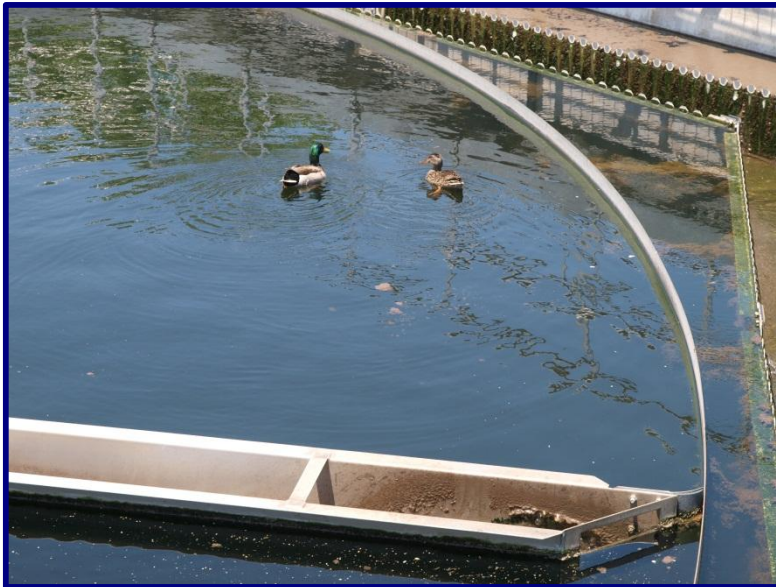


# Phosphorus Removal In Wastewater Treatment



by  
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# Why do we care?

- Eutrophication of surface water - Especially reservoirs
- Maximum agronomic uptake - Limiting irrigation
- Because TCEQ cares. . .Now we have a winner!

# What's happening?

- Organic - you and me - approximately 1 pound per year
- Inorganic - detergents - up to 7 pounds per year
- Plant Influent - varies from 5 mg/l to 30 mg/l
- All biological wastewater treatment removes 1 to 4 mg/l

# Rules

## TCEQ 217 . 163 - Advanced Nutrient Removal

- (a) A facility designed to provide advanced nutrient removal must specify the process units needed to achieve the permit's effluent limits.
- (b) Biological nutrient removal, membrane filtration, sand filtration, or a combination of these processes may be used for advanced nutrient removal without applying for the executive director's approval under the innovative or nonconforming technology criteria in § 217.7(b)(2) of this title (relating to Types of Plans and Specifications Approvals).
- (c) If a BNR unit is proposed, the report must include:
  - (1) The anticipated food to microorganism ratio in both the anoxic and anaerobic zones;
  - (2) The volatile fatty acid recycle ratio; and
  - (3) The design of a **foaming control system**.
- (d) If a chemical addition unit is proposed, it must comply with the requirements in Subchapter K of this chapter (relating to Chemical Disinfection).
- (e) A fixed film and filtration process must comply with the requirements of Subchapter G of this chapter (relating to Fixed Film and Filtration Units).

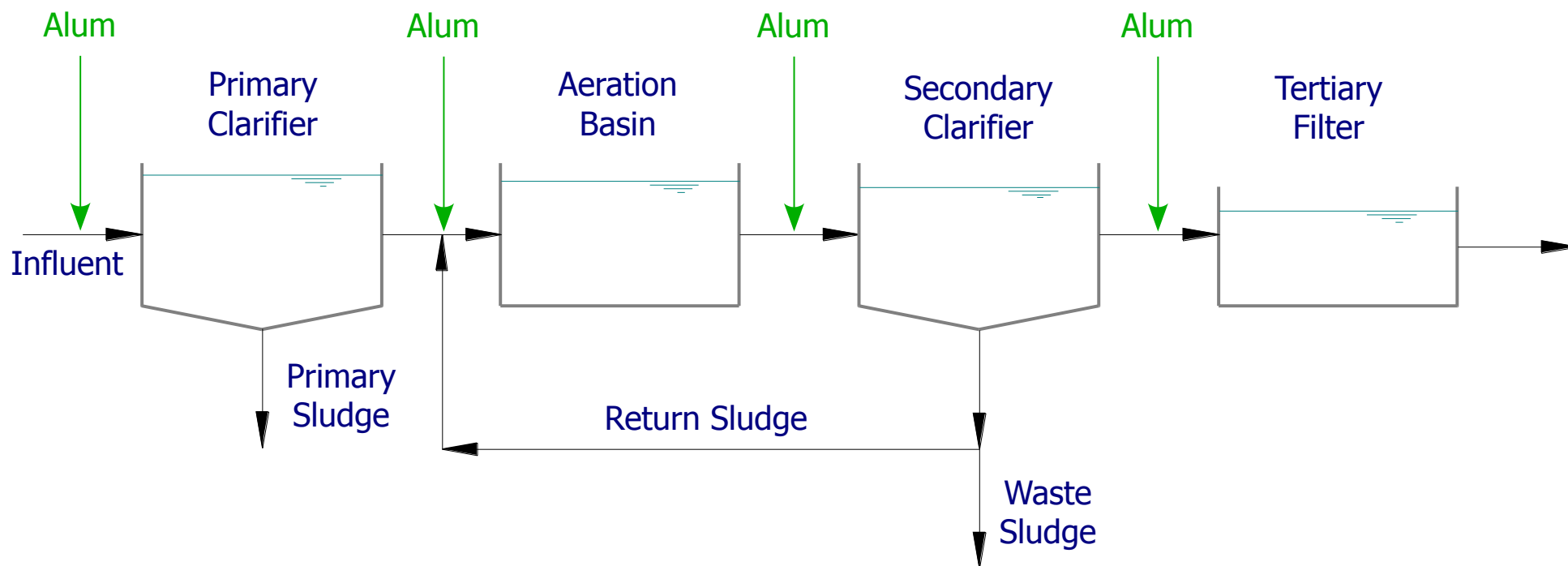
# Choices?

- Physical Treatment or Adsorption - not really
- Chemical Precipitation - easy to implement - chemical cost
- Biological Removal - serious construction - lower chemical cost
- Both options involve binding the phosphorus up in a solid and **removal** in the typical liquid / solid separation processes.

# Chemical Precipitation

- Metal Salt - Alum or Ferric Chloride - usually Alum
- Dosage - varies widely - 18 to 1 is a good start
- Requires - chemical storage, chemical feed pump(s), tubing
- Very reliable - Positive Operator control
- Can be installed at almost any existing plant
- Minimal Installation Cost
- Additional sludge production - Chemical cost

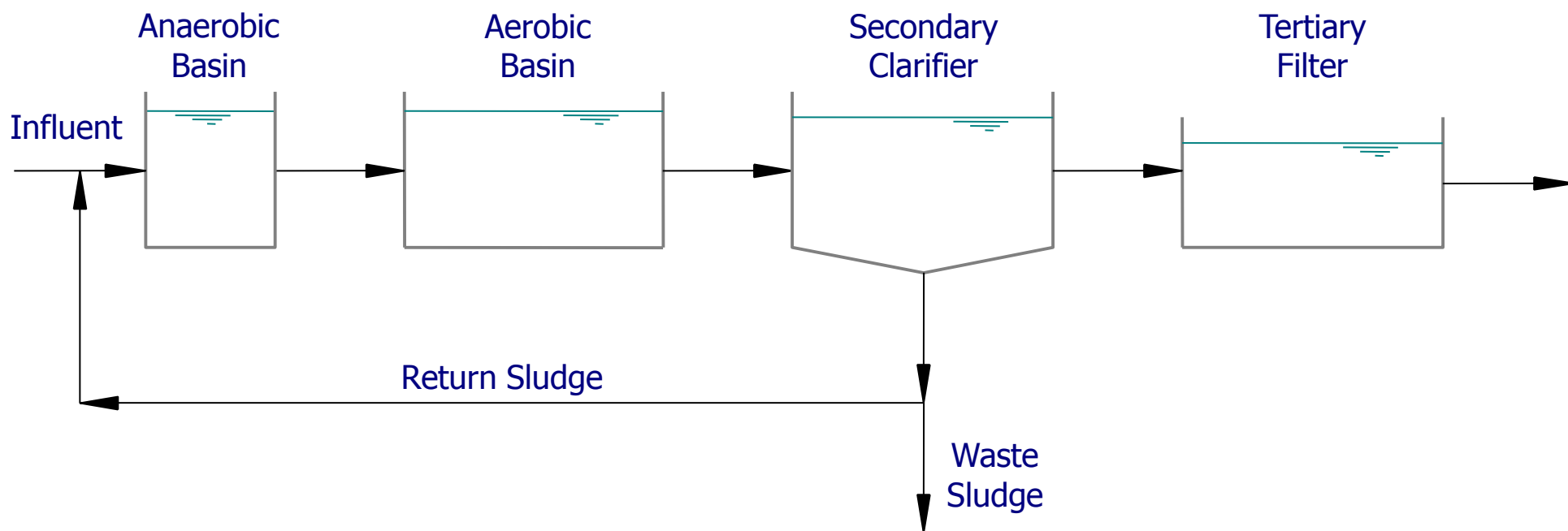
# Chemical Feed Points



# Biological Removal

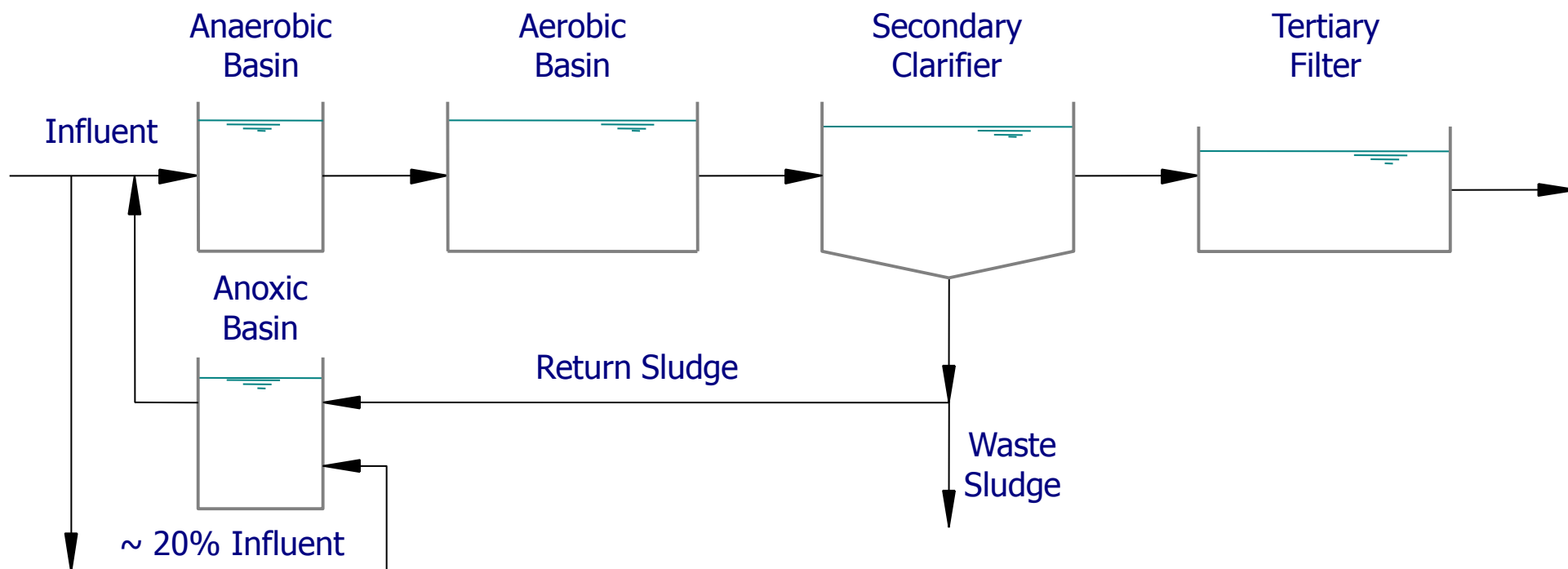
- Process Conditioning of the microbes to “consume” more Phosphorus
- Addition of un-aerated basin(s) - Anoxic and Anaerobic
- Chemical savings
- Phosphorus rich sludge
- Can be difficult to operate - Pay close attention to Sludge Treatment
- Can be installed at most plants
- Substantial construction cost

# Bio P Layout

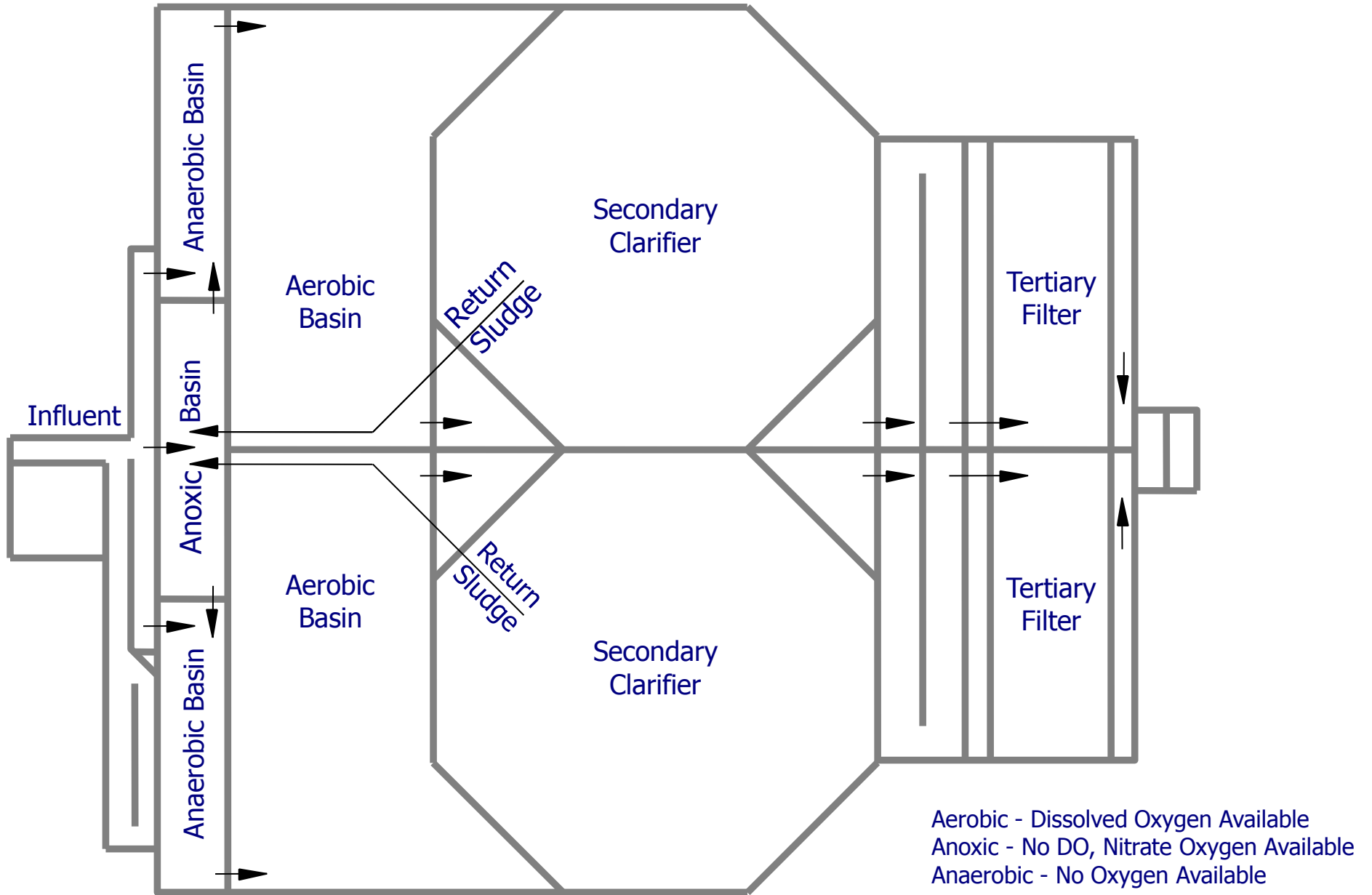


Aerobic - Dissolved Oxygen Available  
Anoxic - No DO, Nitrate Oxygen Available  
Anaerobic - No Oxygen Available

# Bio P Layout 2.0



Aerobic - Dissolved Oxygen Available  
Anoxic - No DO, Nitrate Oxygen Available  
Anaerobic - No Oxygen Available



# Effluent Limits

- Biological Phosphorus 2 - 3 mg/l
- Chemical Precipitation 1 - 2 mg/l
- Tertiary Filtration 0.5 - 1 mg/l
- Membrane Filtration 0.1 - 0.5 mg/l

# All done.

- Any intelligent fool can make things bigger and more complex. It takes a touch of genius and a lot of courage to move in the opposite direction. - Albert Einstein