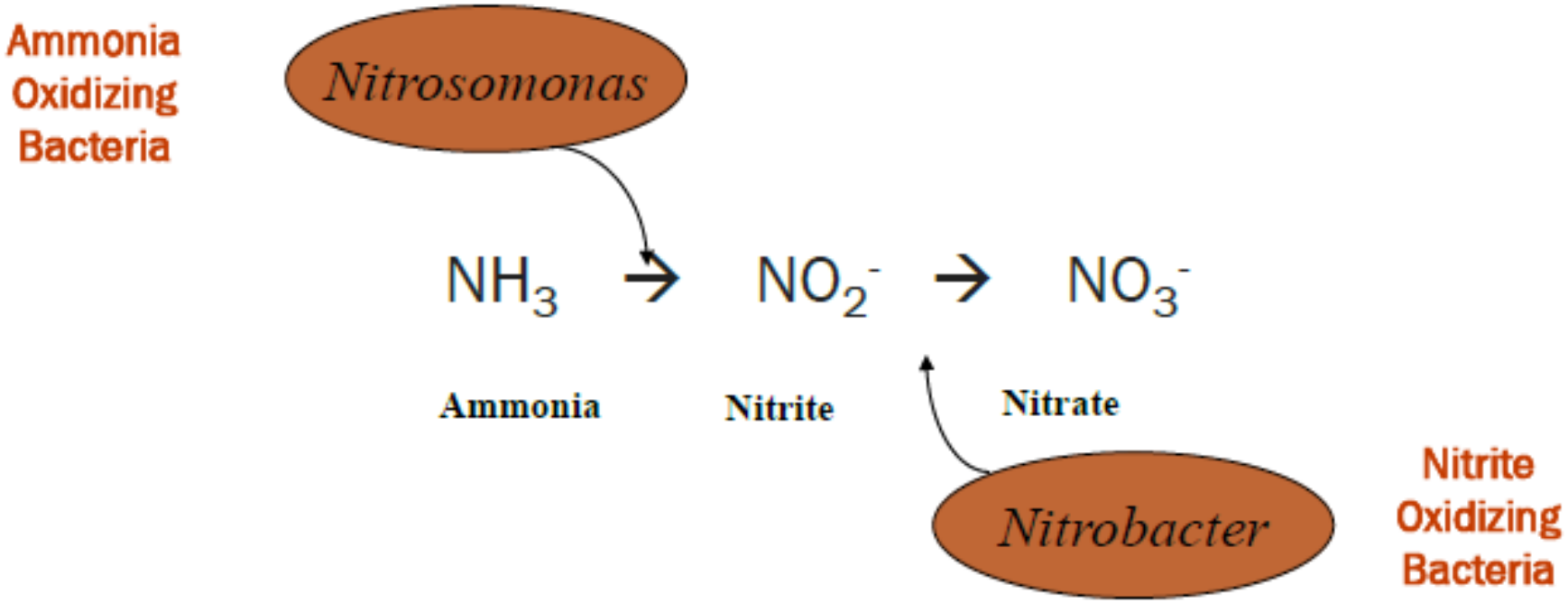
THE RESULT OF PHOSPHORUS OVER FERTILIZATION OF A LAKE, OCCOQUAN RESERVOIR, NORTHERN VIRGINIA, 1972

What are the effects of excess nutrients?
Low oxygen levels in water.
FISH DIE!

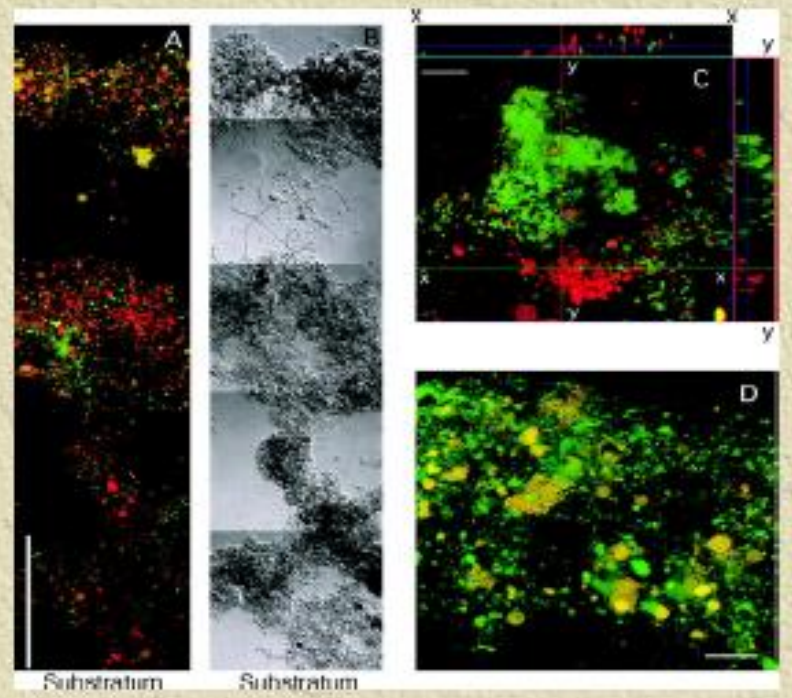
Nitrification

Oxidation of Ammonia to Nitrate



Genera of Nitrifying Bacteria

- Ammonia Oxidizers
  - Nitrosomonas
  - Nitrosococcus
  - Nitrosospira
  - Nitrosorbio
- Nitrite Oxidizers
  - Nitrobacter
  - Nitrospira
  - Nitrococcus
  - Nitrospina



C- Ammonia oxidizers appear red and Nitrospira appear green

Characteristics of Nitrifying Organisms

- Autotrophic
- Aerobic
- Slow growing
- Non-floc forming
- More sensitive to environmental changes than heterotrophs

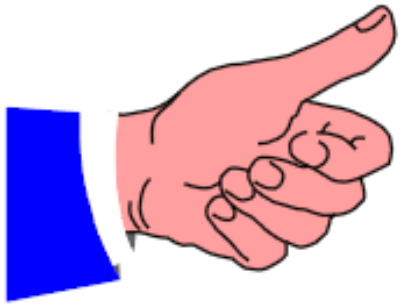
Effect of Temperature on Nitrification

As temperature increases, nitrifier growth rate increases (within the range of 4° C to 35° C).

T ↑ μ ↑

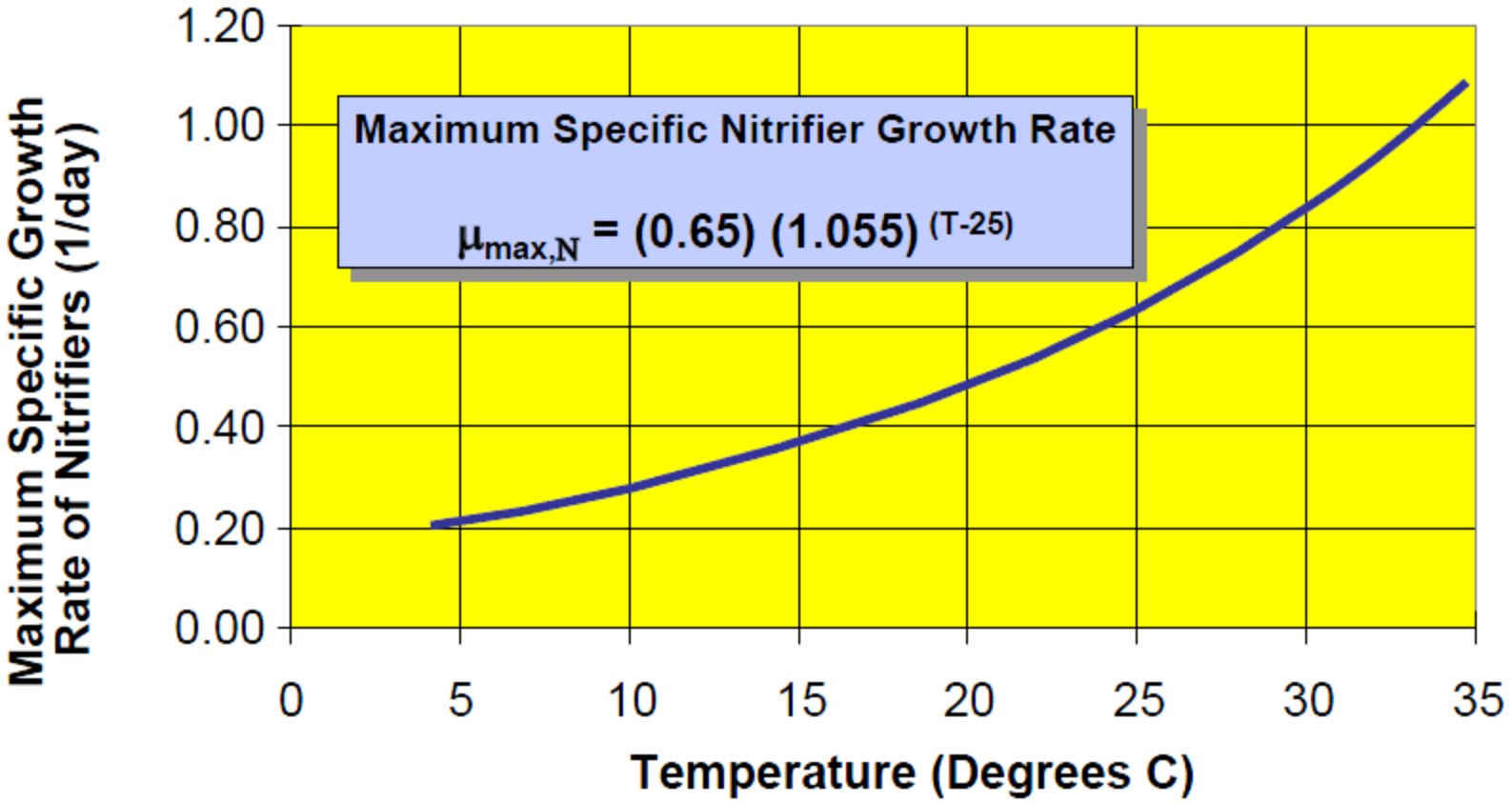
As nitrifier growth rate increases, required MCRT decreases.

μ ↑ MCRT ↓



<u>Rule of Thumb</u>:
For every 10°C increase in temperature, nitrifier growth rate doubles, required MCRT is cut in half and required MLSS concentration is also reduced.

Effect of Temperature on Nitrifier Growth Rate



Design Guidelines

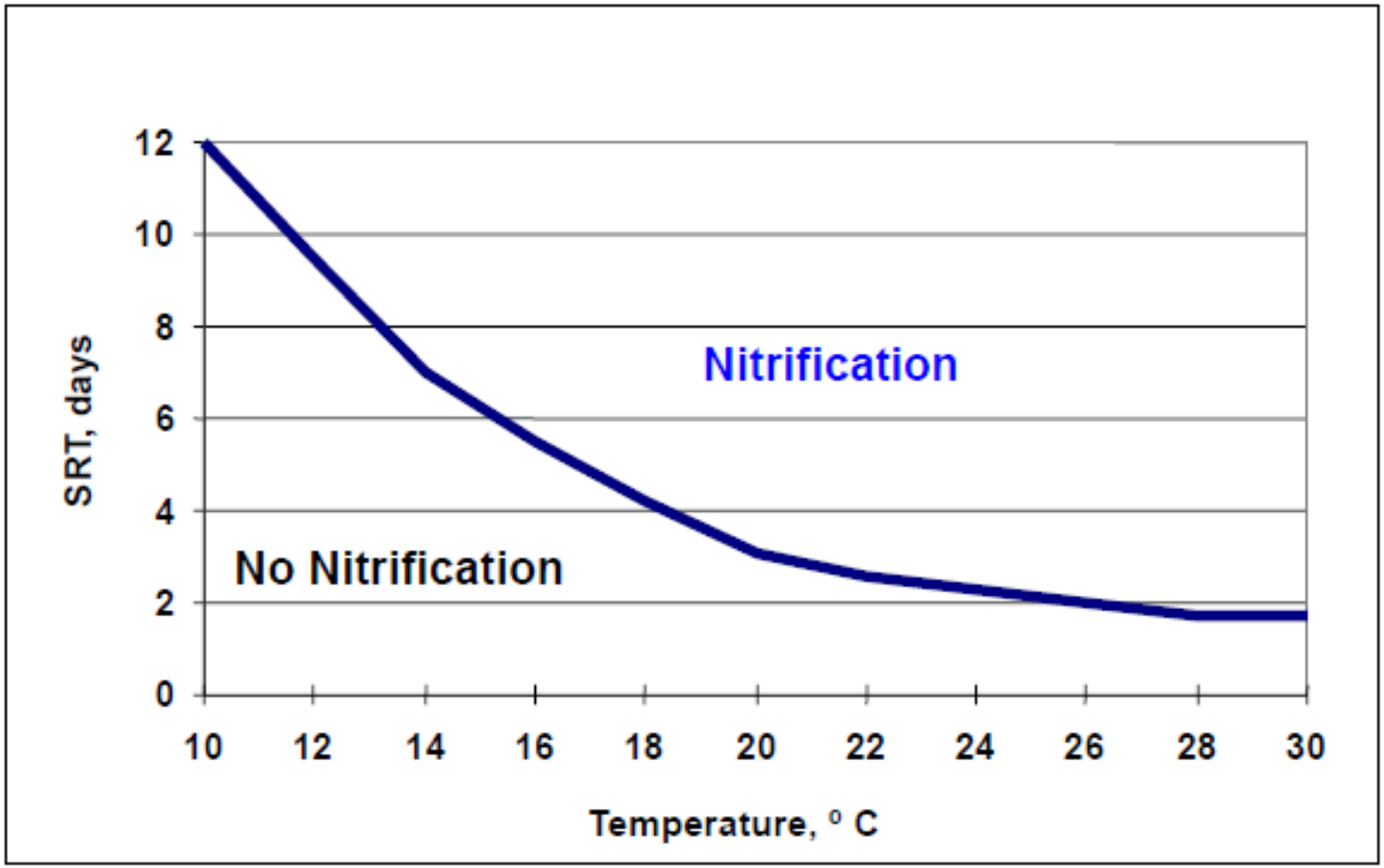
Nitrification

Temperature, ^{0}C	Min. SRT, days
10	20
15	15
20	10

Alkalinity is Consumed or Produced by

Process	Alkalinity Change, mg/L	Per mg/L of
Nitrification	-7.1	Ammonia-N oxidized
Denitrification	+3.6	Nitrate-N reduced
Chlorination	-1.4	Chlorine added
Breakpoint Chlorination	-1.4	Chlorine added
Dechlorination	-2.4	Sulfur dioxide added
Dechlorination	-1.4	Sodium bisulfite added
Phosphorus Removal	-5.6	Aluminum added
Phosphorus Removal	-2.7	Iron added

SRT drives nitrification.....
Temperature drives SRT



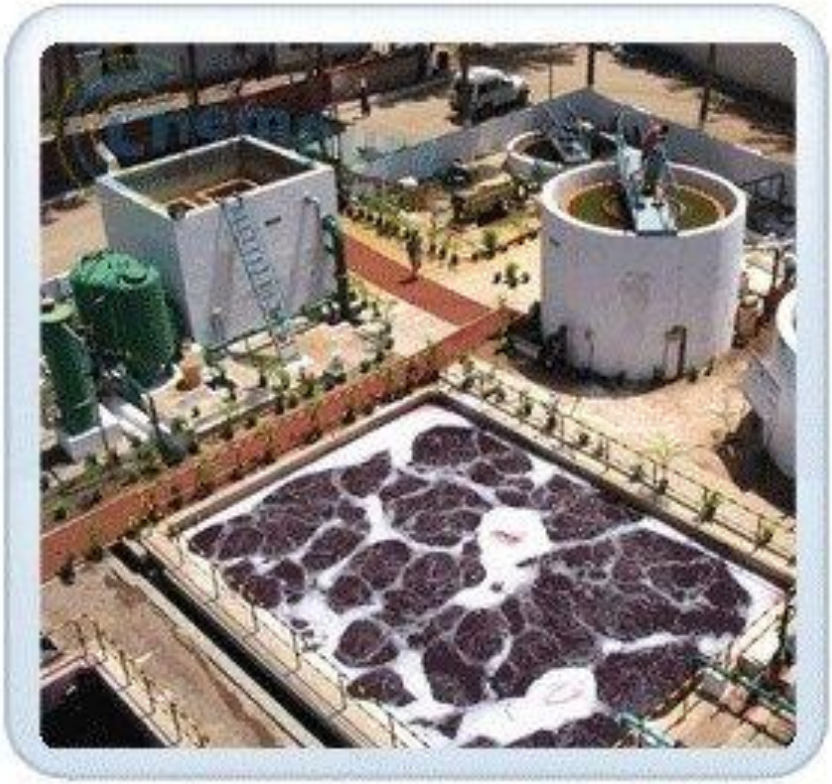
Where Does Nitrogen End Up In A Nitrifying Plant ?

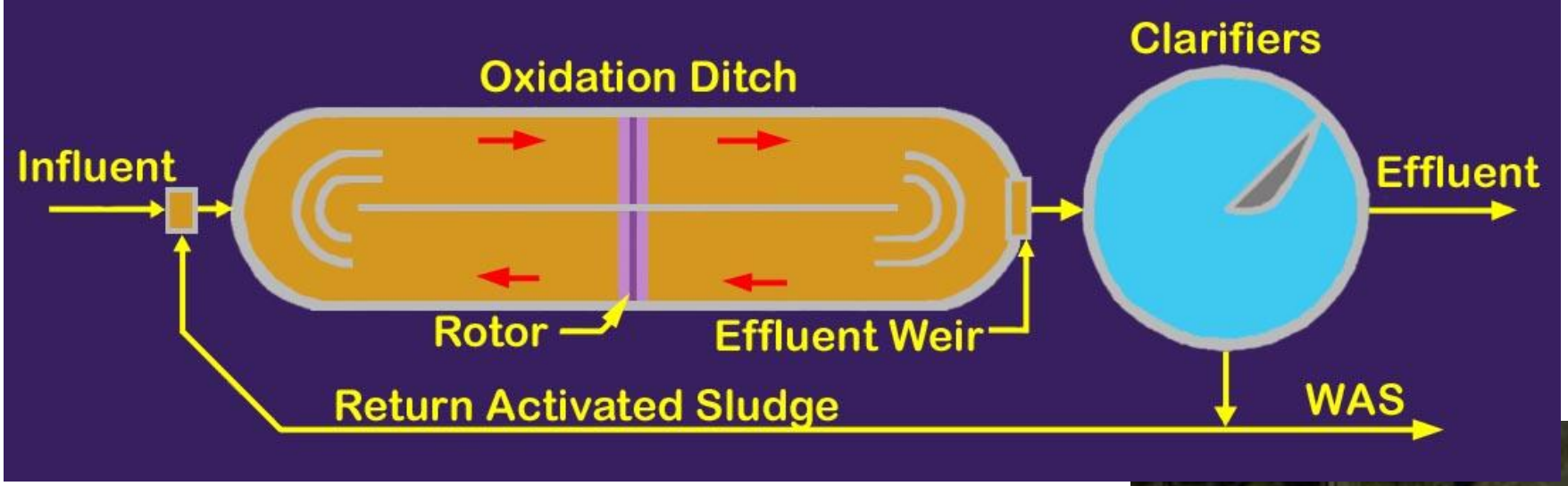
- **In the Sludge**
- **In the Effluent**
- **In the Atmosphere**

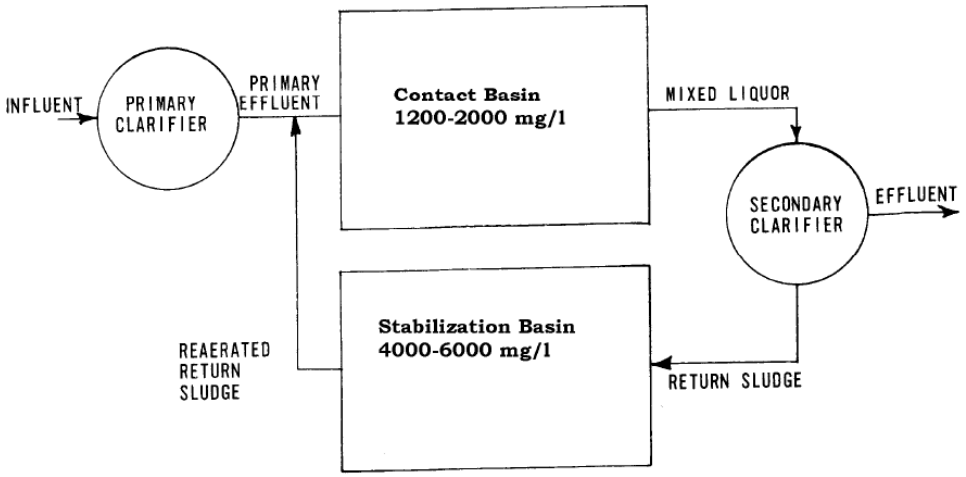
How Much Nitrogen is in the Sludge ?

Primary Sludge	**-**	**About 2.5% of Total Solids is Nitrogen**
Secondary Sludge	**-**	**8 - 12% of Total Solids is Nitrogen on VSS basis**

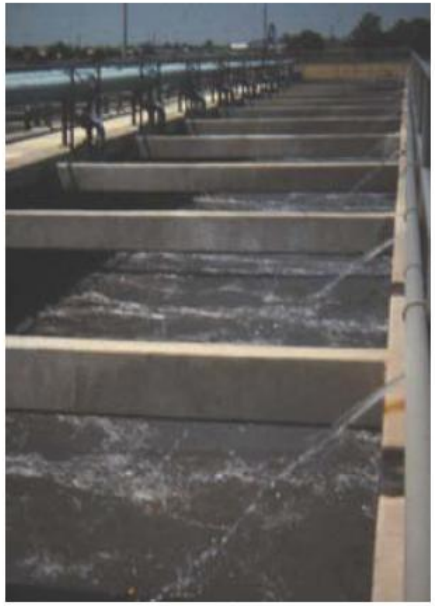
CONVENTIONAL EXTENDED AERATION




Clarifiers
Oxidation Ditch
Influent
Effluent
Rotor
Effluent Weir
Return Activated Sludge
WAS



Contact Stabilization



Contact Basin solids on the left and Stabilization Basin solids on the right.