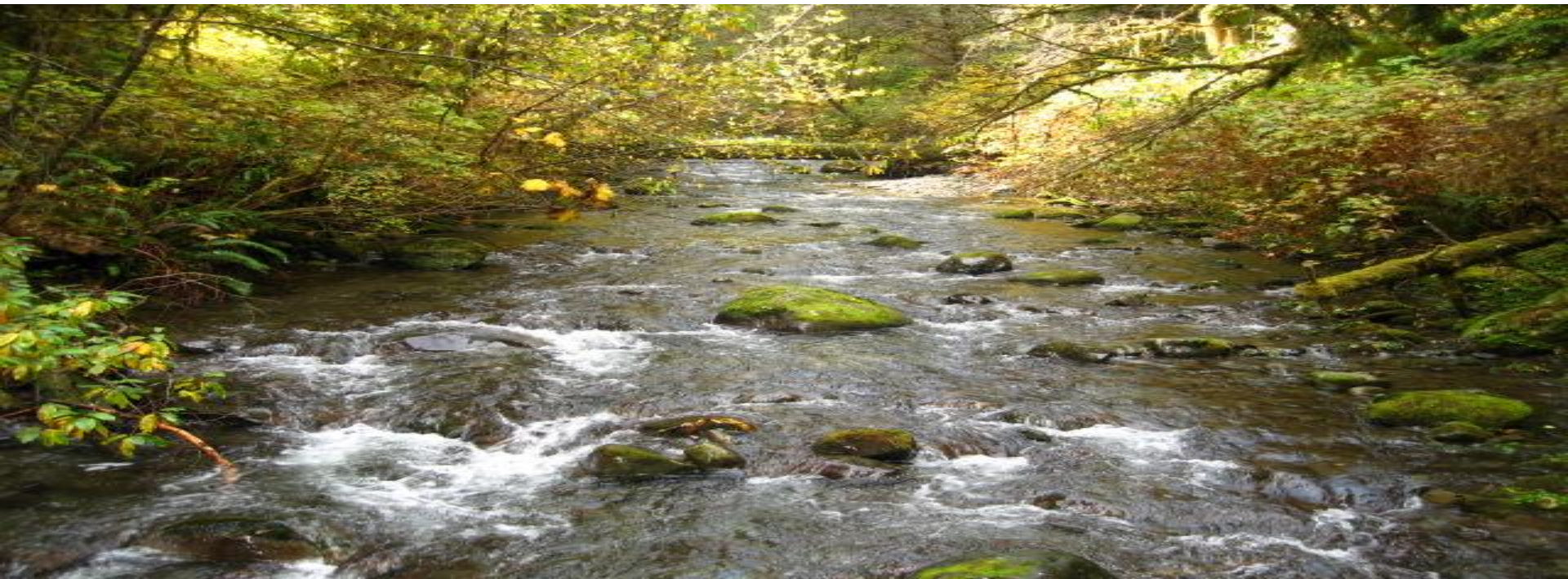


Understanding Nutrients and Their Affects on the Environment



Humans & Ecosystems

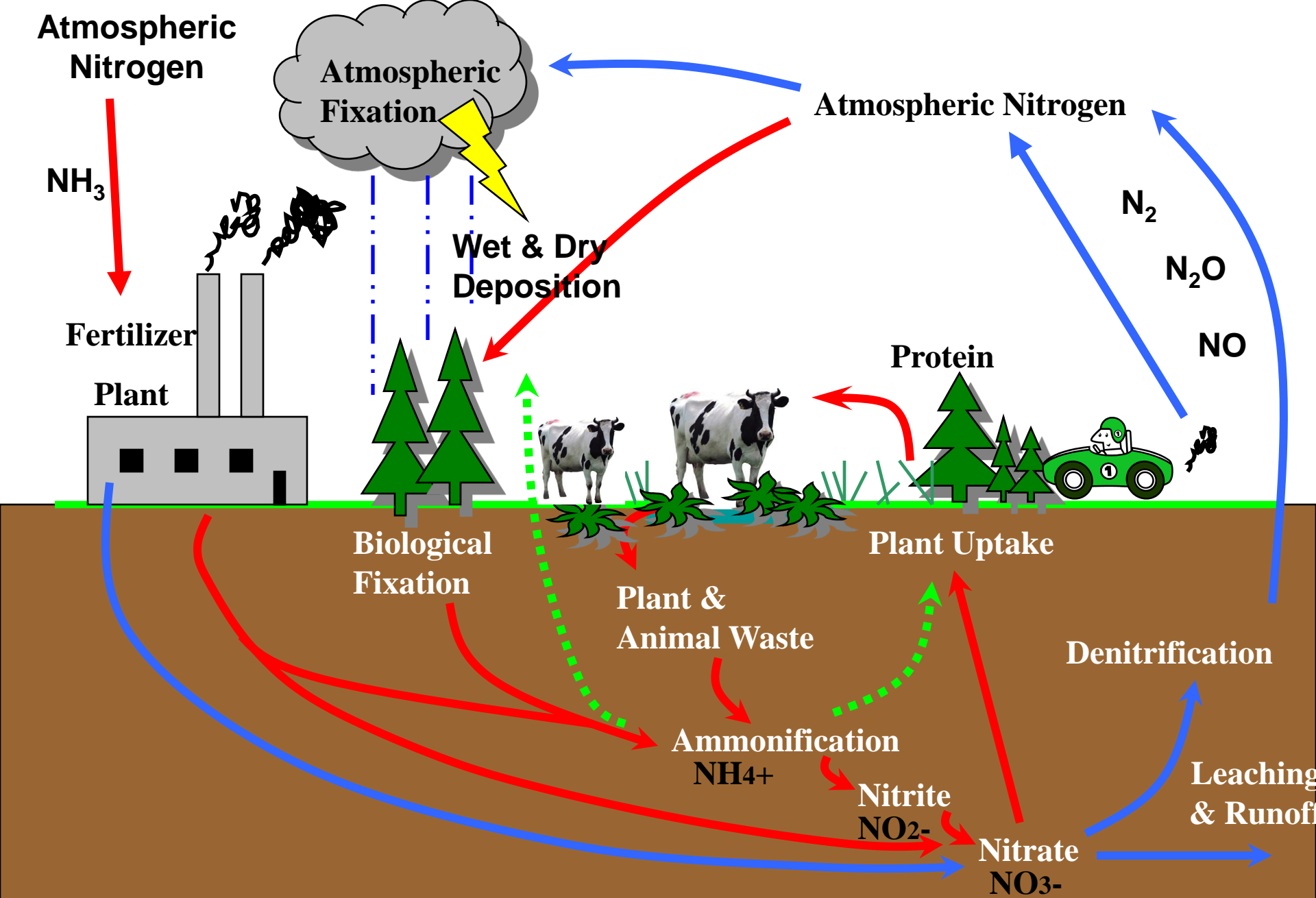
- **Humans are just like ecosystems, too much or too little of a nutrient is bad for the system.**
- **Nutrient management is a balancing act.**
- **Without nutrients plants and smaller organisms would no longer be able to survive, causing everything to shut down.**
- **Too much of a nutrient can throw the system into chaos!!!!**



Nutrients Important to Plant Growth

- **Macro Nutrients** (Plants need these in large quantities)
 - Carbon (C), Oxygen (O), Hydrogen (H) (Mainly Atmospheric)
 - **Nitrogen (N)** (Frequently the most deficient)
 - **Phosphorus (P)**
 - Potassium (K)
 - Calcium (Ca), Magnesium (Mg), Sulfur (S)
- **Micro Nutrients** (plants need these in smaller amounts)
 - Iron (Fe), Manganese (Mn), Boron (B), Zinc (Zn), Copper (Cu), Chlorine (Cl), Cobalt (Co) Molybdenum (Mo), and Nickel (Ni).





Nitrogen Cycle

Nitrogen (N)

- **It can take multiple different forms in the environment:**
 - Nitrogen Gas (N_2)
 - Ammonia (NH_4^+)
 - Nitrite (NO_2^-)
 - **Nitrate (NO_3^-)**
- **Each of the forms has its own properties, behaviors, and consequences to water quality.**
- **Most emission sources contributing to airborne nitrates to the Chesapeake Bay originate in an area which is seven times larger than the Chesapeake Bay watershed. It is called the Chesapeake Bay Airshed.**
- **About 98% of the earth's nitrogen is actually contained in rocks deep under the earth's surface. So our environment is only in contact with 2% of the nitrogen found on Earth!!!!**

WHY PLANTS LIKE NITROGEN



- **Helps plants use carbohydrates to gain energy**
- **Controls how plants take their form and how they function inside.**
- **Helps plants make protein.**
- **Part of chlorophyll**

Phosphorous Cycle

Fertilizer



Plant Tissue



Animals

Humans

Plant residue, manure, sludge

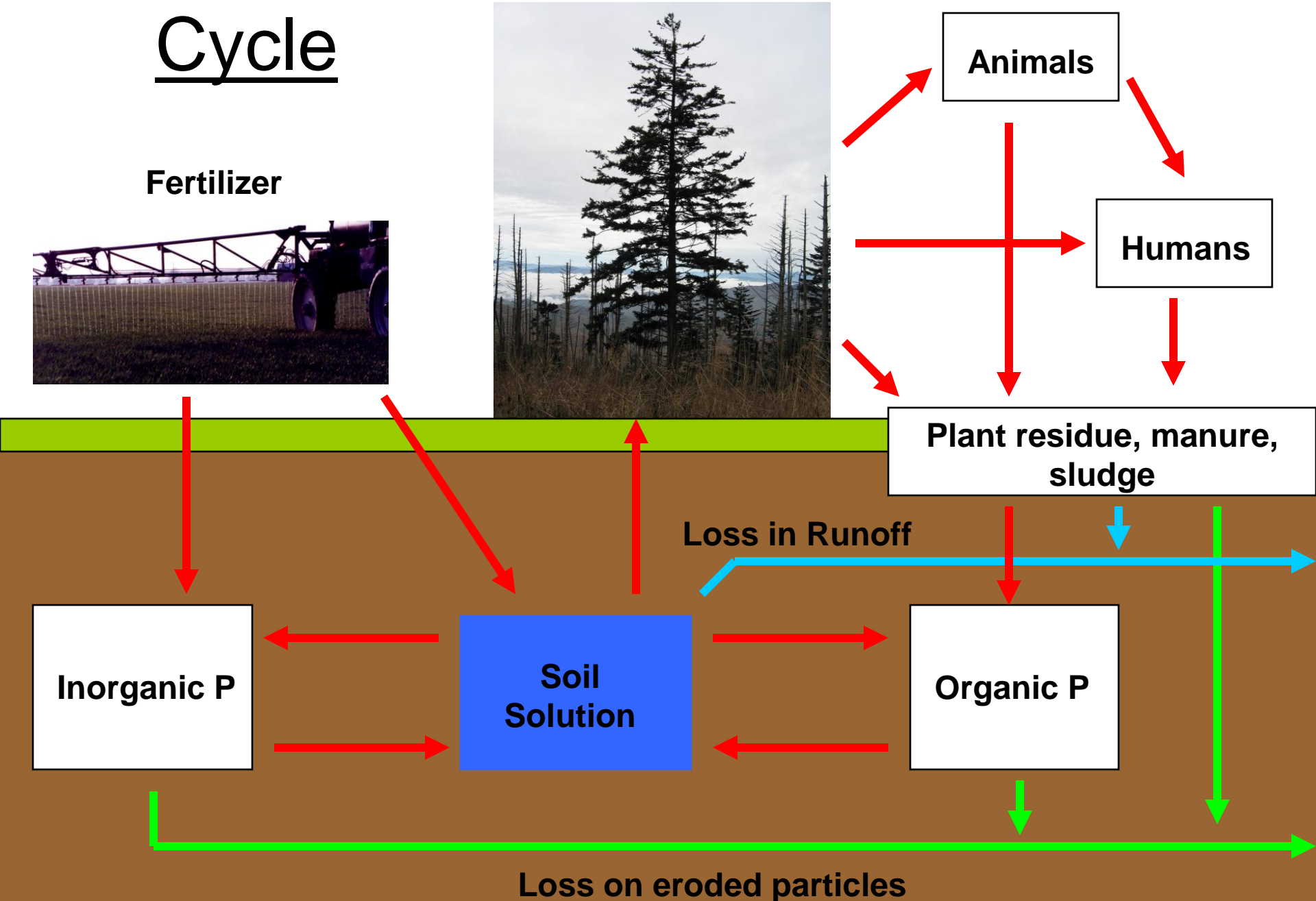
Inorganic P

Soil Solution

Organic P

Loss in Runoff

Loss on eroded particles

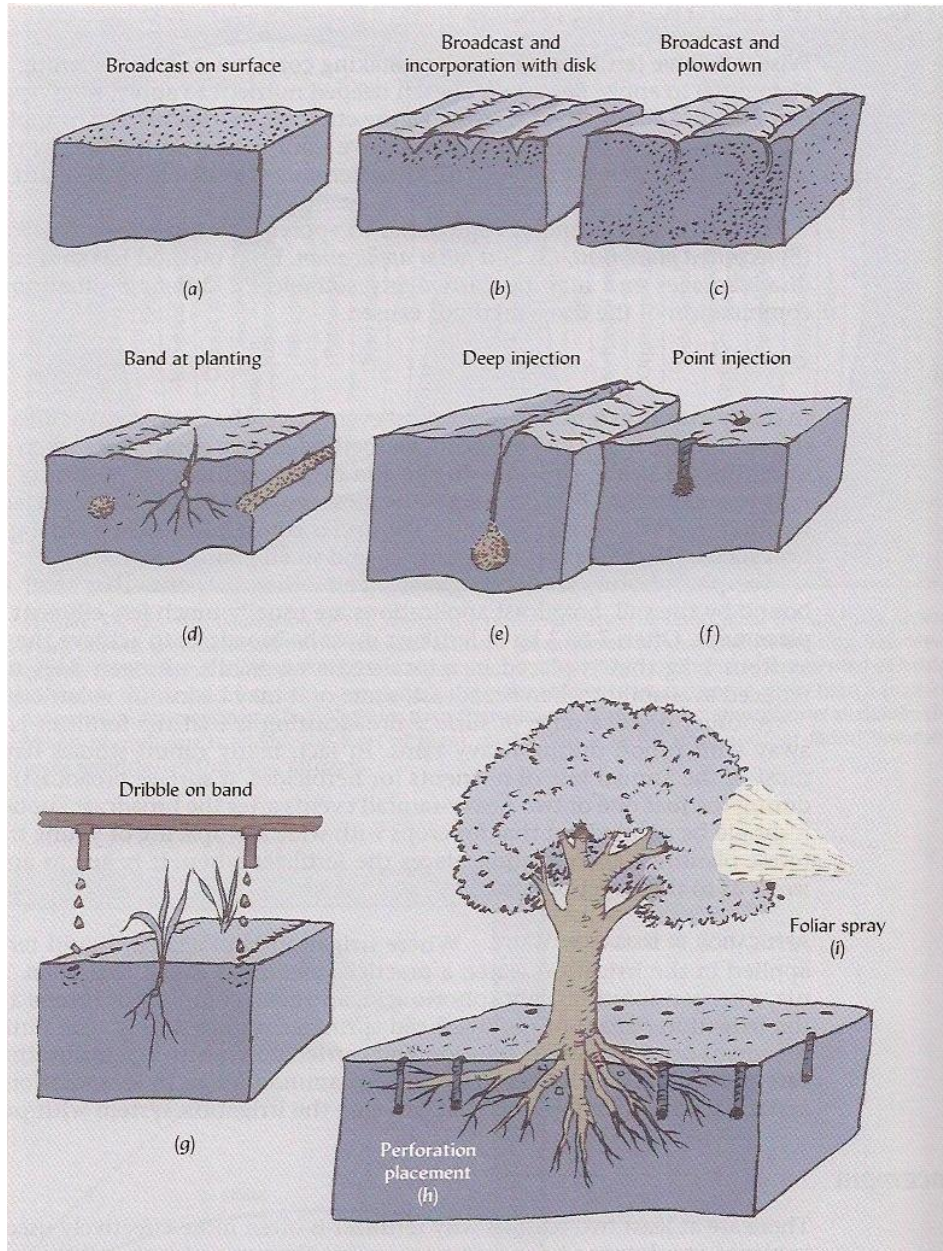


WHY PLANTS LIKE PHOSPHORUS

- **Role in how plants form and in how they function and grow**
- **Help plants during photosynthesis**
- **Helps plants respire**
- **Provides energy transfer and storage**
- **Helps plants efficiently use water**



How Fertilizer is Applied



Don't Know How Much Fertilizer To Use?

- **Soil Test!!**
- **Soil Test!!**
- **Soil Test!!**
- **Sample from 10 or more spots within area**
- **Should be random and representative of area**
- **4 to 6 inches deep for lawns, 6 to 8 inches for gardens**
- **Boxes and forms from Extension Office**



Sources of Nitrogen Pollution

- Fertilizer Applications
 - Agricultural & Urban
- Forestry Operations
 - Logging Roads
 - After Harvest Flux of N
- Runoff from Agricultural Operations
 - Feed lots
 - Barn yards
 - Watering areas in or near streams and ponds
- Runoff from Urban Areas
 - Roads and Parking lots
 - Pet waste
 - Yards
- Fossil Fuels
- Industrial Inputs
- Land Disturbances
- Drain Fields
- Sewage Treatment Plants
- Wet and Dry Deposition from Atmosphere

How Phosphorous Enters Our Waters

- **The main reason phosphorus pollution occurs in the environment is because too much P fertilizer is added to soil, then during rain storms it travels on soil particles, across the land, and into surface waters.**
- **Unfortunately, excess P in the environment has caused and continues to cause pollution in streams, rivers, lakes, and groundwater which is used for drinking water. Aquatic life and wildlife living in and around these waterways also are affected.**

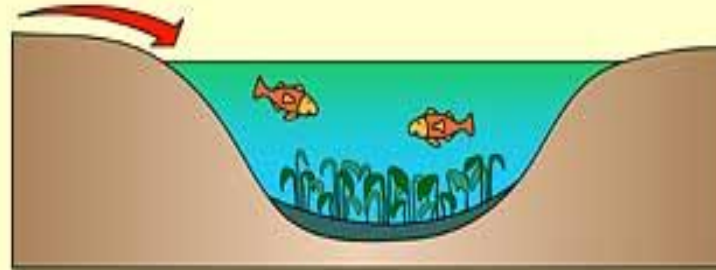
What Problems occur From Nutrients



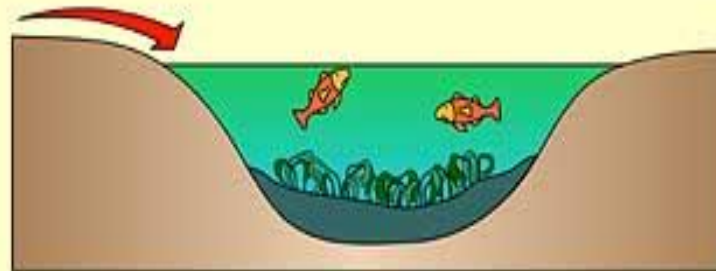
What is Eutrophication?

- **Eutrophication** is the process of nutrient enrichment leading to dense algae growth, which then sends the entire aquatic system into a nose dive.

Fertiliser run-off

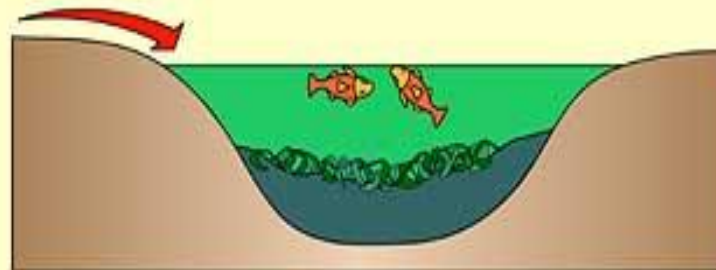


1. Algae grow fast, using up lots of oxygen and blocking sunlight



2. Aquatic plants begin to die

3. Dead matter provides food for microbes ...



4. ... increasing the competition for oxygen

5. Water becomes deoxygenated - fish die

Affects of Eutrophication

- First blocks sunlight from reaching submerged vegetation.
- Then creates an anaerobic (oxygen depleted) environment.
- Kills plants, macro-invertebrates, and fish.
- Some algae can produce toxins harmful to humans and animals.



Other Nitrogen Problems

- Nitrate leached into ground or surface waters has the potential to cause blue baby syndrome. This can also affect ruminant animals.
- Nitrogen in the atmosphere degrades the ozone layer and also is contributed to the green house effect.



What are the solutions?



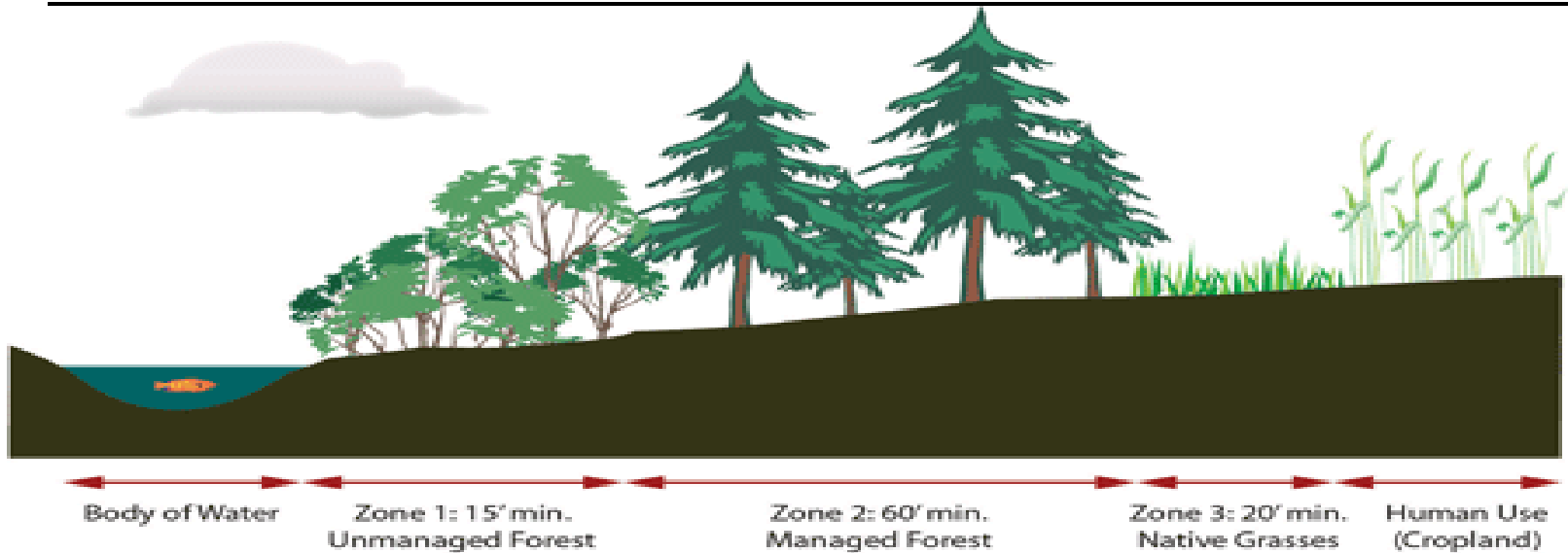
Agricultural BMP's

- Apply appropriate amounts of N and P by submitting soil samples to be tested.
- Timely Fertilizer Applications
- Incorporate Fertilizers
- Proper cropping / residue management
- Control soil erosion
- Cover crops to take up remaining NO_3
- Reduce runoff from concentrated livestock areas.
- Provide alternative water sources for livestock and fence streams.
- Provide buffers to or limit activities in environmentally sensitive areas (streams, wetlands, steep slopes).
- Complete a Nutrient Management Plan through the USDA Natural Resource Conservation Service (NRCS). It is required for all of their cost share programs.

Riparian Buffers



Removal of Nutrients With Buffers



Sediment

Nitrogen

Phosphorus

Buffer Width (m)	Buffer Type	Sediment			Nitrogen			Phosphorus		
		Input Concentration	Output Concentration	Reduction [§] (%)	Input Concentration	Output Concentration	Reduction [§] (%)	Input Concentration	Output Concentration	Reduction [§] (%)
		—mg l ⁻¹ —			—mg l ⁻¹ —			—mg l ⁻¹ —		
4.6*	Grass	7,284	2,841	61.0	14.11	13.55	4.0	11.30	8.09	28.5
9.2*	Grass	7,284	1,852	74.6	14.11	10.91	22.7	11.30	8.56	24.2
19.90‡	Forest	6,480	661	89.8	27.59	7.08	74.3	5.03	1.51	70.0
23.6	Grass/forest	7,284	290	96.0	14.11	3.48	75.3	11.30	2.43	78.5
28.2#	Grass/forest	7,284	188	97.4	14.11	2.80	80.1	11.30	2.57	77.2

* Calculated from masses of total suspended solids, total N, total P, runoff depth, and plot size (22 × 5 m).

+ Nitrogen = Nitrate-N + exch. part. ammonium + diss. ammonium + part. organic N + diss. organic N. Phosphorus = part. P + diss. P.

‡ Surface runoff concentrations at 19 m into forest reported by Peterjohn and Correll (1984). N and P constituents same as input.

§ Percentage of reduction = 100 * (input - output)/input.

|| 4.6-m grass buffer plus 19 m of forest.

9.2-m grass buffer plus 19 m of forest.

SOURCE: Lawrence et al., U.S. EPA, Wash. DC. 903-R-95-004 (1995).

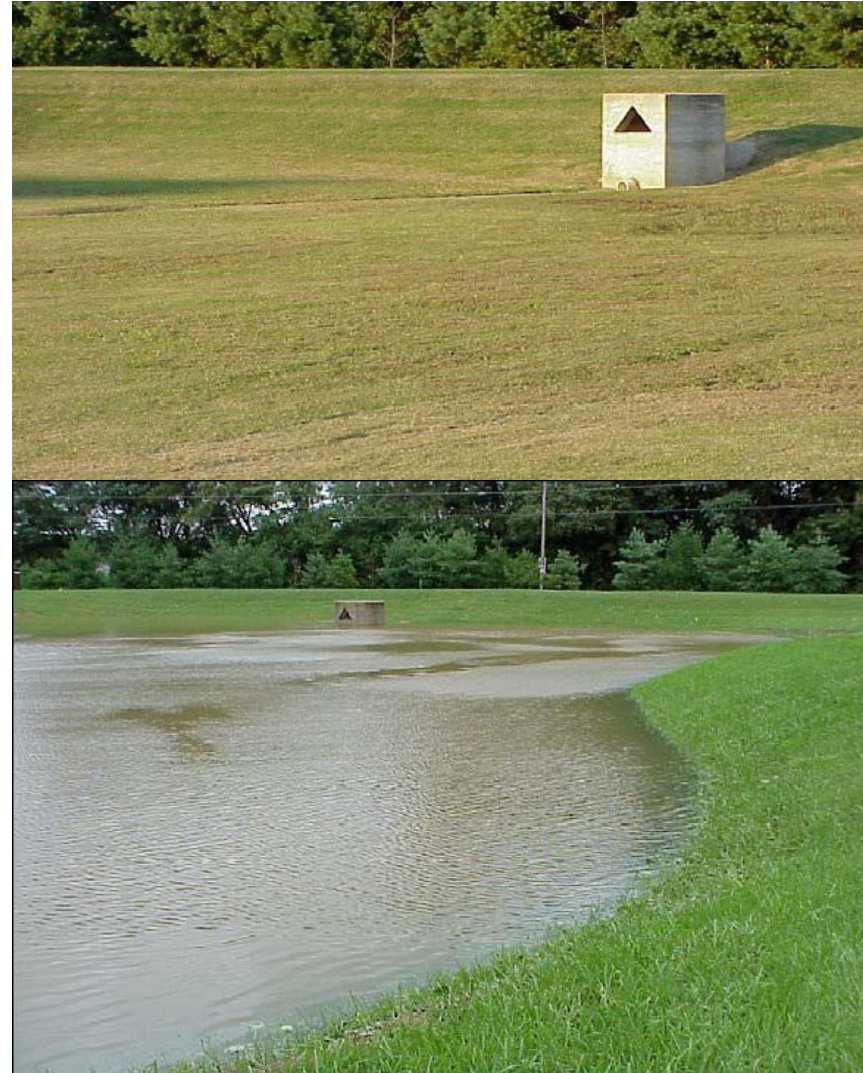
Preserve Wetland Areas



Stormwater Management (SWM) Facilities

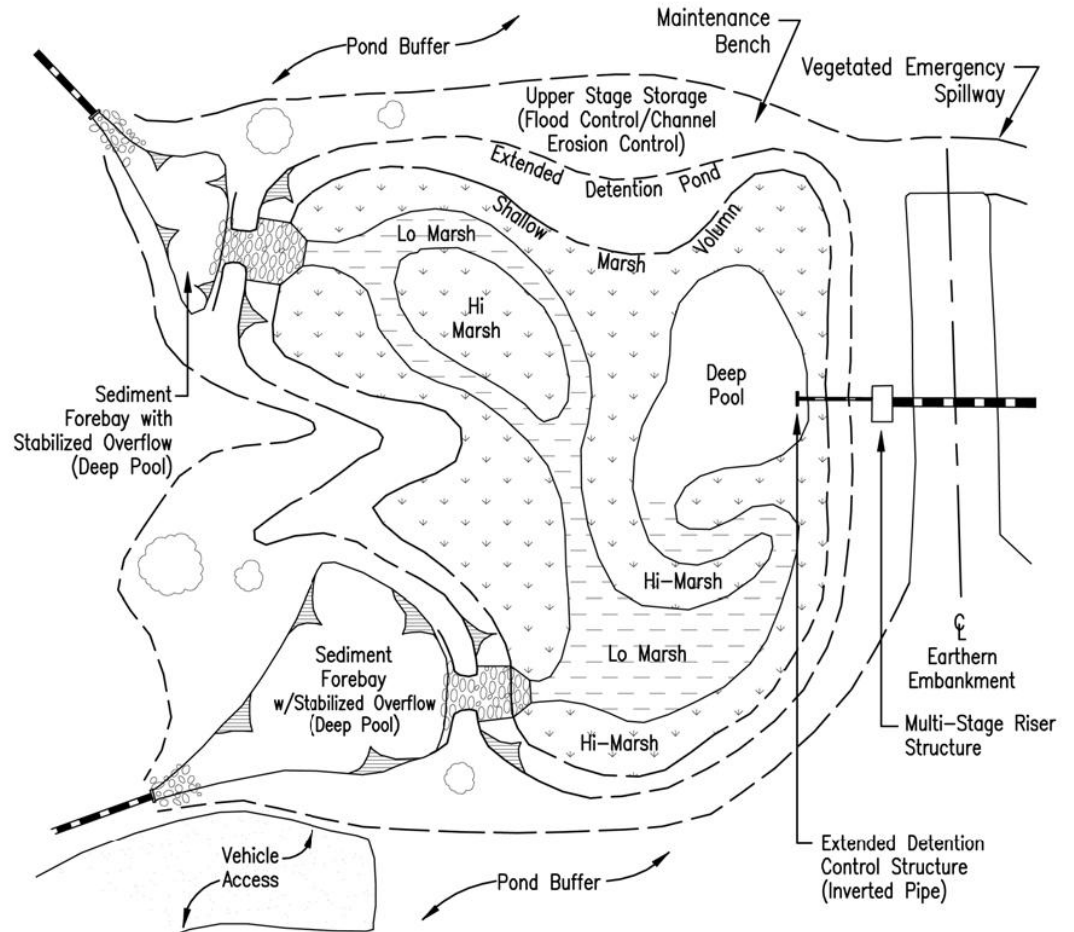
Extended Detention Basin or
“Dry Pond” Target P
Removal of 35%

Constructed Stormwater Wetland



More SWM Facilities

**Enhanced Extended
Detention "Wet Pond"
Target P Removal of
50%**



Depth Zone	% of Surface Areas
Deep Pool	20%
Lo Marsh	35%
Hi Marsh	45%

LID Practices



Questions/Comments

