Wastewater Treatment for Small Communities

Summary of the 2003 Workshop sponsored by Canadian Council of Ministers of the Environment (CCME)

Environment Canada Environnement Canada

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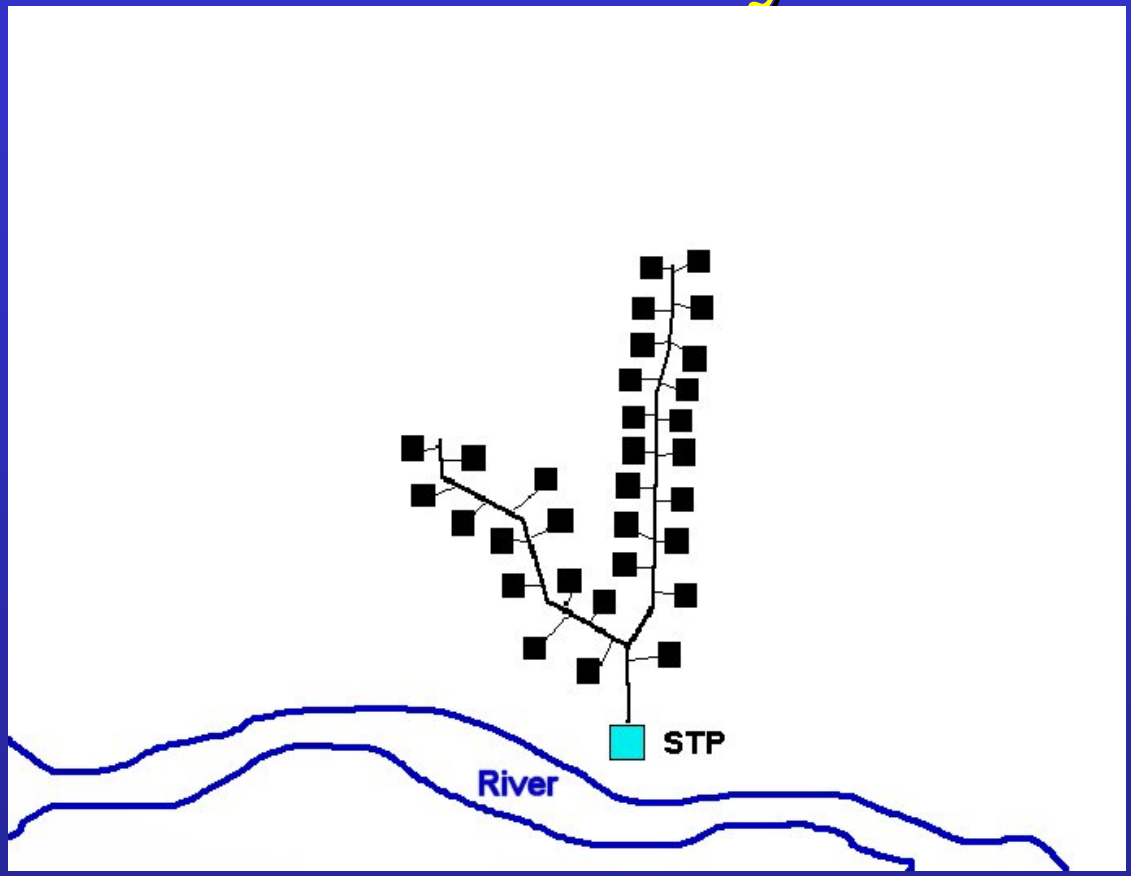
Presentation Format

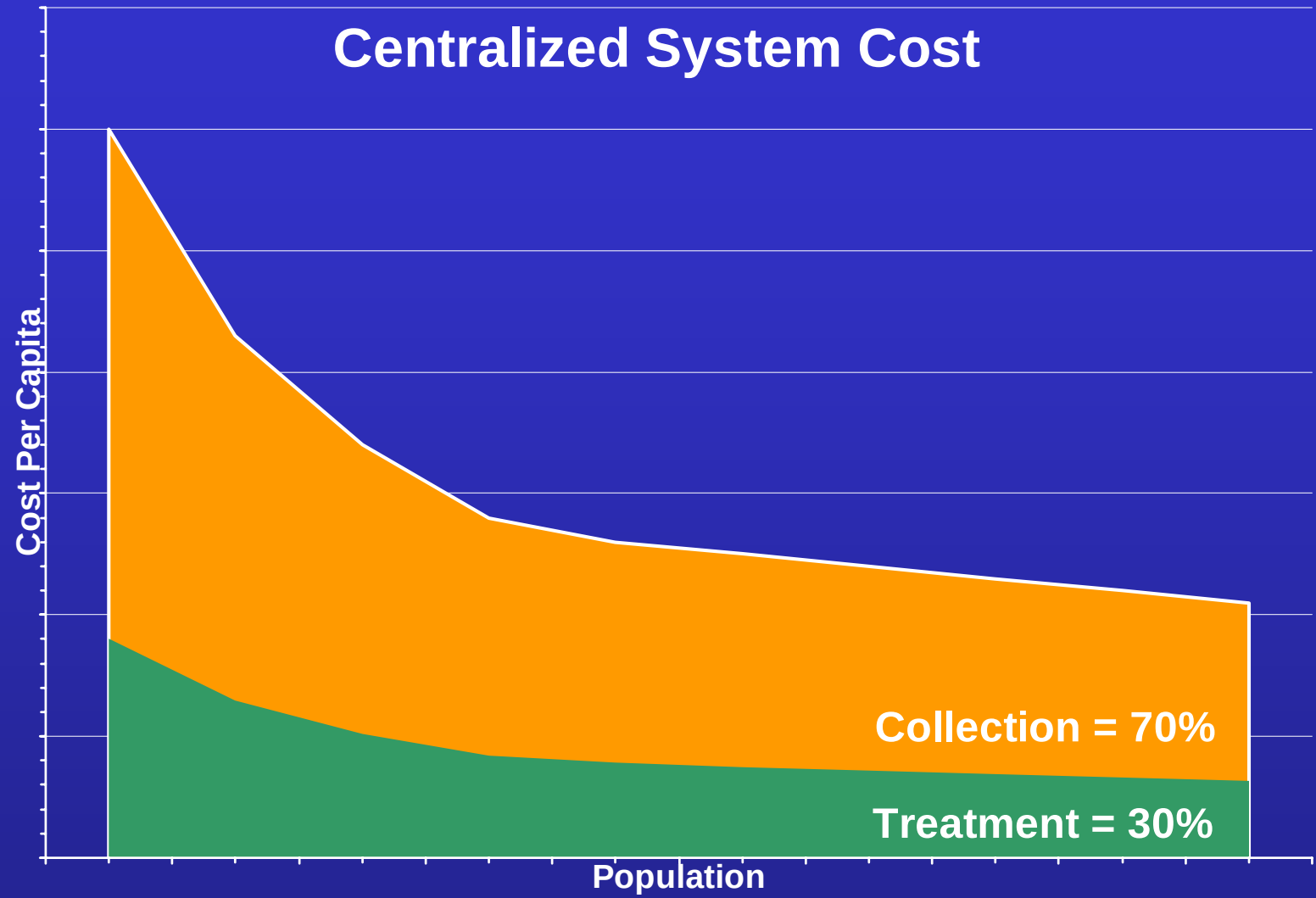
- Definitions
- Technology Options
- Cost Comparison
  - Centralized vs. Decentralized Systems
- Elements for Program Success

Definitions

- Small Community
  - no clear cut
  - suggest 2000 people
- Type of Community
  - rural
  - cottage
  - fringe
  - semi-urban
- Treatment Systems
  - Centralized
  - De-centralized
    - on-site
    - clusters

Centralized System





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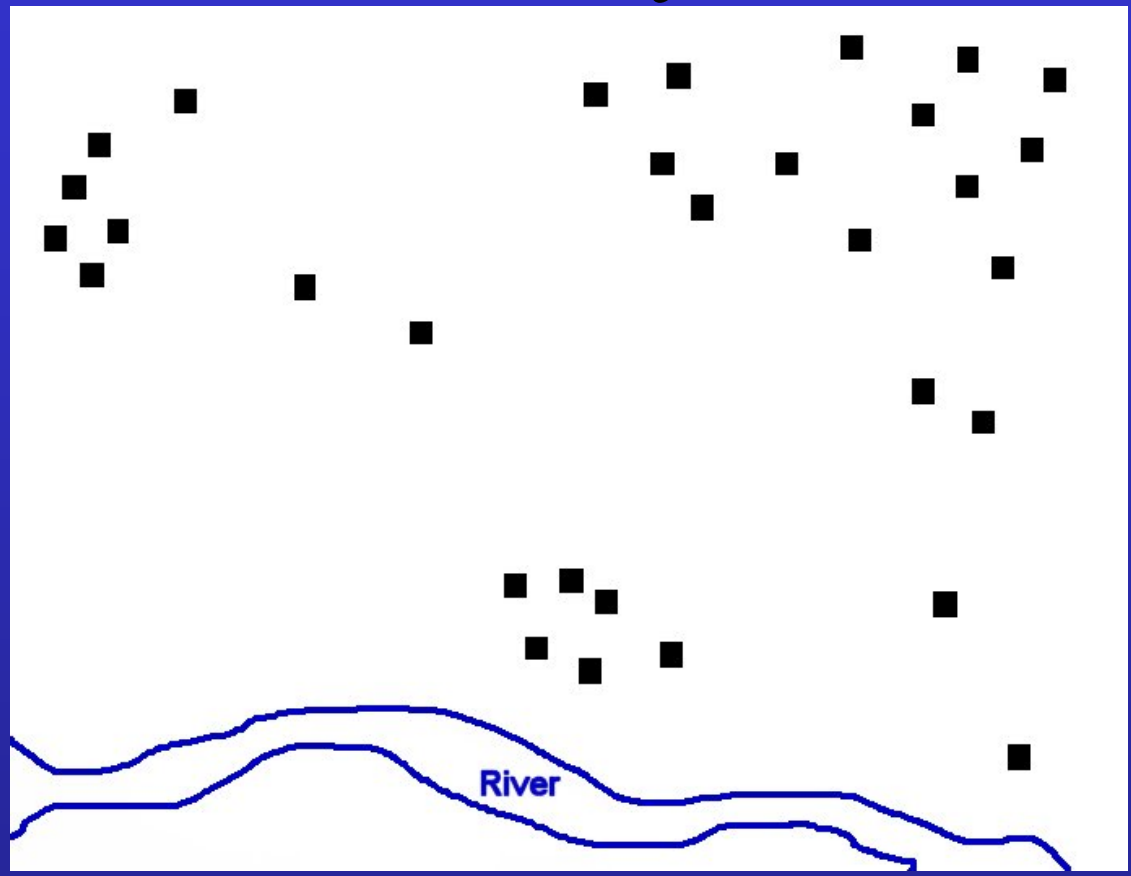
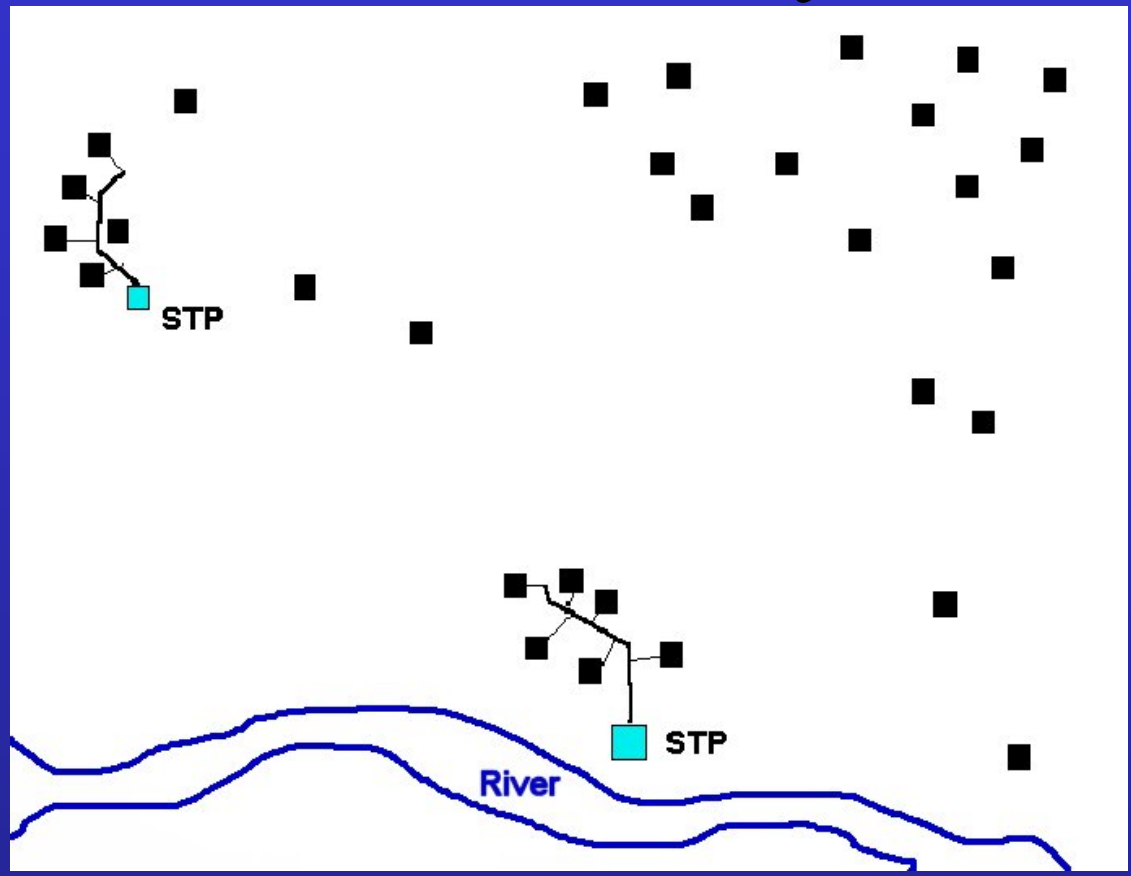
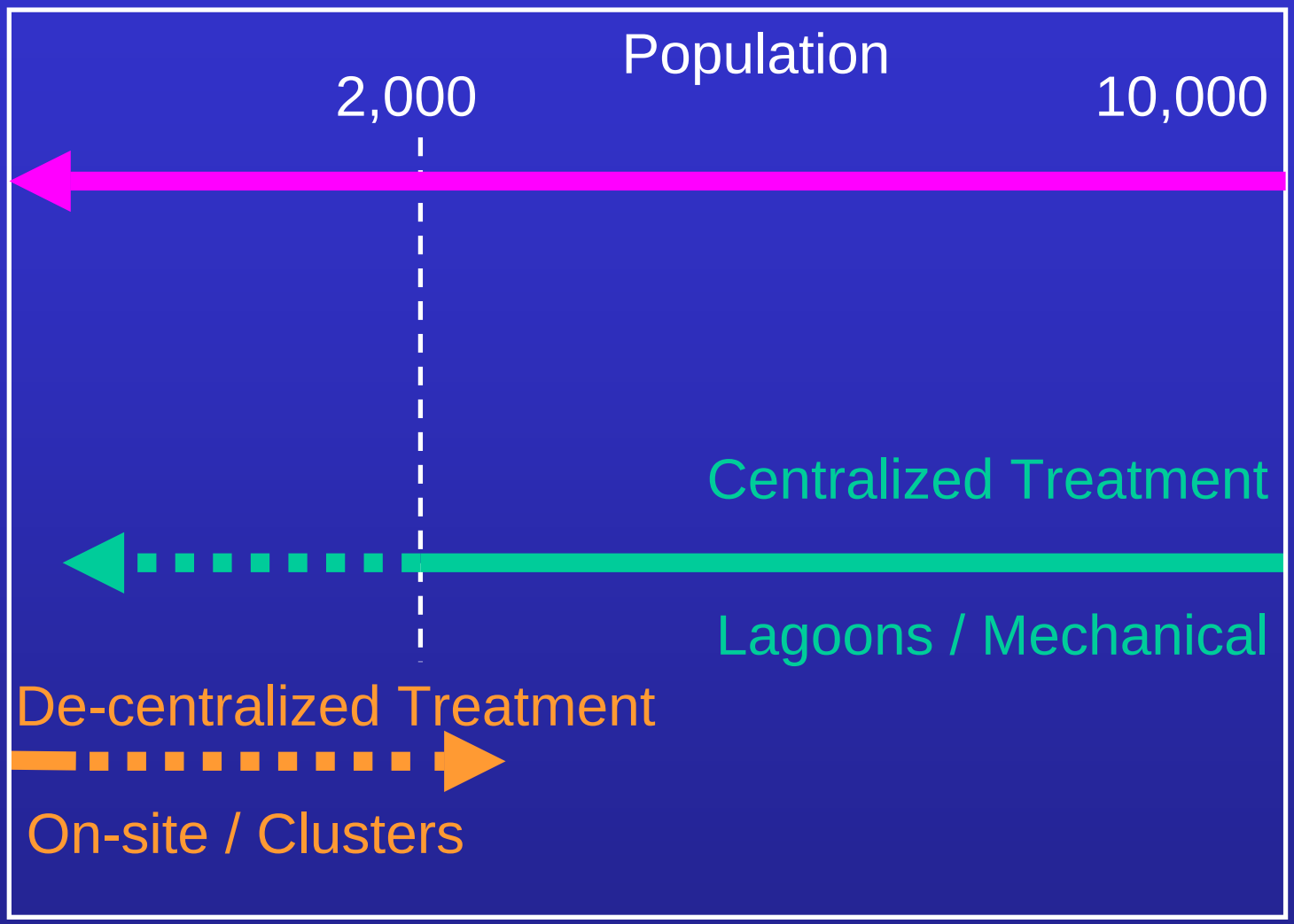
On-Site System



Decentralized System




Population
2,000
10,000
Centralized Treatment
Lagoons / Mechanical
De-centralized Treatment
On-site / Clusters

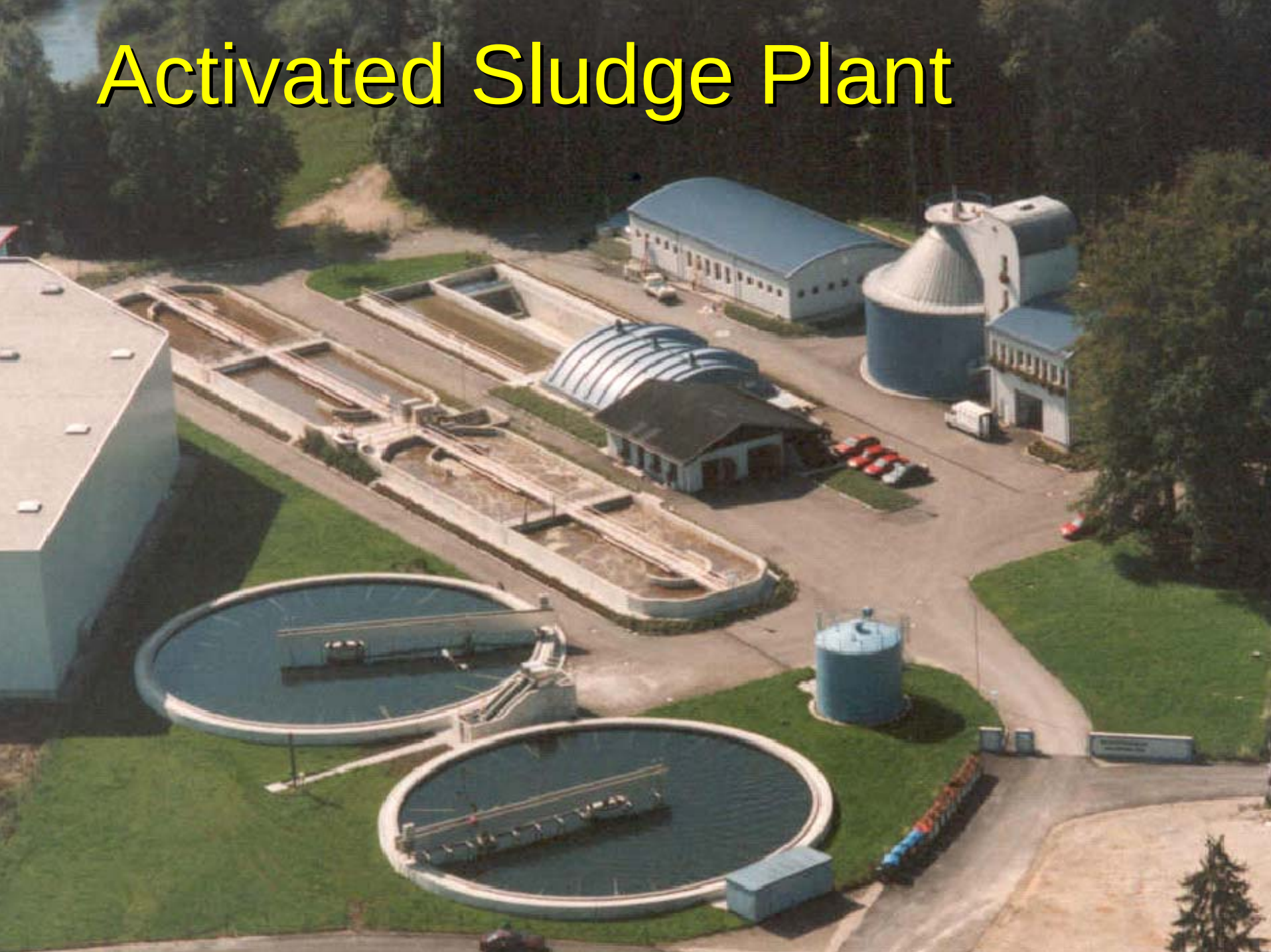
Presentation Format

- Definitions
  - ≤ 2000 population
  - centralized/decentralized
  - no clear cut solution
- Technology Options
- Cost Comparison
  - Centralized vs. Decentralized System
- Elements for Program Success

Technology Options for Centralized System

- Mechanical
- Lagoon

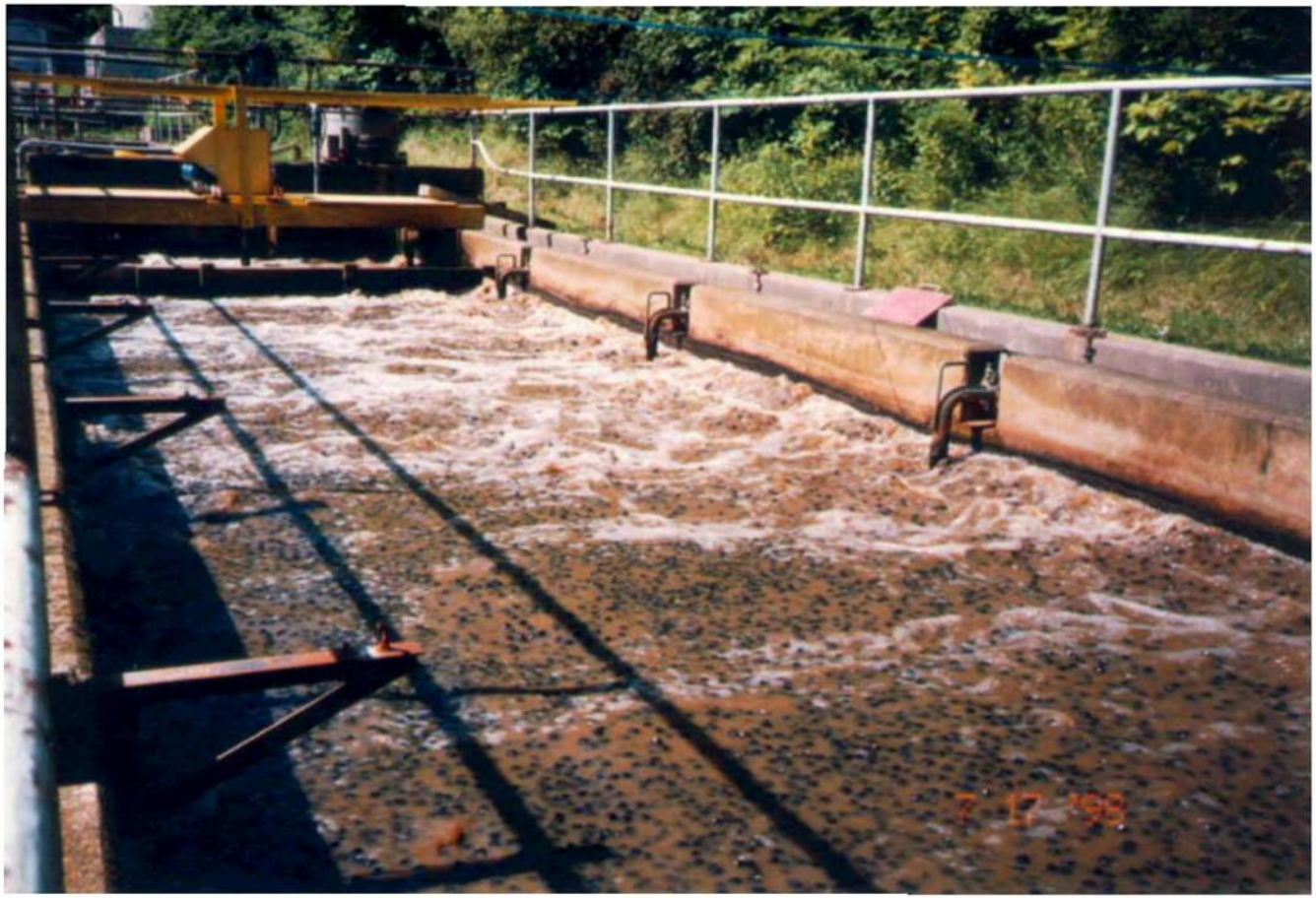
Activated Sludge Plant



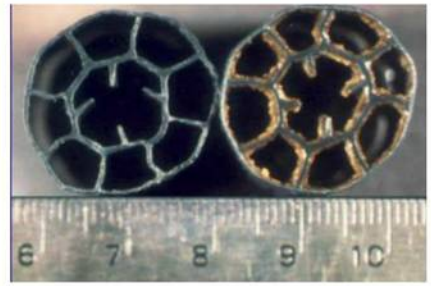

RBC discs
drive

Moving Bed Technology

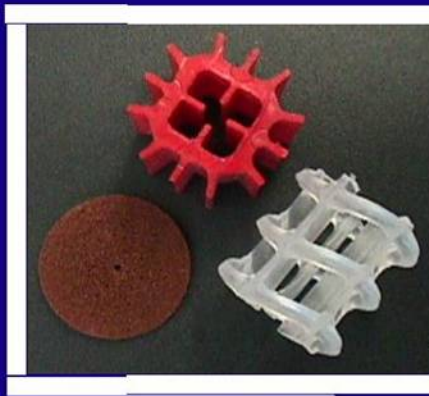
... floating homes for bugs ?



Waterdown STP

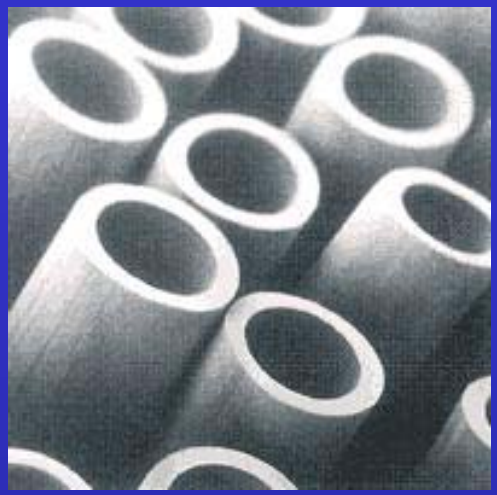


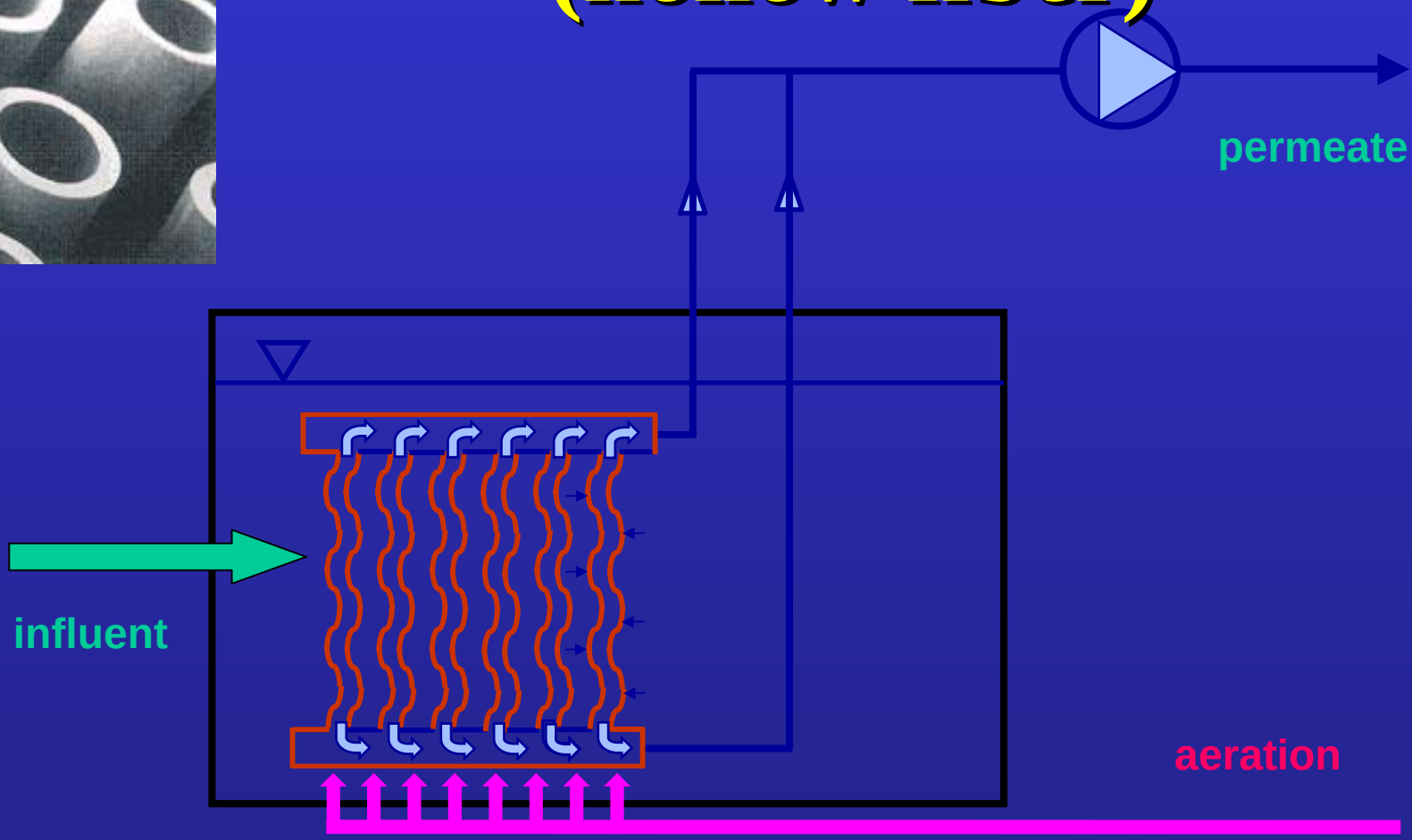
Media Used



Other Media

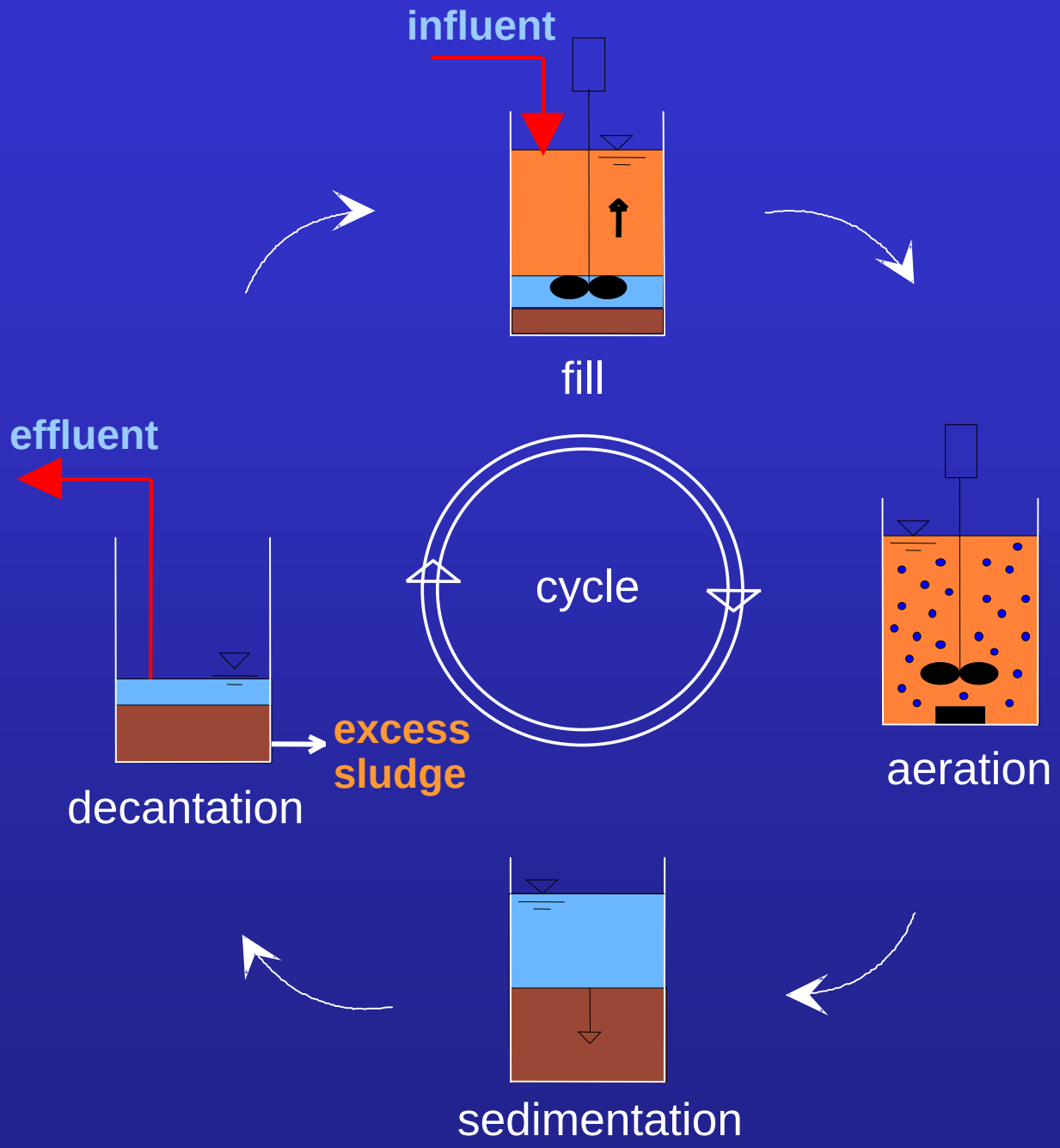
Membrane AS plant (hollow fiber)



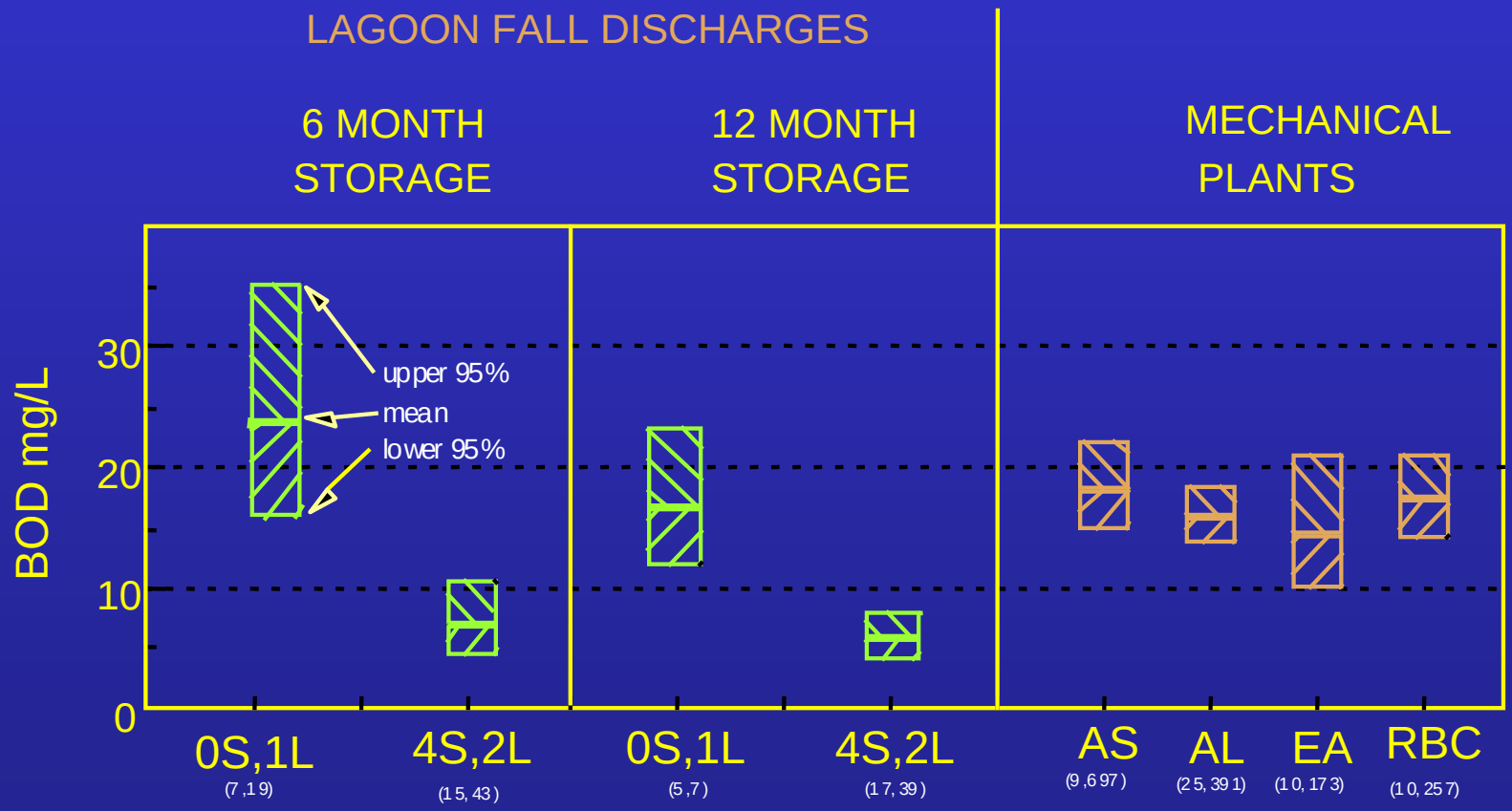


SBR process (Sequencing Batch Reactor):

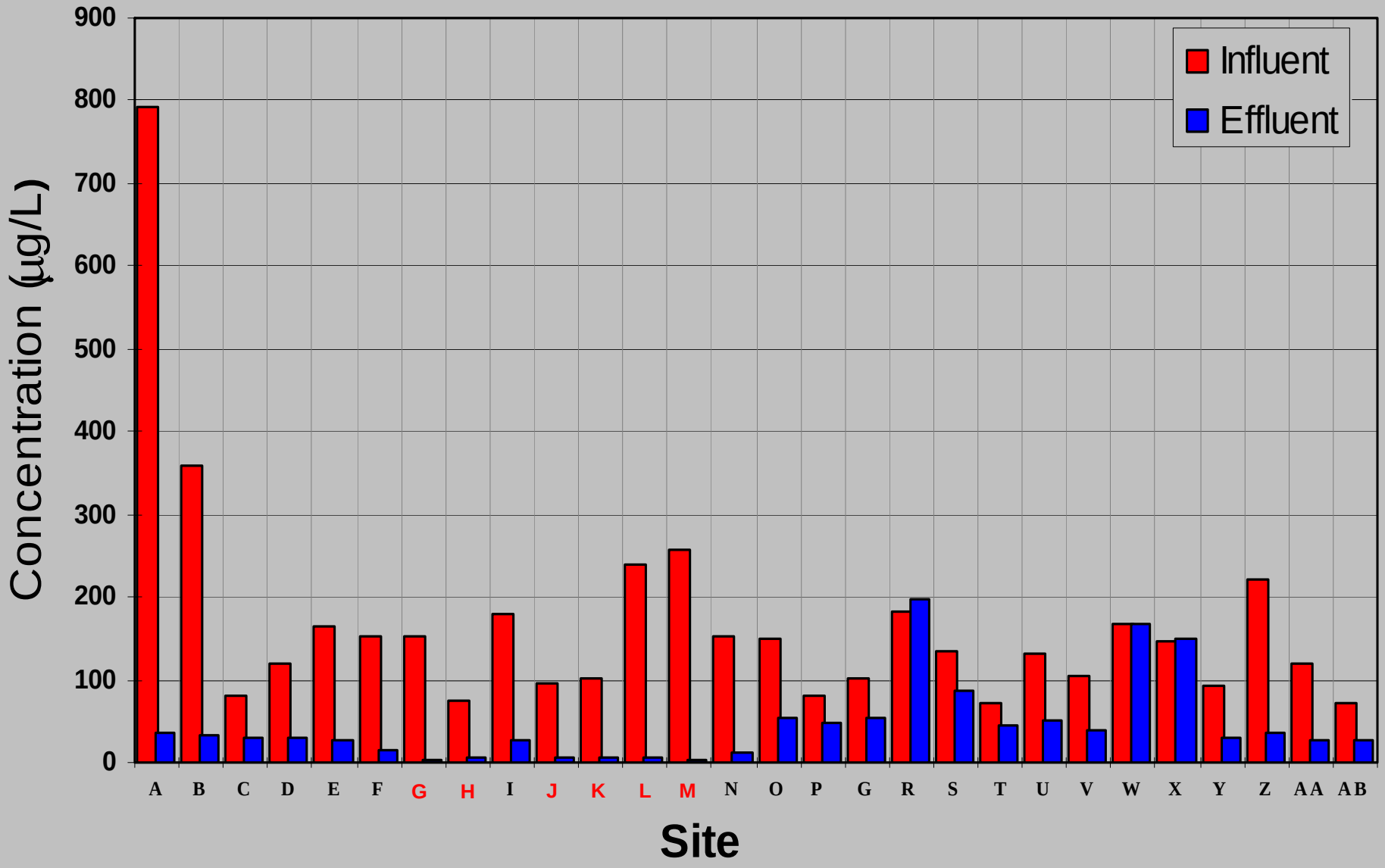
Biol. process and sedimentation in the same tank:



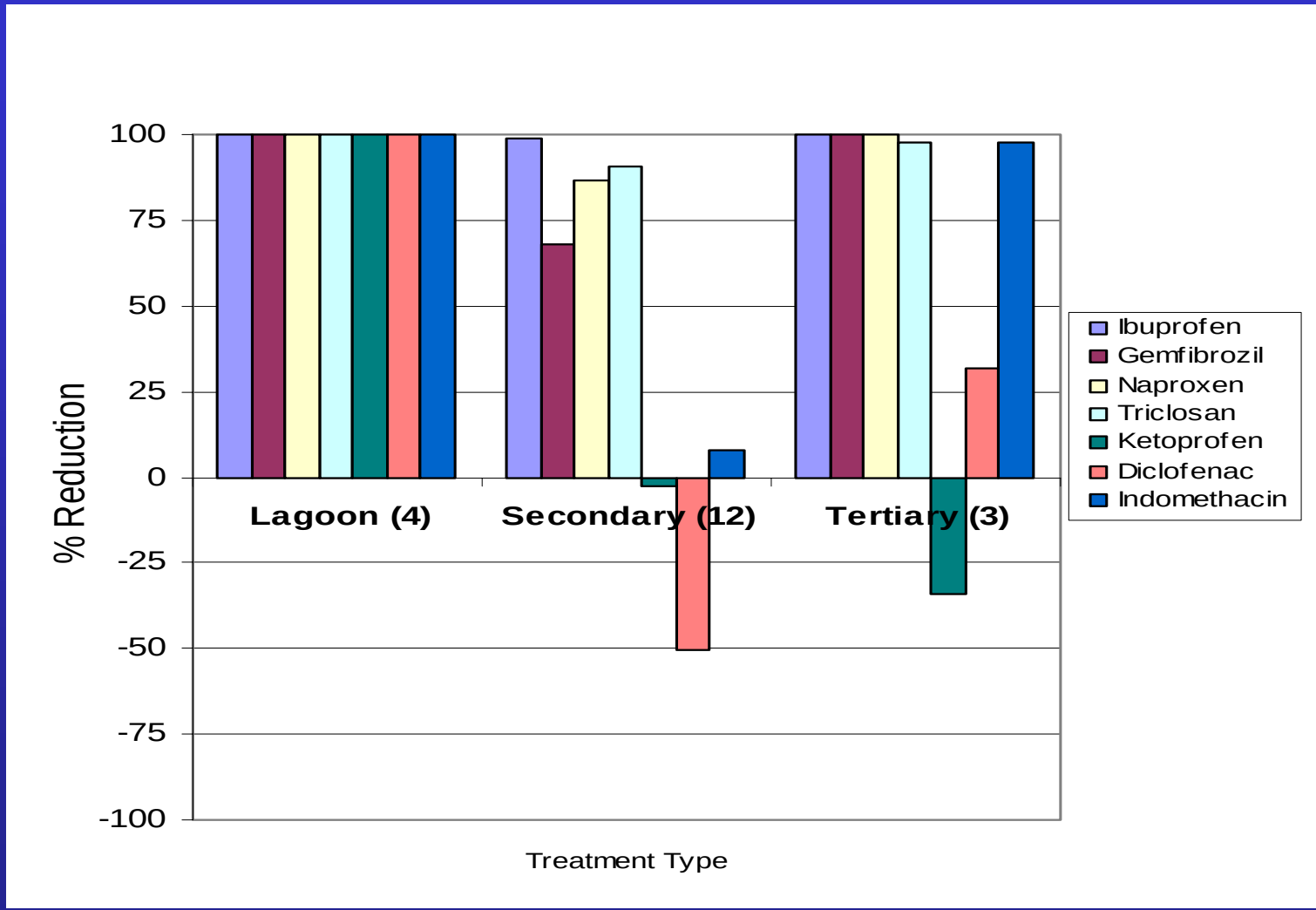
Lagoon Performance Effluent BOD



Alkylphenolics in STPs



Median Per Cent Reduction of Acidic Drugs
Thames River, Grand River and Highland Creek plants

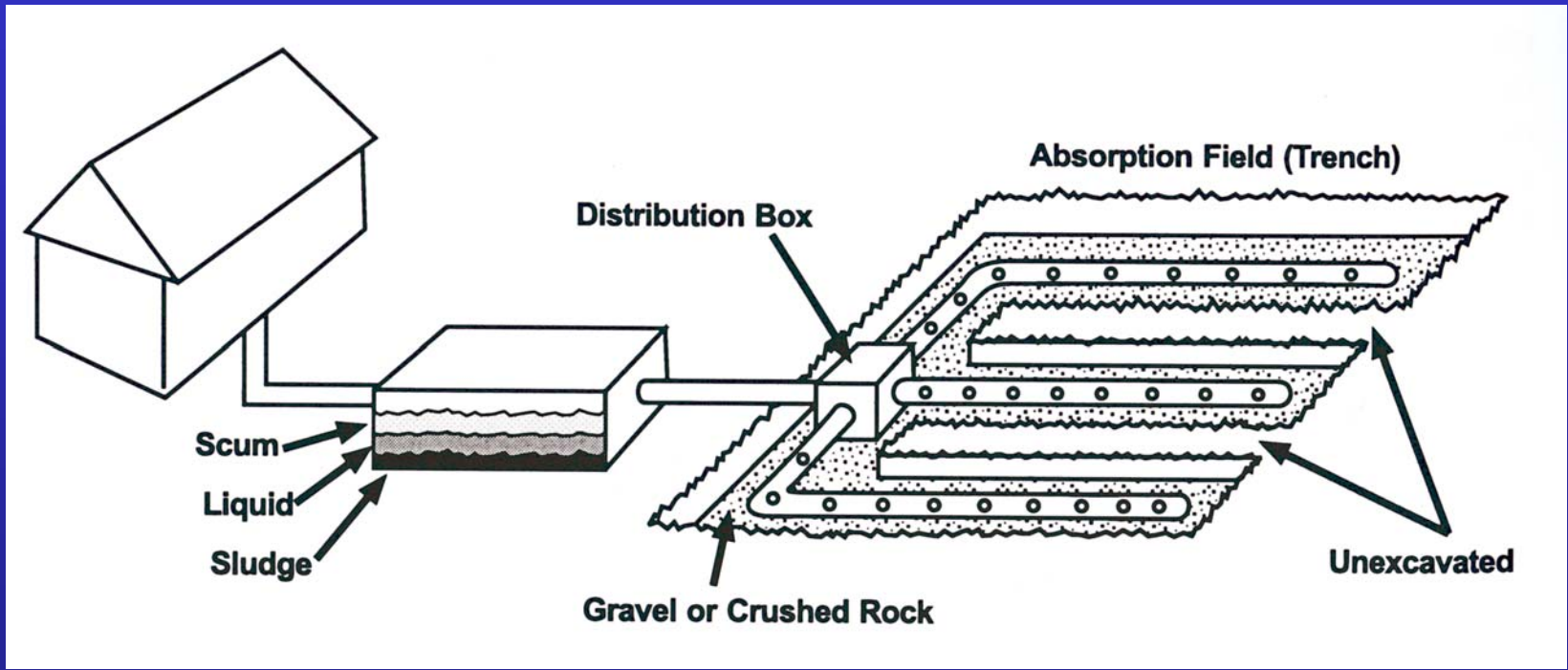


Technology Options for Decentralized System

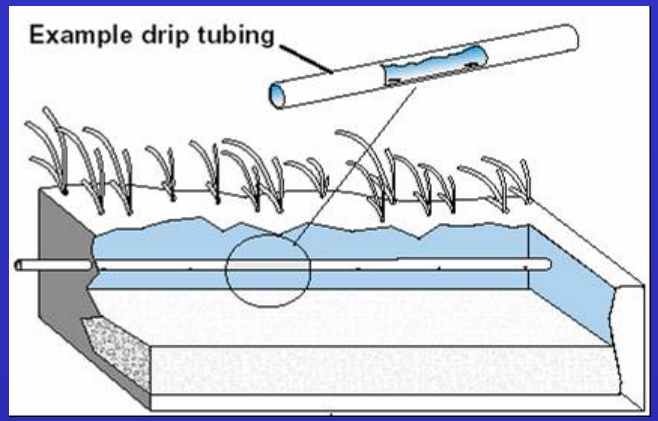
- soil-based
- package plants

19th Century England

Soil-based System

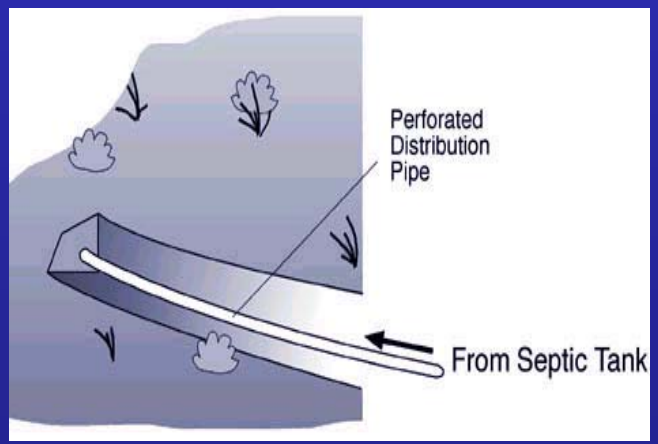


Examples of Dispersal Technologies

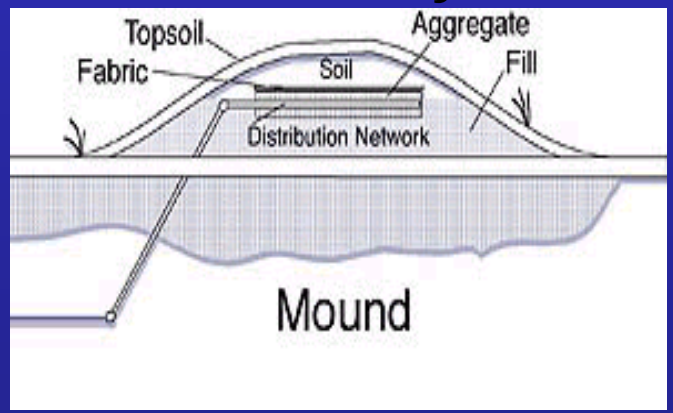


Drip Irrigation

Chamber System

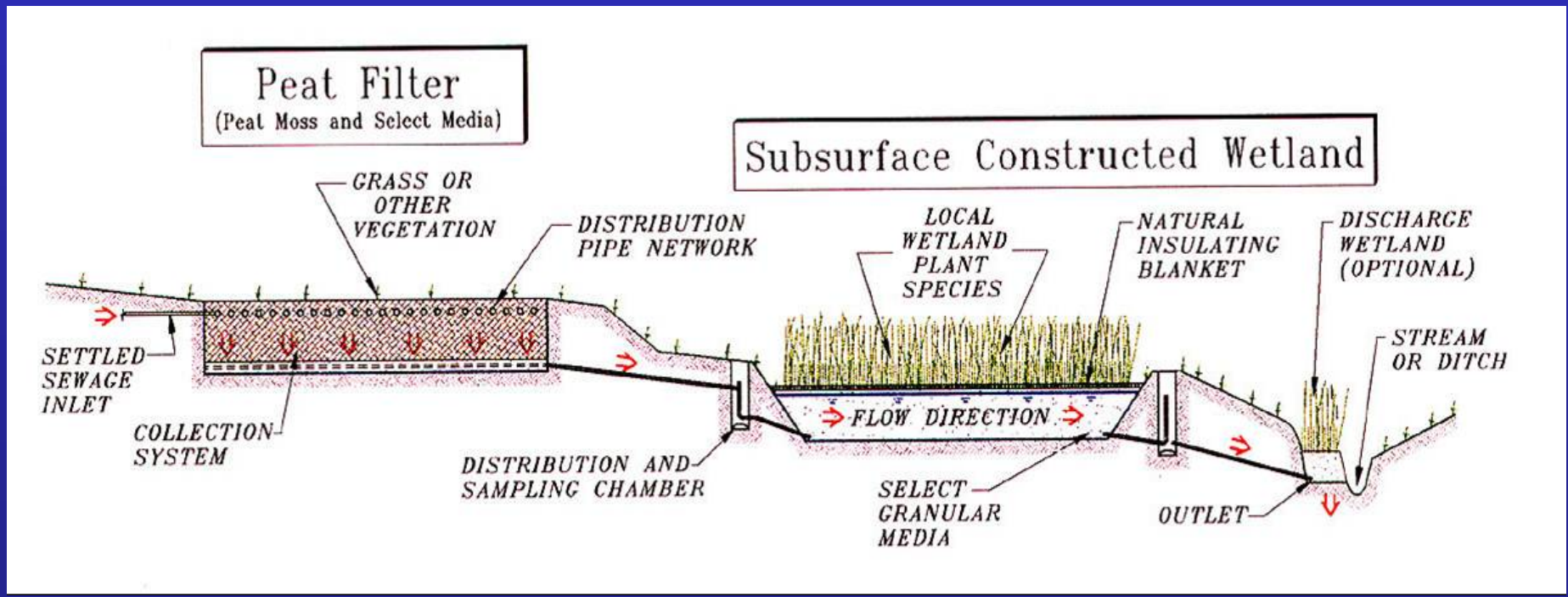


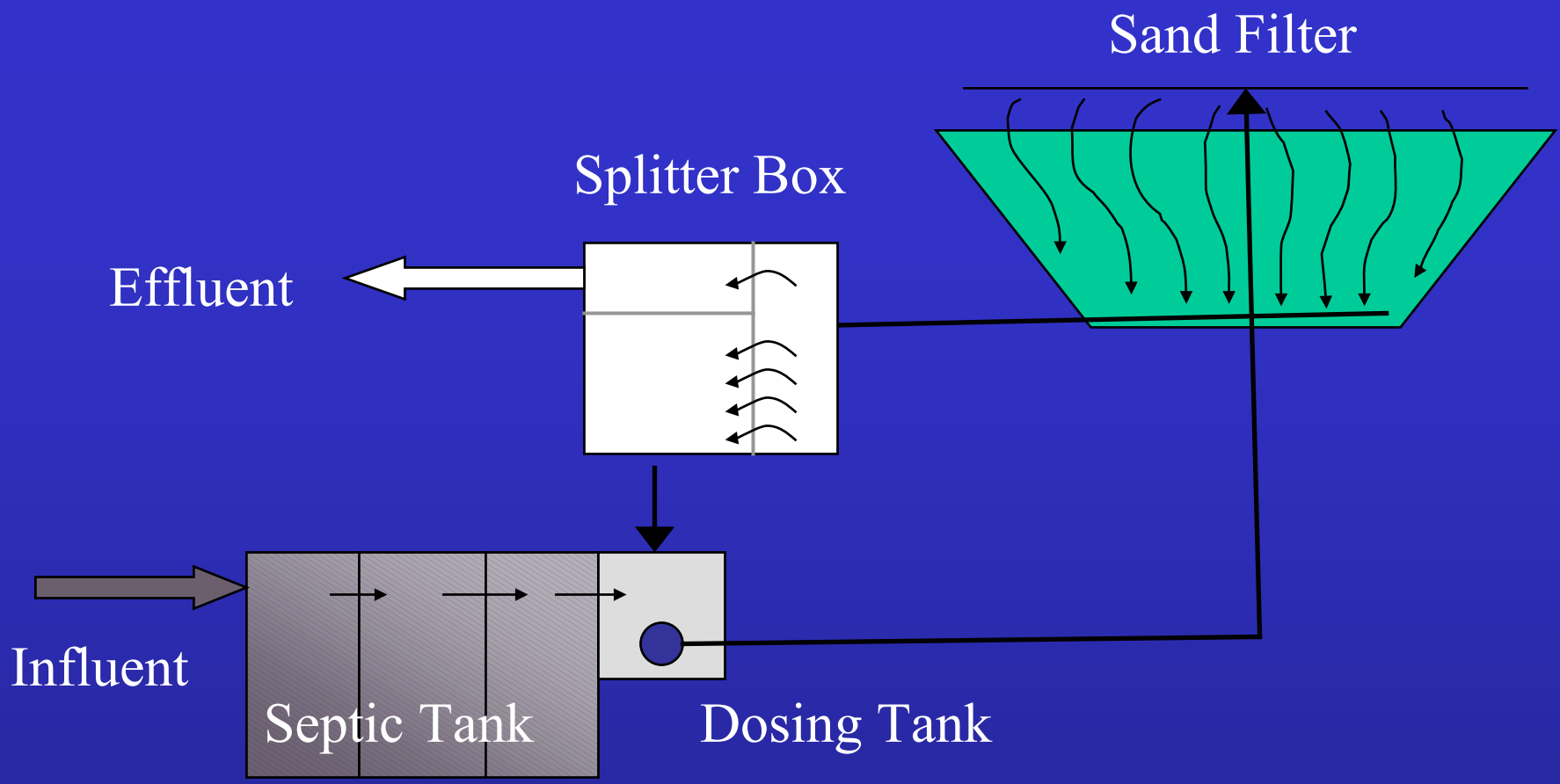
Contour Trench



Mound System

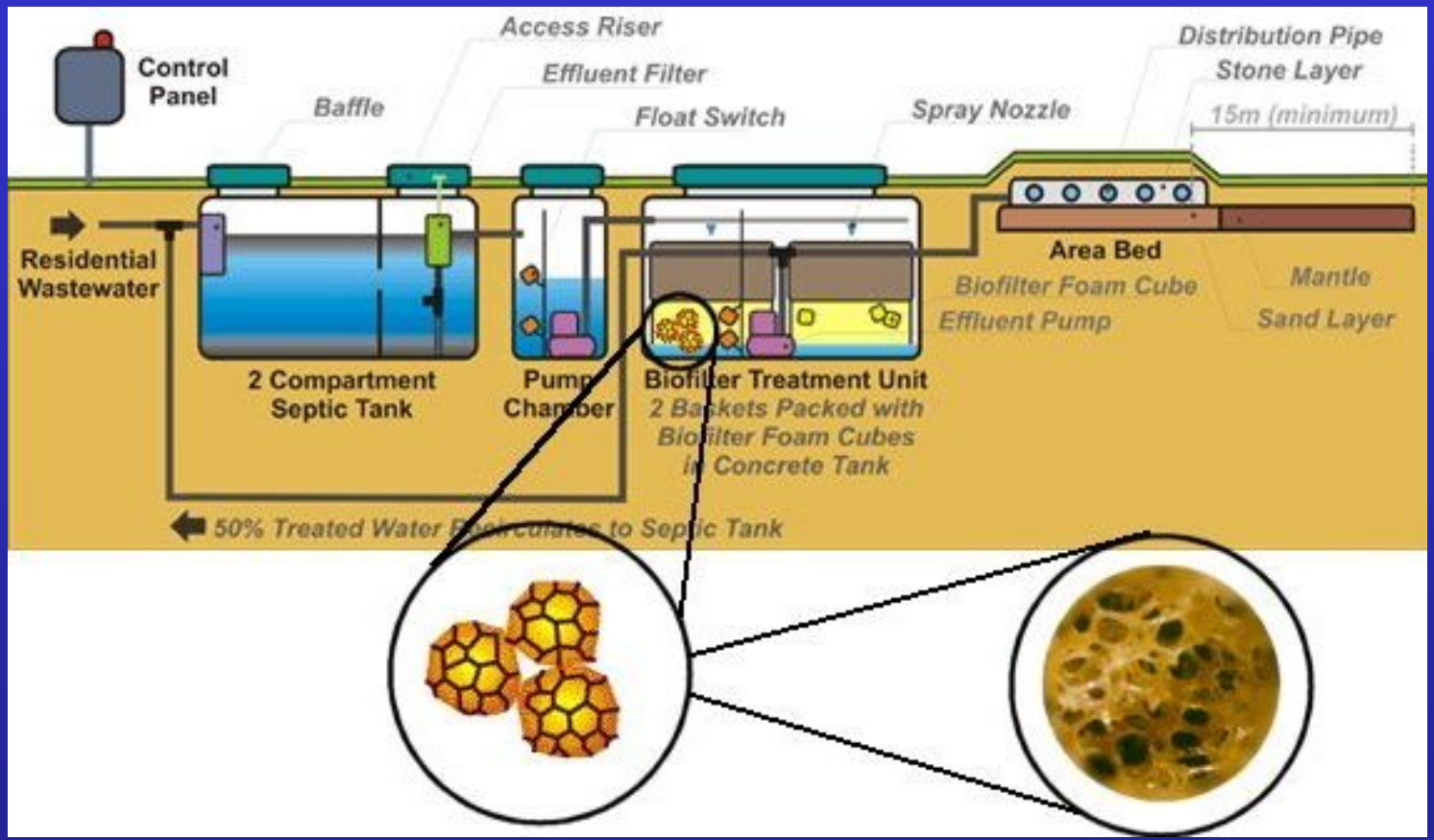
Peat Filter + Wetland





Recirculating Sand Filter Schematic

Waterloo Biofilter



Air-tight 5000 L/d Polyethylene Tanks

- **modules installed as needed**
- **new or existing garage-type structure**
- **standard plumbing & electrical**
- **no confined space problem**

Waterloo 30-40 m^3/d ISO Container

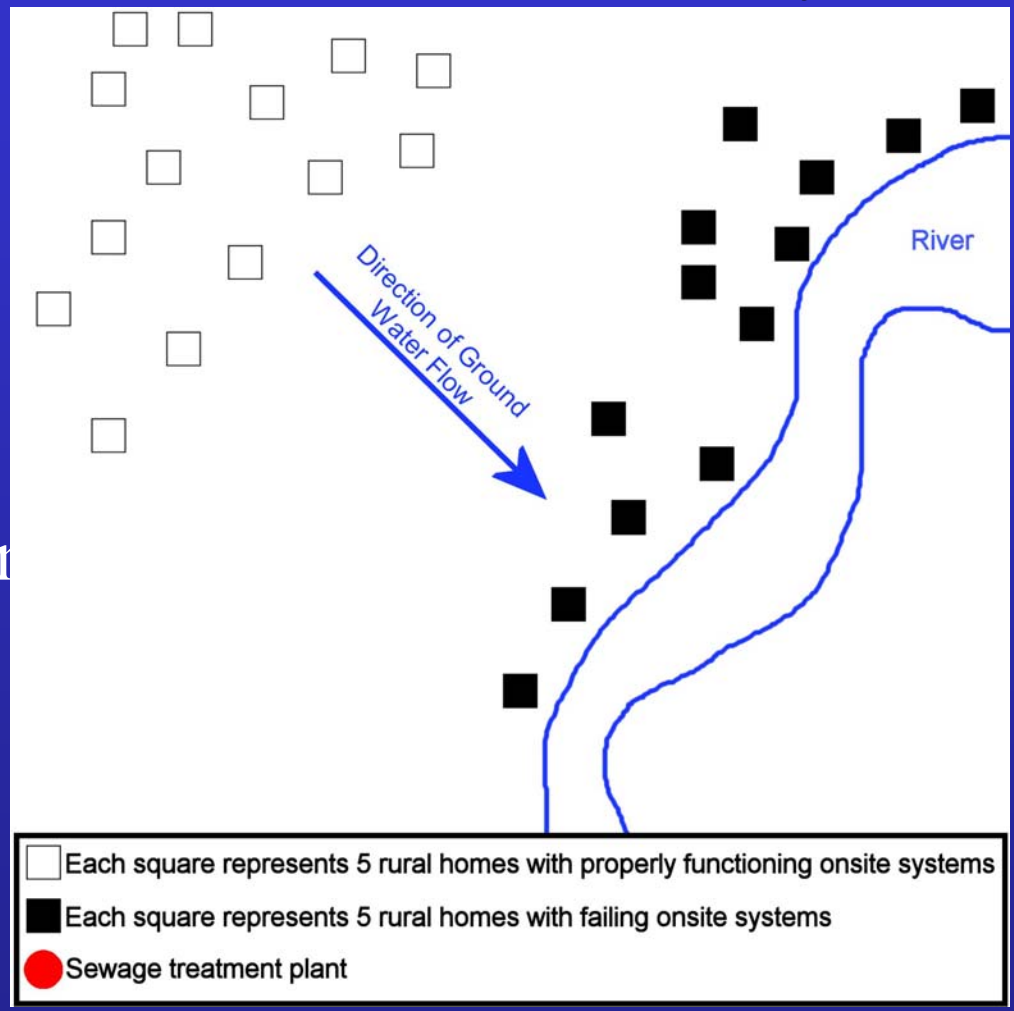
- **30-40 m^3/d ISO container combines building & Biofilter**
- **shipped as standard container; ideal for off-shore**
- St. Louis & Paddockwood, Saskatchewan

Presentation Format

- Definitions
- Technology Options
  - centralized/decentralized systems
  - no clear cut
- Cost Comparison
  - Centralized vs. Decentralized System
- Elements for Program Success

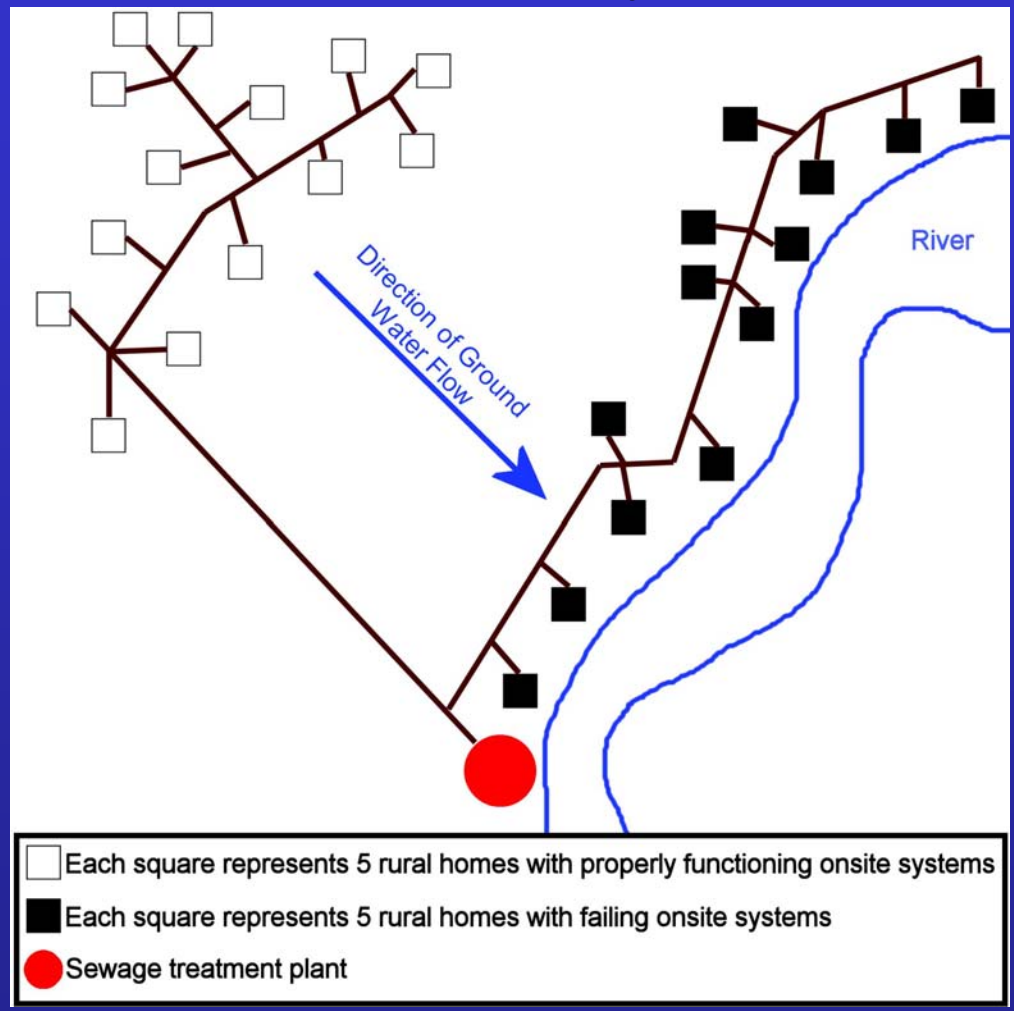
Scenario 1 – Rural Community

- 450 people
- 135 homes
- 1 acre lots
- 50% on-site syster
  failed



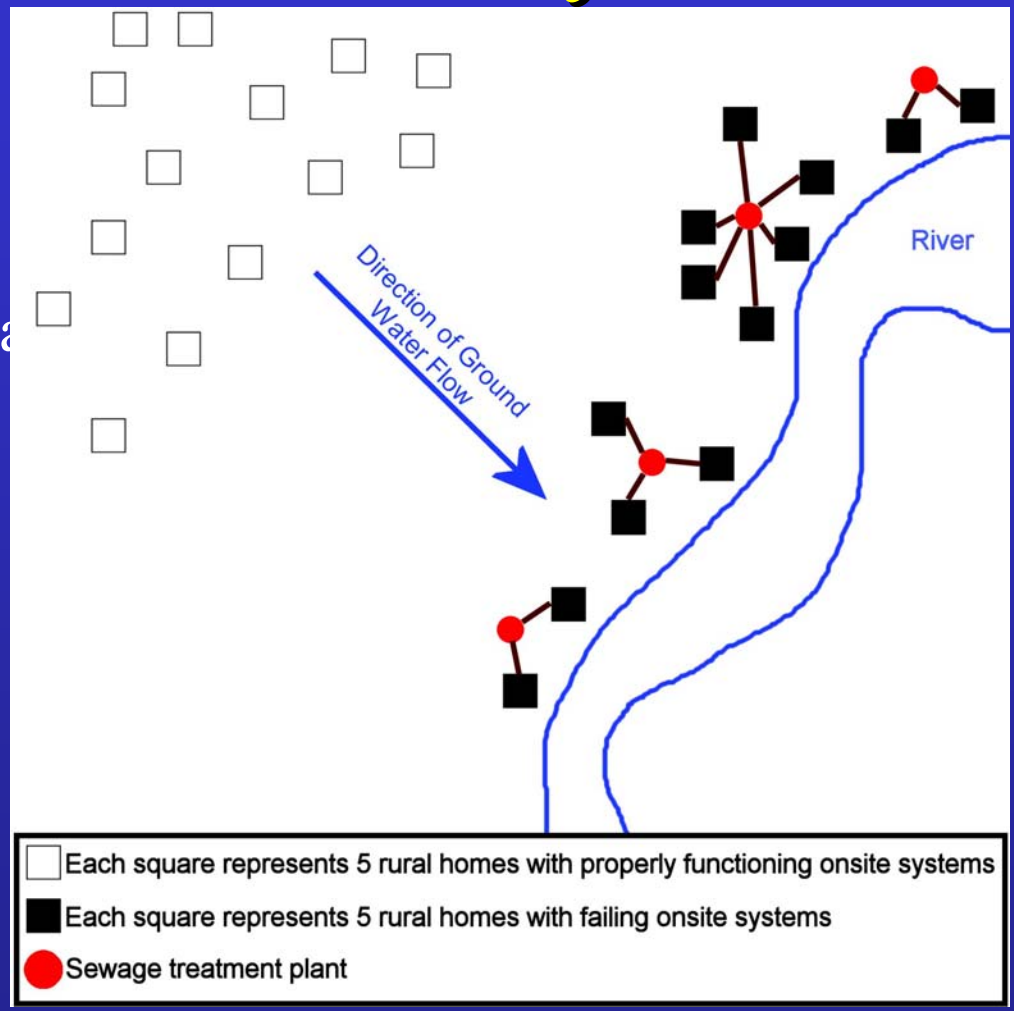
Scenario 1 – Centralized System

- collection
  - gravity sewers
- treatment
  - facultative lagoon
  - disinfection



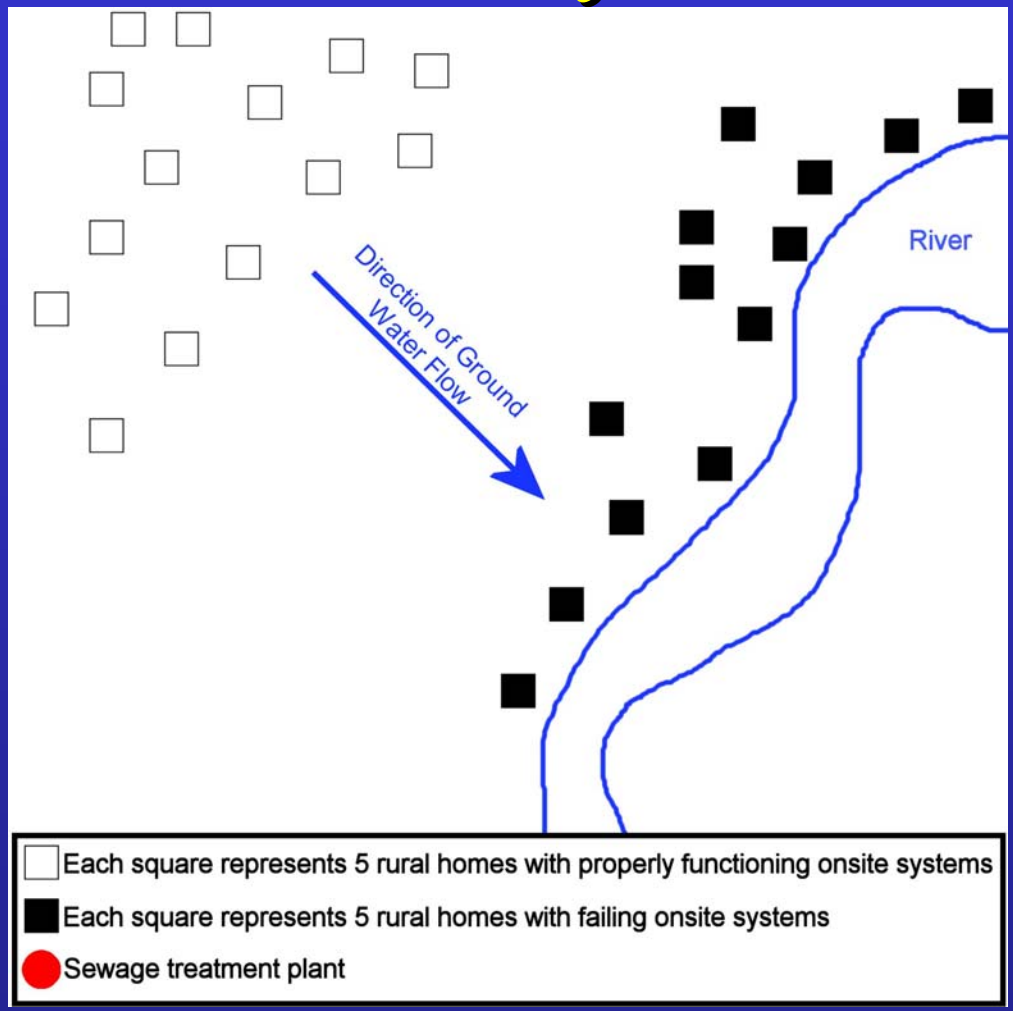
Scenario 1 – Cluster System

- collection
  - small diameter gra
    sewers
- treatment
  - septic tank
  - sand filter
  - leach field



Scenario 1 – On-Site System

- failing on-site systems
  - septic tank and leach field
- new on-site systems
  - septic tank
  - sand filter
  - leach field



Summary of Rural Community System Costs (1995 $)

System Option	Capital Cost	Annual O & M Cost	Total Annual Cost
Centralized System	$ 2,321,840	$ 29,740	$ 216, 850
Small Cluster System	$ 598,100	$ 7,290	$ 55,500
On-site System	$ 510,000	$ 13,400	$ 54,500
Rural community consists of 450 people in 135 homes			

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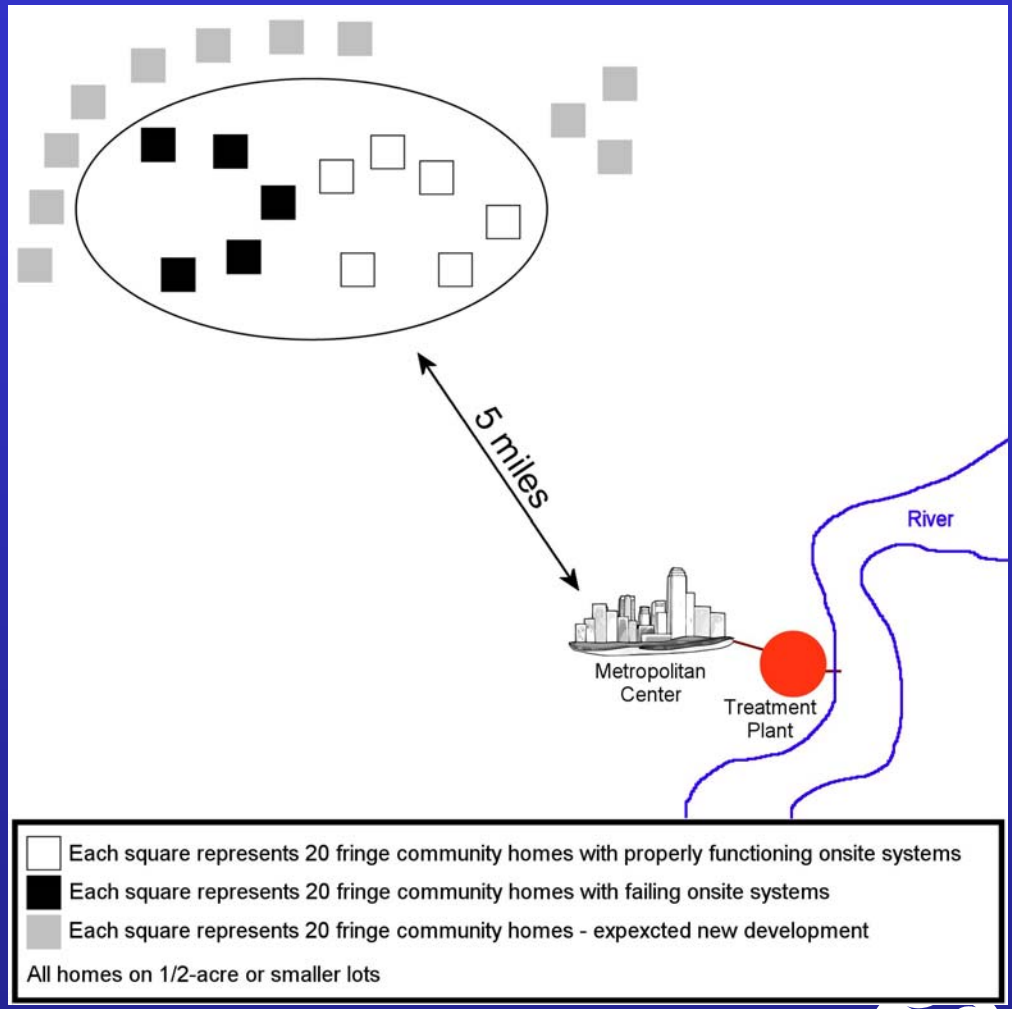
Scenario 2 – Fringe Community

- 770 people → 1550 people
- 220 homes → 443 homes
- ½ acre lots
- 50% (110 homes) failed on-site systems



Summary of Fringe Community System Costs (1995 $)

System Option	Capital Cost	Annual O & M Cost	Total Annual Cost
Centralized Systems			
•at 5 miles from existing sewer	$ 5,377,800	$ 95,900	$ 529,300
•at 1 mile from existing sewer	$ 3,322,900	$ 83,800	$ 351,600
Small Cluster Systems	$ 3,783,700	$ 18,000	$ 322,900
On-site Systems	$ 2,117,100	$ 59,240	$ 229,900
Fringe community consists of 1,550 people in 43 homes (includes future growth)			

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Conclusion

- A decentralized system is generally cost effective for:
  - rural community
  - fringe community

    (except when situated very close to an existing centralized system)

- Each case based on site-specific considerations

Presentation Format

- Definitions
- Technology Options
- Centralized vs. Decentralized Cost Comparison
  - decentralized system could be cost effective
- Elements for Program Success

Elements for Program Success

- appropriate technology
- responsive regulation
- adequate finance
- tighter management

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Appropriate Technology

- technology certification/verification
- innovative technology demonstration
- education and training

Responsive Regulatory Control

- harmonize regulation coverage
- performance-based limits (vs. prescriptive codes)
- inspection and monitoring
- enforcement
- licensed/certified practitioners

Adequate Financing

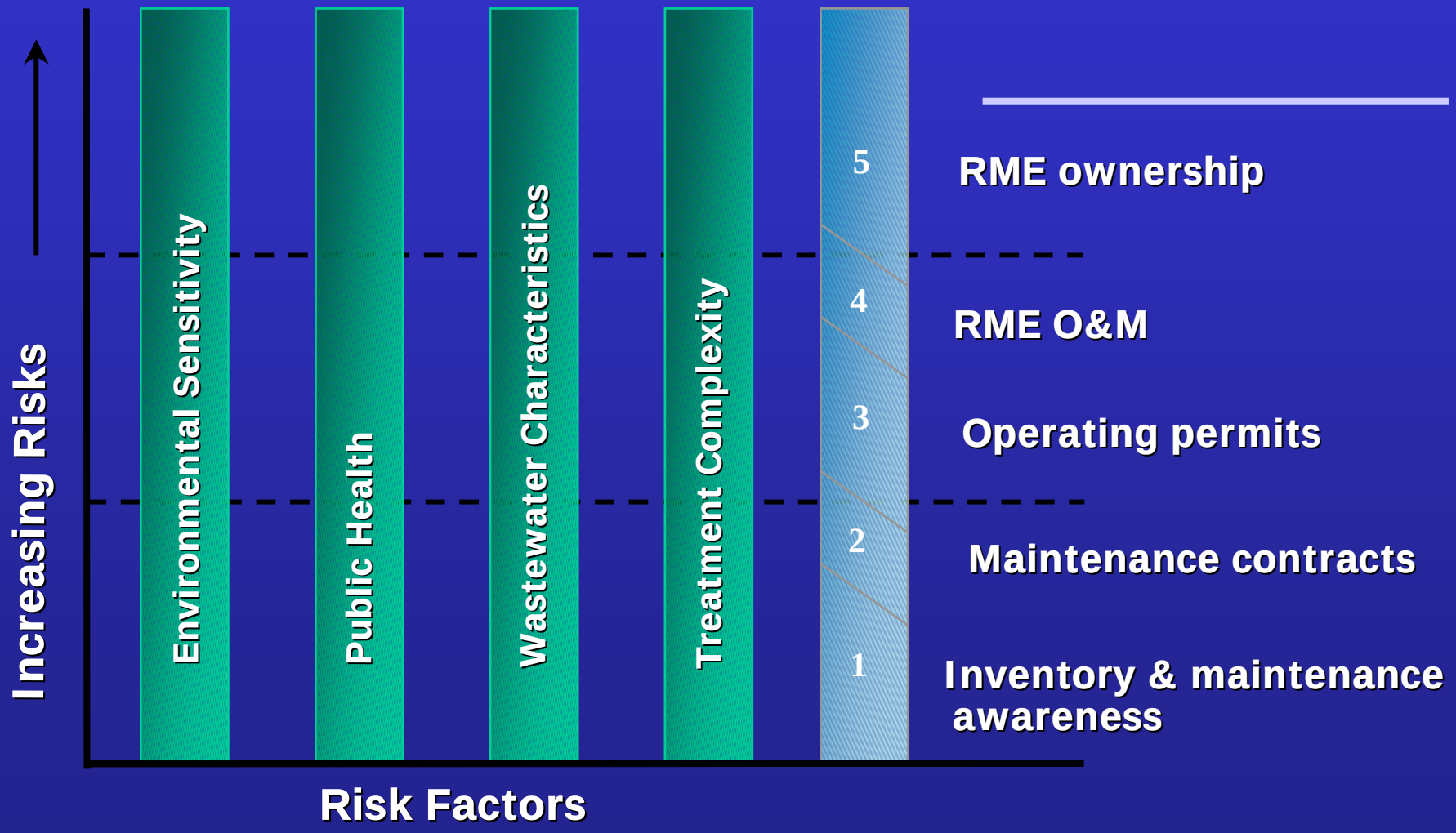
- government grants
  - equitable distribution
- revolving funds
- amalgamation to district organization
- public-private partnership

EPA Proposed Five Levels of System Management

1. homeowner awareness
2. maintenance contracts
3. operating permits
4. RME operation and maintenance
5. RME ownership/management

* RME = Responsible Management Entity

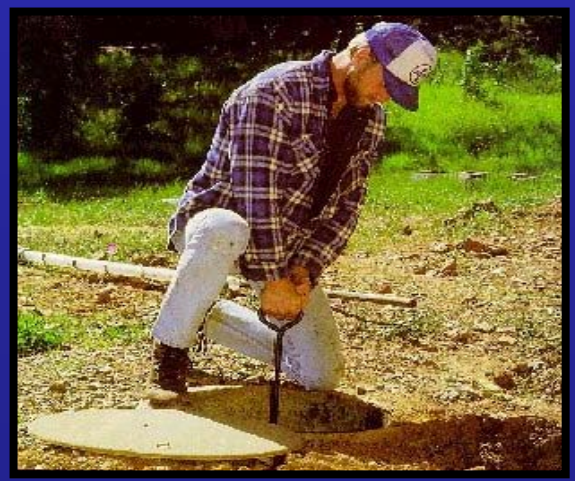
Application of the Management Levels



MANAGEMENT LEVEL 1

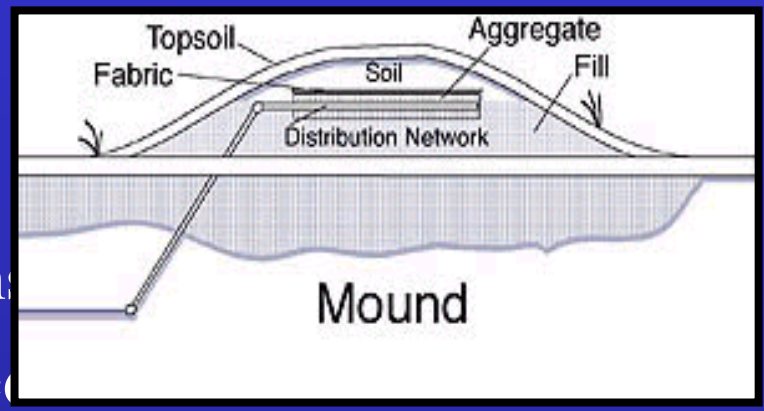
Homeowner Awareness of Maintenance Needs

- Covers conventional septic systems
- Low environmental sensitivity
  - i.e., adequate space, separation distance, etc.
- Local agency is aware of system locations
- Periodic operation and maintenance reminders



MANAGEMENT LEVEL 2
Maintenance Contracts

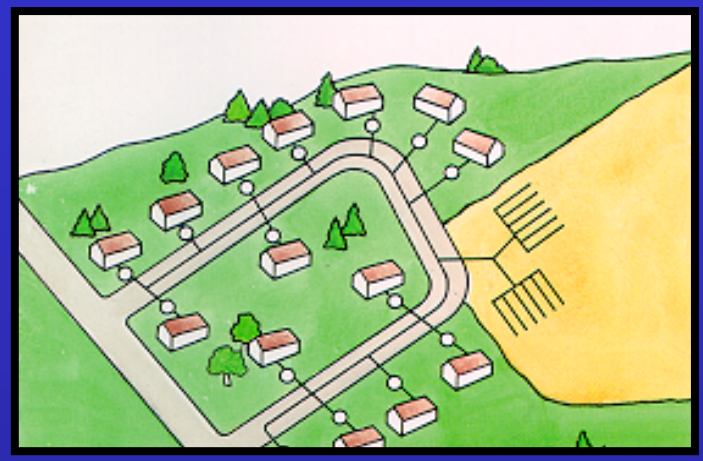
- Complex systems given more attention
  - e.g., mounds, pressure dosed systems
- Maintenance contracts with trained service providers



MANAGEMENT LEVEL 3

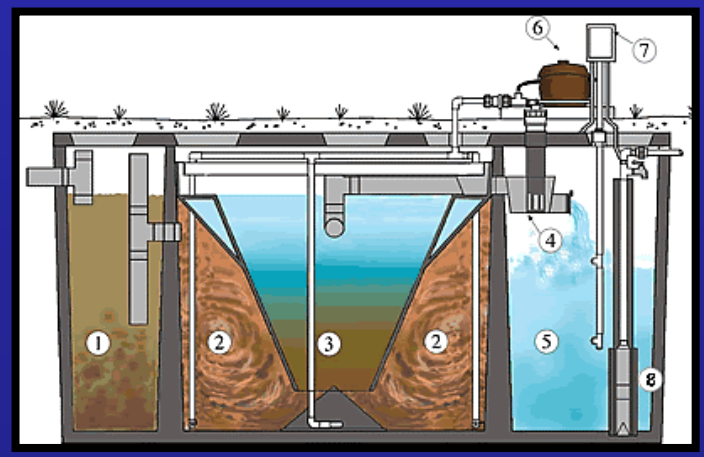
Operating Permits

- Minimum for clusters, aerobic units, large capacity systems



- Sensitive sites
  - lakes, aquifers

- Renewable operating permits
  - Performance requirements
  - Regular monitoring and reporting



MANAGEMENT LEVEL 4
Responsible Management Entity
Operation and Maintenance

- Very sensitive areas - recreational uses, wellhead protection

- Responsible Management Entity for operation and maintenance
  - Systems still owned by homeowners
  - RME performs routine inspections & maintenance
  - ensures consistent performance

MANAGEMENT LEVEL 5
Responsible Management Entity
Ownership and Management

- Ultra sensitive environment and public health protection
- Same as Level 4, except RME is owner
  - Professional management of all activities
  - Analogous to centralized collection and treatment

Canadian Case Study – Nova Scotia

- Guysborough (population 360)
- formed a wastewater management district
  - one cluster – small conventional treatment plant
  - one cluster – aerated lagoon
  - individual homes – septic tank and leaching bed
- all home owners paid $ 2,100 initially and have annual fees of $ 125 (in 1994)

Canadian Case Study – Nova Scotia

- 19 communities in Nova Scotia were considered
- 17 were recommended decentralized system
  - 3 formed Wastewater Management District (WMD)
  - 6 chose to centralize
  - 5 actively considering WMD
  - 5 in prolonged debate

- Problems
  - equity costs and services
  - public perception favours centralized system

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- Definitions
- Technology Options
- Cost Comparison
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- Elements for Program Success
  - technology
  - responsive regulation
  - adequate finance
  - tighter management

Examples of Provincial Initiatives

- Nova Scotia – wastewater management district
  – centre for water resource studies
  – program review
- Newfoundland – technology demonstration
- Quebec – updated regulation
  - system maintenance
  - technology performance standards
  - new technology testing & certification

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Examples of Provincial Initiatives

- Ontario
  - municipal agreement for private systems
  - require septage treatment
  - Ontario rural wastewater centre
- British Columbia
  - new regulation for on-site systems
    - performance-based standards
    - O&M requirements
    - training and certification
    - enforcement

Future Coordination

- national body to coordinate efforts
  - harmonize provincial regulations
  - prioritize research
  - protocols for technology testing/certification/selection
  - national best practice
  - financing
  - continue dialogue among stakeholders

Acknowledgement

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