WASTEWATER TREATMENT

By

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What is Sewage

- Sewage is the wastewater released by residences, businesses and industries in a community. It is 99.94 percent water, with only 0.06 percent of the wastewater are dissolved and suspended solid material.
- The cloudiness of sewage is caused by suspended particles which in untreated sewage ranges from 100 to 350 mg/l.
- Pathogens of disease causing organisms are present in sewage. Coliform bacteria are used as an indicator of disease-causing organisms.
- Sewage also contains nutrients (such as ammonia and phosphorus),minerals and metals.
- Ammonia can range from 12 to 50 mg/l and phosphorus can range from 6 to 20 mg/l in untreated sewage.

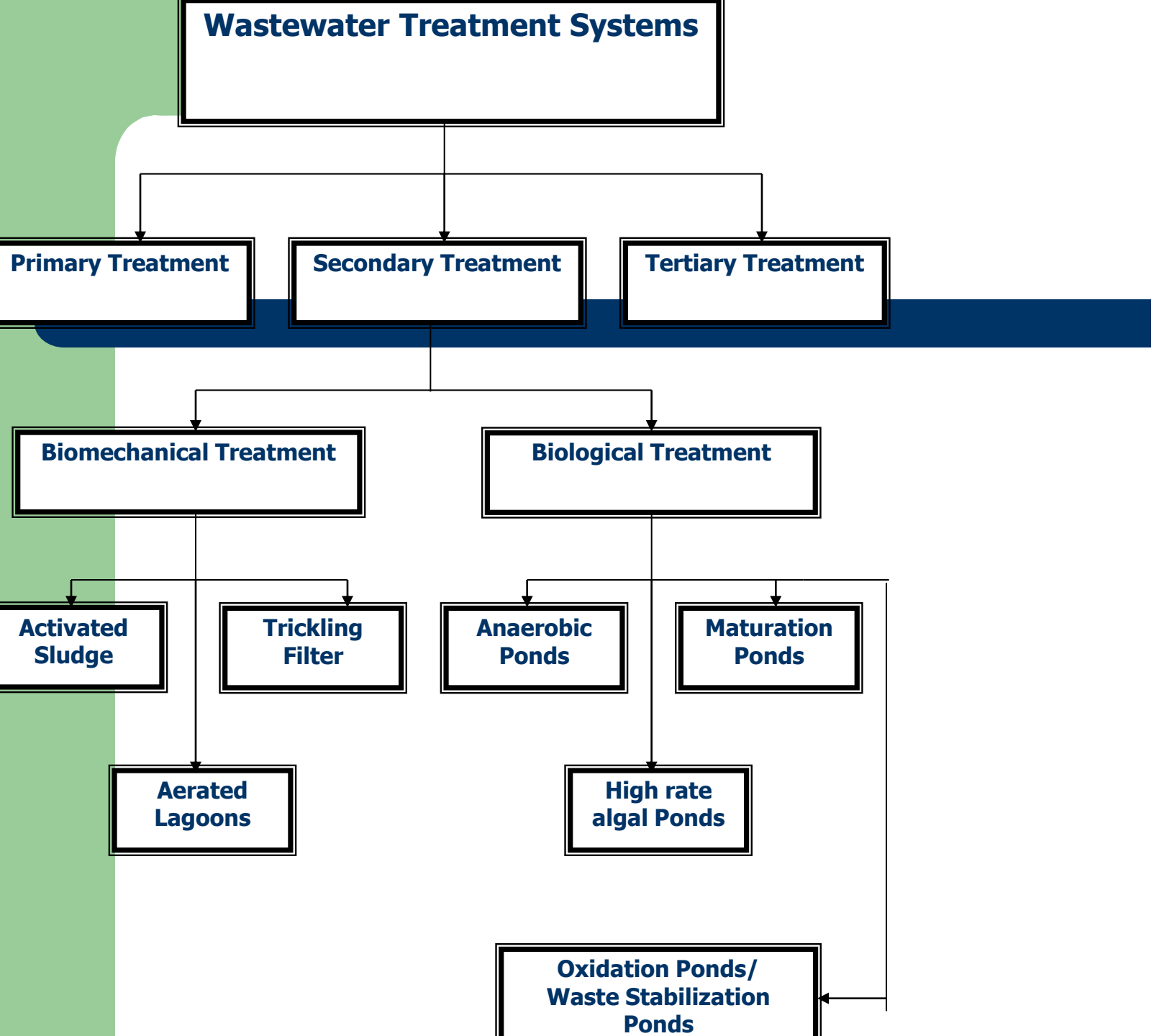

Wastewater Treatment Systems
Primary Treatment
Secondary Treatment
Tertiary Treatment
Biomechanical Treatment
Biological Treatment
Activated Sludge
Trickling Filter
Anaerobic Ponds
Maturation Ponds
Aerated Lagoons
High rate algal Ponds
Oxidation Ponds/ Waste Stabilization Ponds

TABLE- 1

Comparison between biological and biomechanical systems of wastewater treatment

S#	Biological system (Oxidation ponds)	Biomechanical system (Activated sludge/ Trickling filters)
1	No complex mechanical equipments required	Complex mechanical equipment required
2	No highly skilled labour required	Highly skilled labour required
3	Operation, maintenance and fixed costs are very low	Operation, maintenance and fixed costs are very high
4	Normally no special materials required	Special materials required which increases cost
5	Can be made safe and reliable at a very low cost	Can be made safe only at considerable added cost because they arevery sensitive to mechanical failures, human errors and to sudden changes in flows and waste quality
6	Because of the absence of complex mechanical system not much repair cost is involved	Mechanical systems are very costly to repair
7	No artificial source of energy is required. Sunlight is used as source of energy	External source of energy required for the operation of intensive mechanical system

TABLE-1 cont'd

S#	Biological system (Oxidation ponds)	Mechanical system (Activated sludge/ Trickling filters)
8	As a result of oxidation pond treatment technology methane recoverable fermentation, photosynthetic oxygenation and algal biomass production could be achieved. All these unit processes being of commercial importance could eventually reduce the cost of treatment (low cost treatment technology)	The system is such that only a very small amount is recoverable
9	No foreign exchange component is involved	Roughly more than 50 % foreign exchange component is involved.
10	A better quality treated effluent is produced which has little or no undesirable health effect. It is much better for the removal of disease producing microorganisms	Mechanical systems are not as efficient for the removal of disease producing microorganisms

Parameters %	**KUC** **Oxidation ponds**	**KDA** **Aerated lagoons**	**KMC** **Trickling filter**
Total suspended solids	81 (30-86)	Not done	60 (15-97)
BOD_5	81 (71-96)	81 (60-92)	49 (31-74)
COD	81 (66-95)	56 (45-86)	59 (29-86)
Ammonia	48 (41-58)	56 (45-80)	26 (10-48)
Phosphate	53 (11-82)	21 (4-50)	29 (27-31)
Total coliform count	98.30 (98-99.80)	89.60 (81-90.98)	80 (50-89)
Total faecal coliform count	99.30 (98-99.99)	89 (61-99.80)	98 (93-98)
Total faecal streptococci	96.40 (85.5-99.86)	95 (95-99)	Not done

WASTE STABILIZATION PONDS

- Facultative waste stabilization ponds
- Anaerobic ponds
- Maturation ponds/Polishing ponds

Developing countries			Developed countries		
Countries	Population served	No. of ponds	Countires	Population served	No. of ponds
Brazil	---	4	Australia	---	>4000
Egypt	---	2	Canada	---	868
India	>100,000	10	USA	---	>16000
Iraq	90000	2			
Israel	800,000	>21			
Jamica	3500	1			
Jordan	52%	6			
Kenya	400,000	5			
Libya	16,000	4			
Pakistan Pilot ponds (Kar. Univ.)	5,000	4			
Phillipines	45,000	5			
Portugal	---	1			
Uruguary	---	1			
Sudan	---	1			
Zambia	200,000	5			
Total	---	>60			>20868

Facultative Lagoons

Facultative Lagoons

Facultative waste stabilization ponds

- Like most natural environments, conditions inside facultative lagoons are always changing.
- Lagoons experience cycles due to variations in the weather, the composition of the wastewater, and other factors .
- In general, the wastewater in facultative lagoons naturally settles into three fairly distinct layers or zones. Different conditions exist in each zone, and wastewater treatment takes place in all three.

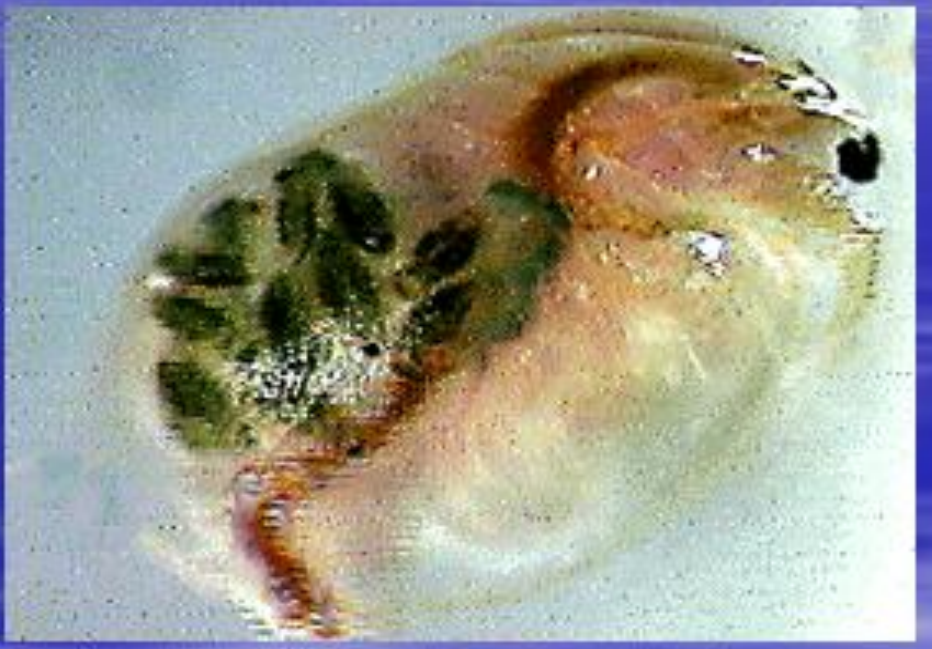
Facultative waste stabilization ponds

- **The top layer** in a facultative lagoon is called the aerobic zone, because the majority oxygen in present there.
- How deep the aerobic zone is depends on loading, climate, amount of sunlight and wind, and how much algae is in the water.
- The wastewater in this part of the lagoon received oxygen from air, from algae, and from the agitation of the water surface (from wind and rain, for example).
- This zone also serves as a barrier for the odors from gases produced by the treatment processes occurring in the lower layers.

Facultative waste stabilization ponds

- **The middle layer include the facultative, intermediate, or aerobic anaerobic zone.**
- Both aerobic and anaerobic conditions exist in this layer in varying degrees.
- Depending on the specific conditions in any given part of this zone, different types of bacteria and other organisms are present that contribute to wastewater treatment.


Photograph by James Swaddark



Facultative waste stabilization ponds

- **The anaerobic zone** is the layer at the very bottom of the lagoon where no oxygen is present.
- This area includes a layer of sludge, which forms from the solids that settle out of the wastewater.
- Here wastewater is treated by anaerobic bacteria, microscopic organism, such as certain protozoa, and sludge worms, all of which thrive in anaerobic conditions.

Facultative waste stabilization ponds

Facultative lagoons are designed to hold the wastewater long enough for much of the solids in the wastewater to settle and for many disease causing bacteria, parasites, and viruses to either die off or settle out.

Time also allows treatment to reduce the overall organic strength of the wastewater, or its biochemical oxygen demand (BOD).

In addition, some of the wastewater eventually evaporates.

SUNLIGHT

Sunlight is also extremely important to facultative lagoons because it contributes to the growth of green algae on the water surface.

Because algae are plants, they require sunlight for photosynthesis. Oxygen is a byproduct of photosynthesis, and the presence of green algae contributes significantly to the amount of oxygen in the aerobic zone.

The more warmth and light the sun provides, the more green algae and oxygen there is likely to be in the lagoon.

Aerobic Zone

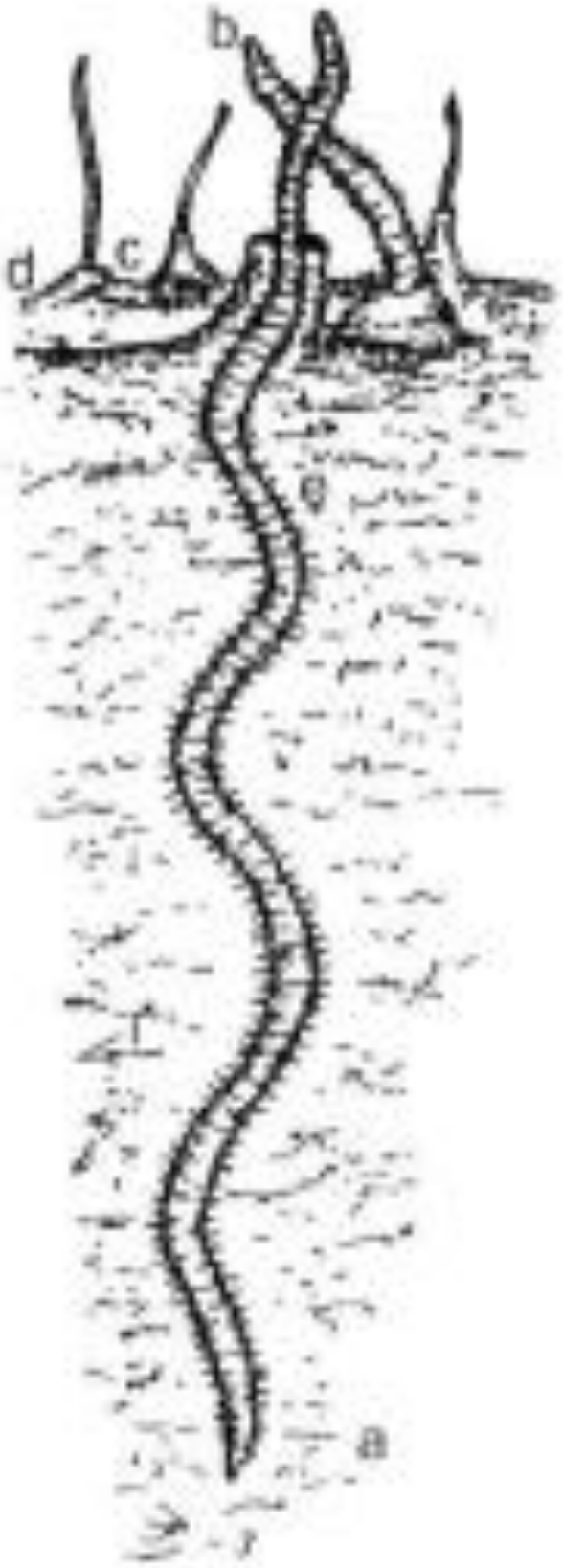
- The oxygen in the aerobic zone makes conditions favorable for aerobic bacteria. Both aerobic and anaerobic bacteria are very important to the wastewater treatment process and to each other.
- Bacteria treat wastewater by converting it into other substances.
- Aerobic bacteria convert wastes into carbon dioxide, ammonia, and phosphates, which, in turn, are used by the algae as food.
- Anaerobic bacteria convert substances in wastewater to gases, such as hydrogen sulfide, ammonia and methane. Many of these by products are then used as food by both the aerobic bacteria and algae in the layers above.

Anaerobic zone

The sludge layer at the bottom of the lagoon is full of anaerobic bacteria, sludge worms and other organisms, which provide treatment through digestion and prevent the sludge from quickly accumulating to the point where it needs to be removed.

How often sludge must be removed from facultative lagoons varies depending on the climate the individual lagoon design, and how ell it is maintained.

Sludge in all lagoons accumulates more quickly in cold than in warm temperatures.



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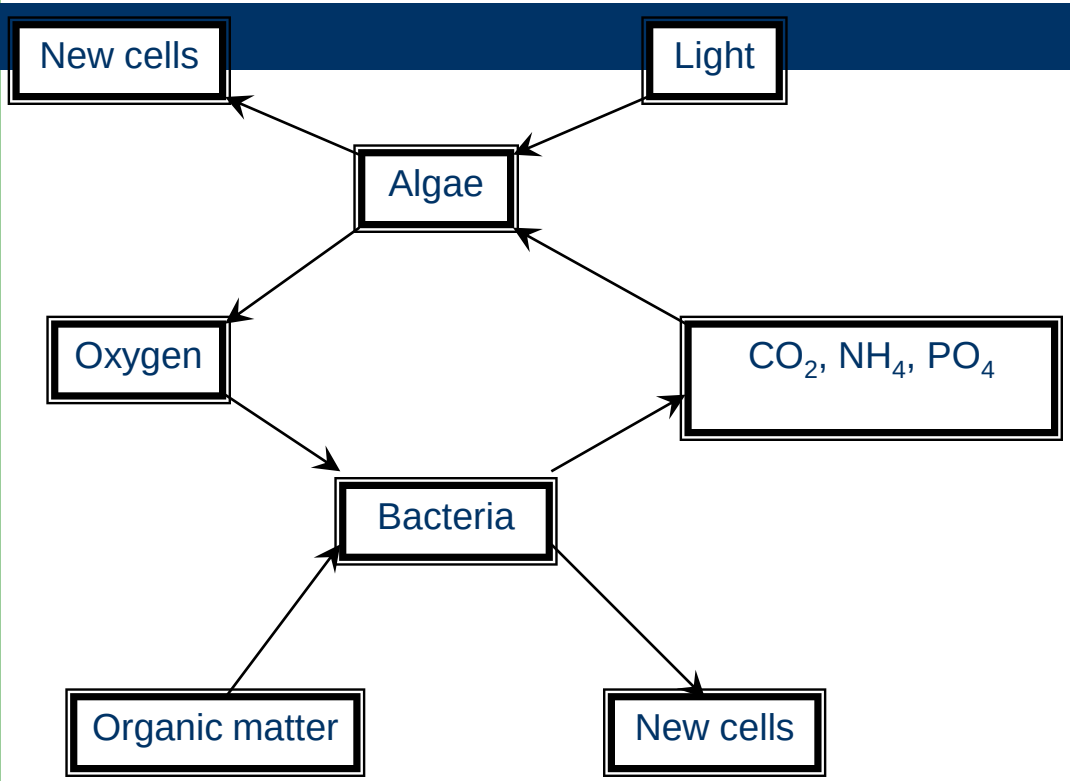
SYMBIOTIC RELATIONSHIP BETWEEN ALGAE AND ORGANOTROPIC BACTERIA

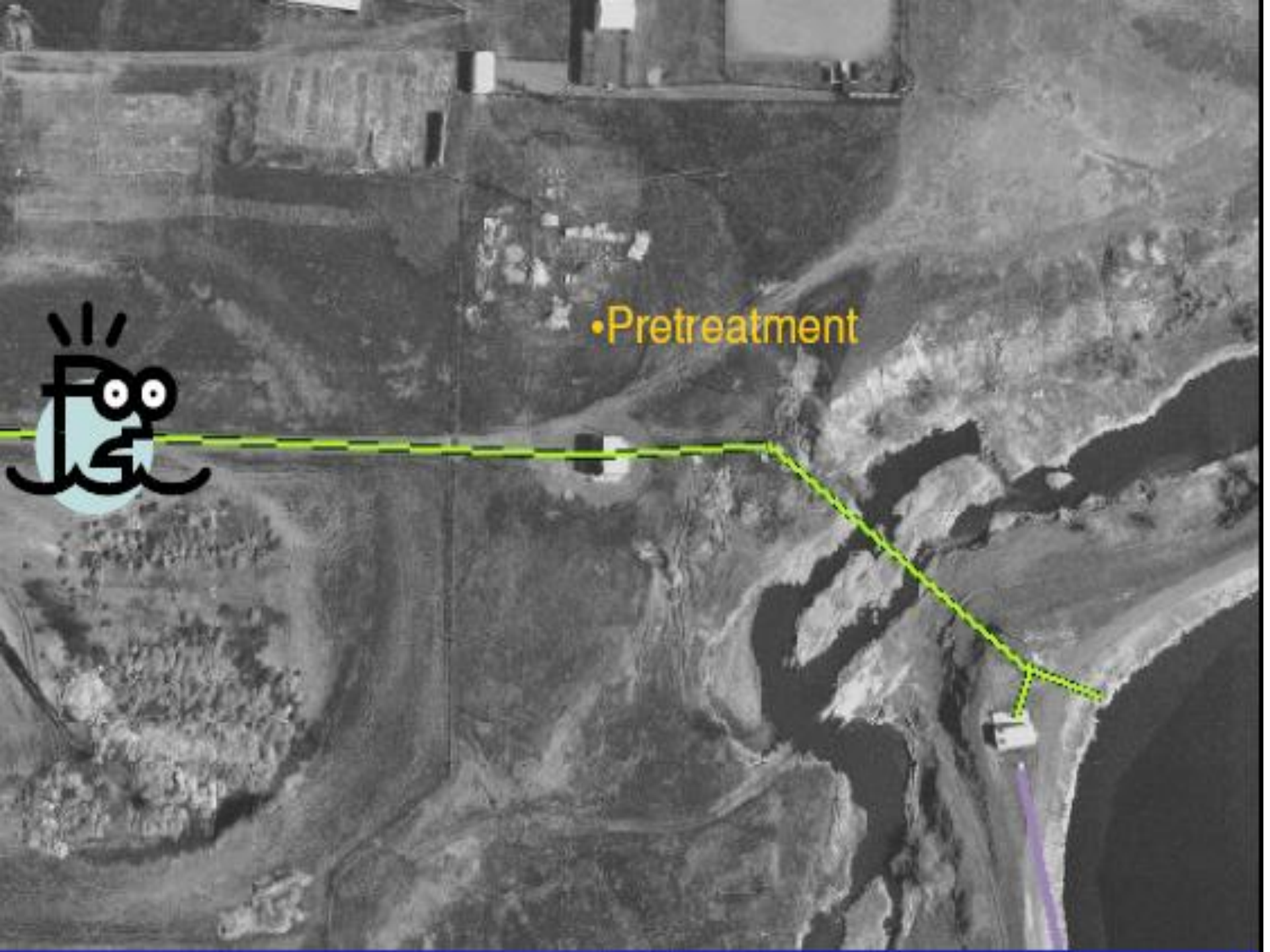


Design criteria

- Normal design flow 2.85 MGD
- Maximum design flow 5.7 MGD
- Peak on Maximum day 9.1 MGD

PRELIMINARY TREATMENT

There is a lot debris which comes through our waste stream. Things like rags, sand gravel and larger pieces of organic matter must be removed before it enters our Treatment System.


•Pretreatment

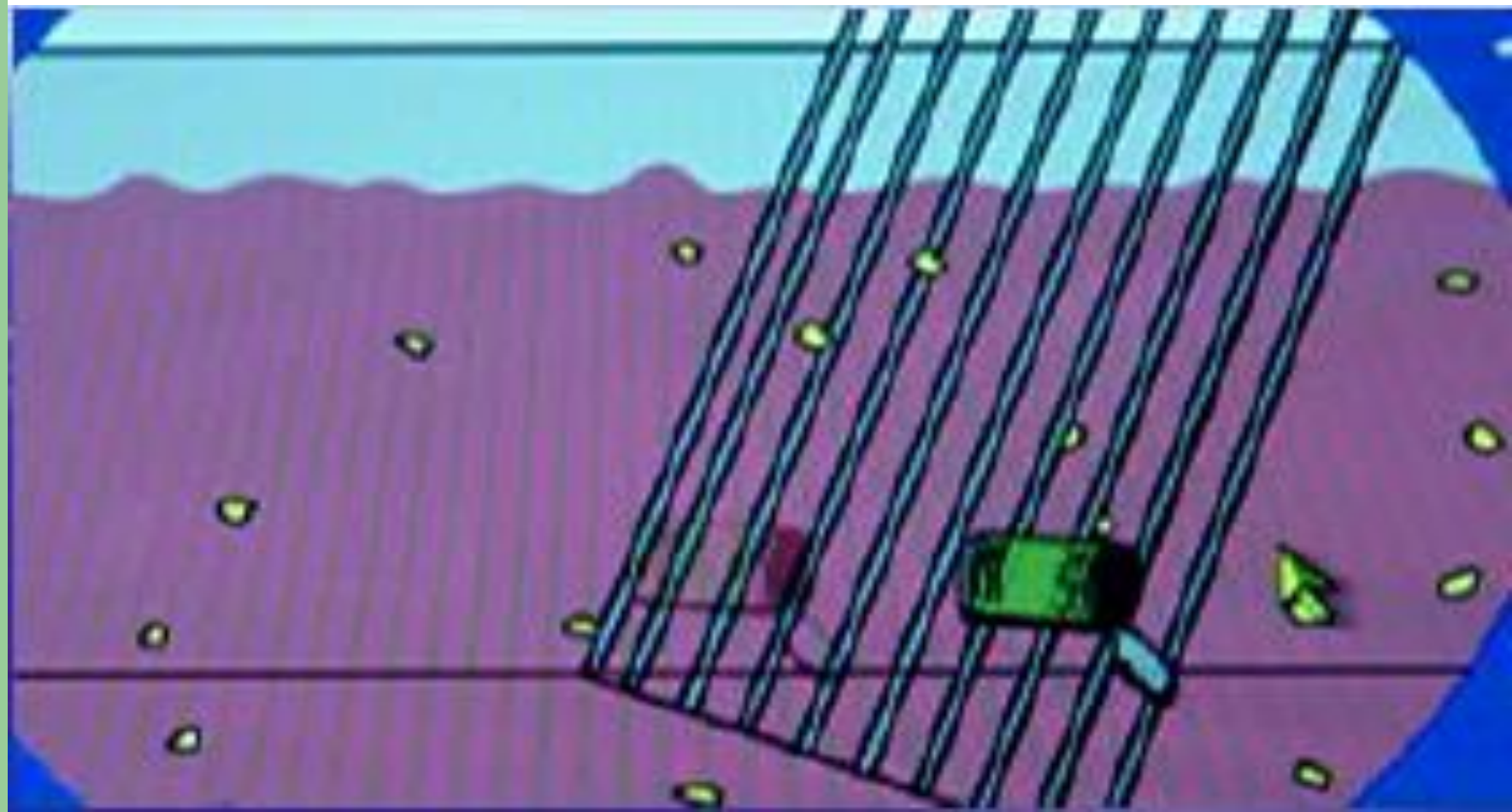
BAR SCREENS

A bar screen with evenly spaced vertical bars is placed at the beginning of a Wastewater Treatment Plant to remove large fresh, sticks, plastic material, rags, ect.

It is important to remove these materials because they could cause damage to equipment and decrease the capacity of the treatment plant.

The captured martial is then removed and properly disposed of.

BAR SCREENS



Climber Screen

Circulating Grit Tank

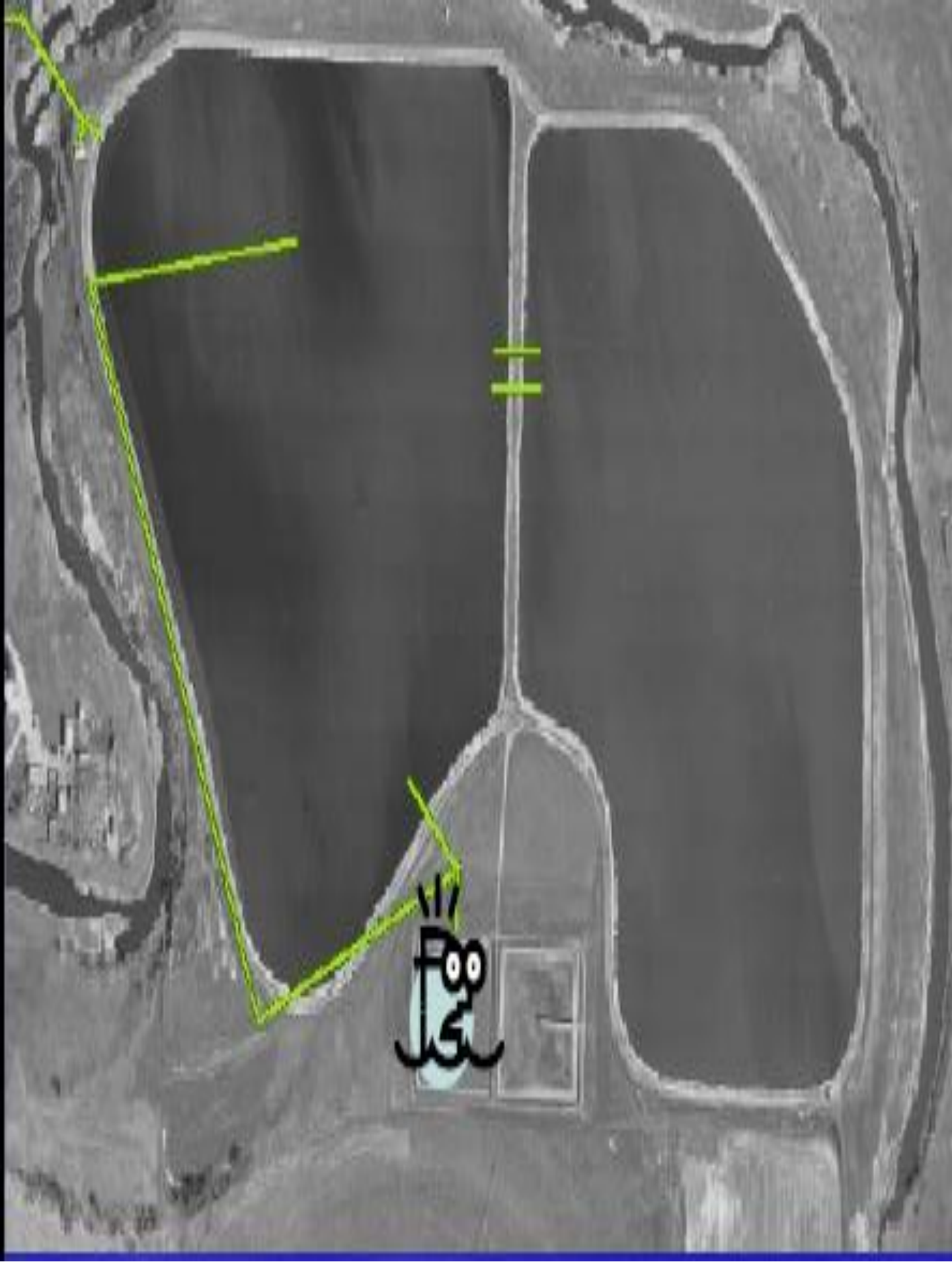
The circulating grit tank is a Vortex Grit Removal System.

This type of system uses an adjustable mechanical grit tank circulator to set up at three dimensional flow pattern that gently rolls the basins contents and allows the heavier material to settle into the sump.

Once the grit has been settled in the sump it is removed by a grit pump which pumps the material to the main floor where it is dewatered using a static dewatering screen.


Circulating Grit Tank

Static Dewatering Screen



Monitoring Requirements

Parameter	Frequency	Type of Measurements
Total flow	Continuous	Recorder
pH	Daily	Instantaneous
TSS	Weekly	Grab
BOD	Weekly	Grab
Fecal	Weekly	Grab
Temp	Daily	Instantaneous
Ammonia	Weekly	Grab
Oil & Grease	Daily	Visual