

Wastewater Design

CE 40340

Spring, 2009



Outline

- Introductions
- Syllabus
- Course overview
- A “brief history of wastewater”
- Overview of wastewater treatment

Personal/Professional Background

- Civil Engineering (UBA)
- Ann Arbor wastewater treatment plant (0.5 years)
- ALN&M consulting in Ann Arbor (2.5 years)
- Montgomery Watson Harza (5 years)

Some projects...



Course Overview

- Modeling of microbial growth
 - Thermodynamics
 - Kinetics
- Wastewater characterization
- Biological processes
 - Suspended growth
 - Attached growth
- Physical/chemical processes
 - Settling
 - Aeration
 - Disinfection
- Process Modeling

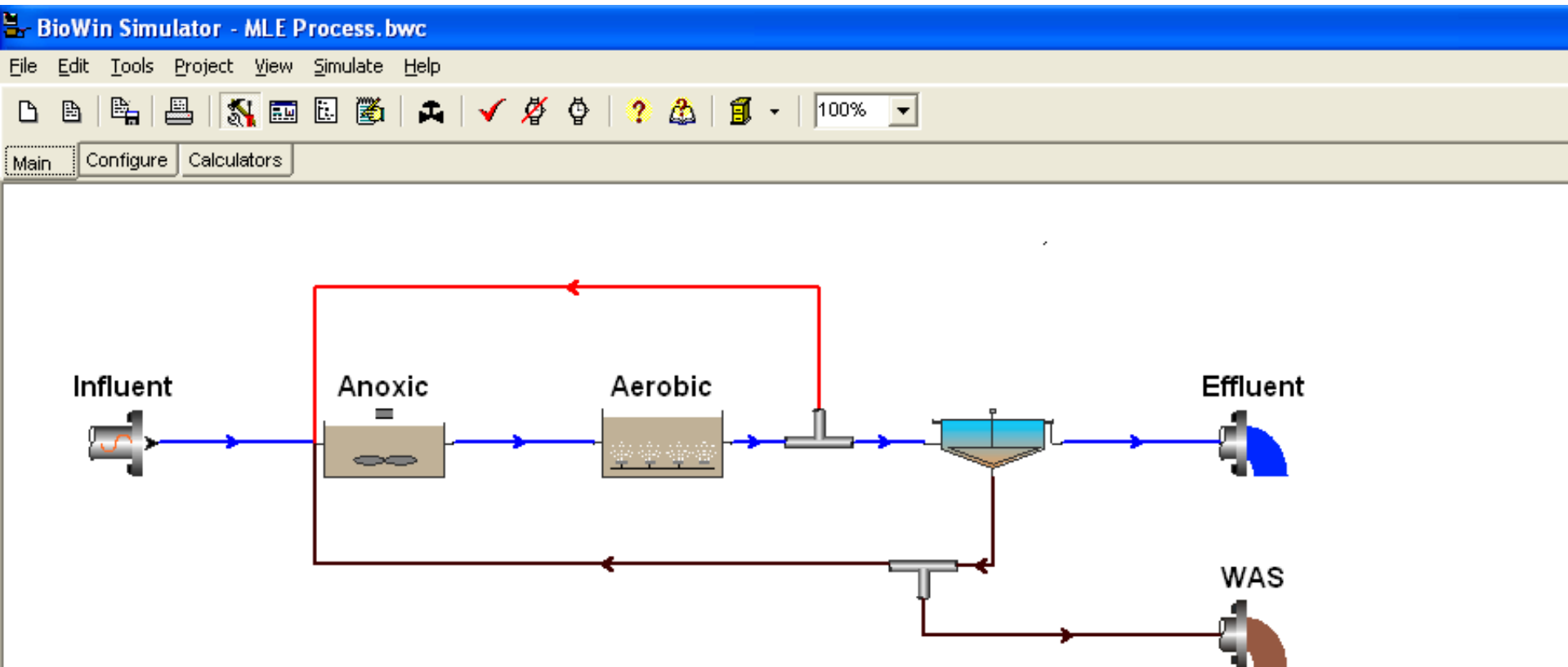
Potential Design Topics

- Metcalf & Eddy Design Competition
- Mishawaka Wastewater Treatment Plant
 - Modeling
- South Bend Treatment Plant
 - Waste heat to digesters
- Metcalf & Eddy Design Competition
 - Nutrient removal
 - Carbon footprint

Guest speakers

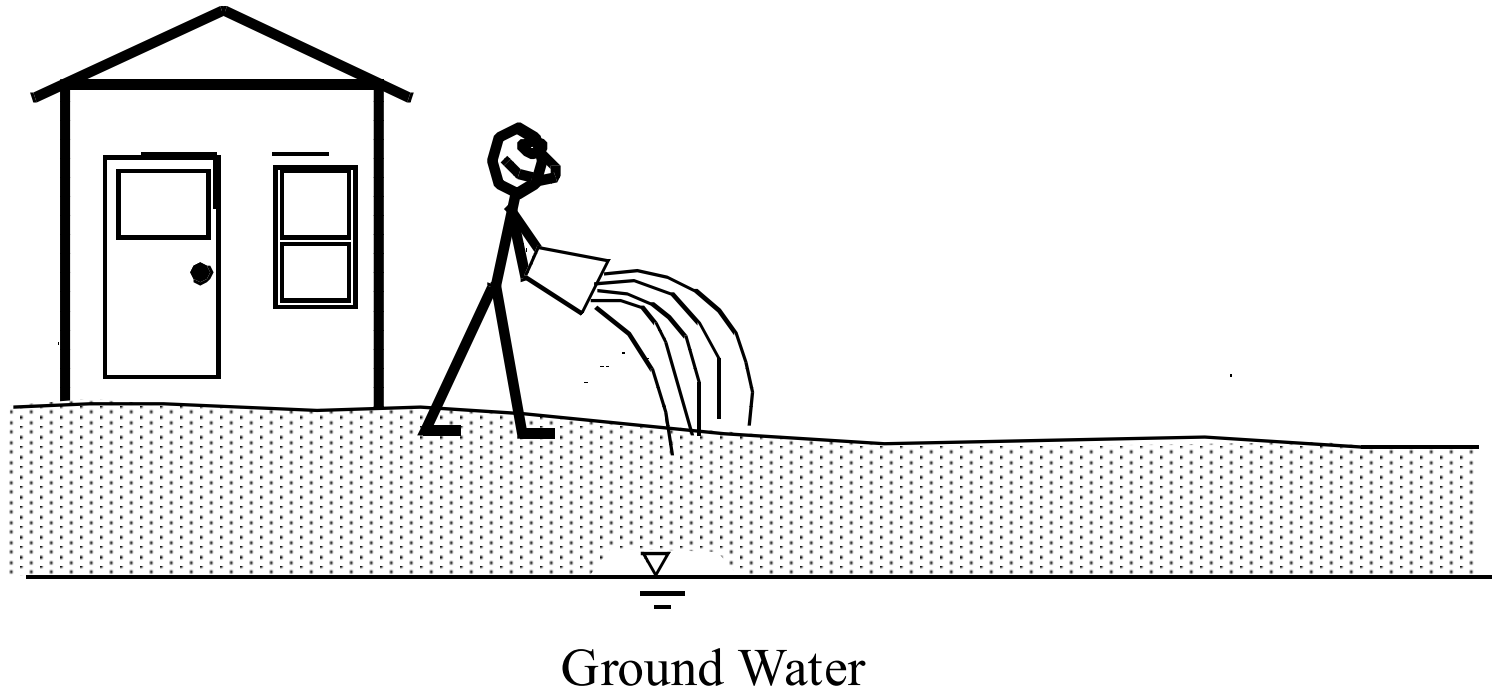
- Karl Kopec (Mishawaka WWTP)
- Joshua Boltz, Ph.D. (CH2MHill)
- Art Umble, Ph.D. (Greeley and Hansen)
- Joe Cantwell (SAIC - Wisconsin Focus on Energy)
- Prakasam Tata, Ph.D. (formerly MWRDGC)
- Stephen Fralish (Wightman Petrie)

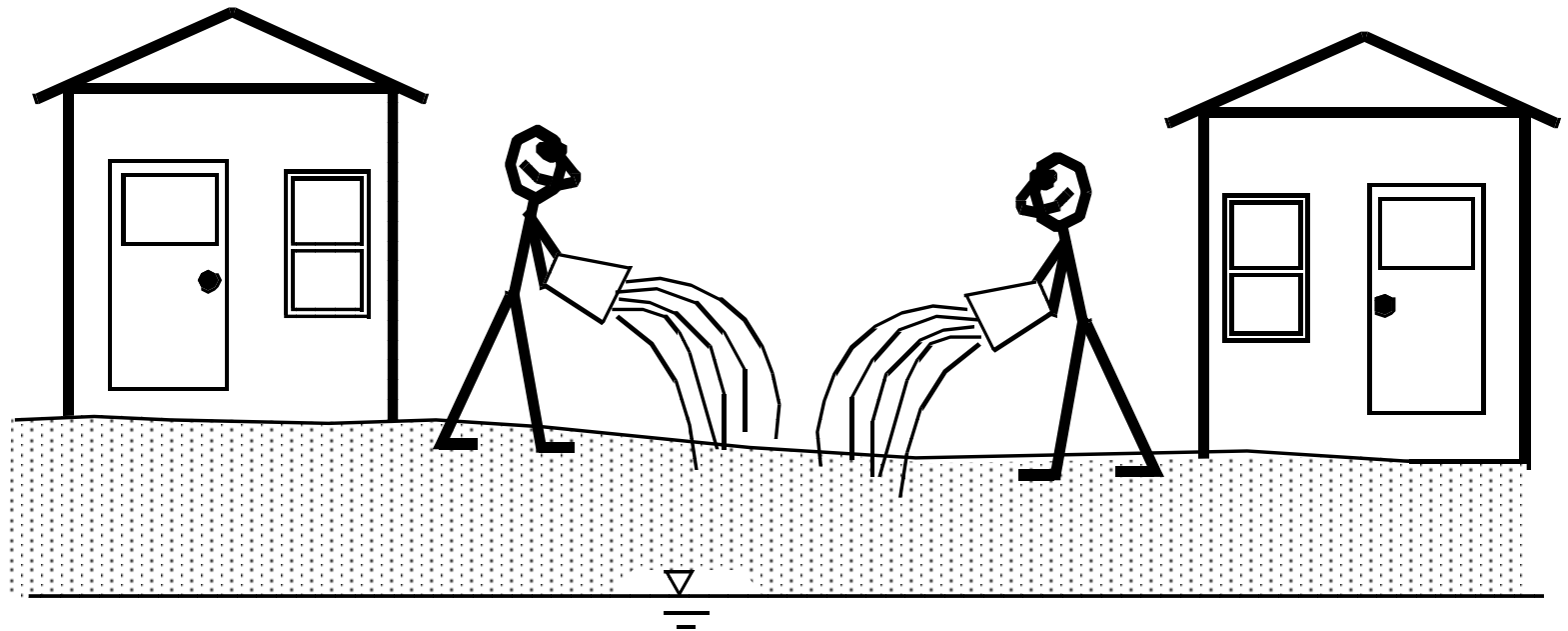
Modeling - BioWin



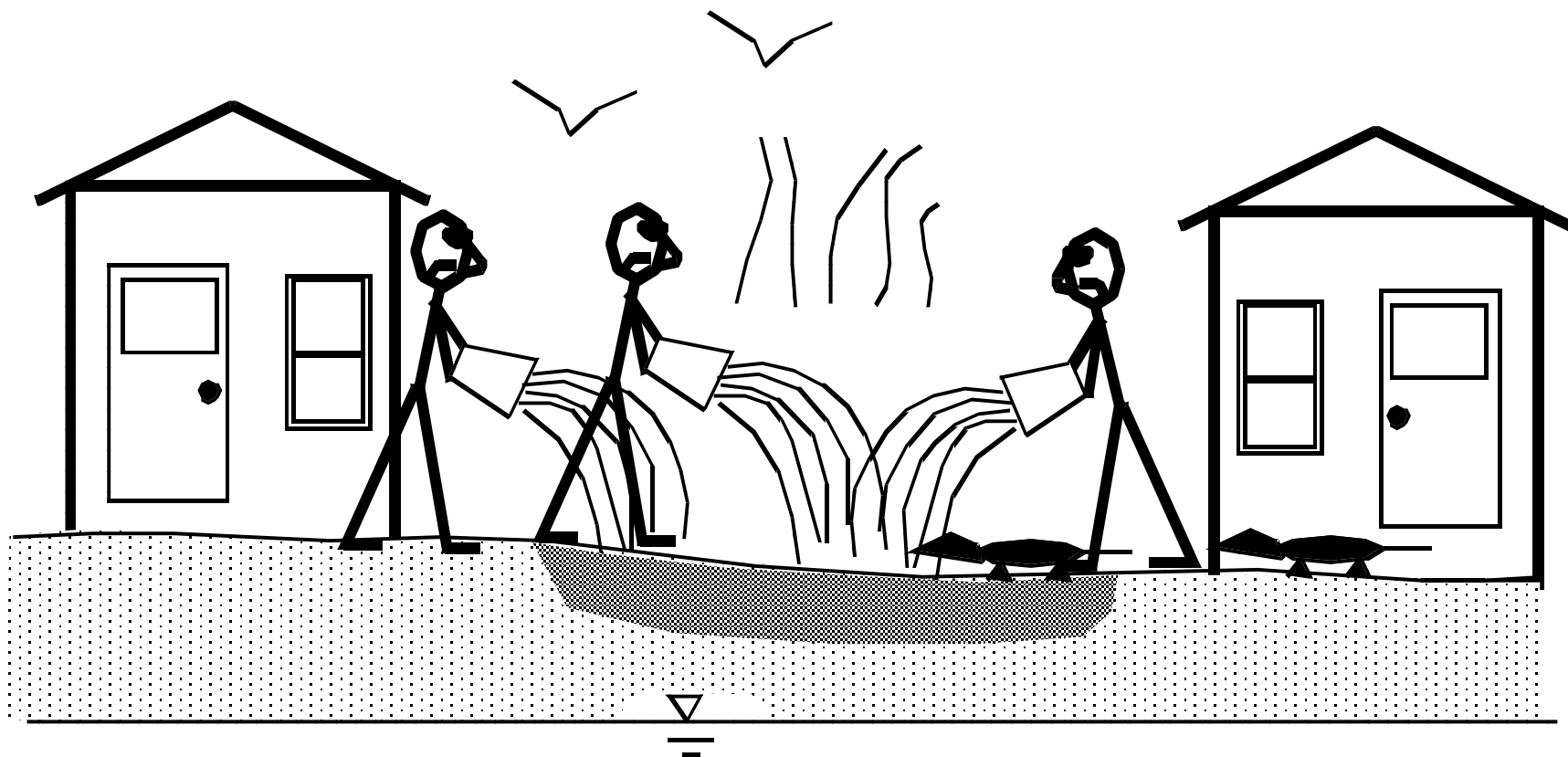
A Brief History of Wastewater Treatment

(by Prof. Ketchum)

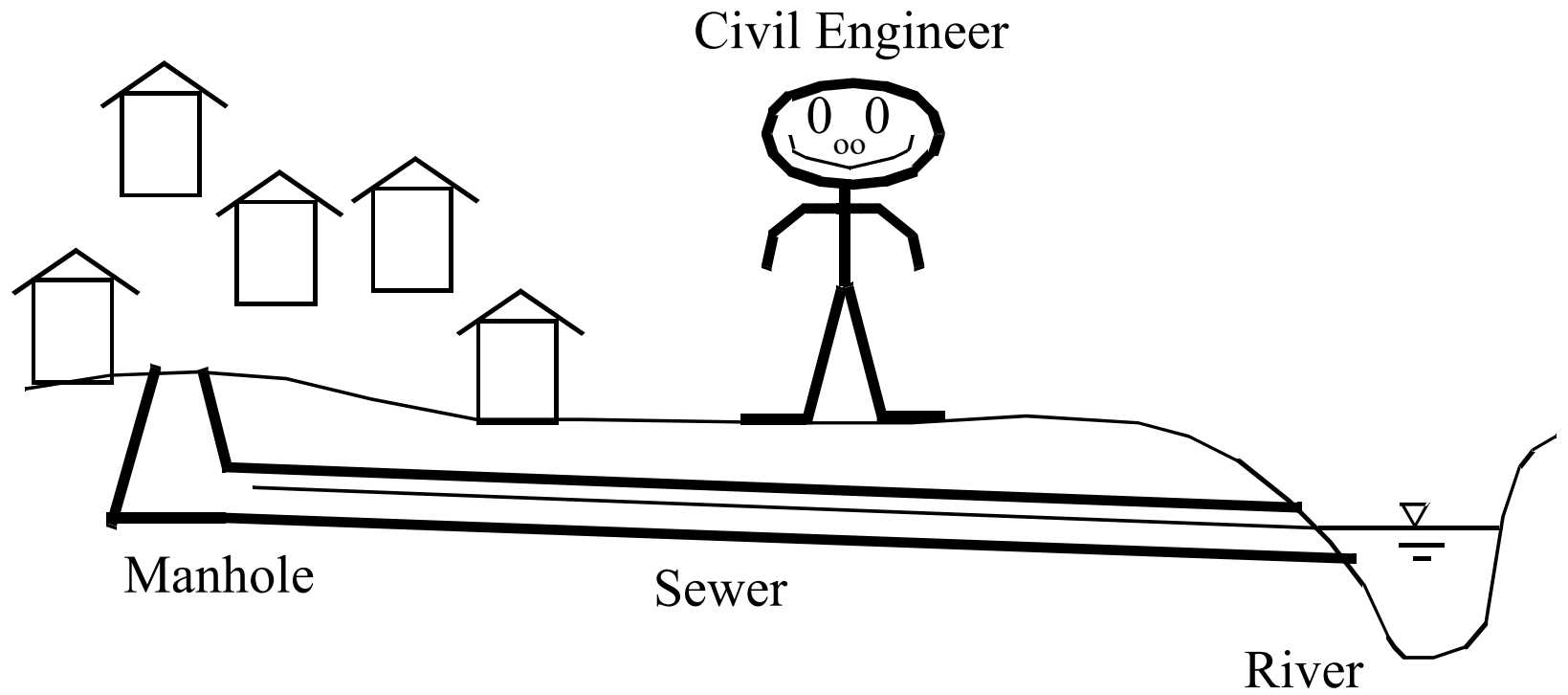




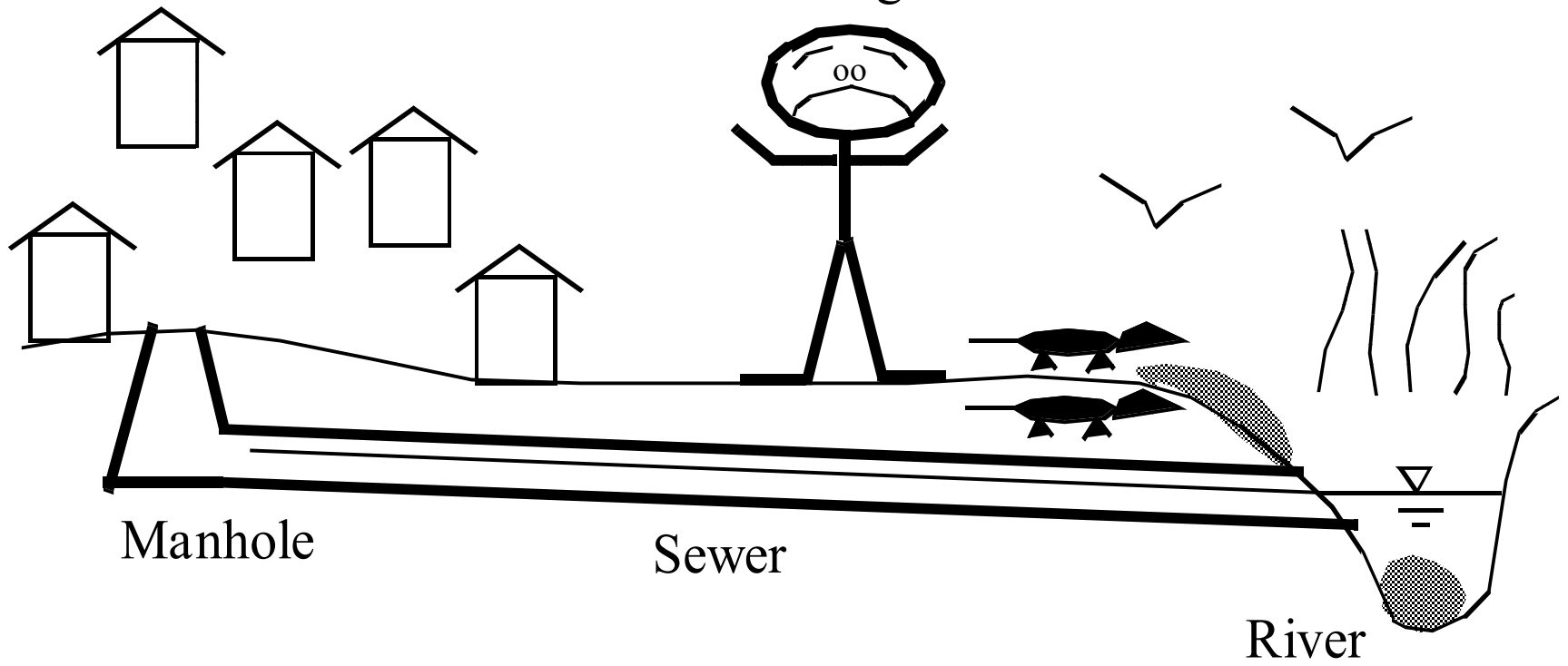
Ground Water



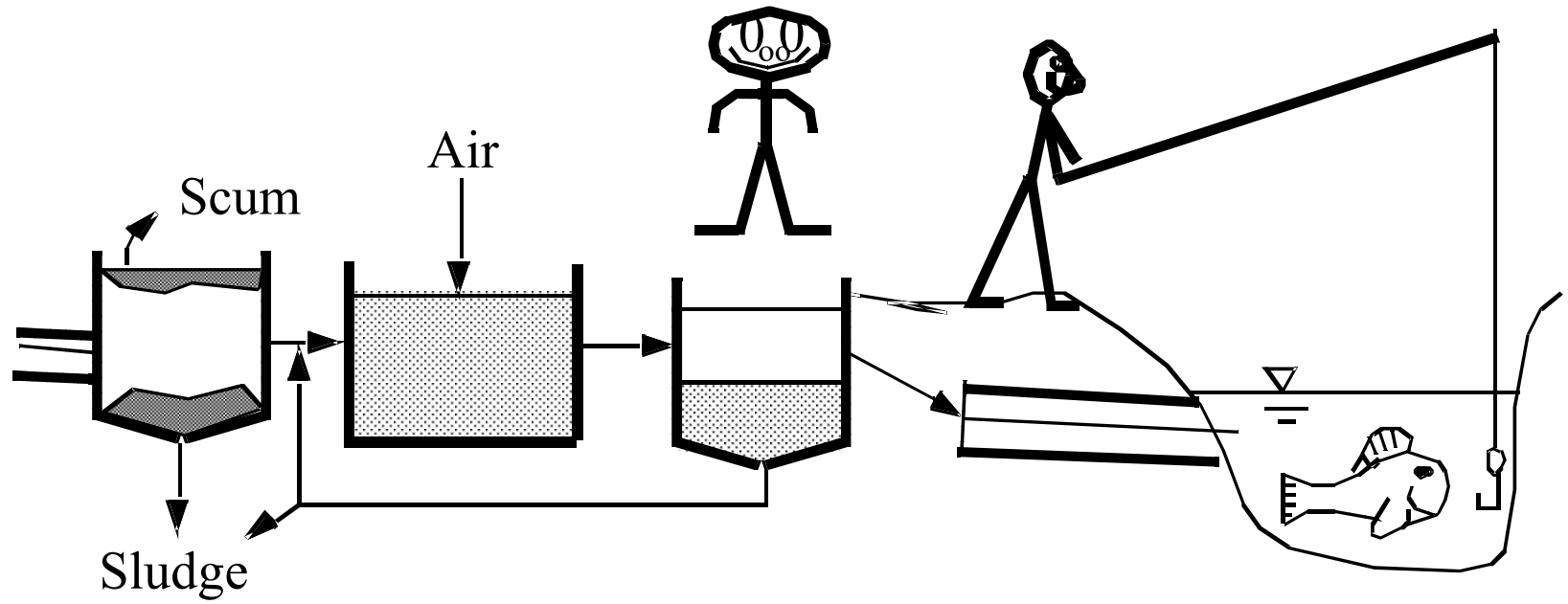
Ground Water



Civil Engineer

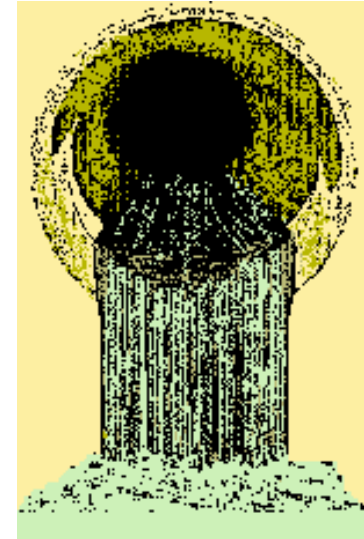


Environmental Engineer



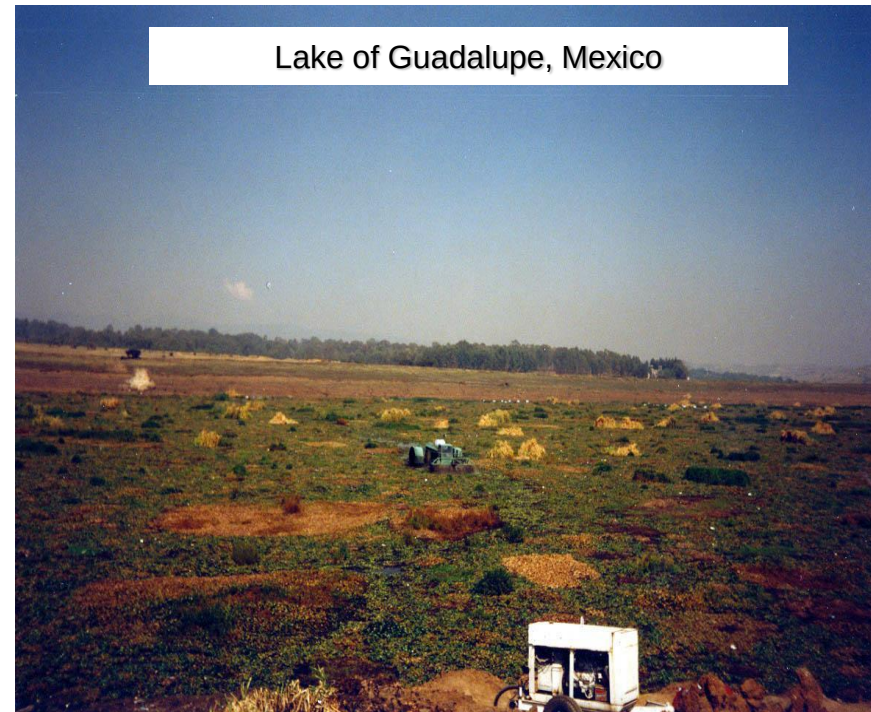
What is Wastewater?

- Used potable water
- Domestic sources
- Commercial and industrial sources
- Stormwater, groundwater
- May contain
 - Pathogens
 - Degradable/non-degradable organics
 - Nutrients (P, N, C)
 - Inorganic contaminants (heavy metals, NO_3^-)
 - Solids



Impacts on Environment

- Pathogens (drinking water, bathing)
- Oxygen depletion
- Turbidity, silt buildup in receiving waters
- Eutrophication
- Toxicity to ecosystems, humans



Wastewater Treatment Objectives

- 1900 to early 1970s
 - Suspended and floatable material
 - Biodegradable organics
 - Pathogens
- 1970s to 1980
 - Aesthetic, environmental concerns
 - Nutrient removal
 - Widespread treatment of wastewater
- Since 1980
 - Toxic compounds

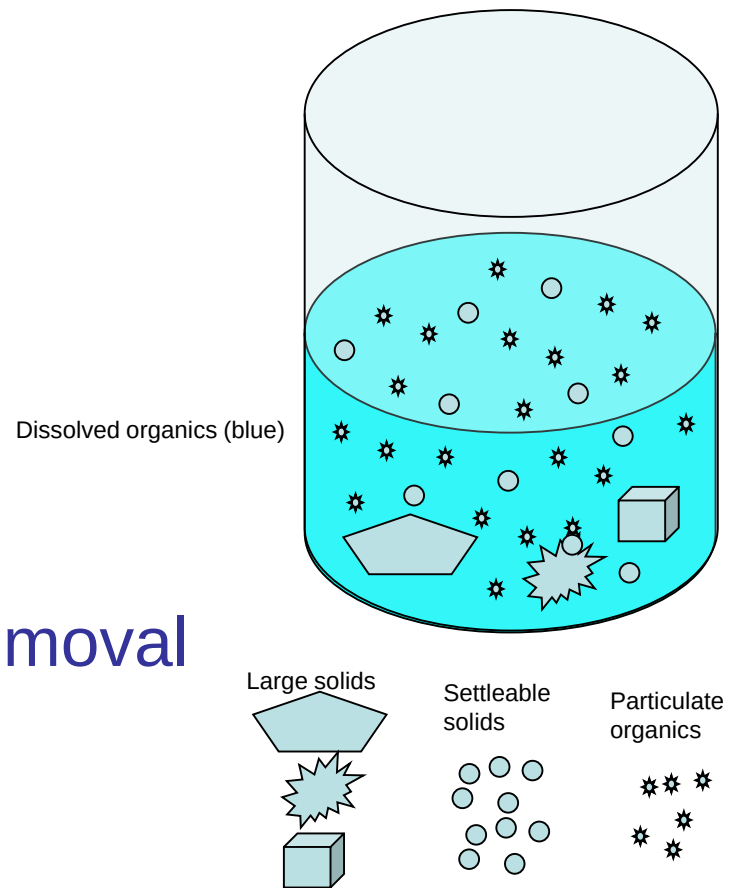


“Hot” Issues

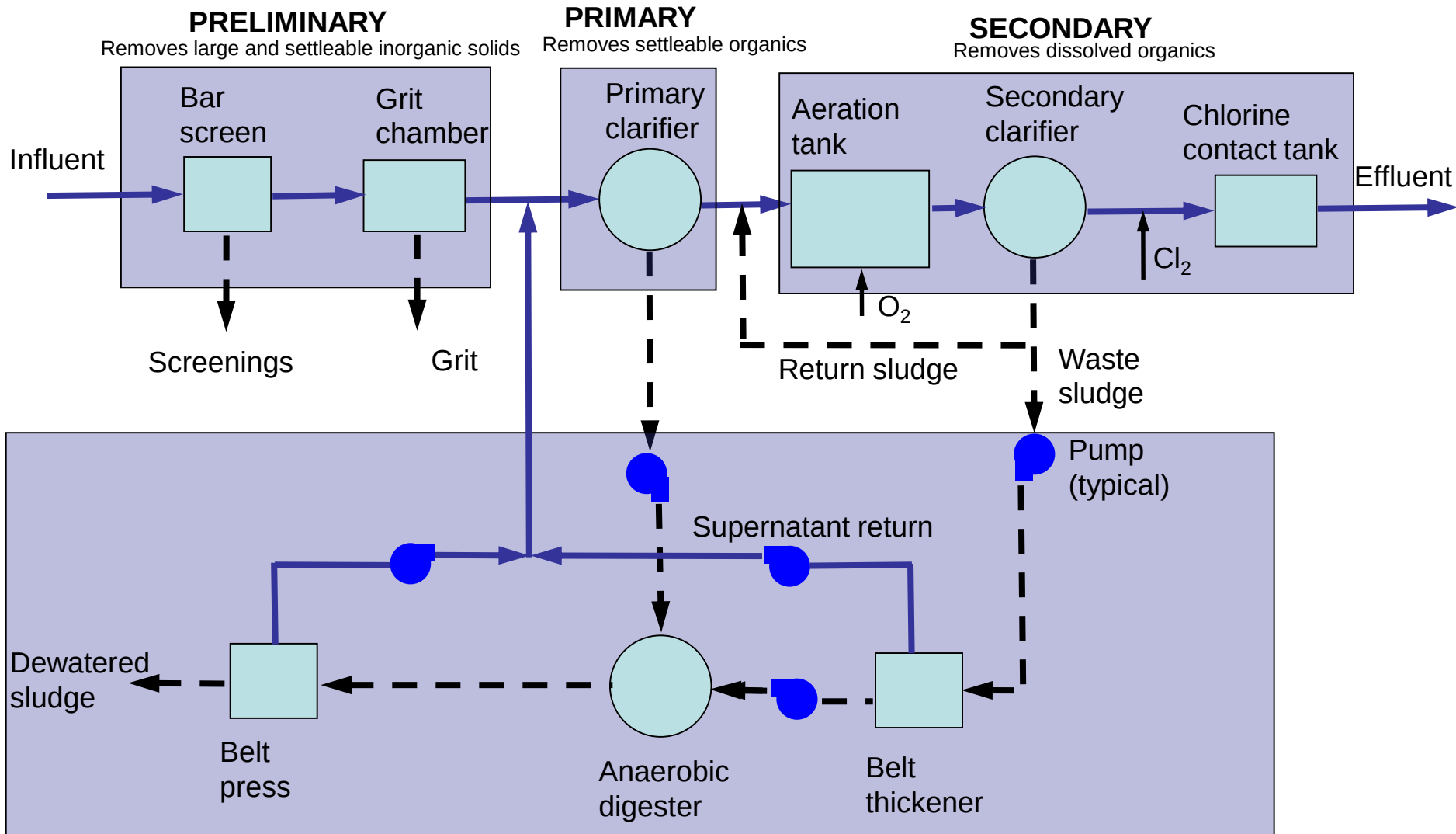
- Wastewater as an energy sink/source
- Wastewater as a water source (reuse)
- Nutrient removal
- Priority pollutants, heavy metals
- Unregulated contaminants (endocrine-disrupting compounds, PPCPs)
- Combined sewer overflow

Treatment Processes

- Large solids
→ strainer
- Settleable solids
→ short settling
- Particulate organics
→ longer settling
- Dissolved organics
→ biodegradation
- Dissolved nutrients
→ chemical, biological removal



Wastewater Treatment Process



Screens



Grit Removal



Primary Settling



Activated Sludge



Secondary Settling



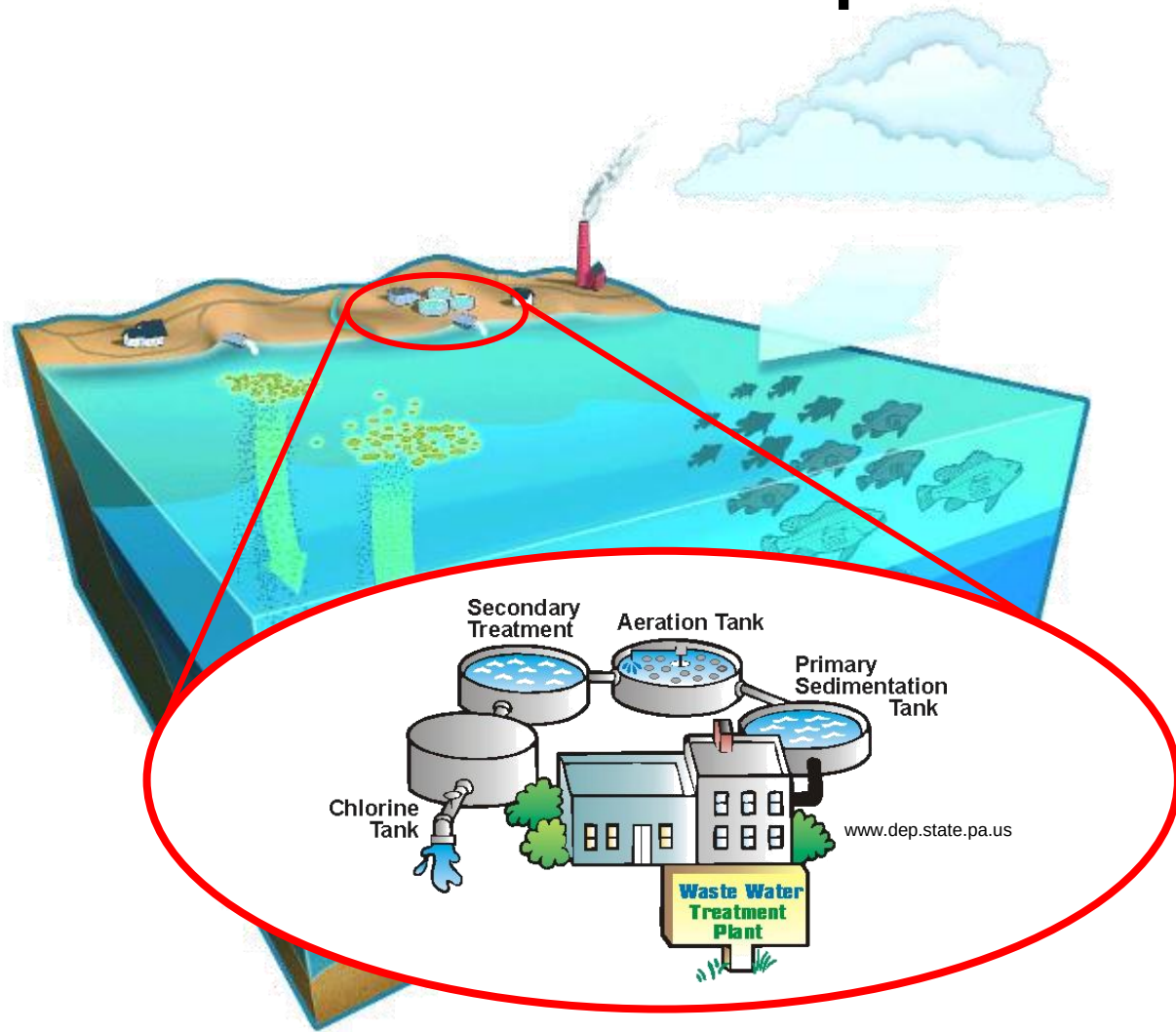
Solids Digestion



Treatment Levels

- Preliminary – large objects, grit
- Primary – settleable solids
- Secondary – biodegradable organics
- Tertiary – nutrients, suspended solids
- Advanced – additional dissolved and suspended materials - reuse applications

Nutrients cause eutrophication

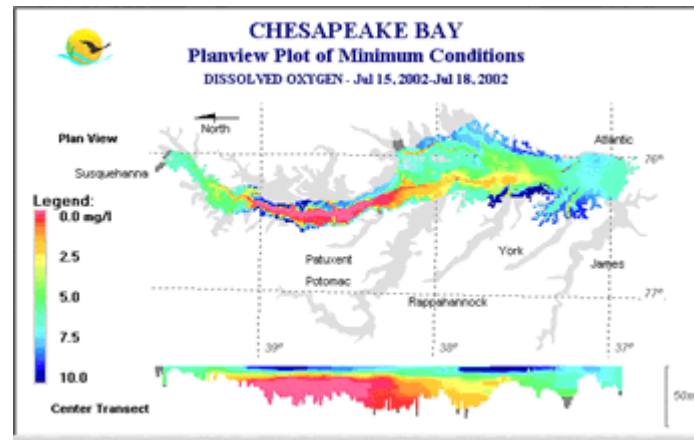


Examples of nitrogen-induced eutrophication

Long Island Sound



Chesapeake Bay

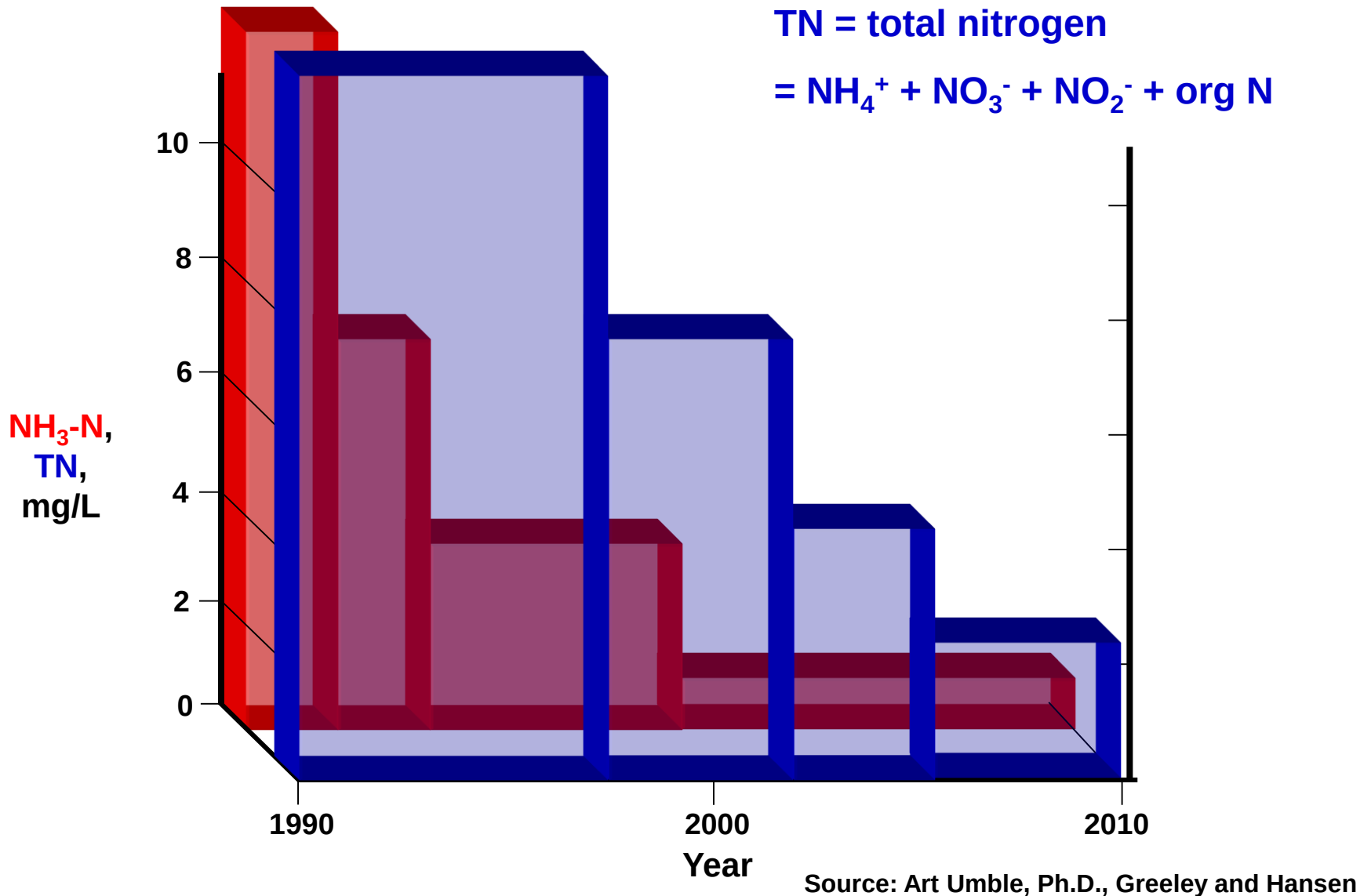


Gulf of Mexico

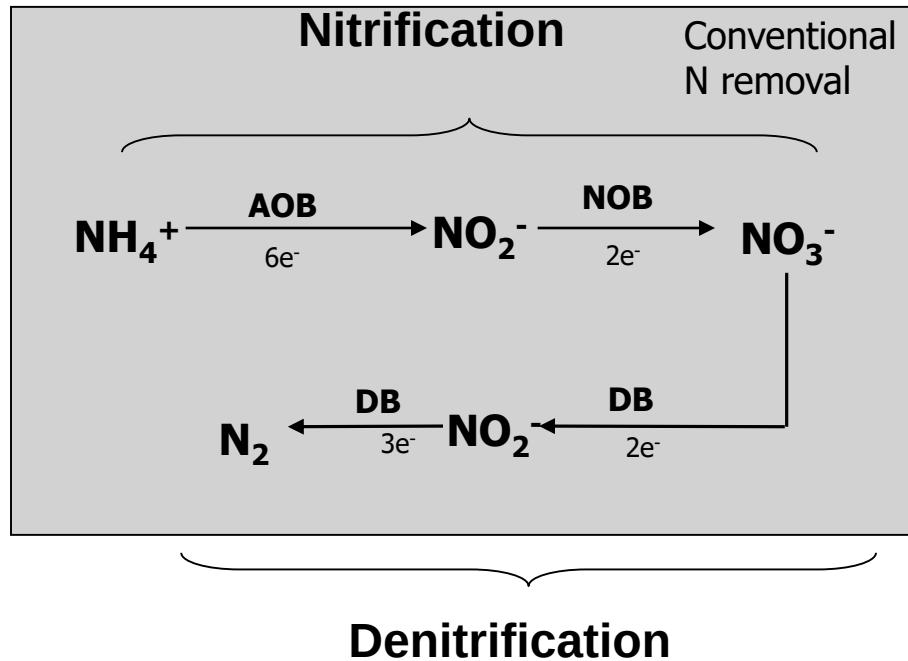


<http://www.ncat.org/nutrients/hypoxia/hypoxia.html>

Nitrogen Standards for Wastewater



Biological Nitrogen Removal



Nitrogen Removal in Activated Sludge

