

# Fundamentals of Wastewater Treatment

Presented by:  
The Virginia Department of Environmental Quality (DEQ)

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# Discussion Topics

- Overview of DEQ Wastewater Permitting Programs
- Basics of Wastewater Treatment

# Regulatory Background

## ◆ Clean Water Act (1972)

- Established the National Pollutant Discharge Elimination System (NPDES)
- Every point source discharger of wastewater into the environment must have a permit

## ◆ Virginia Pollutant Discharge Elimination System (VPDES)

- 9VAC25-31-10 et. seq.
- Parallels NPDES regulations from federal government

## ◆ Sewage and Collection Treatment Regulations (SCAT)

- 9VAC25-790-10 et. seq.
- Applies to the operation, construction, or modification of sewerage systems or treatment works

# DEQ Wastewater Permitting

- ◆ Virginia Pollution Abatement (VPA)
- ◆ Water Reclamation and Reuse
- ◆ VPDES

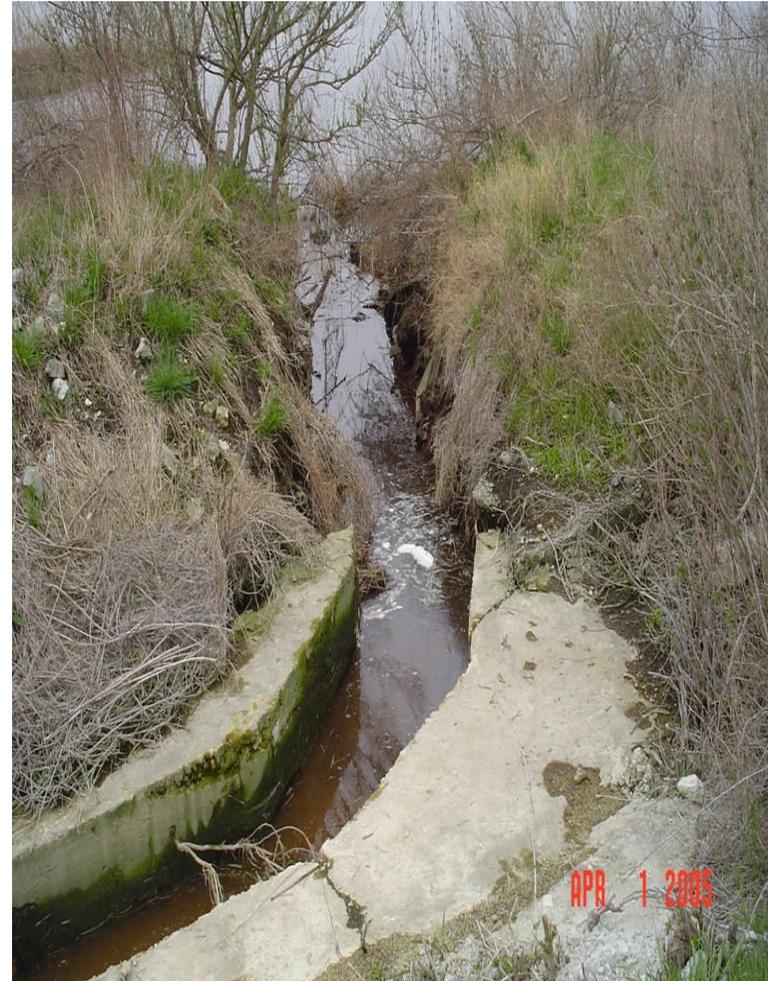
# VPDES Framework

- ◆ All point sources
- ◆ Discharging pollutants
- ◆ Into waters of the State



Must obtain a  
VPDES permit

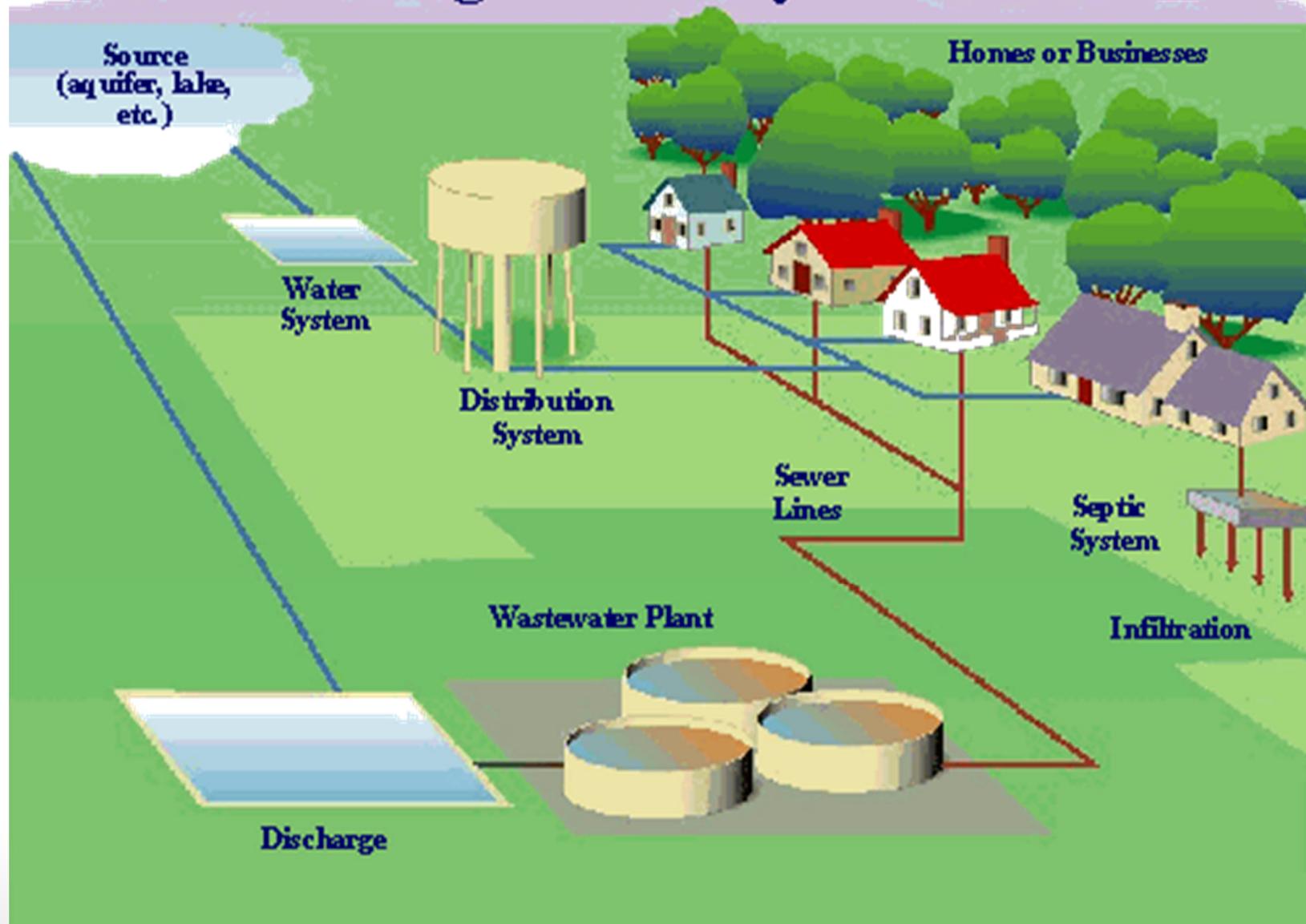
# Point Source Examples



# What is Wastewater?

- 💧 Wastewater is “used” water from homes and businesses
- 💧 Everyday sources include:
  - Flushing toilets
  - Showers / Sinks
  - Washing machines
  - Dishwashers
- 💧 Wastewater leaves the home or business travelling through a network of underground pipes known as the sanitary sewer system (aka collection system)

# The Drinking Water Cycle



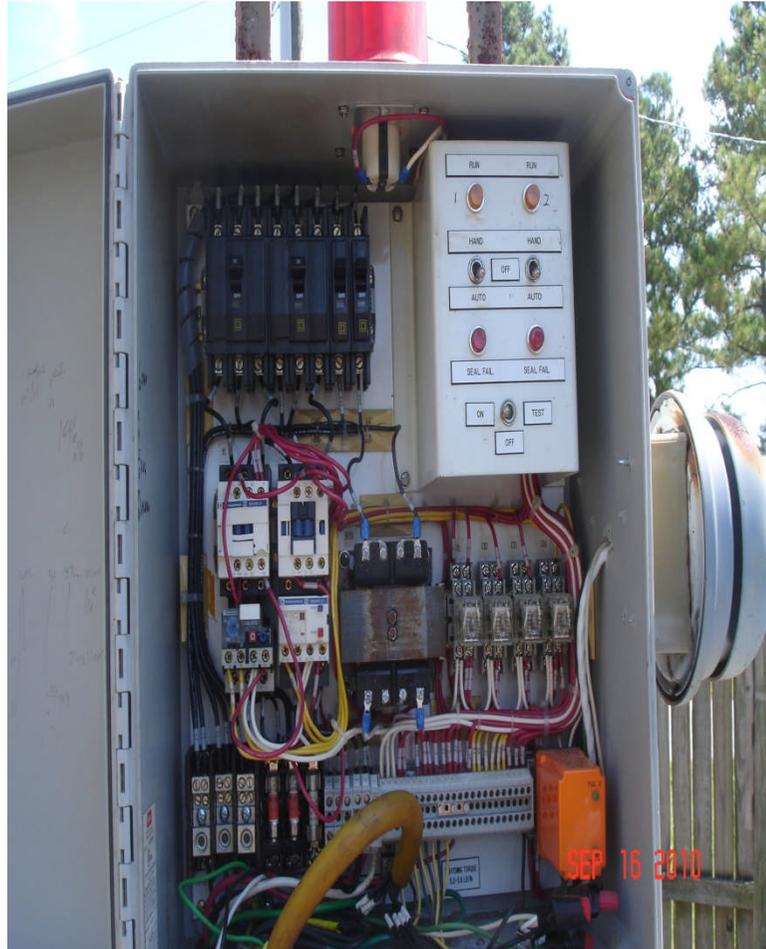
# Pump Station

- 💧 Water within the sanitary sewer system flows towards the wastewater plant primarily by gravity
- 💧 Pump stations are used in low lying areas to lift the water so it may then flow by gravity to the treatment plant

# Pump Stations



# Pump Stations



# Wastewater Treatment Objectives

- ◆ To manage water discharged from homes, businesses, and industries to produce clean water that is safe to return to the environment
- ◆ To protect public health
- ◆ To protect aquatic environment

# Wastewater Treatment

💧 Preliminary

💧 Primary

💧 Secondary

💧 Tertiary

💧 Disinfection

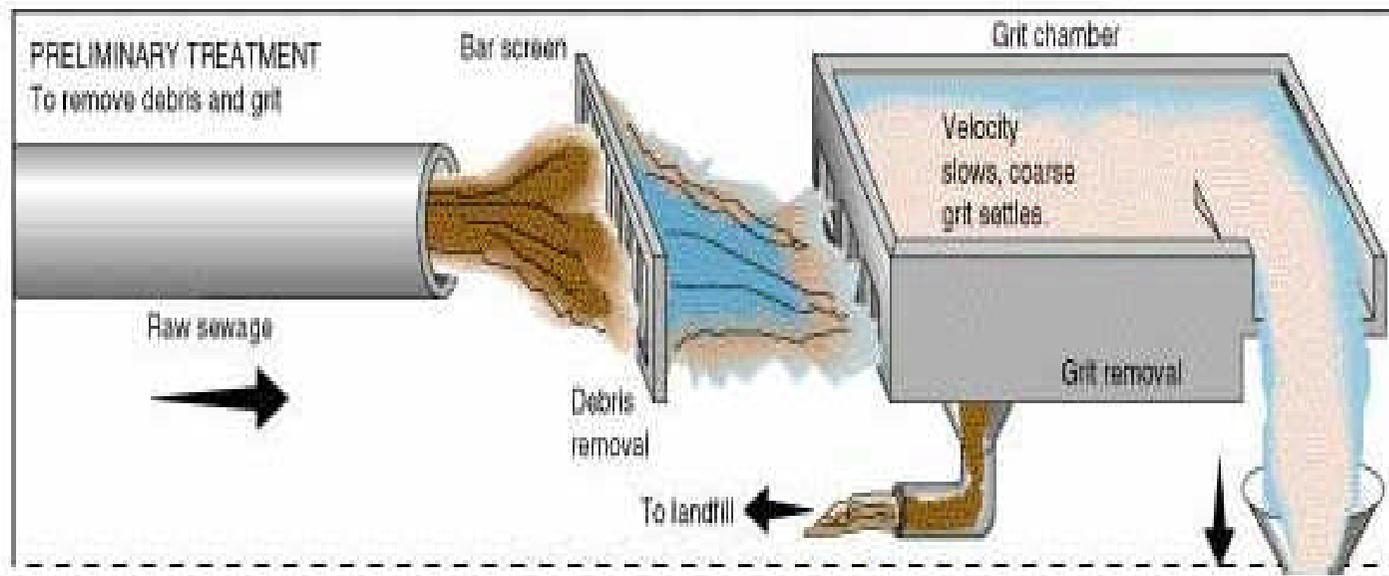
# Preliminary Treatment

- 💧 First form of treatment received
  
- 💧 Physical process
  
- 💧 Screening
  - Removes large objects that have entered the sanitary sewer system such as bottles, rags, pieces of wood
  - Protects pumps and equipment from damage
  
- 💧 Grit Removal
  - Removes heavy inorganic solids such sand, gravel, coffee grounds, etc
  - Provides protection from excessive wear in plant

# Bar Screens



# Preliminary Treatment



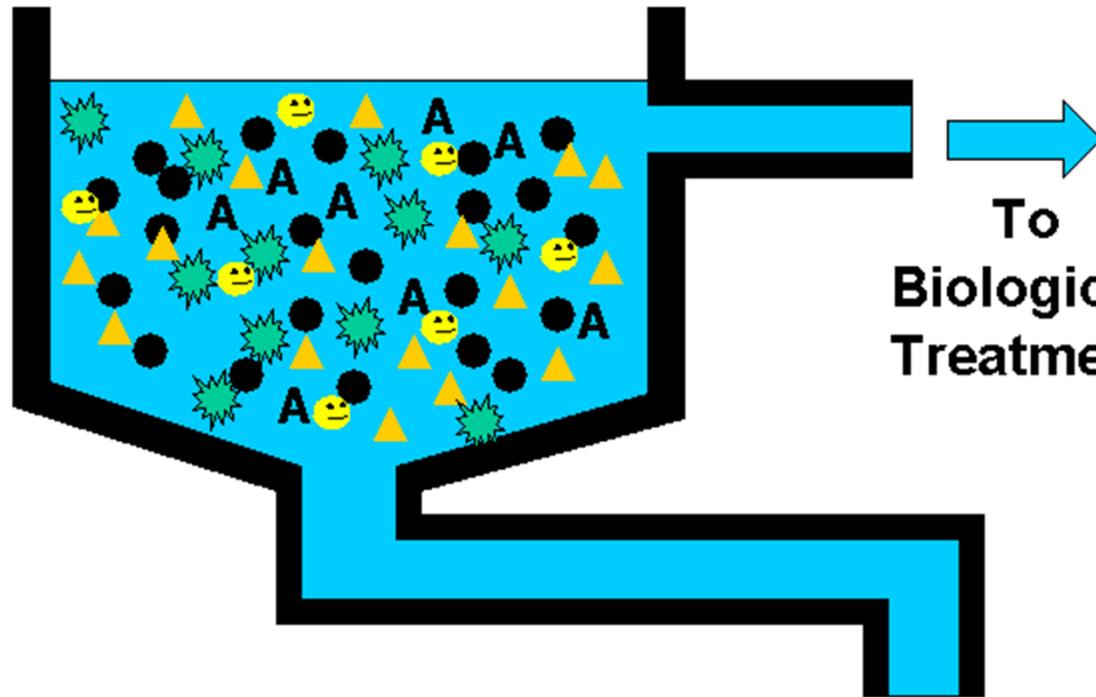
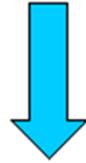
# Primary Treatment

- 💧 Second step in wastewater treatment
- 💧 Also referred to sedimentation
- 💧 Physical process
  - Removal of solids and floating materials
  - Heavy particles sink
  - Floating materials such as oils and greases rise to the surface and are skimmed off
- 💧 Solids are deemed sludge
- 💧 Comparable to the treatment provided by a septic system

# Primary Treatment



Untreated  
Wastewater



To  
Biological  
Treatment

To Sludge Treatment

# Secondary Treatment

- Biological process
- Air is pumped in to the wastewater to support microorganisms (aka “bugs”) that consume pollutants
- Another round of settling (clarification) typically follows this process
- Minimum level of treatment required by Clean Water Act

# Secondary Treatment



# Secondary Treatment



# Secondary Clarification



# Tertiary Treatment

- 💧 Also known as advanced treatment
- 💧 Process used to improve the quality of water even more
- 💧 Uses additional treatment to remove suspended solids and nutrients
- 💧 Not required at all treatment plants

# Advanced Filtration



# Disinfection

- ◆ Reduces the microorganism population, including pathogens, to a level that is safe to release to the receiving stream
- ◆ Chlorination
- ◆ Ultraviolet Light

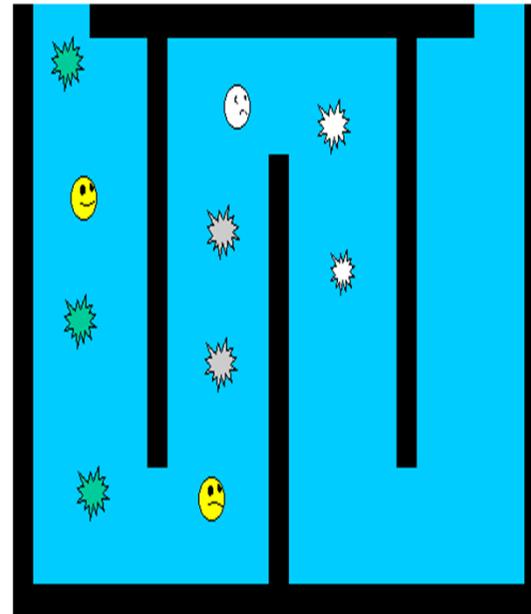
# Chlorination



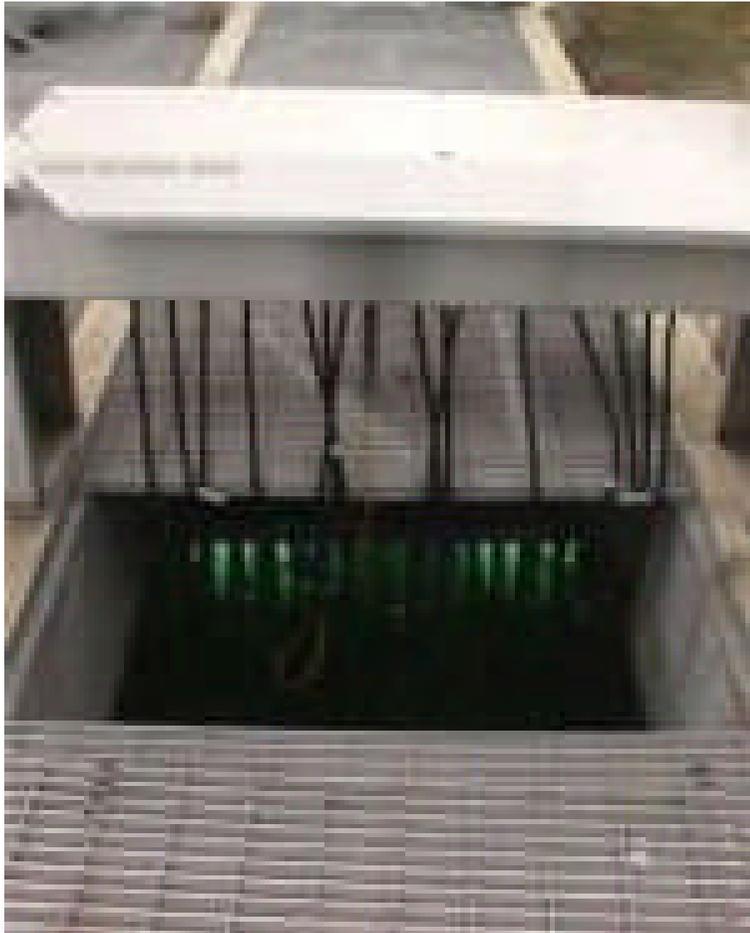
From Final  
Settling



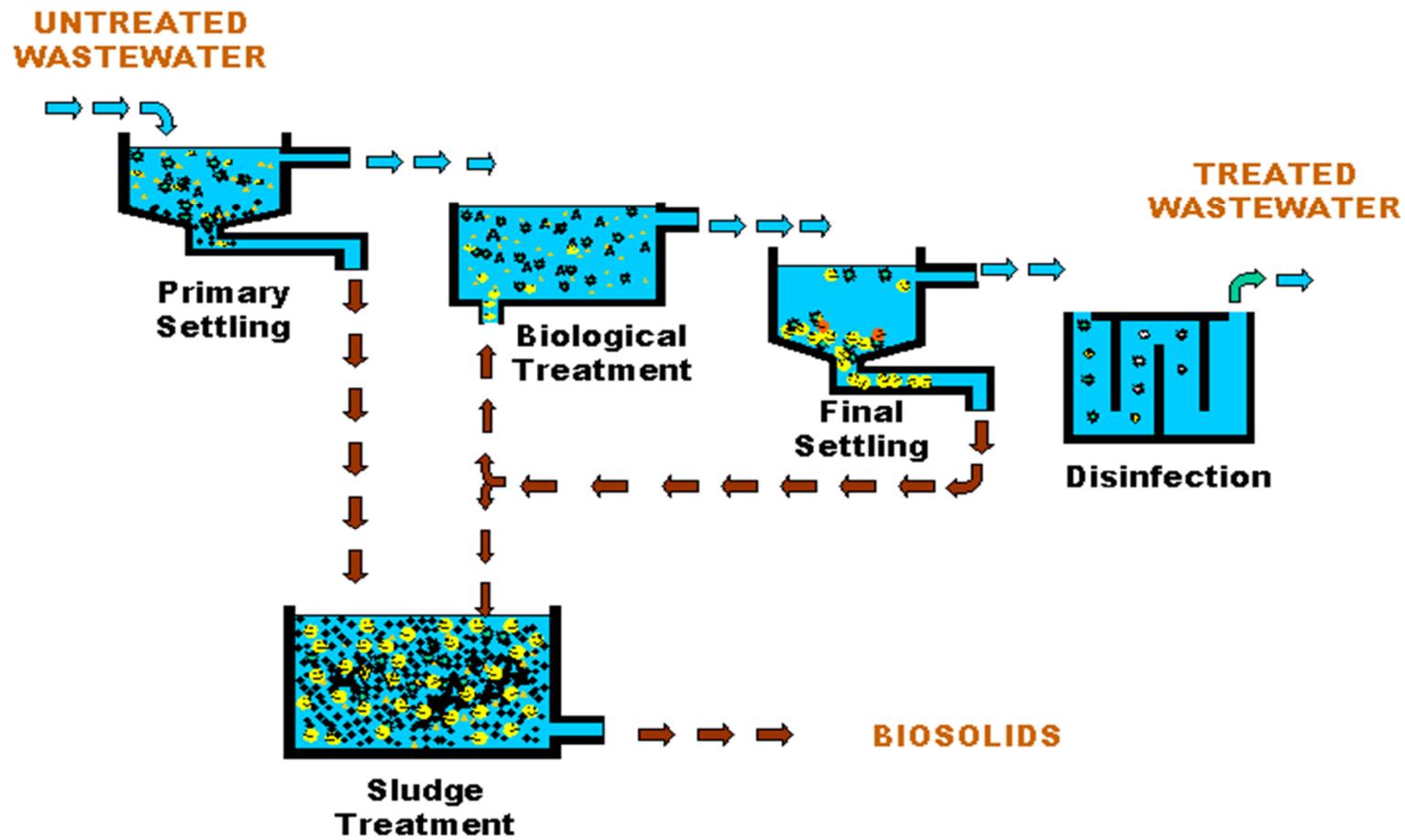
Treated Water  
to River



# Ultraviolet Light



# The Final Flow



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