholders through publication and workshops.

Methods: Objective 1 was carried out in three stormwater ponds within the Easton Club East development (350 homes) on the southeast side of Easton, MD in 2010 and 2011. In 2010 three replicate floating treatment wetlands per pond were planted with six plant species: Asclepias (milkweed), Decodon (swamp loosestrife), Hibiscus, Iris, Justicia (water willow), and Pontederia (pickerelweed) using the MAN floating treatment wetlands for a total of 12 wetlands per pond. In addition, one Biohaven FTW was deployed in each pond and planted with the same four plant species. Due to budget constraints only one BH FTW was deployed and therefore no direct comparison of FTW performance was intended or made in this study. In 2011, the best performing four plants, hibiscus, Decadon, Justicia and iris were used in the FTW's. The homeowners association and specific homeowners were involved in the project and educated as to the findings of the study.

Results:
Floating wetland and plant nutrient uptake/remediation:
Decodon and Justicia were shown to sequester the greatest concentration nitrogen (0.59-67.8 mg/ft2/day, and 0.036-42.8 mg/ft2/day respectively) and phosphorus (0.0095-4.18 mg/ft2/day, and 0.0044-5.45 mg/ft2/day respectively) among the three ponds compared to Hibiscus and Iris (Table 5). Therefore these two species should be recommended for nutrient remediation when considering using FTW's as a stormwater management practice. Hibiscus with its relative good biomass production is also a good choice with range in nitrogen uptake of 0.11-13.8 mg/ft2/day, and phosphorus uptake of 0.02-1.32 mg/ft2/day. Other practices to consider when trying to maximize nutrient remediation are to harvest plant shoot biomass at the end of the growing season. However, consideration to

the use of the plant biomass must be made. One option may be composting if the homeowner or community has the capability.

Floating wetland denitrification rates:
This study generated the first quantified measurement of planted floating wetlands in stormwater application. Average rates of denitrification were 4.06±0.07 mg N/ft2/day and 1.28±0.09 mg N/ft2/day for the Farm and Dutchmans pond sediments respectively. If we look at the relative contributions of plant N assimilation in the rafts, denitrification in the rafts, and sediment denitrification, we can calculate a N removal of ~10 mg N/ft2/day for the footprint of the raft, with denitrification being ≥ 50% of the N removal rate. These removal rates would deplete the overlying water nitrate in ~1-2 months.

Results were disseminated to participating homeowners and at two Chesapeake Stormwater Network workshops. An extension publication as well as proposal plans to expand the work to provide for more year-round data (denitrification of FTW's and pond soils, and FTW plant nutrient assimilation) is underway at the time of final report submission.

Project Evaluation

This project provided additional actual nitrogen and phosphorus assimilation or uptake data by several species of aquatic plants in a floating wetland system. Further this project identified that Decadon and Justicia were the best suited plants with the greatest N and P uptake. Specific uptake values in mg/ft^2/day (a more desirable unit of measure to aid in comparing data form other species, settings, etc…) were found to be higher than previous studies, for stormwater applications. This study also noted that nutrient assimilation by FTW depends on several variables most notably: plant species and ambient nutrient concentrations, with greatest assimilation in higher ambient nutrient concentrations. Hibiscus also performed well (as noted in this study and previous studies by the investigators).

This study appears to have generated the first quantification of denitrification rates for FTW's with identified rates being approximately 20-40% of plant assimilation rates depending on species and pond.

Transferability and Sustainability

This study showed plant nutrient assimilation rates results for only a portion of two growing seasons and only a snapshot of dentirification rates. To more completely describe rates, a two full growing season as well as seasonal denitrification analysis is suggested.

Currently this work and other research data is being evaluated as a possible stormwater BMP. This effort is led by the Chesapeake Stormwater Network. Depending on the determination, study results may be adopted in other stormwater applications. In addition, other researchers as well as development communities have inquired about the results for review of potential applications.

It is the intent of the investigators to build on this work and conduct multi-seasonal data collection in other stormwater applications collaborating with other communities.

Monitoring and Maintenance

The FTW's deployed in the three ponds remain actively managed and will for several years in the future. The partnering homeowner association is committed to having the FTW's maintained and possibly expanded into the other two ponds in the development. In addition, they have and plan to continue to communicate their results to other interested people and housing communities and have been active in communication with local officials.

Community Involvement and Outreach Activities

The East Club East Homeowners association have partnered with the investigators in earlier studies and this current study. Approximately 20 homeowners have volunteered (more than 2,500 hours) to monitor the FTW's, pond water quality, wildlife use, and aesthetic value of the FTW's and ponds. Near the conclusion of the study a workshop was presented to the association showing the results and discussed various community watershed practices (turf and landscape fertilization recommendations, waterfowl issues, etc…). In addition the PI has presented twice to the Chesapeake Stormwater Network on project results as well as other studies. The Network is currently reviewing the science of FTW's as a possible BMP for the Chesapeake Bay watershed.

Partnerships

Partners for this project include:

Easton Club East Homeowners Association and Maryland Aquatic Nurseries, Inc.

Accounting of Expenditures

CBT Funds: $59,259
UMD Extension: $14,632
UMCES: $37,167
Total Funds: $111,058