Wastewater Reclamation

IPRO 304-C

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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

$$Flow_{avg} = \left(70\,{}^{gal}/_{day\cdot person}\right)\cdot\left(20000\,people\right) = 1.4MGD$$

$$Flow_{peak} = \left(90\,{}^{gal}/_{day\cdot person}\right)\cdot\left(20000\,people\right) = 1.8MGD$$

  - Design for 2.0 MGD

- Organic Content (OC)

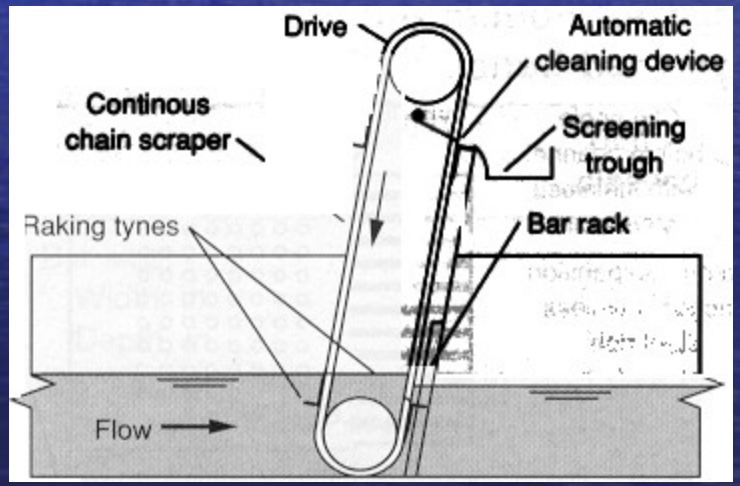
$$OC_{avg} = \left(365\,{}^{mg}/_{L}\right)\cdot\left(3.785\,{}^{L}/_{gal}\right)\cdot\left(1.4MGD\right) = 1.34\,{}^{kg}/_{\min}$$

$$OC_{peak} = \left(365\,{}^{mg}/_{L}\right)\cdot\left(3.785\,{}^{L}/_{gal}\right)\cdot\left(1.8MGD\,{}^{gal}/_{day}\right) = 1.73\,{}^{kg}/_{\min}$$

Primary Treatment

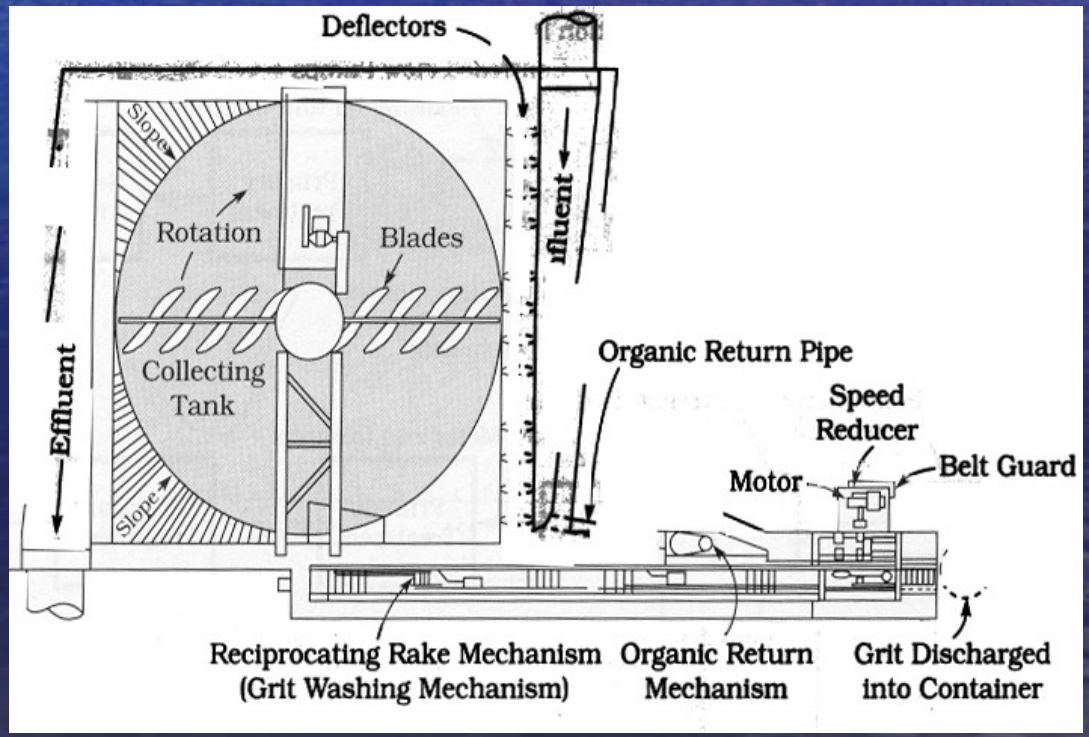
Screening

- 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

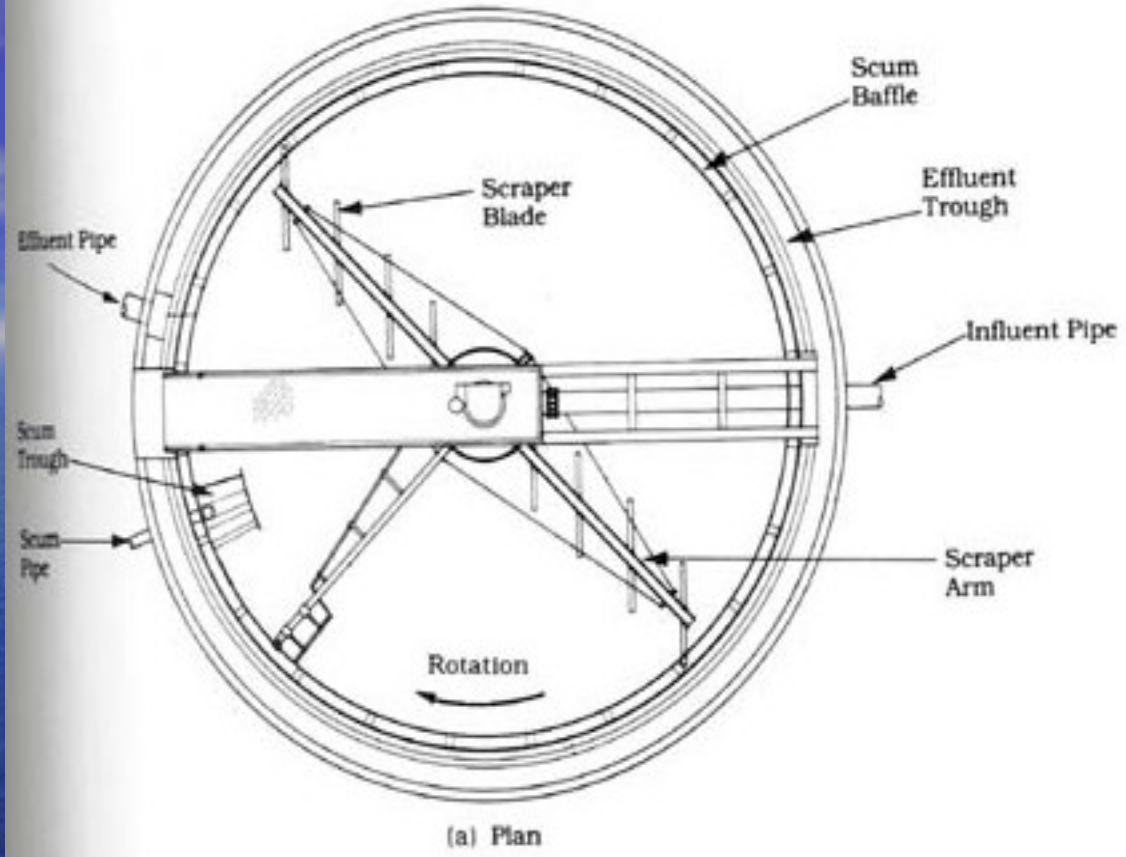


Primary Clarifier

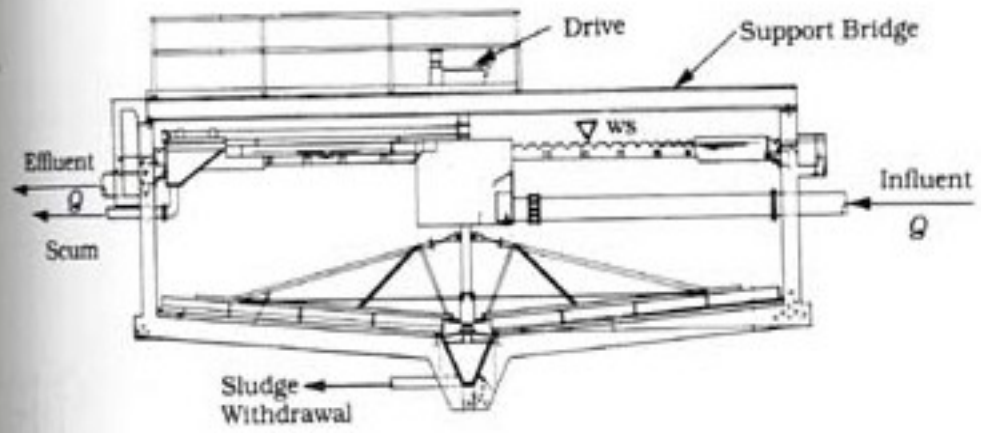
- Design requirements
  - Evenly distributed flow
  - Promote flocculation
  - Dissipate influent energy
  - Minimize sludge blanket disturbance
- Choose circular tank
  - Dimensions: diameter and side wall depth

Primary Clarifier

- Diam = 50 ft
- Depth = 12 ft



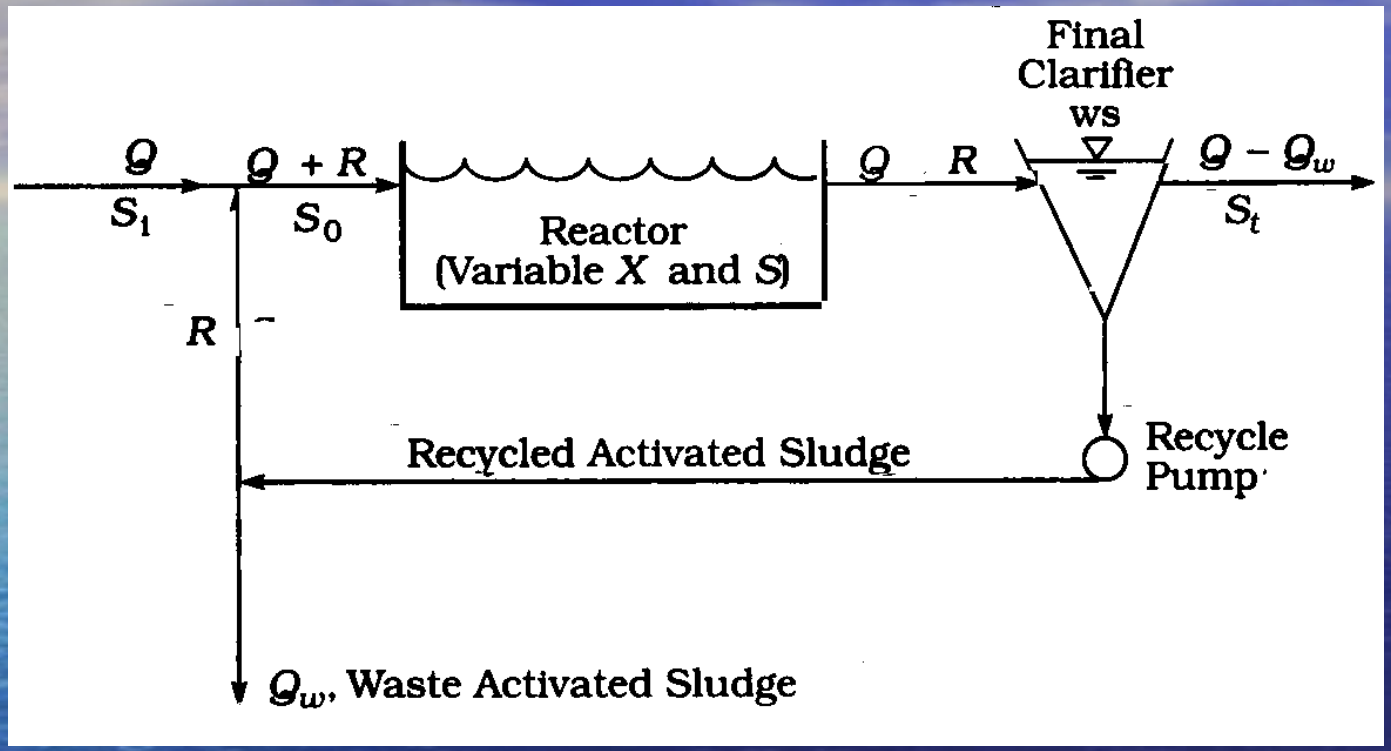
(a) Plan



(b) Elevation

Secondary Treatment

Recycle of Biosolids



$$R = design\_flow\_rate \cdot \mathrm{Re}cycle\_Ratio$$

$$R = \left(1.0\times10^{6}\ {}^{gal}/_{day}\right)\cdot\left(1.0\right) = 1.0\times10^{6}\ {}^{gal}/_{day}$$

$$flow = Q + R = 1.0\times10^{6}\ {}^{gal}/_{day} + 1.0\times10^{6}\ {}^{gal}/_{day}$$

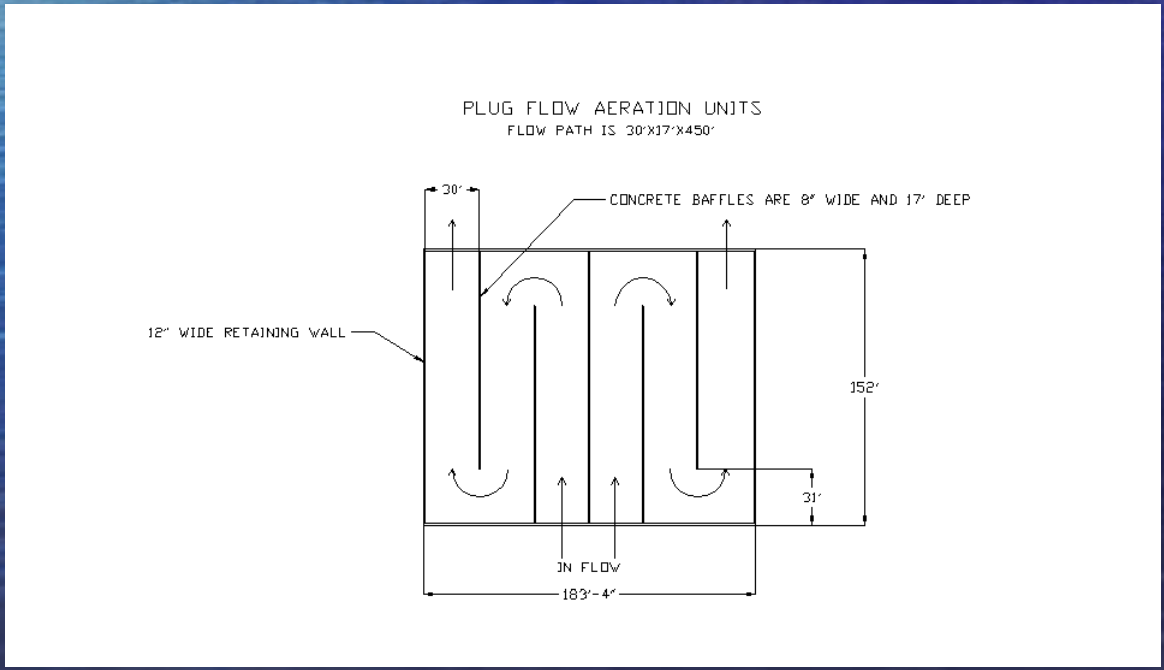
$$flow = 2.0\times10^{6}\ {}^{gal}/_{day}$$

Choosing an Aeration Basin

- Important characteristics
  - Retention time
  - Food-to-microbe ratio
- Basic design choices
  - circular
  - rectangular
  - rectangular with baffles
- Choice: Extended Aeration Basin

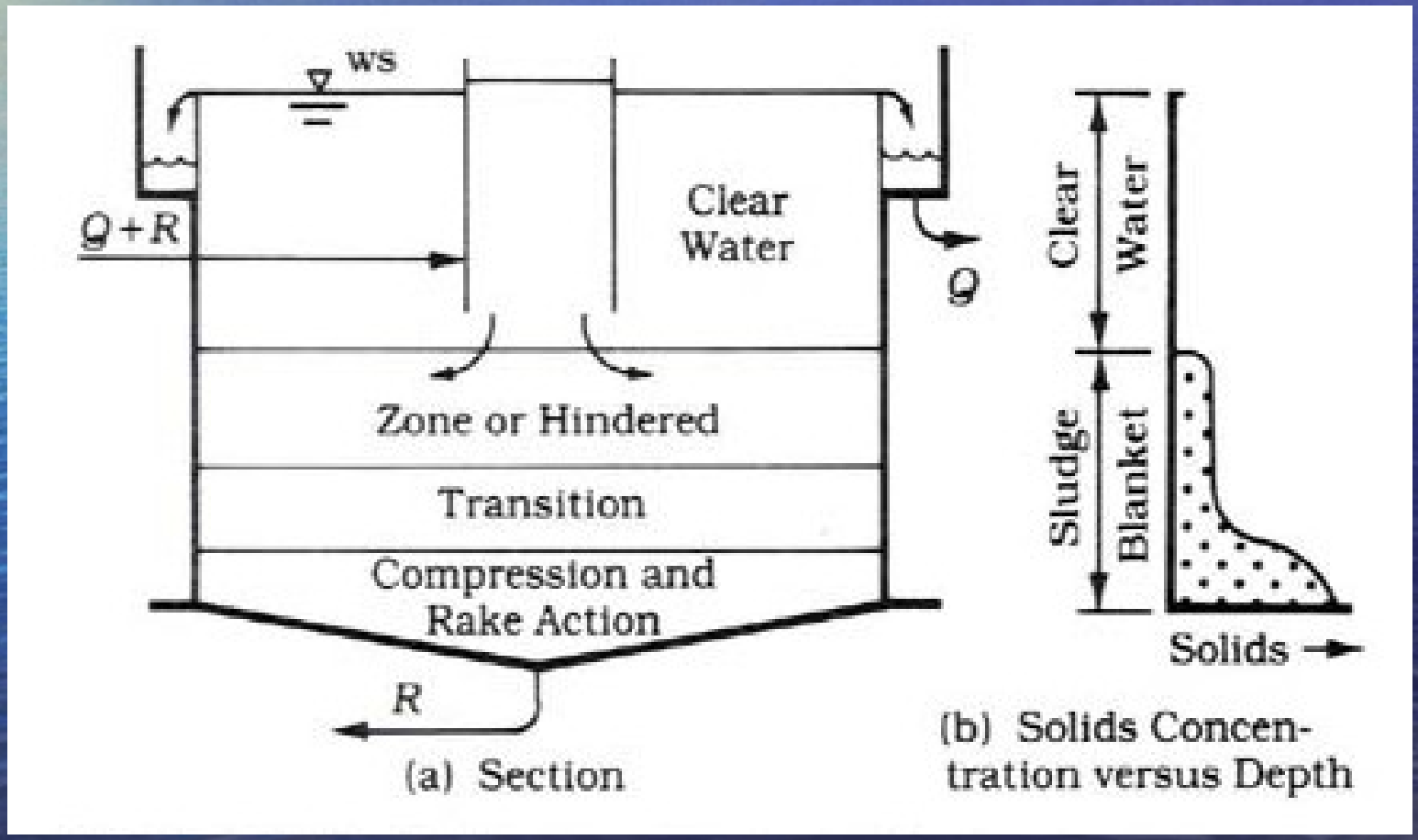
Extended Aeration Basin

- 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

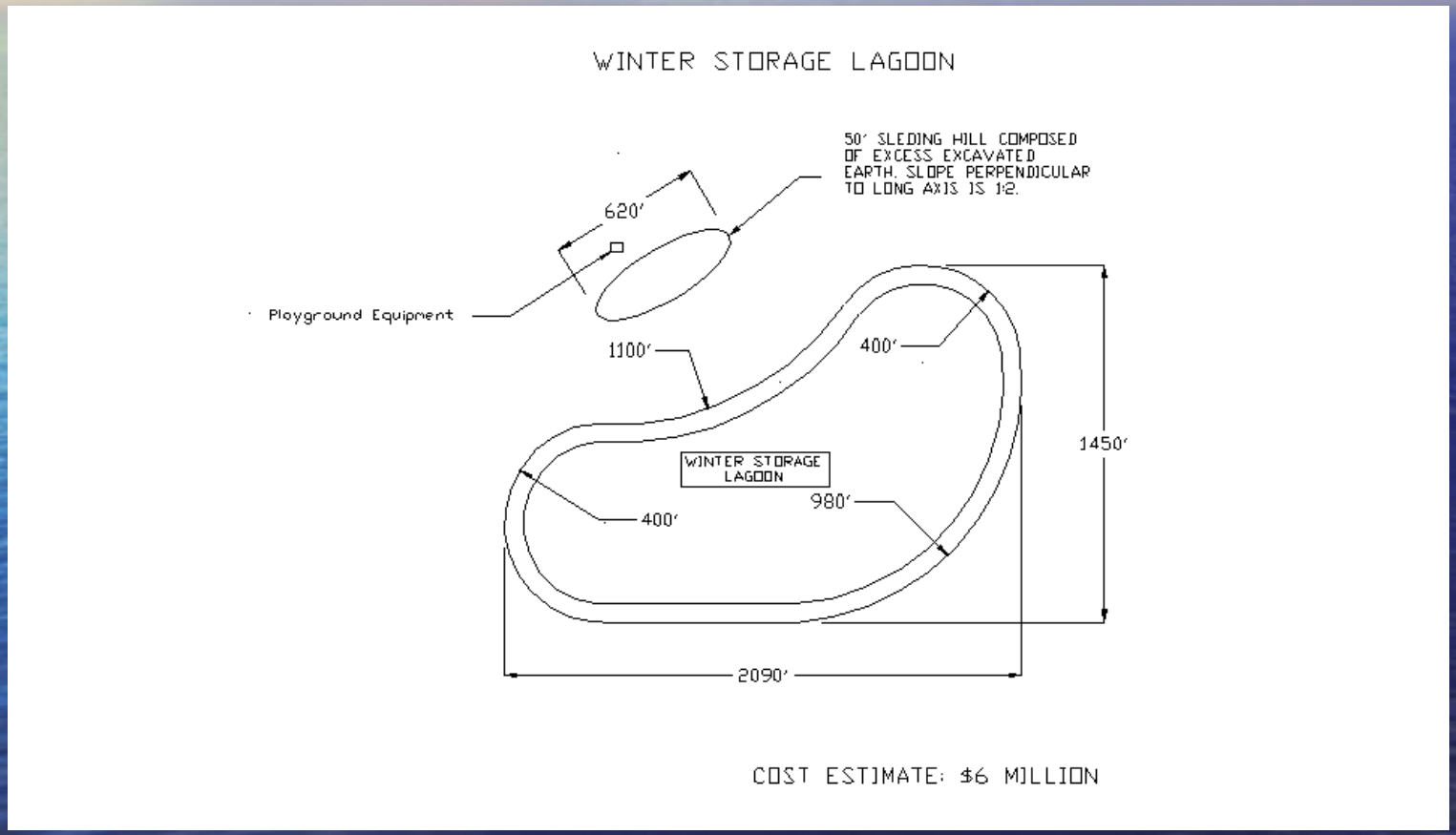
Method of Disinfection

- 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



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

Questions?

Comments?