Courtesy of: www.hkpr.on.ca

Courtesy of: www.fotosearch.com

Water Reclamation

CE 421: Environmental Biotechnology

Jen Morud

Courtesy of: www.kelownagolfski.com/Sunset%20Ranch%20Golf%...

Courtesy of: www.industrialcouncil.com

Introduction

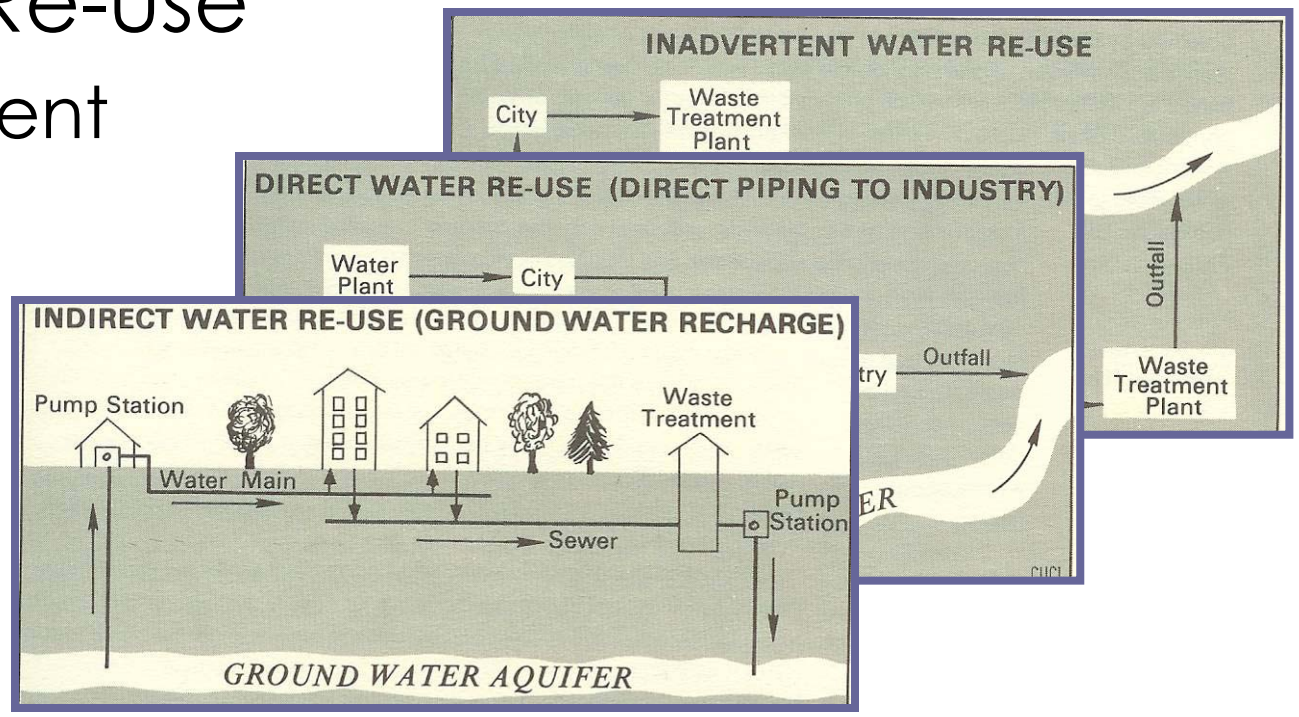
- Demand
  - Water Consumption
    - 408 billion gallons per day
  - Water Availability
    - Ice caps, glaciers, oceans = 99%
    - Human consumption = 1%
  - Sustainable Technologies

Courtesy of: www.turbulence.ocean.fsu.edu

Courtesy of: www.mfe.govt.nz

Definitions

- Reclamation
  - Upgrading of water to make it usable again
- Types of Re-use
  - Inadvertent
  - Direct
  - Indirect



Application

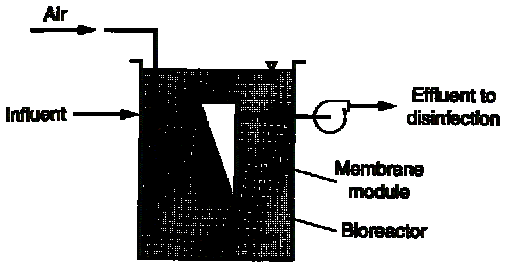
- Agricultural Irrigation
- Landscape Irrigation
- Thermalelectric Power
- Industrial Activities
- Groundwater Recharge
- Recreational/Environmental Uses
- Non-potable Urban Uses
- Potable Use

Health Aspects

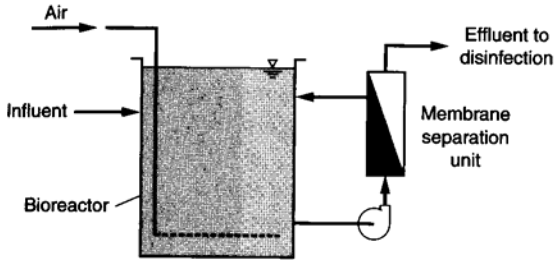
- Pathogens
  - Viruses
    - *Rotavirus, Norwalk Virus*
  - Bacteria
    - *Salmonella, Shigella, E.Coli, Campylobacter*
  - Protozoans
    - *Giardia Lamblia, Cryptosporidium*
  - Helminths
    - *Schistosomiasis, Ascariasis*

Treatment Technologies: MBR

- Membrane Biological Reactors (MBR)



Submerged Bioreactor



External Bioreactor

  - Retrofit existing plant
  - Higher effluent quality

Treatment Technologies: Filtration

- Membrane Processes
  - Microfiltration (MF)
  - Ultrafiltration (UF)
  - Nanofiltration (NF)
  - Reverse Osmosis (RO)

Constituent	Membrane technology MF	UF	NF	RO	Comments
Biodegradable organics		✔	✔	✔	
Hardness			✔	✔	
Heavy metals			✔	✔	
Nitrate			✔	✔	
Priority organic pollutants		✔	✔	✔	
Synthetic organic compounds			✔	✔	
TDS			✔	✔	
TSS	✔	✔			TSS removed during pretreatment for NF and RO
Bacteria	✔[b]	✔	✔	✔	Used for membrane disinfection. Removed as pretreatment for NF and RO with MF and UF
Protozoan cysts and oocysts and helminth ova	✔	✔	✔	✔	
Viruses			✔	✔	Used for membrane disinfection

[a] Specific removal rates will depend on the composition and constituent concentrations in the treated wastewater.
[b] Variable performance.

(Metcalf & Eddy, 2003)

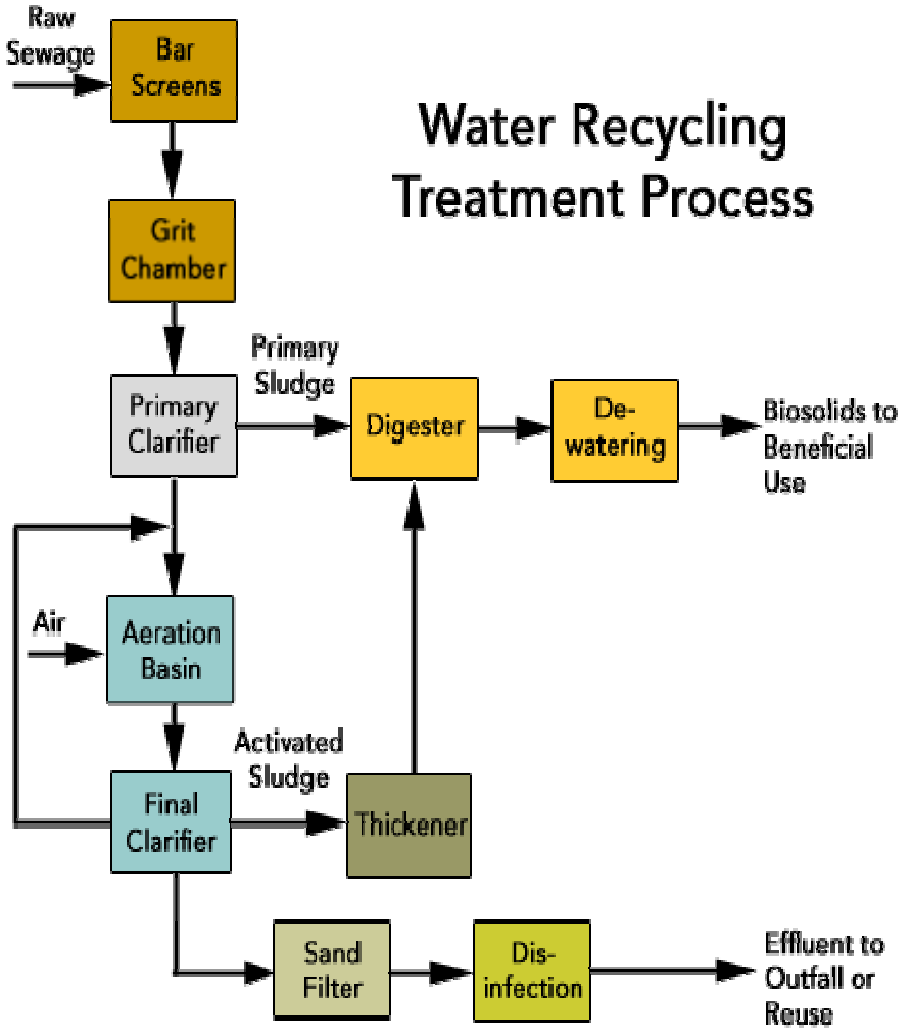
Treatment Technologies: Disinfection

- Ultraviolet Radiation (UV)
  - No residual
- Chlorination
  - Disinfection by-products
- Ozone
  - Potential for adverse effects to aquatic life

Case Studies: San Antonio, TX

- Depletion of the Edwards Aquifer
- 3 Treatment Facilities
  - Treatment similar to conventional treatment
  - Dechlorination follows chlorination
- Reclaimed water for recreational use

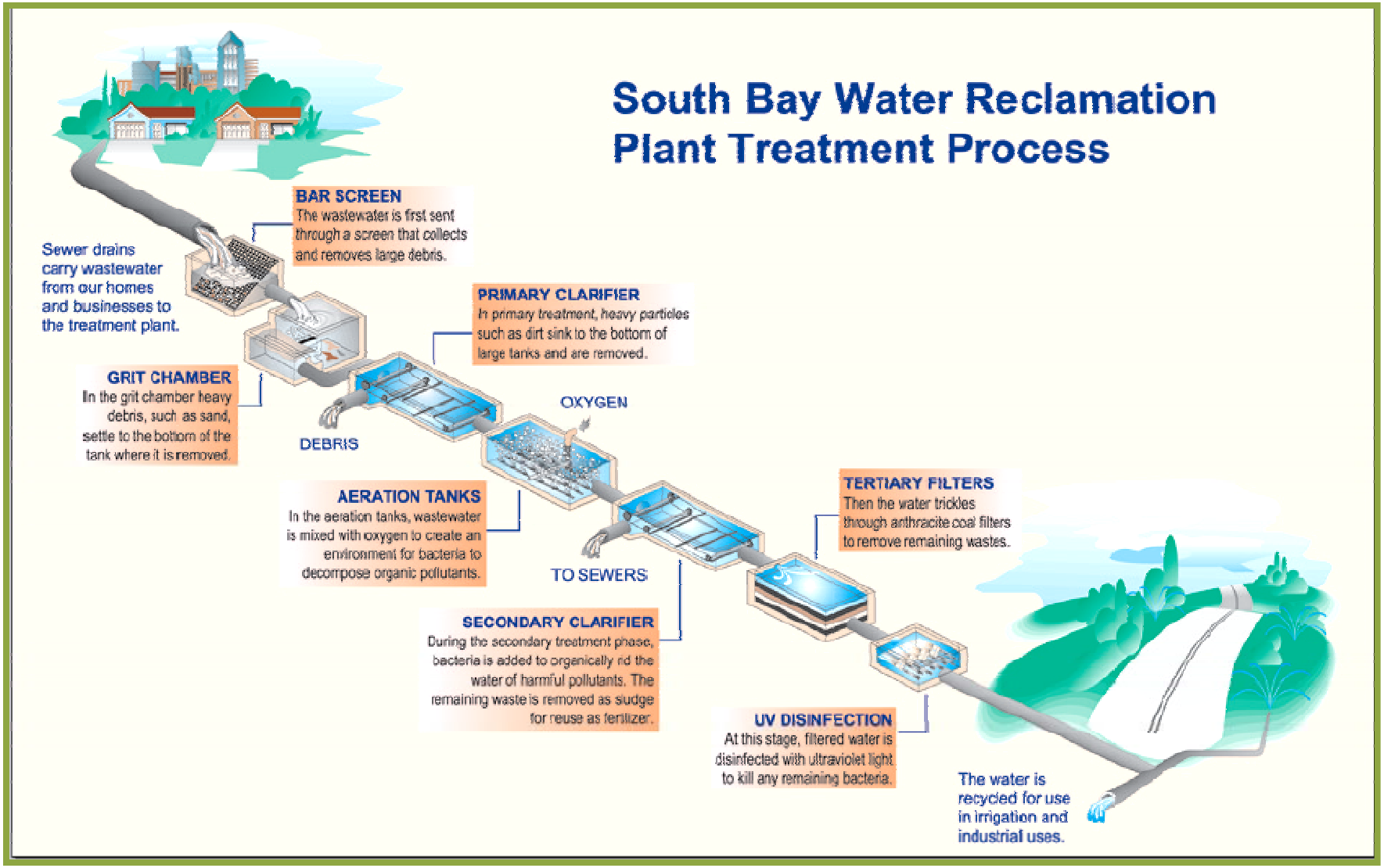
Case Studies: San Antonio, TX



Case Studies: San Diego, CA

- City imports ~90% of water
- Reclaimed water for irrigation and industrial purposes
- 2 treatment facilities
  - South Bay
    - UV disinfection
  - North City
    - Demineralization process, Chlorine-contact basins

Case Studies: San Diego, CA



Case Studies: San Diego, CA

- Controversial Issues
  - Incorporation of reclaimed water into drinking water supply
  - Low public support

Mike Osbun
Courtesy of: www.hcn.com

Conclusion

- Feasible Water Alternative
  - Numerous activities
  - Proper treatment
- Education
  - Support
  - Sustainable technologies

Questions?