

Wastewater Treatment Ponds

New Mexico Rural Water Association

2007

Use of Ponds

- **Wastewater Treatment Facility**
- **Employs natural biological processes**
- **In use since ancient times**
- **Used around the world**
- **Industrial and municipal applications**
- **Cost effective for smaller communities**

Advantages of a Well-designed Pond

- Does not require expensive equipment
- Does not require a *highly* trained operator
- Economical to construct
- Treatment can be equal or superior to some other treatment processes
- Can be adaptable to variable loadings



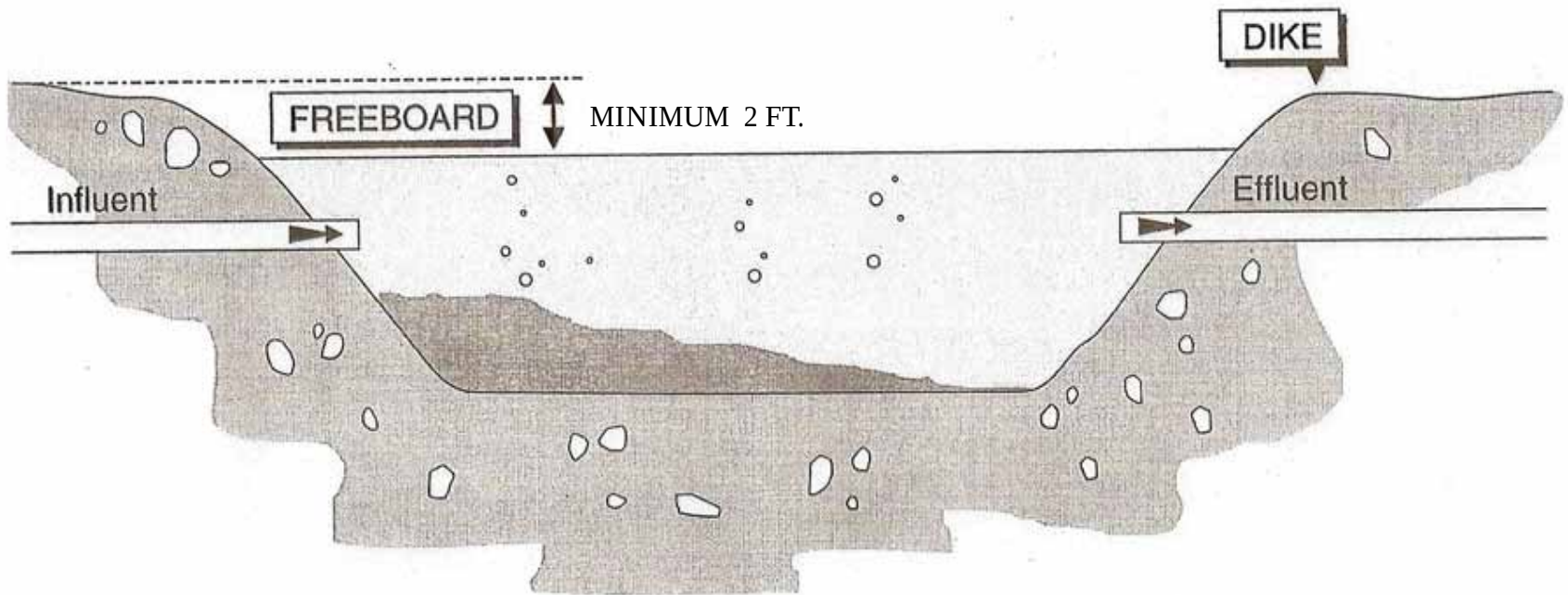
- Consumes little energy
- Provides wildlife habitat
- Few sludge handling & disposal problems
- Most trouble-free of any treatment process
 - When designed & used correctly
 - Provided a high quality effluent is not required

Pond Limitations

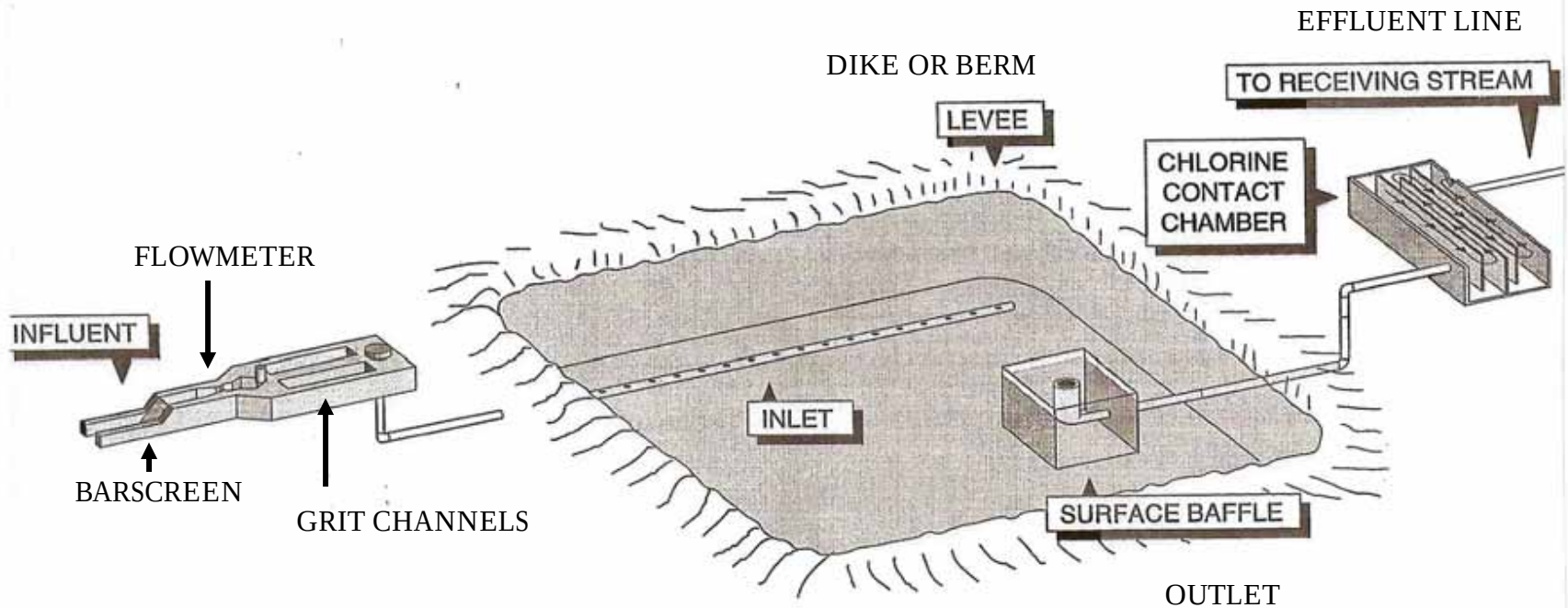
- **Odors**
- **Land requirements**
- **Lack of control over effluent quality**
- **Possible groundwater contamination unless lined**

PONDS OR LAGOONS

Secondary - Biological Treatment



Pond Parts



TRANSFER LINE
RECIRCULATION LINE

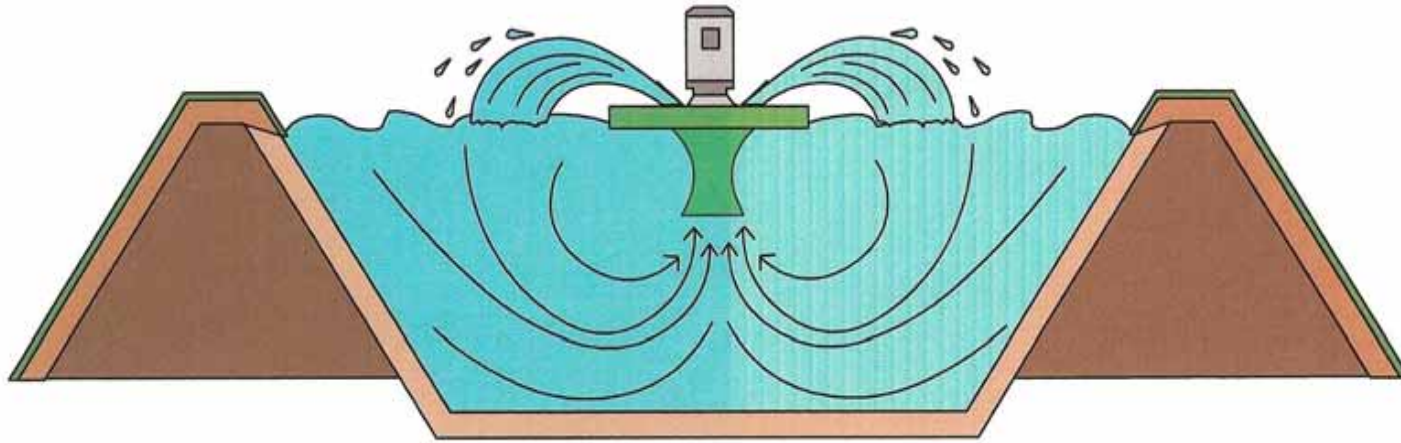
Pond Classifications

- **Aerobic**
- **Anaerobic**
- **Facultative**



Aerobic Lagoons

(aerated)



- Complete mix throughout basin
- Saturated with dissolved oxygen
 - Mechanical mixing (shown)
 - Subsurface diffused aeration
- Usually much deeper than other lagoons
 - Up to 10 ft. deep

3 – 20 days detention time
in a two pond system

Floating Surface Aerator





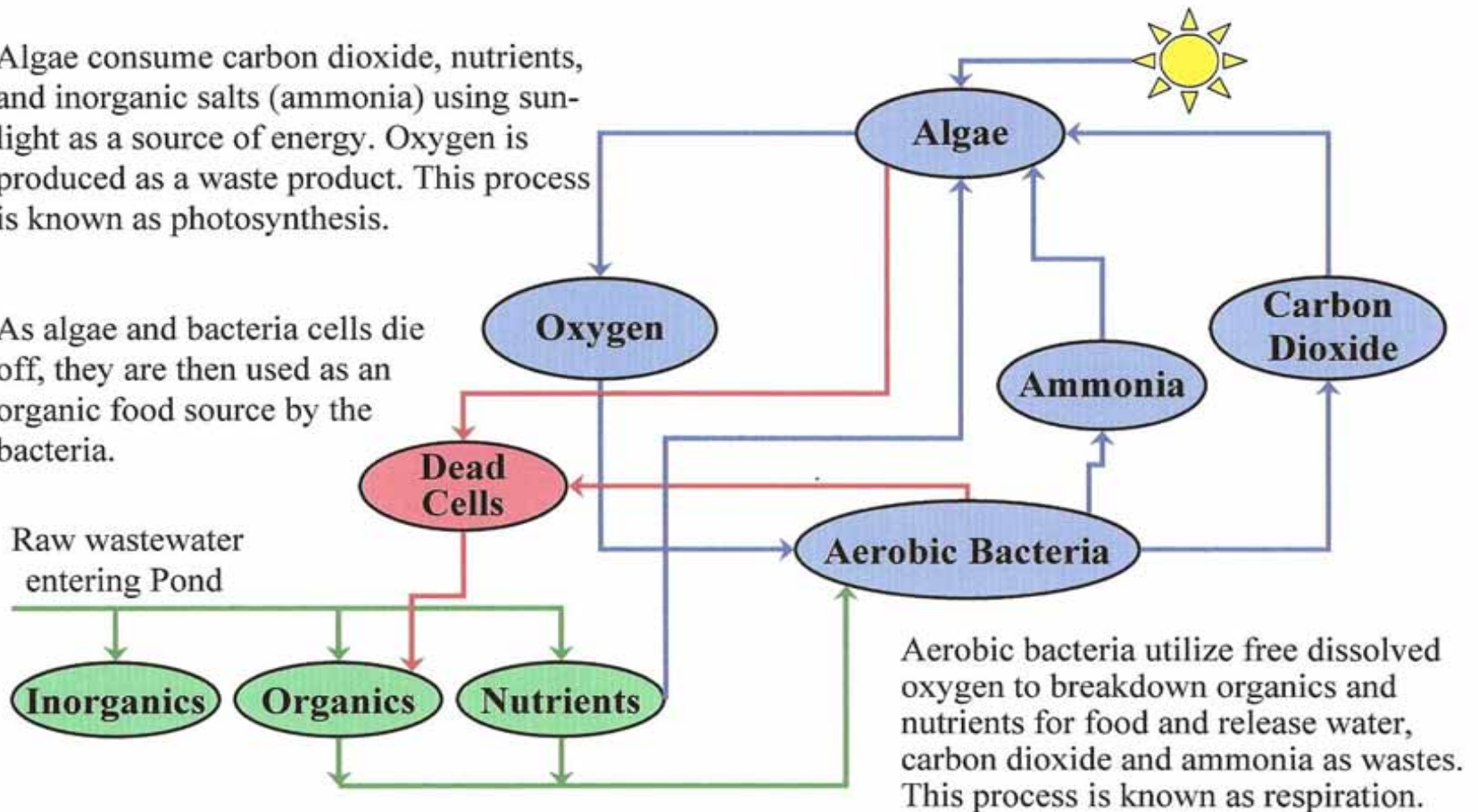
Sub-surface Diffused Aeration

Aerobic Process

Algae consume carbon dioxide, nutrients, and inorganic salts (ammonia) using sunlight as a source of energy. Oxygen is produced as a waste product. This process is known as photosynthesis.

As algae and bacteria cells die off, they are then used as an organic food source by the bacteria.

Raw wastewater
entering Pond

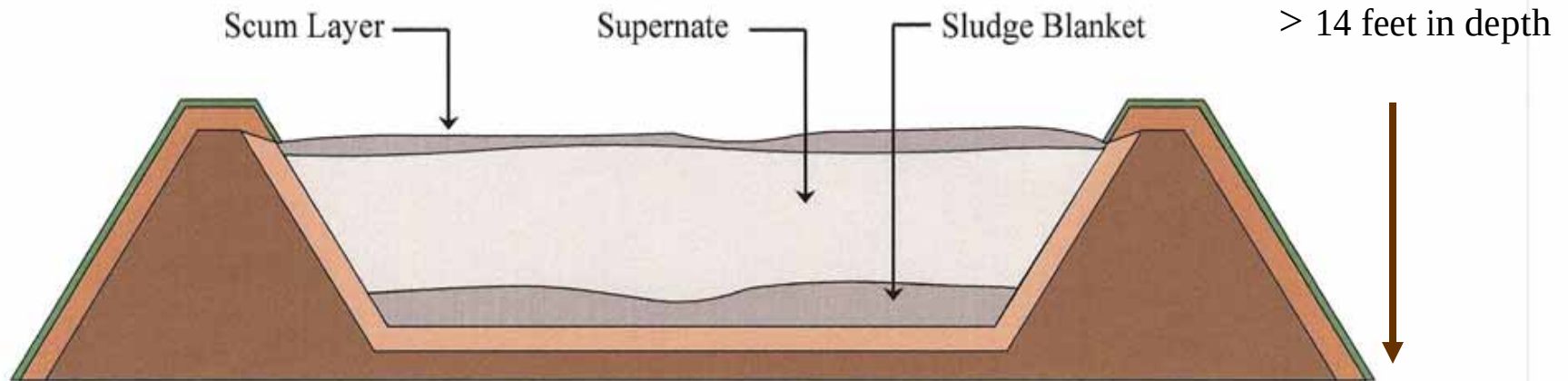


Surface Loading Rate

Organic Loading in lbs. BOD /acre /day

- **Aerobic ponds** **60-200 lbs. BOD /acre /day**
- **Mechanically aerated ponds** **20-400 lbs. BOD /acre /day**

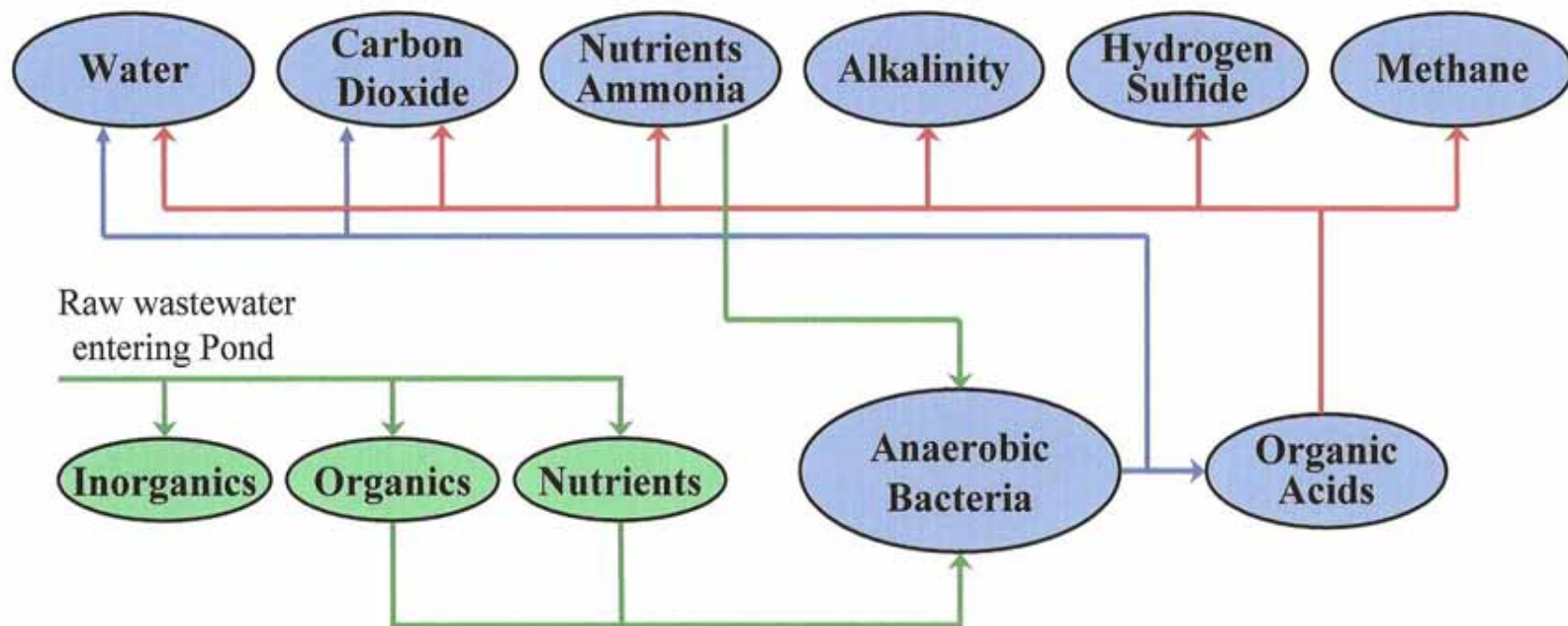
Anaerobic Lagoons



- Consists of three layers
 - Scum Layer
 - Usually grease and other floating solids
 - Supernate
 - Sludge Layer
 - Heavy organic and inorganic solids which settle to the bottom
- Same operating principals as septic tanks

Surface Loading Rate = 200-1000 lbs. BOD / acre / day

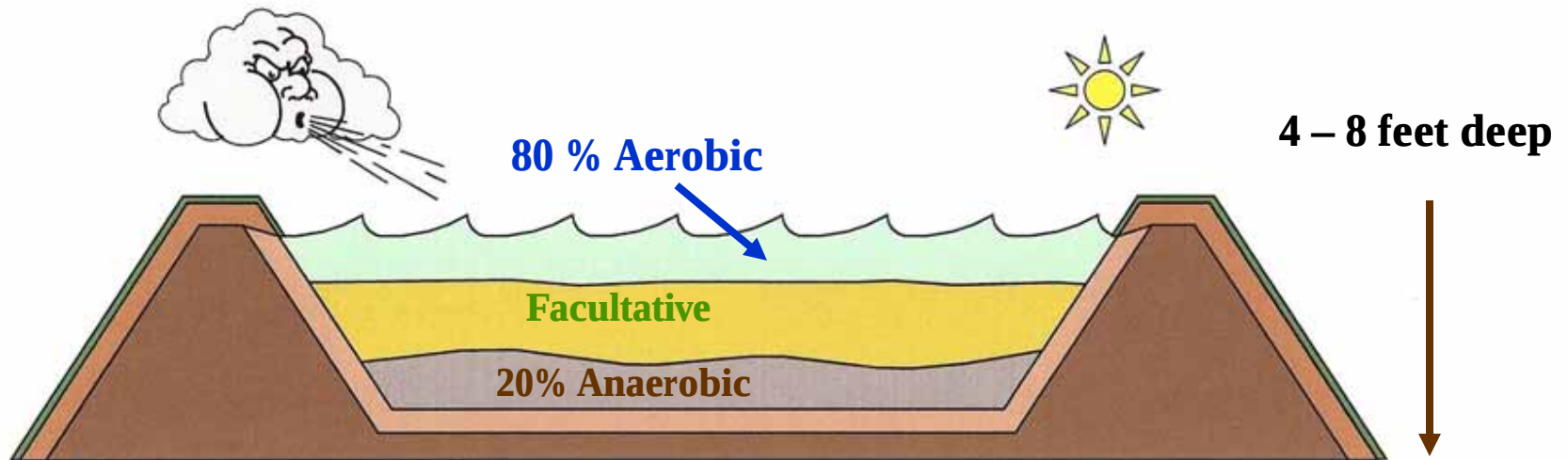
Anaerobic Process



Acid producing bacteria convert organic matter to volatile acids, carbon dioxide, water, and nitrogen.

Methane fermenting bacteria break down acids and other products to methane gas, carbon dioxide, hydrogen sulfide, alkalinity, and water.

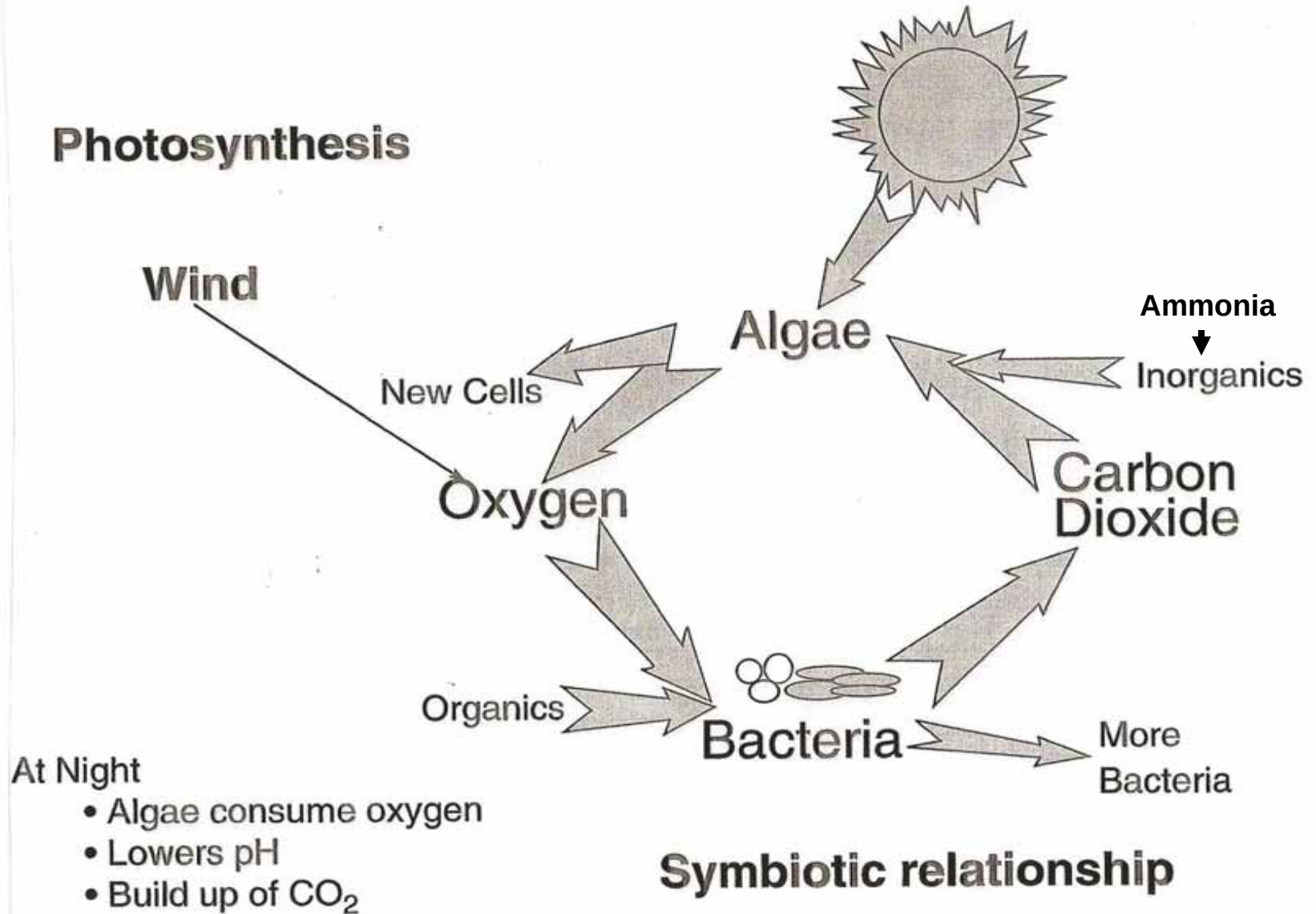
Facultative Lagoons



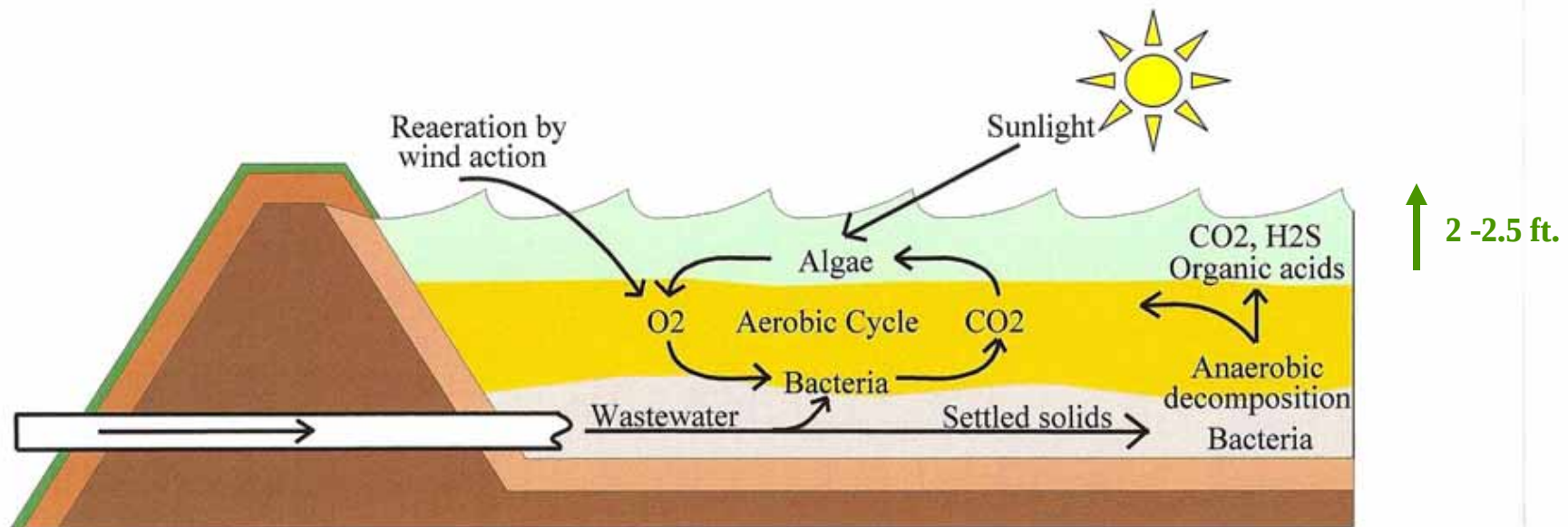
- Contains three layers
 - Aerobic
 - Facultative
 - Anaerobic

Surface Loading Rate =
15-50 lbs. BOD / acre / day

Photosynthesis



Facultative Treatment Process

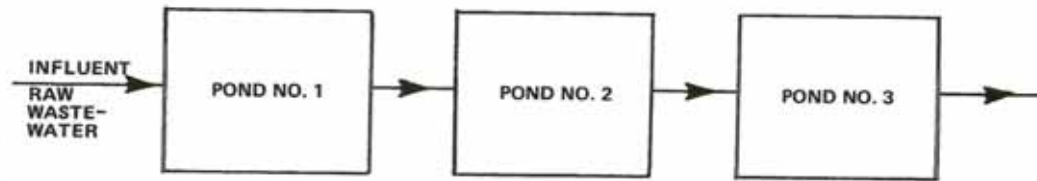


Most algae growth and O_2 production occurs in the top 2-2.5 feet

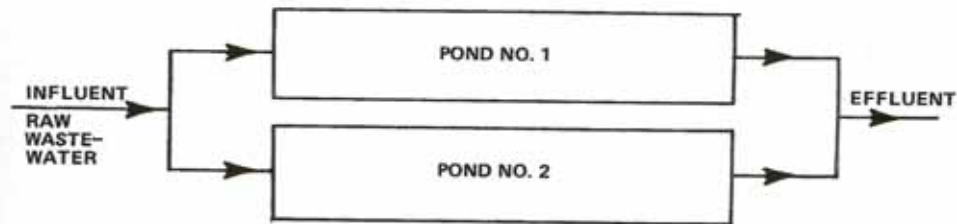
Cold water holds MORE dissolved oxygen (DO)

Surface Loading Rates

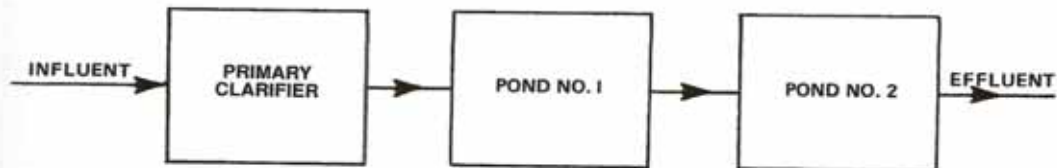
- **Anaerobic** 200-1000 lbs. BOD/ac/day
- **Mechanically aerated** 20-400 lbs. BOD/ac/day
- **Aerobic** 60-200 lbs. BOD/ac/day
- **Facultative** 15-30 lbs. BOD/ac/day
- **Tertiary or polishing** 5-15 lbs. BOD/ac/day



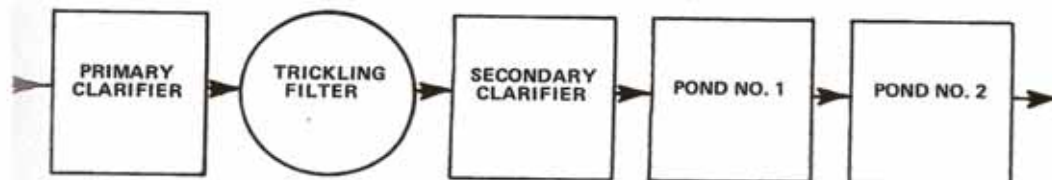
STABILIZATION PONDS IN SERIES



STABILIZATION PONDS IN PARALLEL



OXIDATION PONDS IN SERIES



POLISHING PONDS IN SERIES

Removal Efficiencies

Overall BOD removal 50 – 90 %

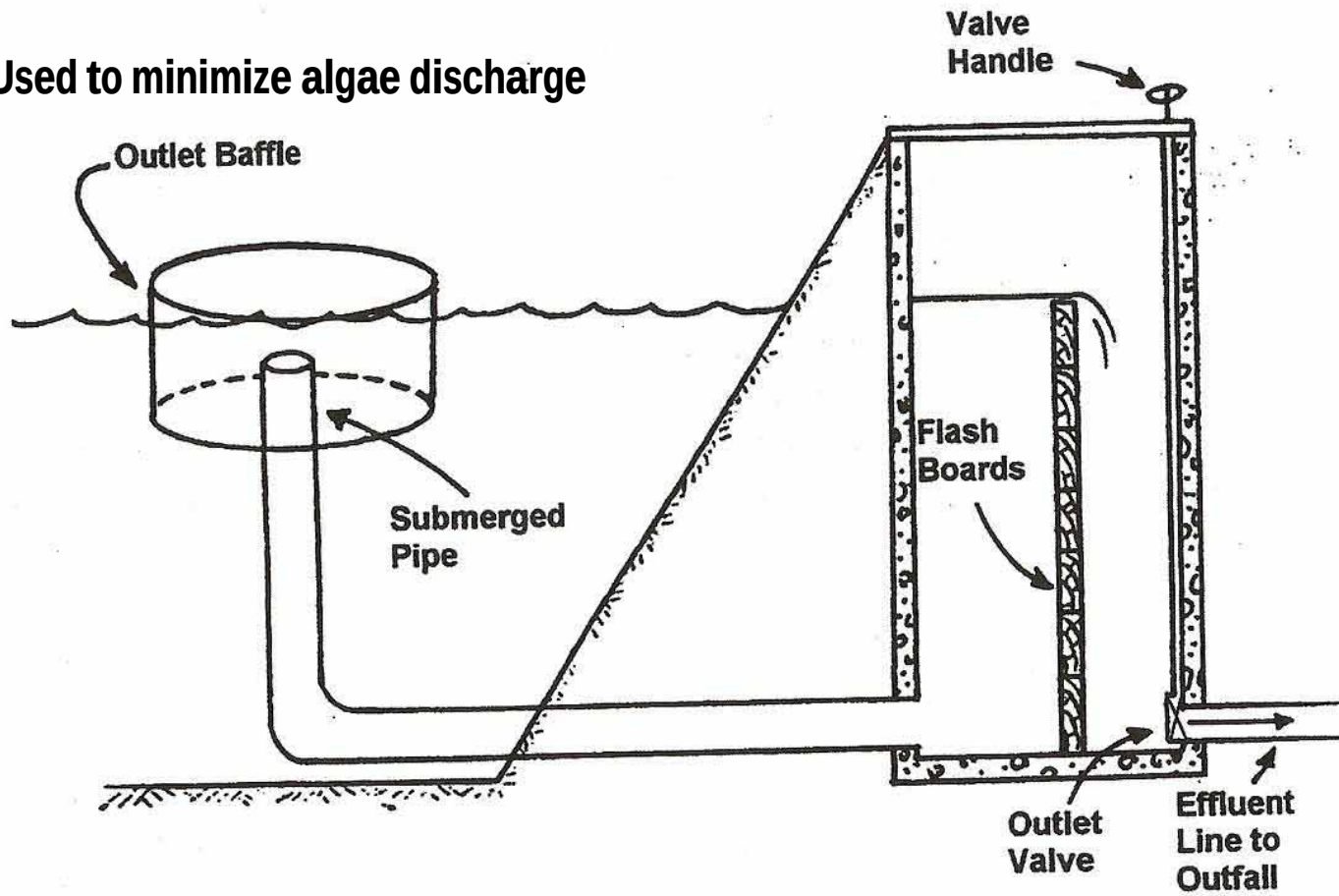
Facultative Ponds (with 50-60 days detention)

- **BOD** 70 – 80 % (80 % of the time)
- **Coliform bacteria** 90 – 95 %

Controlled Discharge Ponds (with 180 days detention)

- **BOD & TSS** 85 - 95 %
- **Fecal coliform** up to 99 %

Used to minimize algae discharge



Lagoon Effluent Structure

Pond Start-up

- Minimum one foot of water in pond prior to introduction of wastewater (recommend 2 ft.)
- Keep pH above 7.5
- Start ponds in warm weather
- Discharge to pond intermittently for first few weeks
- Algal blooms will appear in 7 – 12 days
- Takes at least 60 days to establish a thriving biological community









Lagoon O&M Requirements

- Remove Scum and Floating Debris
 - Can reduce sunlight and oxygen, may cause odors, and provides breeding spots for mosquitoes.
- Control Water Weeds
 - Can provide food and cover for borrowing animals, cause short circuiting, and prevent wave action. Roots may also penetrate pond seals.
- Control Blue Green Algae
 - Forms a mat on pond surface which will lead to low pH and D.O.
- Remove Borrowing Animals
 - Will cause serious damage to pond dikes.
- Control Dike Vegetation
 - Reduces wind action on ponds and provides nesting places for animals.
- Control Odors
 - General nuisance to nearby residents.
- Control Insects



What is this?





Troubleshooting Part 1

Problem	Probable Cause	Solution
Scum and Floating Debris	1. Pond turning over 2. Poor wind action 3. High amounts of grease and oil in influent	1. Keep dike vegetation mowed to improve wind action 2. Use a rake to remove 3. Use high pressure spray to breakup scum so it will sink
Water Weeds	1. Poor Circulation 2. Improper Maintenance 3. Insufficient Water Depth	1. Pull weeds by hand 2. Mow weeds with sickle bar mower 3. Lower water level to expose weeds and burn with gas burner 4. Increase water depth above weeds to smother them 5. Install rip rap 6. Use herbicides (check local and state regulations)
Blue green Algae	1. Incomplete treatment 2. Organic overloading 3. Poor nutrient balance	1. Use high pressure spray to break up algae mats 2. Break up blooms with air cooled motor boat



Troubleshooting Part 2

Problem	Probable Cause	Solution
Burrowing Animals	1. Excessive weeds to attract animals 2. High population in area near pond	1. Remove food supply by keeping dike vegetation maintained 2. Fluctuate water level 6-8 inches over several weeks 3. Physical removal by licensed trappers
Excess Dike Vegetation	1. Inadequate maintenance program	1. Periodic mowing is the best and preferred method
Odors	1. Organic overloading 2. Long periods of cloudy weather 3. Poor circulation	1. Use parallel feeding to primary cells to reduce loading 2. Add sodium nitrate to increase dissolved oxygen 3. Keep dike vegetation maintained to allow wind circulation 4. Install supplemental aeration

Troubleshooting Part 3

Problem	Probable Cause	Solution
Insect Infestations	- Poor circulation - Poor maintenance	- Maintain dike vegetation to allow for wind circulation - Stock pond with gambusia (mosquito fish) - Keep pond free of scum
Excessive Suspended Solids in Effluent	Algae	Draw off effluent from below the surface by use of a baffle
Low Dissolved Oxygen	- Poor circulation - Poor light penetration - Low detention time - High BOD loading	- Maintain dike vegetation to allow for wind circulation - Remove scum mats which may be blocking sunlight - Measure sludge in pond bottom to determine if pond detention time is too low, remove sludge - Run primary cells in parallel operation to reduce BOD loading



Pond Cover

Known as “Bird Balls”



Process Control Sampling and Analysis

- pH
- Temperature
- Dissolved oxygen (DO)

Test each pond in the system

Test pH and DO at lagoon outlet

pH and DO will be

- lowest at sunrise
- highest in late afternoon

Always record results

Target Values

Primary Pond

pH > 7.0

DO > 1.0

Secondary Pond

pH > 8.0

DO > 5.0

Deep sparkling emerald green usually indicates
high pH and adequate DO



Dull green or colorless usually indicates declining
pH and lowered DO



Gray usually indicates overloading or other problem





What is this? *PINK???*



***Purple Sulfur
Bacteria !***



Purple Sulfur Bacteria







More Toilet History

14th Century:

Toilet paper was first introduced in China (for the Emperor's use). Sheets were approximately 60 cm X 90 cm.

1596:

The flushing toilet was invented.

