Hydrology and Ponds

Changes in the Existing Hydrologic Balance. Both the annual and seasonal water balance can change dramatically as a result of development practices. These changes include increases in surface runoff volume and decrease in evapotranspiration and groundwater recharge rates. For example, eastern hardwood forests typically have an annual water balance comprised of about 40% evapotranspiration, 50% subsurface flows and less than 10% surface runoff volume. Development, depending on its size and location in a watershed, alters the existing hydrologic balance by increasing surface flow volumes up to 43%, reducing subsurface flows to 32%, and reducing evapotranspiration rates to 25%. All this results in major changes to the local hydrology.

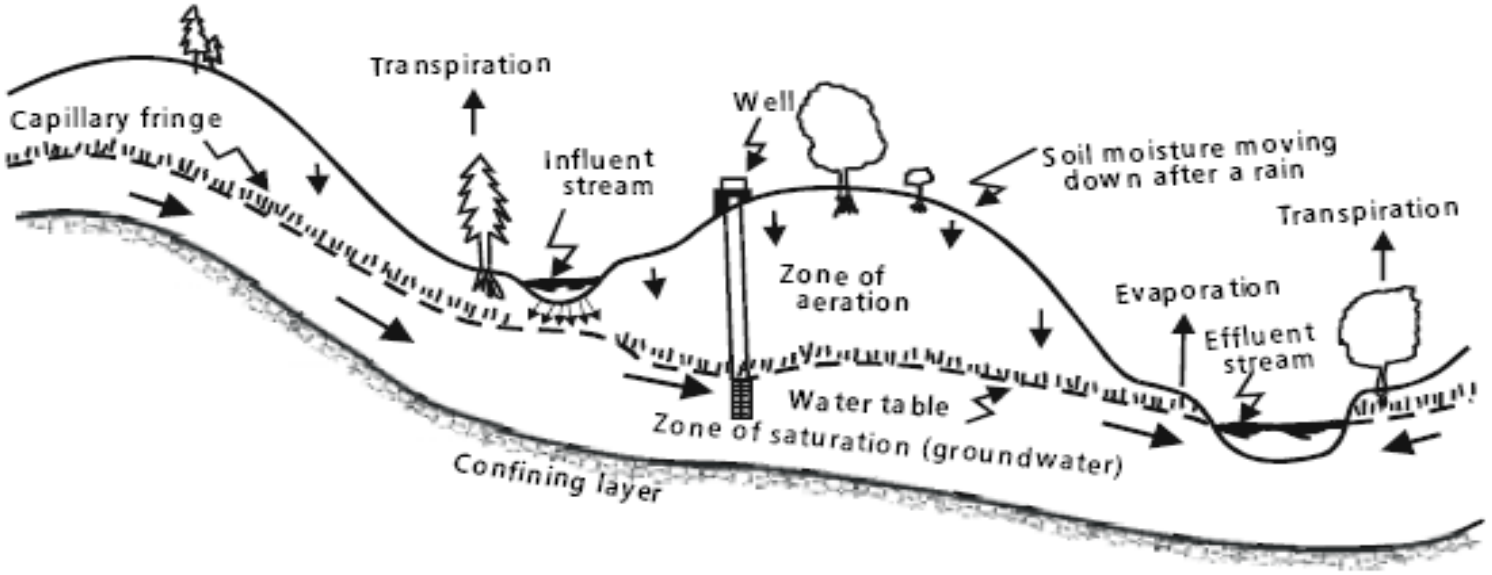


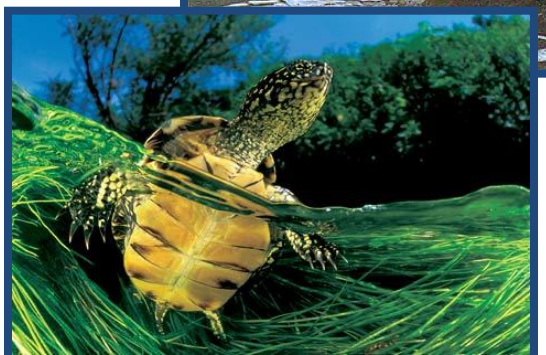
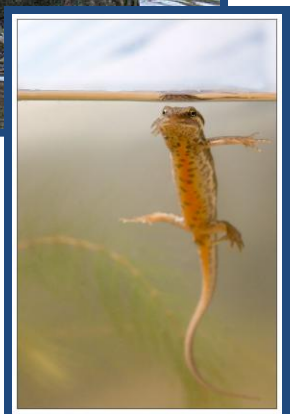
Figure 1.3. Groundwater in Local, Intermediate, or Regional Setting

Ecosystems

- Every pond has its own unique set of biological, chemical, and physical characteristics which can vary over time.
- Ponds can support a wide array of life.
- The more complex the pond habitat the more species the pond will support.





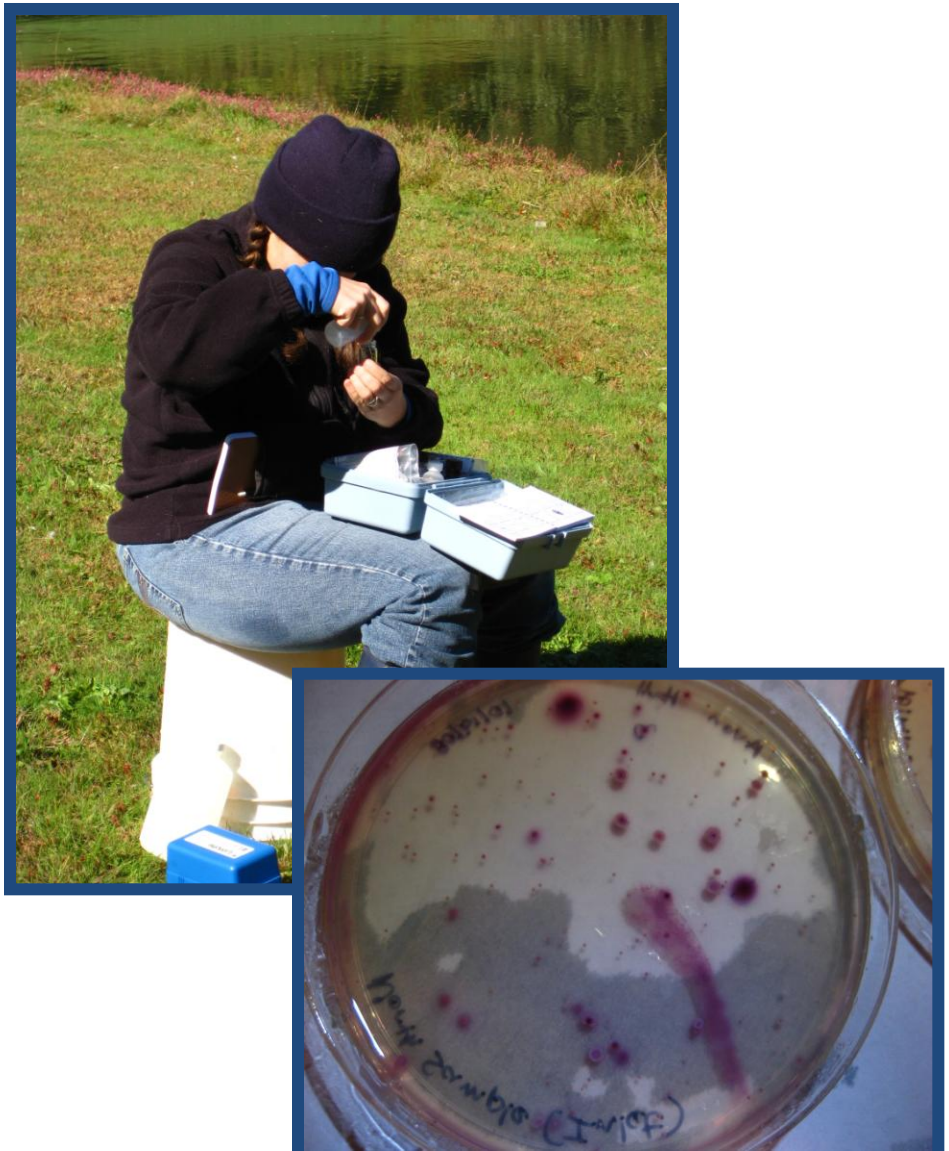




Pond Food Chains

- Phytoplankton, better known as algae are single celled, photosynthetic organisms that make up the bottom of the food chain in a pond ecosystem
- In warm water ponds stocking largemouth bass and blue gill provides an ideal “predator-prey” relationship. Just don’t go bass happy!

Water Quality

- Water Clarity
- Temperature
- pH
- Dissolved Oxygen (DO)
- Biological Oxygen Demand (BoD)
- Nitrogen and Phosphorous
- Bacteria Count (E.Coli)
- The limit & amount of the conditions above depends on the use of the pond.



Muddy Water

- Besides the problems aesthetically…
  - Low sunlight penetration
  - Reduced plankton production
  - Low dissolved oxygen production
  - Increased temperatures
  - Suffocated fish eggs and young
  - Reduced fish food availability
  - Reduced visibility and fish growth
  - Off flavor of cooked fish
  - Diminished pond water volume

Why Is My Pond Water Muddy

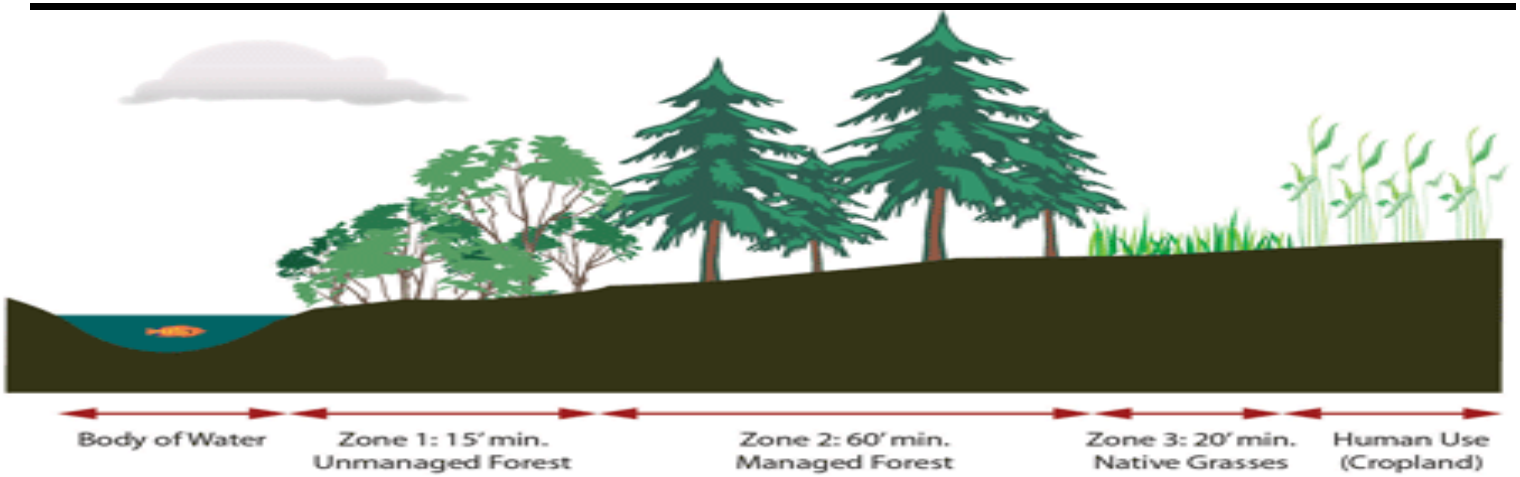
- Livestock in the pond
- Adjacent Activities:
  - unprotected croplands, overgrazed pastures, forest operations, any type of land disturbance.
- Bare shorelines
- Bottom feeding fish

How Do I Fix It?

Prevention of soil erosion is the best management practice.

- **It is much easier to prevent soil from entering ponds than it is to remove clay particles once they have become suspended in water.**

Removal of Sediment With Buffers

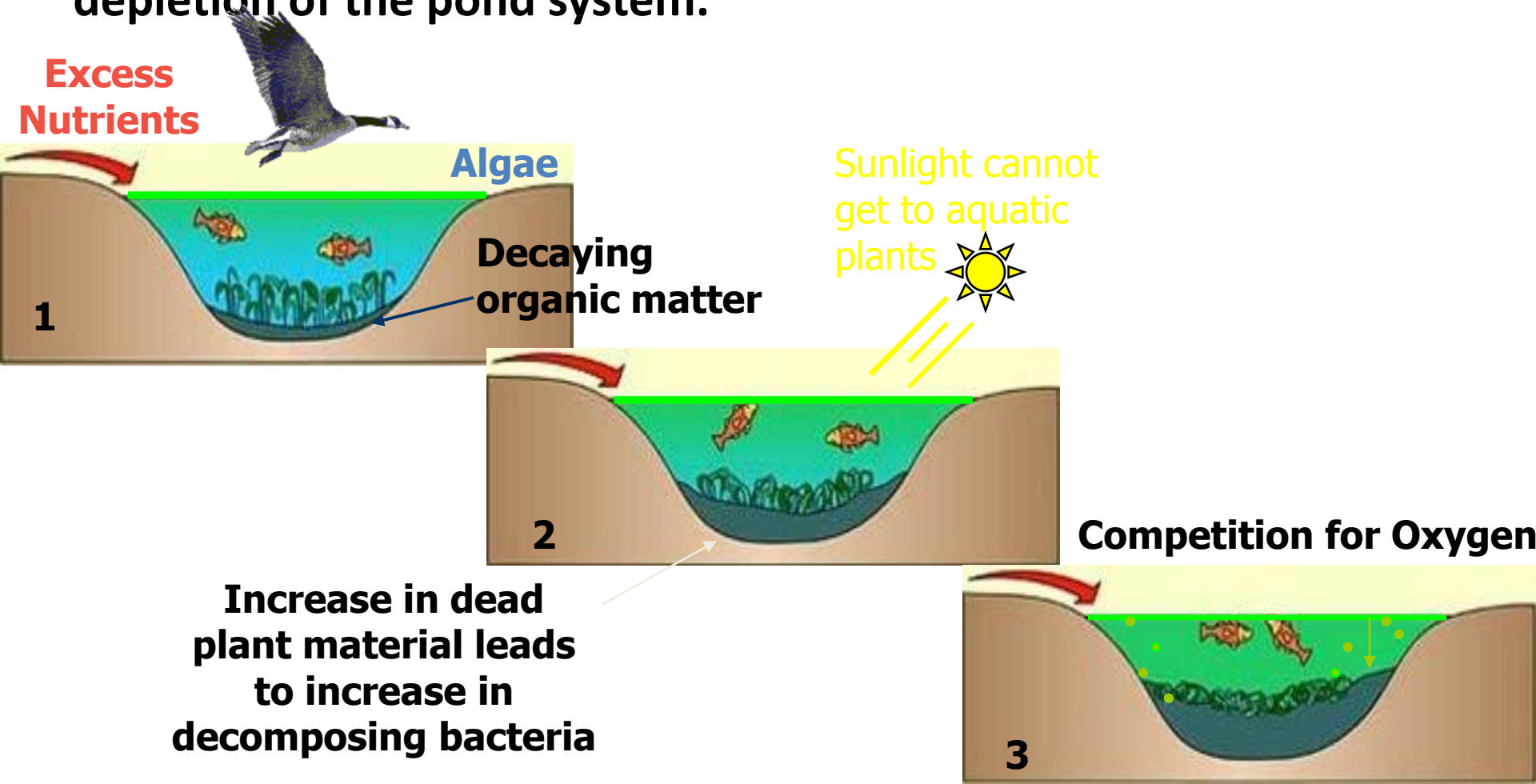


		Sediment			Nitrogen			Phosphorous		
		Before	After	Reduction	Before	After	Reduction	Before	After	Reduction
Buffer Width (ft)	Type of Buffer	mg l^{-1}	mg l^{-1}	%	mg l^{-1}	mg l^{-1}	%	mg l^{-1}	mg l^{-1}	%
15	Grass	7,284	2,841	61	14.11	13.55	4	11.3	8.09	28.5
30	Grass	7,284	1,852	74.6	14.11	10.91	22.7	11.3	8.56	24.2
65	Forest	6,480	661	89.8	27.59	7.08	74.3	5.03	1.51	70
77	Grass(15 ft.) /Forest	7,284	290	96	14.11	3.48	75.3	11.3	2.43	78.5
93	Grass (30 ft.)/ Forest	7,284	188	97.4	14.11	2.8	80.1	11.3	2.57	77.2

Source: Lawrence et al., U.S. EPA, Washington, D.C. 903-R-95-004 (1995)

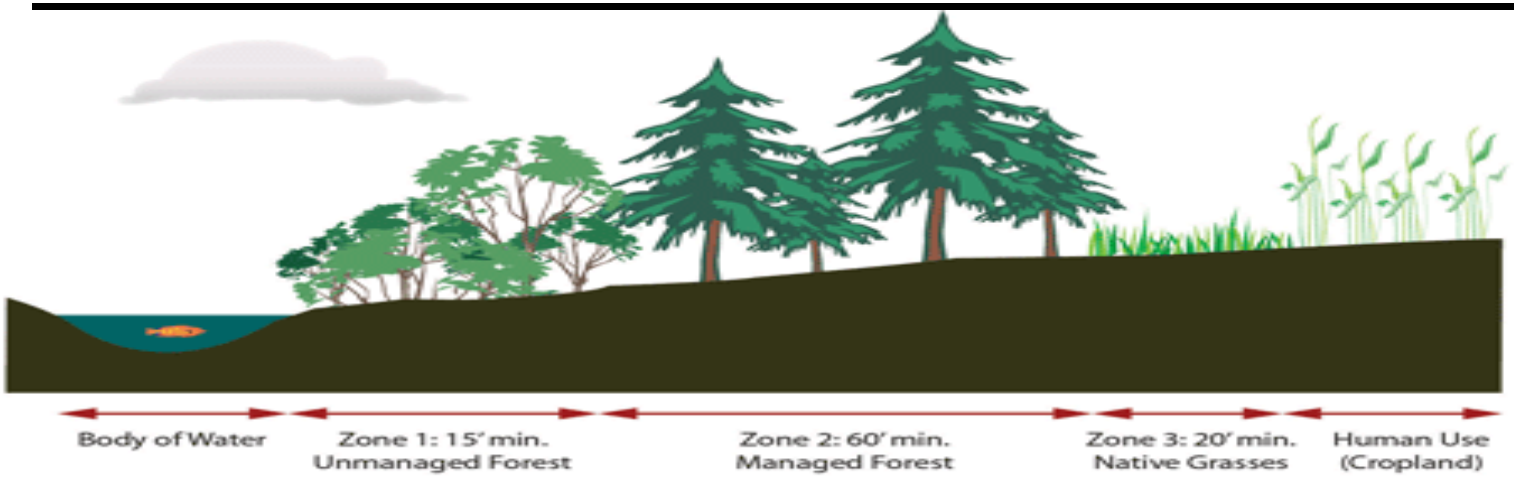
Eutrophication

- **Eutrophication is the process of nutrient enrichment leading to dense algae growth and ultimately to oxygen depletion of the pond system.**



Eutrophication

Removal of Nutrients With Buffers

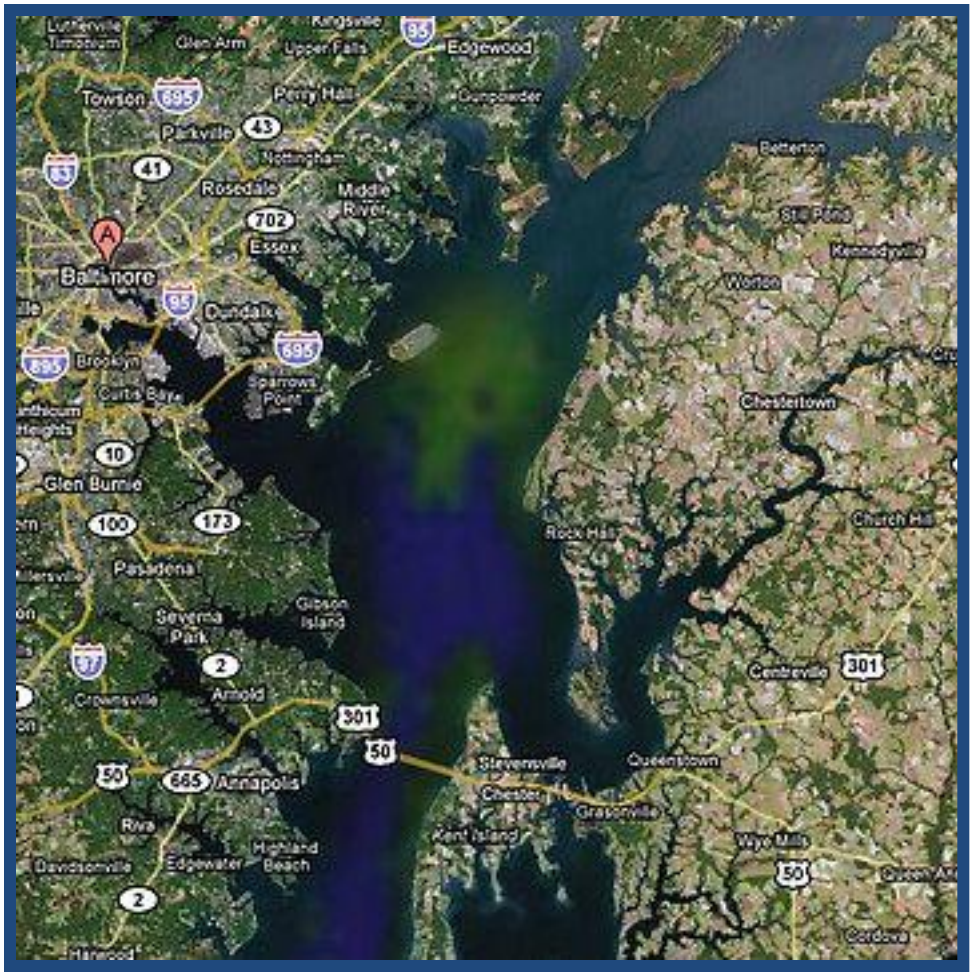


		Sediment			Nitrogen			Phosphorous		
		Before	After	Reduction	Before	After	Reduction	Before	After	Reduction
Buffer Width (ft)	Type of Buffer	mg l^{-1}	mg l^{-1}	%	mg l^{-1}	mg l^{-1}	%	mg l^{-1}	mg l^{-1}	%
15	Grass	7,284	2,841	61	14.11	13.55	4	11.3	8.09	28.5
30	Grass	7,284	1,852	74.6	14.11	10.91	22.7	11.3	8.56	24.2
65	Forest	6,480	661	89.8	27.59	7.08	74.3	5.03	1.51	70
77	Grass(15 ft.) /Forest	7,284	290	96	14.11	3.48	75.3	11.3	2.43	78.5
93	Grass (30 ft.)/ Forest	7,284	188	97.4	14.11	2.8	80.1	11.3	2.57	77.2

Source: Lawrence et al., U.S. EPA, Washington, D.C. 903-R-95-004 (1995)

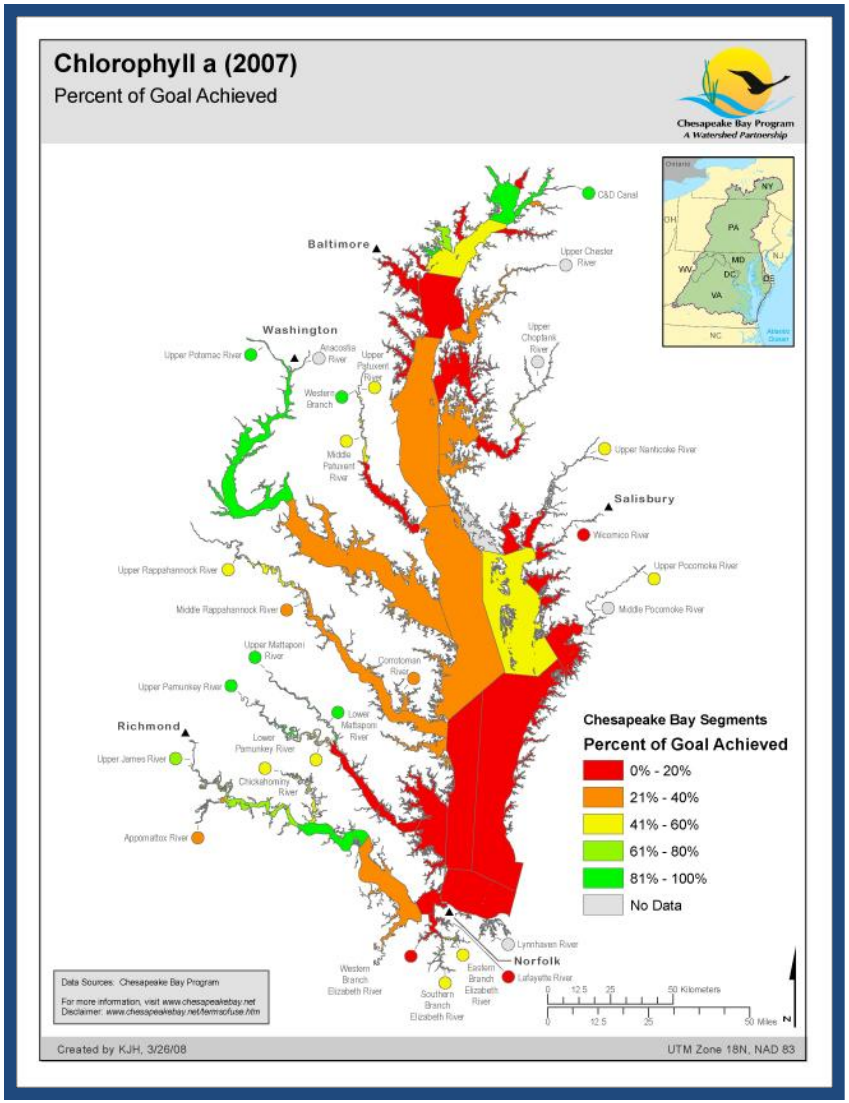
Nutrients and Increased Algae: Effects on the Chesapeake Bay

- Excess nutrients can cause large-scale algal blooms that block sunlight from reaching bay grasses, reducing available habitat for Bay life and significantly reducing oxygen levels.
- The subsequent death of the algae that grow in the bay lead to additional decrease in oxygen, choking out life



Chesapeake Bay Algal Blooms

- Scientists measure the amount of chlorophyll *a* in the Bay's waters to assess the amount of algae present. The amount of chlorophyll-a in water is a measure of phytoplankton (aquatic algae) biomass and, therefore, is an indicator of water quality.
- Plans for an overall reduction of Chlorophyll a levels in the bay have so far been overall unsuccessful. (Proposed limit of 15 micrograms per liter)



Questions to ask if you find a Fish Kill

- Whenever you observe a fish kill, ask the following questions:
  - What is the source of water for the pond? Is there a source of organic material or contaminates entering the pond?
  - Is the pond choked with vegetation?
  - Were the gills of the dead fish flared?
  - Did you find mostly large or small fish, or were the fish of all sizes? And what species have been affected?

More on Fish Kills

- If larger fish die first then dissolved oxygen depletion is most likely the suspect
- Toxic substances will cause smaller fish to die before larger ones
- If you observe a few deaths each day it is mostly likely a low-level mortality agent
  - Hydrogen sulfide from decaying plant matter
- Stocking and spawning can make fish susceptible to disease due to increase in stress or injuries during stocking.

What's Next?

New Pond Owned By Gene Banks – Construction Begun Late Summer 2007

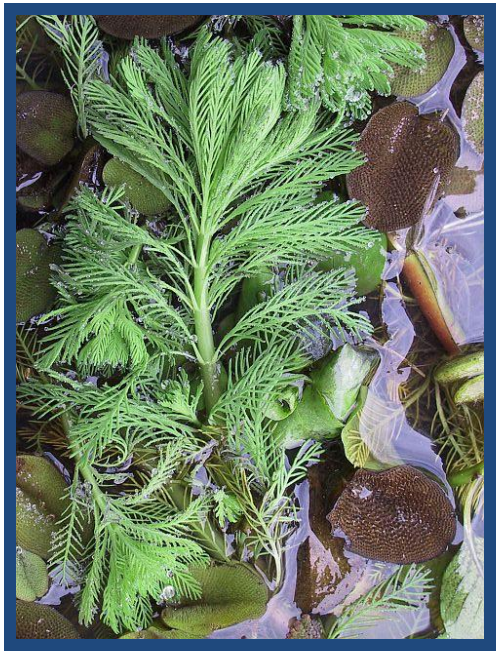
Photo By Bruce Jones

Established Pond Owned By Bruce Jones.

Why Plant?

- Control Erosion and Sedimentation
  - Improve Water Clarity
- Filter Stormwater Runoff Entering the Pond
  - Remove Nutrients and Other Pollutants
- Stabilize Pond Shoreline
- Attract Wildlife
  - Provide Food and Cover
- Naturalize Pond Within the Landscape

Invasive Plants to Avoid

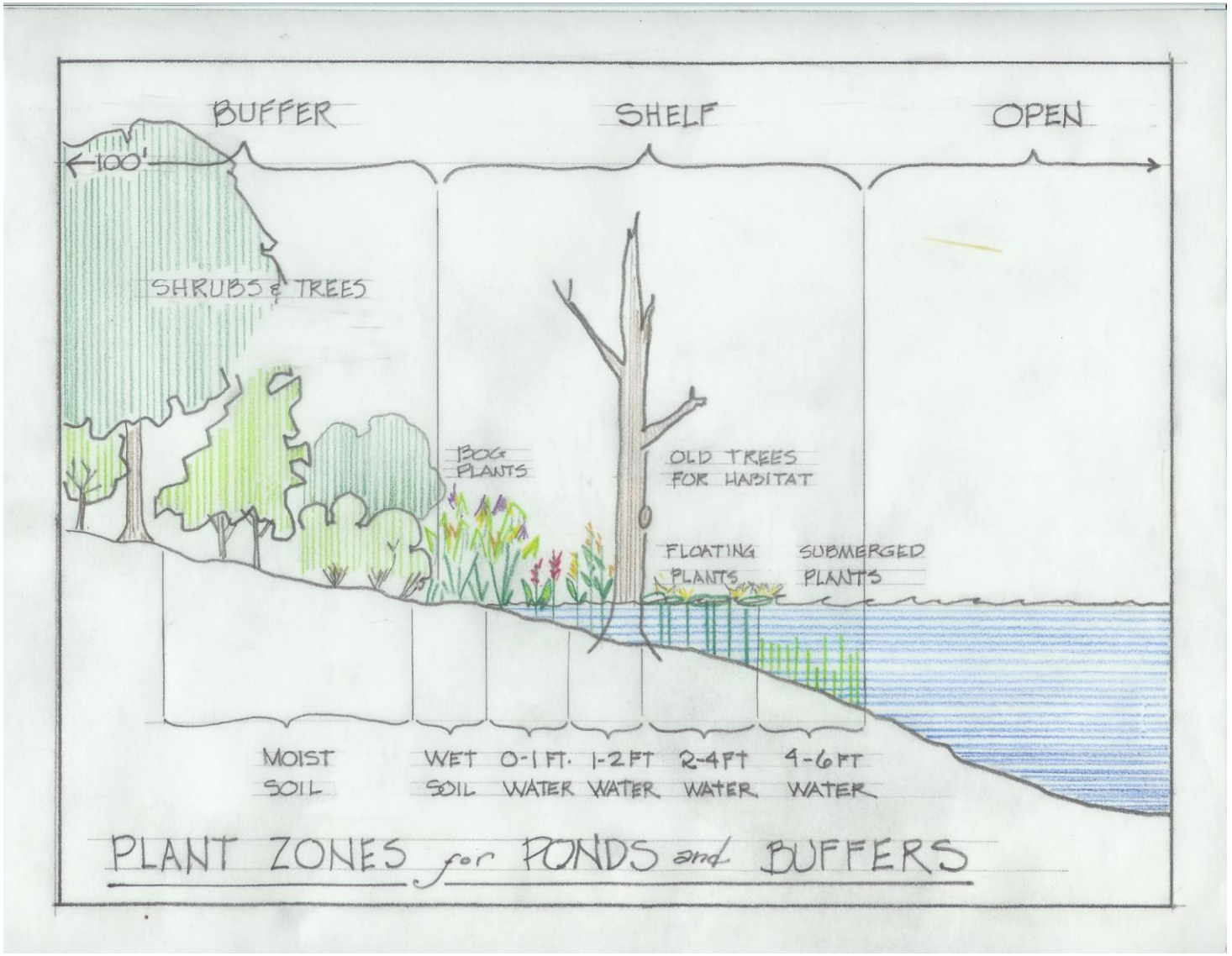


Parrot's Feather
(*Myriophyllum spicatum*)

Brazilian Waterweed
(*Egeria densa*)

Eurasian Watermilfoil
(**Myriophyllum spicatum)**

Pond Planting Zones



Drawing By Marc Malik

Why ponds are important for Amphibians

Frogs and salamanders are

- **key species in the aquatic food web**
- **dependent on ponds and wetlands for breeding (frogs and many salamanders)**
- **declining due to pollution and loss of wetland habitats**

What makes good pond habitat for amphibians?

- **Unpolluted ponds & pools near forests, marshes, and tall grassy areas**
- **Vegetation to provide food & cover**
- **Few fish and/or abundant vegetative cover**
- **Gently sloping sides for easy entry & exit**

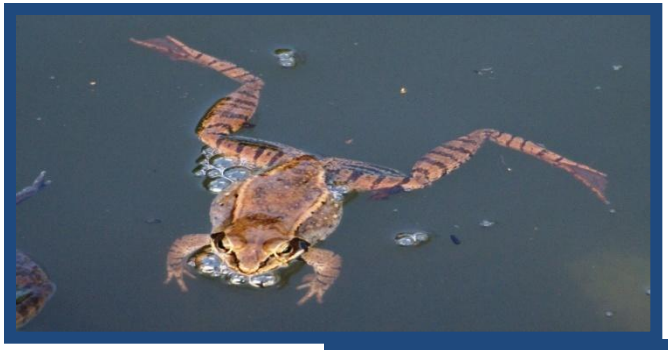
Some pond-breeding frogs of Rappahannock County

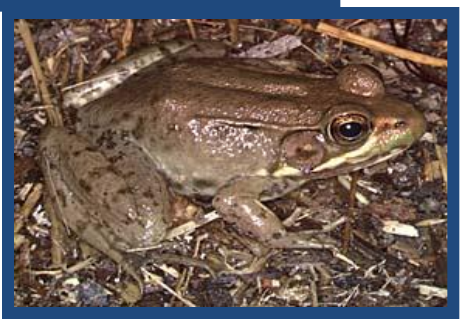
Wood frog – small ponds w/ no fish in very early spring

Spring peeper – ponds with tall plants and shrubs in spring to early summer

Bullfrog – large ponds and lakes all summer

Green frog–summer to early fall





Some pond-breeding salamanders of Rappahannock County

Spotted salamander – ponds in early spring

Red-spotted newt – woodland ponds in summer

Marbled salamander — fall at shrunken edges of ponds then flooded by late fall rains