Keys to Algae Control in Stormwater Management Ponds

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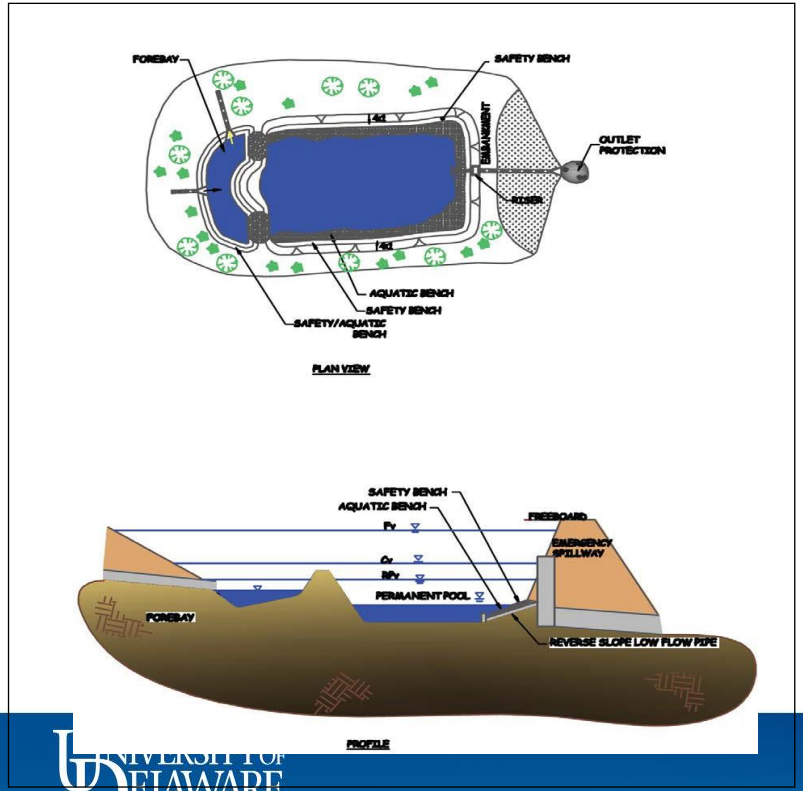
Overview

- Revisiting a wet pond design
  - Post construction maintenance
- Intro to Algae
- Plants sometimes mistaken for algae
- Issues with algae blooms
- Causes of algae blooms
- Algae control (short and long term)
  - Algaecides
  - Nutrient management

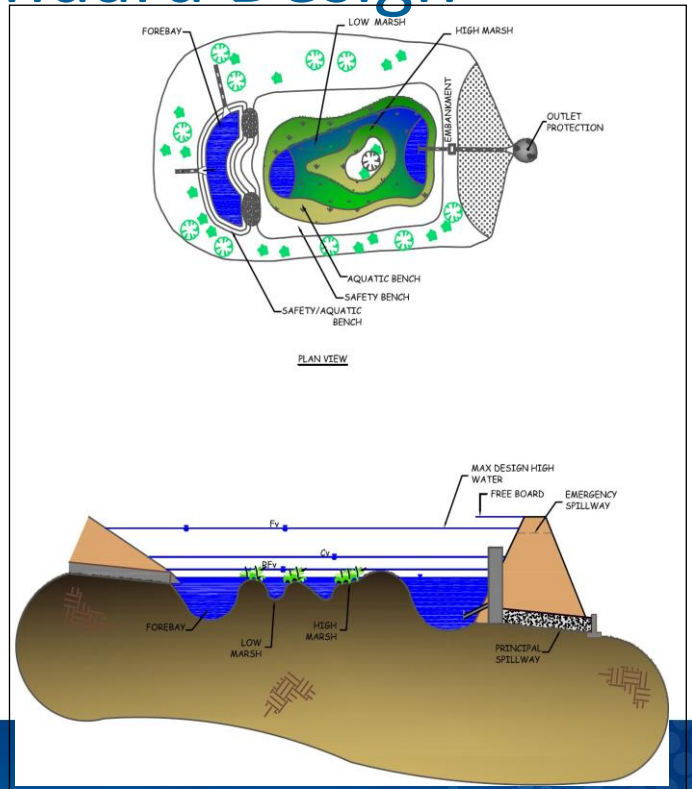
Wet Pond

- Permanent pool
  - Contains water year round
  - Management is difficult due to water quality issues within the pond
    - algae
  - Public safety issues (require bench shelf)
- Vegetative Buffers
  - Embankments, vegetative buffer 25’ outward from the high water level
- Proactive Management Opportunities

Wet Pond Standard Design



Drawings from DNREC Division of Watershed Stewardship



Post Construction (focus on Wet ponds)

- Compliance and functionality
  - Operation and Management Plan
- Aesthetics and vegetation management
  - Can vary greatly from one landowner to the next
- Water Quality
  - Algae, turbidity, and macroinvertebrates are great indicators
- Opportunities
  - Habitat
  - Pollinator forage

Compliance and Functionality

- Preventative maintenance
  - Inspect structures: inlets, outfalls, rip-rap, pipes etc.
  - Unclog structures
    - Trash
    - Organic debris
    - Sediment
  - Basic Vegetation management
    - Mow access areas around inlets and outfalls
    - Prevent establishment of invasive plant species

Permanent Pool

- Water quality Issues
  - Nutrient load and sedimentation
    - Algae growth
    - Turbidity
  - Dissolved Oxygen deficiency
    - Fish kills

What are algae?

- Unicellular
- No roots
- Gathers nutrients as a food source directly from the water column
- Most types are healthy for an aquatic ecosystem at normal levels
- Quickly populates slow moving water bodies which are loaded with nutrients
- Most grow aggressively in warmer temperatures

Types of Algae

- Green Algae
  - Filamentous
  - stoneworts
- Blue-green algae
  - cyanobacteria
- Other problematic floating species
  - -Duckweed
  - watermeal

Green Algae

- Filamentous
- mat forming
- Most are green although some can seem brown or blackish green
- This group of algae provides a food source for aquatic life but quickly becomes a detriment to the ecosystem during aggressive growth periods
- Most species grow on the bottom of aquatic systems
- Gases are formed which allow the algae to float to the surface creating massive mats

Green Algae

- Pithophora
  - Horsehair algae, tends to grow heavier in mid-late summer
  - Very difficult to control when established
- Spirogyra
  - Bright green, slimy mats, easy to control chemically
- Hydrodictyon
  - Mat forming, spongy, net like
  - Hexagonal or pentagonal patterns are visible

Green algae

- Chara
  - Green filamentous algae which anchors self to substrate
  - Can form dense stands in eutrophic waters
  - Resembles pondweeds, chara “pops” when squeezed to help with identification
  - Highly beneficial algae which creates habitat for macroinvertebrates and fish

Green algae

photo by nathistoc

- Hydrodichtion

Photo by Pondpros

photo by
ASAP Aquatics

chara

Spirogyra

Pithophora

Blue-green algae

- Cyanobacteria
- forms what looks like pond scum, some species creates a “pea soup” look to a waterbody
- This type of algae is almost always detrimental to overall aquatic health
- Very quickly lowers dissolved oxygen levels to critical levels
- Main culprit in DO related fish kills
- Some species are able to fix nitrogen
- Some species excrete toxins which can cause incontinence in livestock and people. Can also create kidney or liver problems if ingested
- Some species excrete neurotoxins as well, tainted drinking water can cause mortality in livestock

Blue-green algae

- Microsystis
  - Pea soup appearance
  - Contains the hepatotoxin microsystin
- Lyngbya
  - Mat forming cyanobacteria
  - May cause irritate the skin but poses no long term issues
  - May appear black or dark green
- Anabena
  - Another pea soup colony forming cyanobacteria
  - Contains neurotoxin (anatoxin) and microsystin

Blue-green algae

photo by Alpha Environmental

Micrisystis

Anabena

photo by USGS

Lyngbya

Plants mistaken for algae

- Common duckweed
  - Small floating plant with roots
  - 1 to 3 fronds/leaves per plant
  - Reproduces by seed and asexual budding
  - Beneficial in small amounts for waterfowl and other aquatic inhabitants
  - Becomes a management issue in slow moving, eutrophic waters
  - Quickly covers surface waters in the right conditions

Plants mistaken for algae

- Watermeal
  - Very small seed bearing, free floating, plant
  - Reproduces by seed and budding
  - Budding in eutrophic waters create massive infestations quickly
  - Very hard to control once established

Plants mistaken for algae photo by Mike Kieron

Plants mistaken for algae

Photo by Solitude Lake Management

Issues with algae blooms

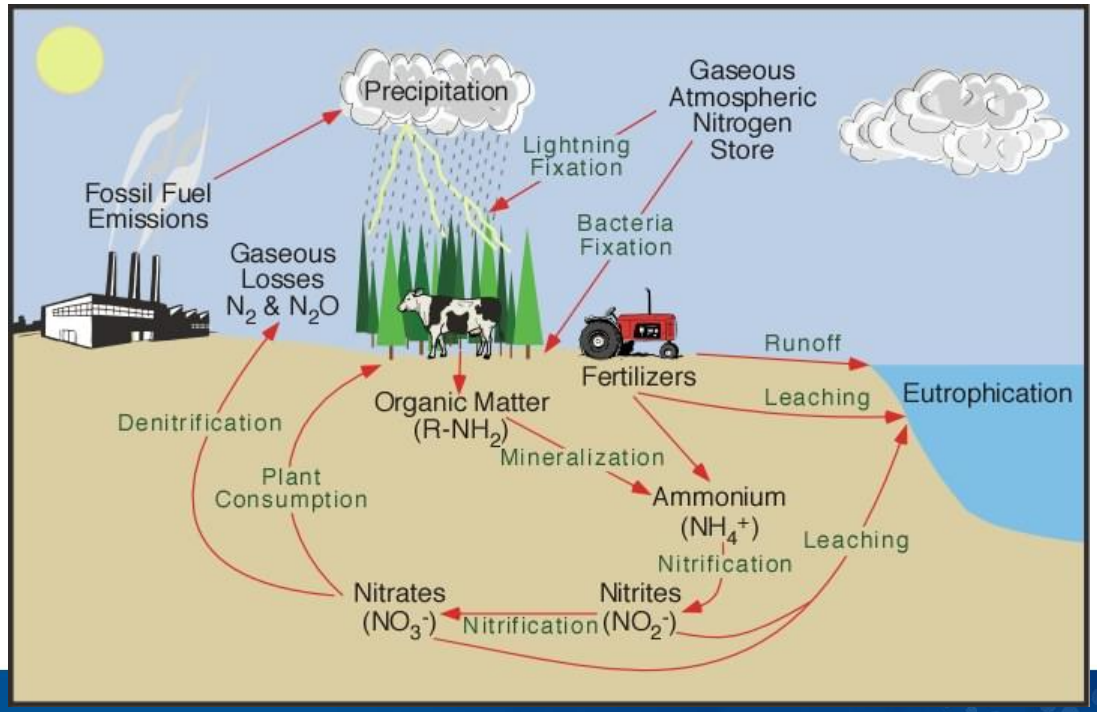
- Unsightly water quality
- Unpleasant smells
- Clogging of outfall structures
- Reduced water storage capacity
- Reduced diversity
- Reduced dissolved oxygen
  - Common cause of fish kills

Causes of algae blooms

- Stagnant waters
- Shallow water
- High nutrient load
  - Nitrogen and phosphorus
    - Sheet runoff
    - Stormwater runoff
    - Fertilizer runoff
    - Canada goose excrement
    - Sedimentation

Sources of nitrogen

photo courtesy of physicalgeography.net

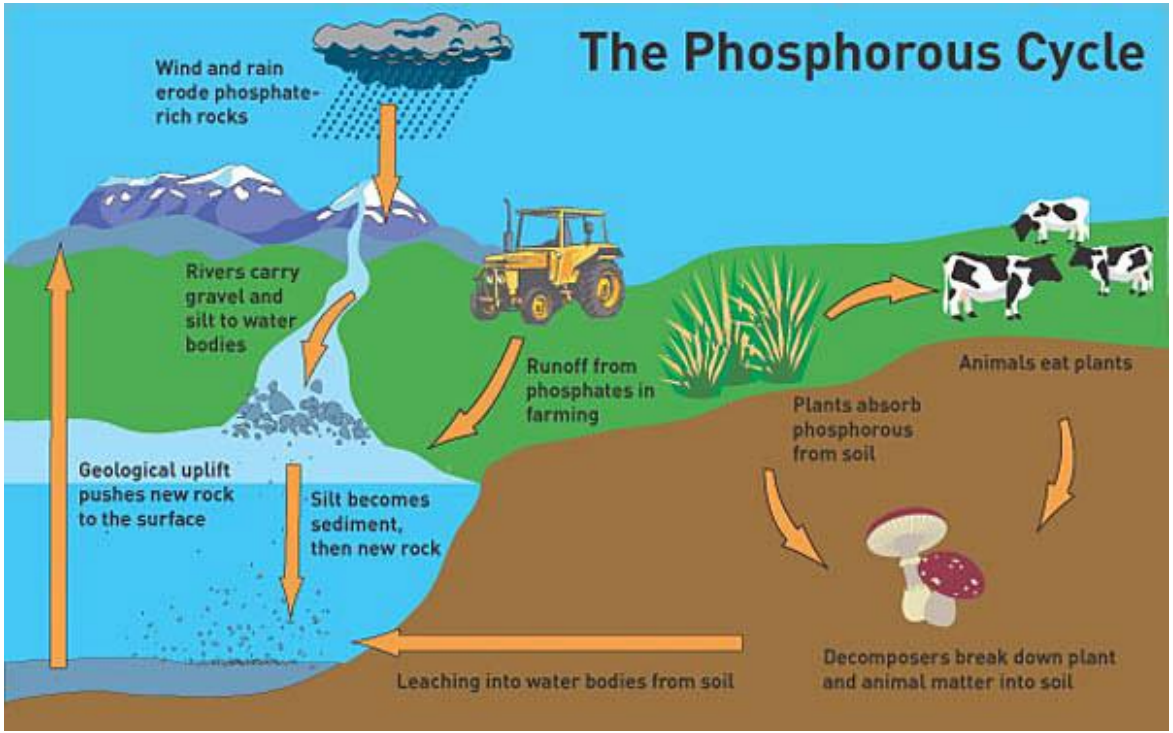


Sources of Nitrogen

Sources of nitrogen

- According to National Geographic 50 Canada geese can produce two and a half TONS of excrement per year

Sources of phosphorus



Sources of phosphorus

Sources of phosphorus

- Fertilization practices
- Sedimentation
- Yard waste being dumped near drainage sites or leaf litter washing into pond
- Microbial activity releasing phosphorus from pond bottom

Now what?

- Most encounters with algae require immediate attention
  - Physical removal
  - Chemical treatment
  - Combination of the two
- Once immediate actions are complete/successful, move to long term nutrient management

Physical removal

- Algae harvesters
- Sein netting
- raking

Chemical treatments

- All pesticides used in aquatic sites must be labelled for use in those systems to include adjuvants.
- Copper sulfate, chelated copper sulfate etc
  - Granular
  - Liquid
  - Potentially toxic to koi and trout
  - Has activity on some pondweeds including Hydrilla
- Sodium carbonate peroxyhydrate
  - granular
  - Safe for use around koi, goldfish and trout
  - Breaks down into safe byproducts
- Algae should be treated above 60 degrees F for best results

Long term management

- Take actions to reduce the amount of available nutrients in the water column
  - Phosphorus precipitation (Lanthanum and clay or aluminum sulfate applications)
  - Removal of accumulated sediment from forebays and pond bottoms
  - Riparian buffers
  - Bench shelf plantings with native beneficial
  - Winter organic material removal
  - Aeration
  - Rain gardens
  - Rain barrels

Phosphorus precipitation

- Lanthanum and clay
  - Permanently locks free reactive phosphorus from the water column
  - Costly but safe and effective tool for phosphorus removal
- Aluminum sulfate
  - Binds phosphorus and suspended sediment for clarification and phosphorus removal solutions

Sediment removal

- Forebays must be cleaned out regularly
- Full pond dredges may be required
- Stabilize areas at risk of eroding

Riparian Buffers

- Maintain a vegetative riparian buffer around any stormwater management system
- Select for native beneficial grasses, forbs, shrubs, and trees
- Buffers should cover all slopes surrounding stormwater systems but at a minimum, maintain 3’ buffers

Bench shelf plantings

- Bench shelf is a safety measure installed in most stormwater ponds and are generally 6” to 12” deep
- Plant native beneficial aquatic plants to stabilize bench shelf and for nutrient removal
- Plantings also create habitat and diversity

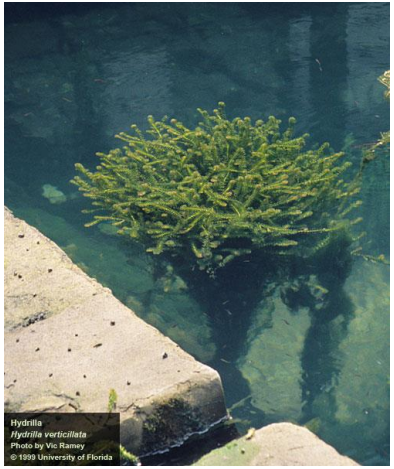
Vegetated Perimeter

- Operate within the Operation and management plan
  - Plantings may include: trees, shrubs, grasses, forbs
  - Helps slow sheet runoff, capture nutrients, protect embankments, and may provide wildlife habitat and pollinator forage
- Management Issues
  - Invasive species
  - Differing opinions on what looks aesthetically pleasing
  - Time consuming

Embankment

- Plantings may only be herbaceous
  - Grasses and forbs
  - Provides stabilization of embankment
  - Opportunity for wildlife habitat and pollinator forage
- Management issues
  - Invasive species management
  - Potential for erosion
  - Sloped terrain
  - Muskrats

Invasive Plant Species



- Delaware Invasive Species Council
- The Delaware Wetland Plant Field Guide

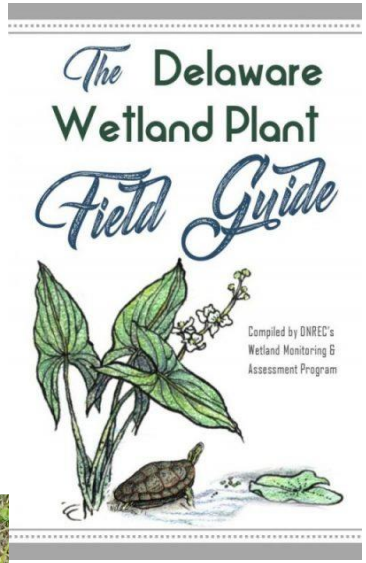
photo by Chris Evans University of Illinois

Desirable Upland Native Plants

- http://udextension.s3.amazonaws.com/factsheet/wp-content/uploads/2012/06/NativePlants.pdf
- https://www.dnlaonline.org/resources/purchasing-native-plants

Desirable Wetland Native Plants

- The Delaware Wetland Plant Field Guide
  - DNREC Wetland Monitoring and Assessment Program



Winter organic removal

- Removal of dormant vegetation or leaves
- Decomposing organic material releases nutrients back into the water column
- To go along with removal, take measures to avoid introducing clippings or yard wastes into ponds and swales

Aeration

- Diffused air systems supply dissolved oxygen to entire water column
  - Also moves water enough to deter algae growth
  - Prevents stratification and fish kills
- Surface aeration supplies dissolved oxygen to top portion of the water column
  - Not as efficient at supplying DO to entire water column
  - Moves more water than diffused air
  - Aesthetically pleasing
- Water movers
  - Systems designed to create flow in low flow areas such as fingers in a pond

At home nutrient removal

- Rain gardens can be planted in areas that receive runoff at home
  - Slowly filters out nutrients
  - Creates habitat
  - Aesthetically pleasing
- Rain Barrels
  - Reduces amount of stormwater runoff
  - Recycle rainwater for use around the home

At Home Stormwater Management

- Rain barrels
- Rain gardens
- Turf conversion to meadow, trees, shrubs, etc
  - Opportunities to diversify services
- Buffers
- Direct gutters away from impervious surface
- Pervious hardscapes

At Home Stormwater Management

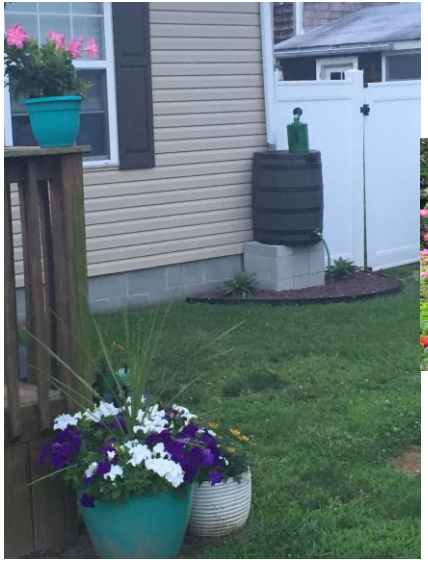


Figure 5: Interlocking Pavers in Oxford, MD. Photo by Eric Buehl.

Stormwater Management Resources

- DNREC Division of Watershed Stewardship
  - http://www.dnrec.delaware.gov/swc/Pages/SedimentStormwater.aspx
- Conservation Districts
  - Sussex - https://www.sussexconservation.org/
  - Kent - http://kentcd.org/
  - New Castle - http://newcastleconservationdistrict.org/
- Private Consultants

Permitting

- NPDES Permit Required in Delaware to apply aquatic pesticides
  - https://dnrec.alpha.delaware.gov/water/surface-water/npdes/aquatic-pesticides/
- Pesticide Discharge Management Plan for services to populations over 10,000
  - Does not need to be submitted, but must be kept on record at the business
  - https://www3.epa.gov › npdes › pubs › pgp_pdmp_template

Certified Pesticide Applicator

- Must be certified with the Delaware Department of Agriculture
  - 5A – Aquatic
  - 5C – Mosquito Control
  - 06 – Right of Way
  - 03 – turf and ornamental
- https://agriculture.delaware.gov/pesticide-management/pesticide-applicator-certification/

In Summary

- Looking at the big picture when managing stormwater management systems is key
- Due to human activity, all stormwater management systems must be monitored and managed over time to create static, healthy, functional, and aesthetically pleasing systems.
- Managing your environmental footprint at home helps reduce the amount of stress to community wide drainage systems

Questions?

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