Wastewater Reclamation

IPRO 304-C

Danielle Burkes  Masami Komatsu
George Derrick  Kelly Morken
Christy Dillard  Anna Patel
Ashanti A. Griffin  Brian Sherman
Katie Gwozdz  Greg Stachurski
Project Outline

• Statement of Problem
• Background
• Design Constraints
• Regulations
• Treatment Plant Design
  – Assumptions
  – Unit Operations
  – Storage Reservoir
• Future of the Project
• Conclusions
Problem

• Water shortages
• Past Solutions
• Type of treatment
• Solution?
• Economics
Background

• Water reclamation is important in the US
  – Plants are used all over the nation especially in dry and overpopulated areas

• Two categories of recycled water
  – Planned
  – Unplanned

• Reclaimed water is used for non-potable uses
  – Irrigation of parks, golf courses, creation of artificial lakes
  – Industrial uses as in cooling of factories, dust control, concrete mixing

• Environmental benefits
  – Provides additional source of water
  – Reduces and prevents pollution
Design Constraints

- Social
- Economic
- Weather
- Environmental
Regulations

- Legal issues: Federal, state, and local statutes.
- Federal laws
- State Legal Issues:
  - State Water rights
    - Appropriative Rights System
    - Riparian Rights System
    - Reuse Water Rights
- State Liability Laws
- Reuse ordinances
Elements of Design

- **Primary Treatment**
  - Screening
  - Grit chamber
  - Primary clarifier

- **Secondary Treatment**
  - Recycle of Biosolids
  - Aeration Basin
  - Secondary Clarifier

- **Tertiary Treatment**
  - Chlorination
  - Dechlorination

- **Distribution System**
- **Storage Reservoir**
Design Assumptions

- Residential Community
- Daily water usage = 70 GPD
- Peak daily water usage = 90 GPD
- Organic Content = 365 mg/L
Design Parameters

- **Flow Rate**
  
  \[
  \text{Flow}_{\text{avg}} = (70 \text{ gal/ day \cdot person}) \cdot (20000 \text{ people}) = 1.4 \text{ MGD}
  \]

  \[
  \text{Flow}_{\text{peak}} = (90 \text{ gal/ day \cdot person}) \cdot (20000 \text{ people}) = 1.8 \text{ MGD}
  \]

  - Design for 2.0 MGD

- **Organic Content (OC)**
  
  \[
  \text{OC}_{\text{avg}} = (365 \text{ mg/ L}) \cdot (3.785 \text{ L/gal}) \cdot (1.4 \text{ MGD}) = 1.34 \text{ kg/ min}
  \]

  \[
  \text{OC}_{\text{peak}} = (365 \text{ mg/ L}) \cdot (3.785 \text{ L/gal}) \cdot (1.8 \text{ MGD \text{ gal/ day}) = 1.73 \text{ kg/ min}}
  \]
Primary Treatment
Screening

- **Solids Removal Methods**
  - Bar Racks
  - Rotary Disks
  - Screens
  - Centrifugal

- **Types of Bar Racks**
  - Chain Operated
  - Reciprocating Rake
  - Catenary
  - Cable Type
Grit Chamber

- **Three Types**
  - Horizontal-flow type
  - Aerated Type
  - Spiral-flow type
Primary Clarifier

• **Design requirements**
  – Evenly distributed flow
  – Promote flocculation
  – Dissipate influent energy
  – Minimize sludge blanket disturbance

• **Choose circular tank**
  – Dimensions: diameter and side wall depth
Primary Clarifier

- Diam = 50 ft
- Depth = 12 ft
Secondary Treatment
Recycle of Biosolids

\[ R = \text{design \_ flow \_ rate} \cdot \text{Recycle \_ Ratio} \]

\[ R = \left(1.0 \times 10^6 \text{ gal/day}\right) \cdot (1.0) = 1.0 \times 10^6 \text{ gal/day} \]

flow = \( Q + R = 1.0 \times 10^6 \text{ gal/day} + 1.0 \times 10^6 \text{ gal/day} \)

flow = 2.0 \times 10^6 \text{ gal/day}
Choosing an Aeration Basin

• **Important characteristics**
  - Retention time
  - Food-to-microbe ratio

• **Basic design choices**
  - circular
  - rectangular
  - rectangular with baffles

• **Choice: Extended Aeration Basin**
Extended Aeration Basin

- Selection reasons
  - Built in safety factor
  - Small amount of solids produced
  - Endogenous respiration phase
Secondary Clarifier

- Diam = 80 ft
- Depth = 13 ft
Tertiary Treatment
Disinfection

- What is Disinfection?
  - The point of disinfection
  - Important factors
  - Types of disinfectants
Method of Disinfection

- Chlorination
  - Types of Chlorine compounds
  - Chlorinator
  - Injector
  - Reactions with Chlorine in water
  - Contact Chamber
Other Aspects of Chlorination

- **Dechlorination**
  - Purpose
  - Types

- Reactions with Sulfur Dioxide in Water

- Effluent Discharge to Distribution
Storage Reservoir

Winter Storage Lagoon

50' sliding hill composed of excess excavated earth. Slope perpendicular to long axis is 12.

Cost estimate: $6 million
Future Work

- Water Distribution System
  - Meets with regulations
    - Contaminant concentrations
    - Maximum loading allowances
  - Economical
  - Recharges groundwater
  - Develop general design procedures
    - Adaptable to any location
Conclusions

- Wastewater Reclamation
  - Possible solution to groundwater depletion
  - Cost prohibitive to rework existing systems
  - Recommended for new plant construction