

# Onsite Wastewater Treatment and ~~Disposal~~

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Michigan Department of Environmental  
Quality

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# Overview

- Intro
- Brief History of Wastewater Management
- A New Paradigm
- Wastewater Constituents and Treatment
- Permitting Wastewater in Michigan
- The Future for Wastewater in Michigan



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Public sector/Quality of life

**Michigan has nation's weakest regulations on septic systems**

14 May 2013

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Quality of life

**Michigan rivers polluted by human, animal waste more than double previous estimates**

22 January 2014

**Human fecal matter in Michigan's great rivers, and what to do about it**

Posted on: Thursday, October 29th, 2015 at 12:16 pm



The MSU team tested 64 river systems in Michigan's Lower Peninsula and found that 100 percent of the rivers were contaminated by human fecal matter, and that household septic tanks were a major source.



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Published: Aug. 3, 2015

**SEPTIC TANKS AREN'T KEEPING POO OUT OF RIVERS AND LAKES**



# Definition of Onsite aka “Decentralized WWT”

- Collection, treatment, and dispersal of wastewater at or near its point of origin
- Subsurface dispersal of effluent
- An alternative to conventional gravity sewers

# Four Categories of Onsite Systems

(per Crites/Tchobanoglous)

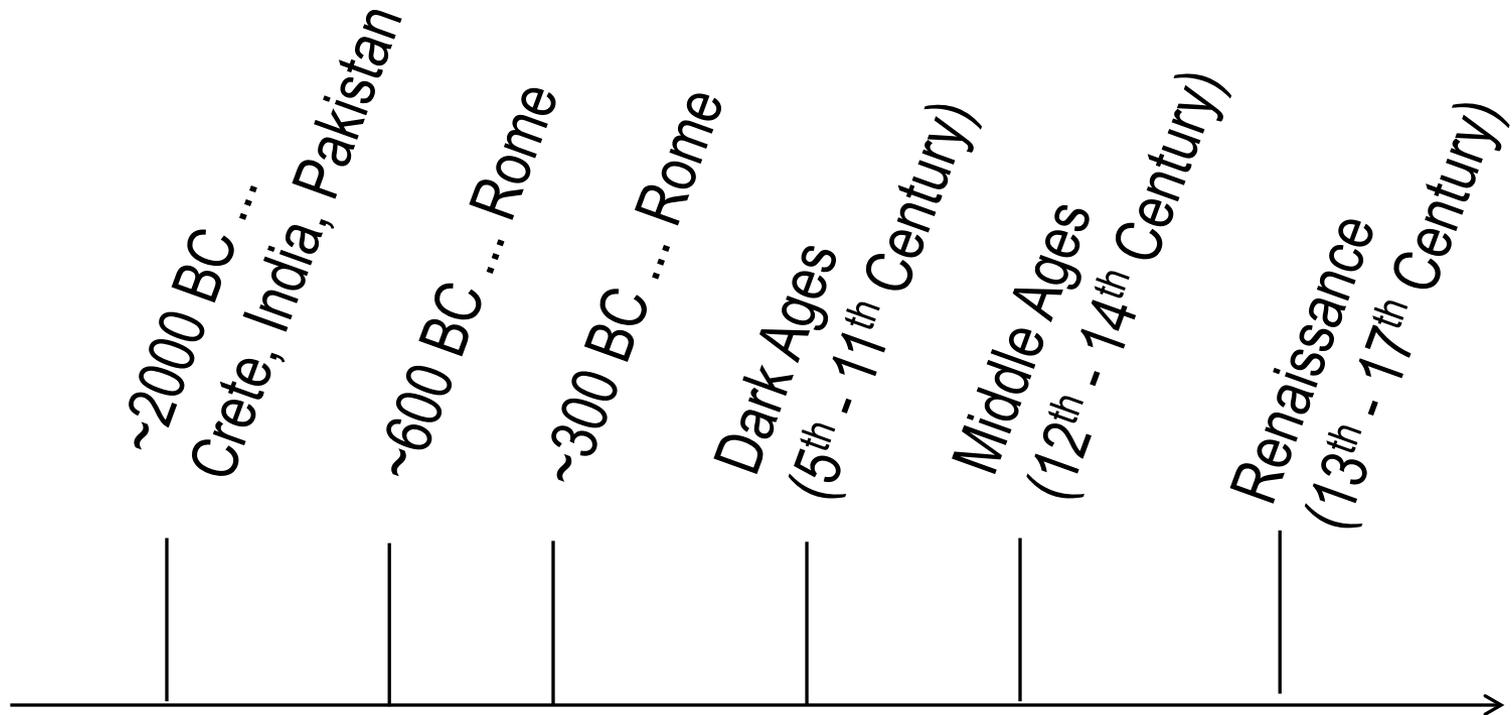
- Conventional (septic tank to soil absorption)
- Modified conventional (shallow trenches, pressure distribution)
- Alternative (mounds, constructed wetlands)
- Additional treatment (packed bed filters, aerobic treatment units)

# Prevalence of DWWT Today

- ~25% of US households use DWWT (Decentralized Wastewater Treatment)
- ~40% of new development uses DWWT
- 1.4 million DWWT Systems in Michigan



# Brief History of WWT\*



\* Onsite Wastewater Treatment Systems, *Bennette Burks and Mary Margaret Minnis, 1994.*

\* Onsite

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# Brief History: 19<sup>th</sup> Century

- Mid-1800's
  - Water added to open sewers
  - Tank systems designed to collect, settle, and liquefy solids
  - Sewage applied to agricultural land
- 1860's, London
  - Sir Edward Frankland treated sewage using different soils and dosing rates

# Brief History: Later 19<sup>th</sup> Century

- 1880's-1920's, Massachusetts
  - Experimental station at Lawrence established
  - Sand beds used to filter liquid effluent from tanks
  - Land area reduced for sewage disposal
  - 26 communities construct and use ISF's
- 1896 Septic Tank Regulation in Skaneateles Lake
  - Syracuse's unfiltered water source still today

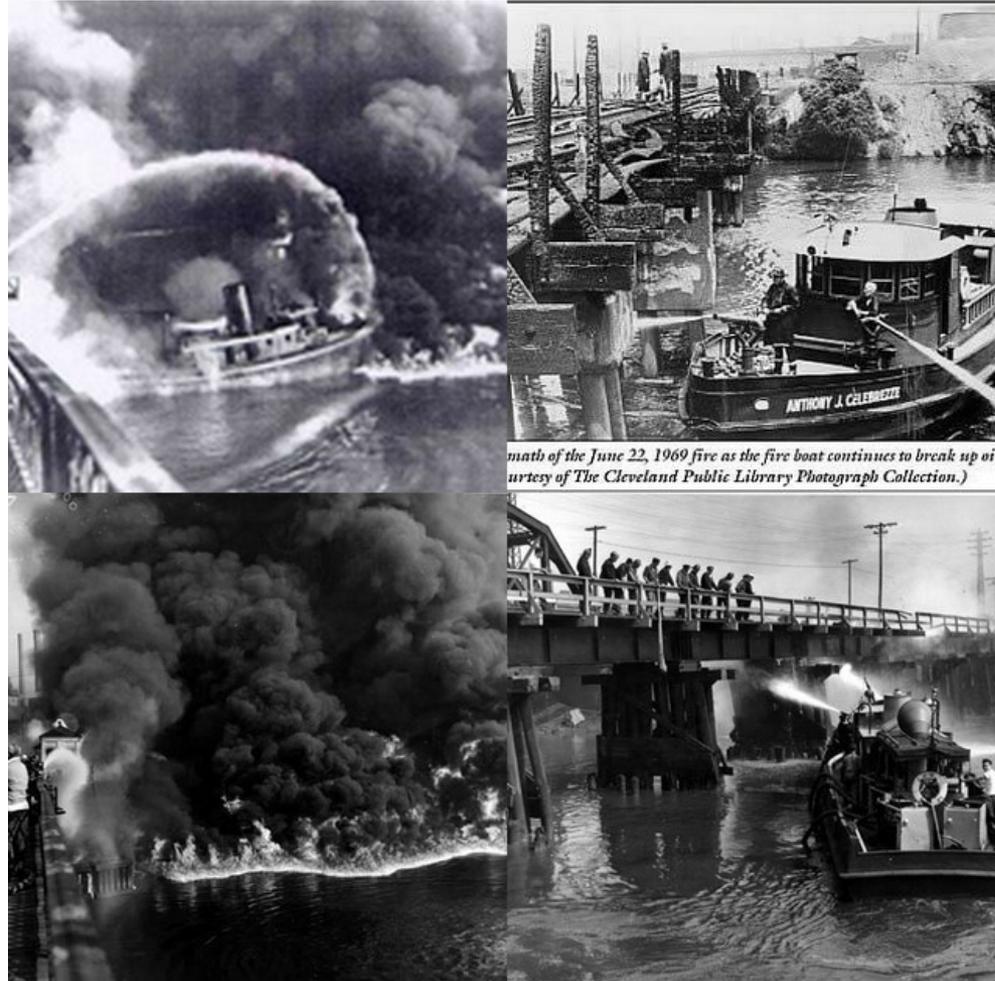
# Brief History: 20<sup>th</sup> Century

- 1940's and 50's, Florida
  - Documented effects of loading rates on sand sizes and depths
- 1960's, Mike Hines et al
  - Studies of recirculating sand filters

# Brief History: 20<sup>th</sup> Century Pre 1972



# Why is clean water mandated?



# Brief History: 20<sup>th</sup> Century

- **1972 The Clean Water Act**
  - No one has the right to pollute.
  - Pollution continues because available treatment technologies are not used.
- National Pollutant Discharge Elimination System (NPDES) permits
- **The Sewer is Coming!**

# Paradigm Shift

- Old Paradigms
  - There Sewer is Coming!
    - Onsite Systems Temporary
  - Just get it to the waterway
    - It will go away!

# New Paradigm

- 1997, EPA's Response to Congress
  - Viability and cost-effectiveness of DWWT confirmed

*“Adequately managed decentralized wastewater systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas.”*

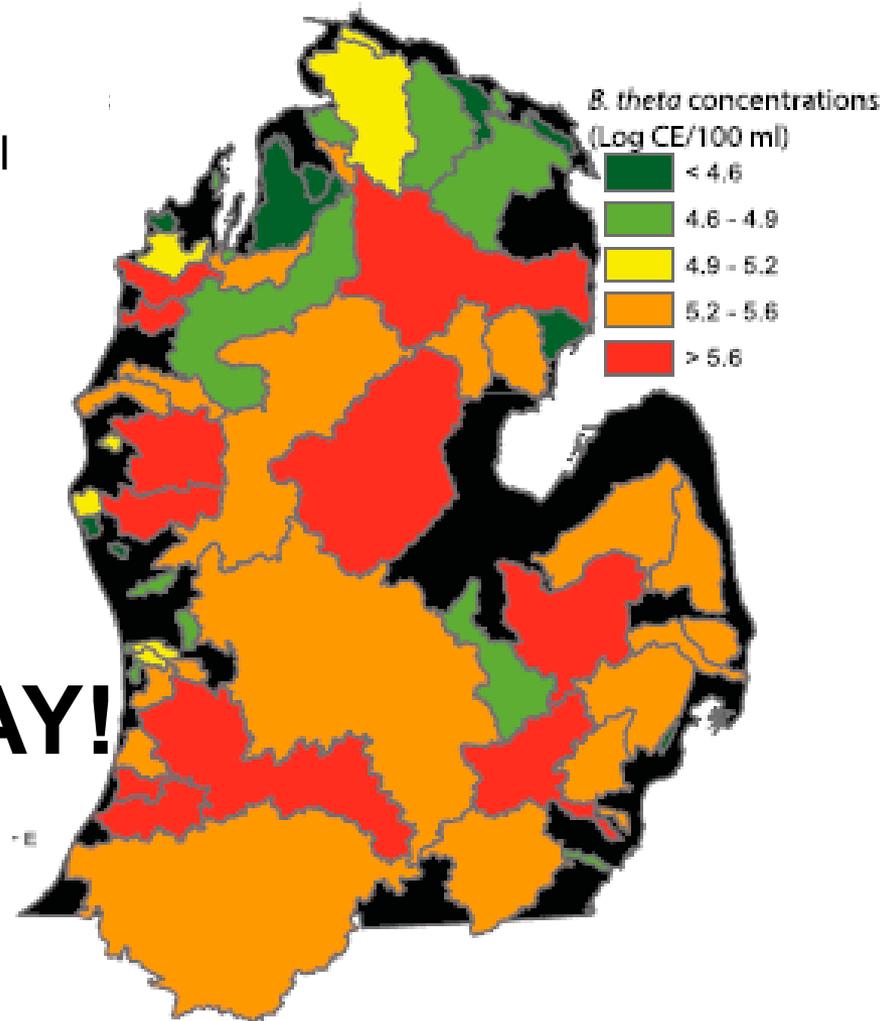
-- Executive Summary, Response to Congress  
US Environmental Protection Agency, 1997

- **The Sewer is Not Coming!**

# New Paradigm

MSU Study Linking Fecal  
Bacteria in Rivers to  
Sources .....

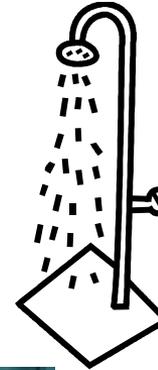
Septic Systems  
Linkage .....



**There is no AWAY!**

# What is wastewater

- Domestic Wastewater
  - Black Water
  - Gray Water
- Commercial
  - Domestic
  - High Strength
  - Process Water
- Storm Water



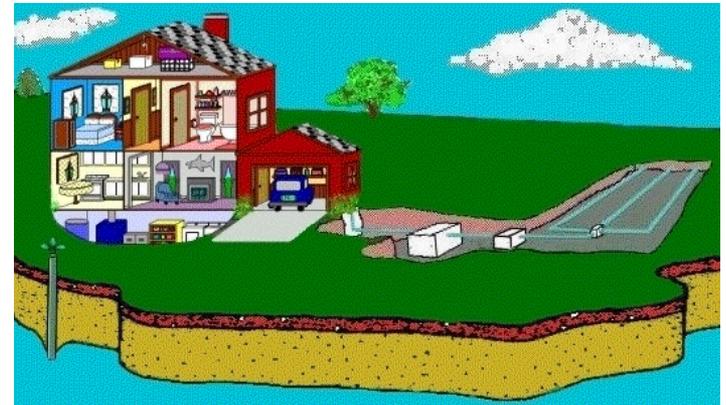
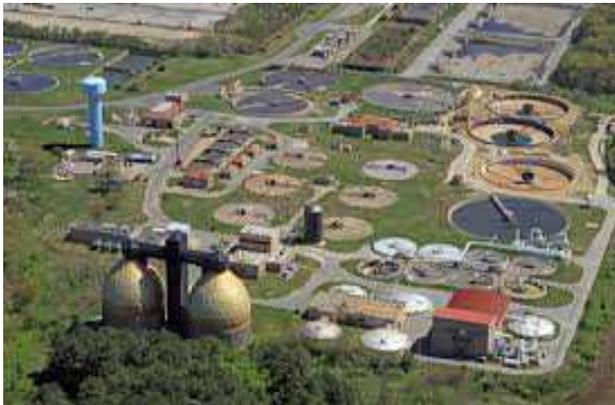
# Why do we care about onsite wastewater management

- Protection of Public Health
- Protection of the Environment
- Cost, cost, cost
- Jobs



# How do we manage WW

- Centralized
  - Planned as a quality of life right
- Decentralized
  - Once thought to be temporary
  - Recognized as long-term solution



# What is in wastewater

- Biodegradable organics
- Total suspended solids
- Nutrients
- Pathogens
- Inorganics

# What is in wastewater

- **Biodegradable organics**

- Total suspended solids

- Nutrients

- Pathogens

- Inorganics

Biochemical Oxygen Demand = BOD<sub>5</sub> (mg/l)

-  = 350 mg/l  
= 140 mg/l (out)

-  = 800 mg/l to  
= 2,500 mg/l

-  = 100 mg/l to  
= 20,000 mg/l

- **Secondary treatment = 30 mg/l**

# What is in wastewater

- Biodegradable organics
- **Total suspended solids**
- Nutrients
- Pathogens
- Inorganics

Total Suspended Solids (mg/l)

-  = 350 mg/l  
= 70 mg/l (out)
-  = 200 mg/l to  
= 300 mg/l
- **Secondary treatment**  
= 30 mg/l

# What is in wastewater

- Biodegradable organics
  - Total suspended solids
  - **Nutrients**
  - Pathogens
  - Inorganics
- Nitrogen = TN
- Phosphorous = TP
-  TN = 65 mg/l  
TP = 10 mg/l
  -  TN = 180 mg/l  
TP = 25 mg/l
- **Low impact Treatment Level**  
TN = 5 to 20 mg/l \*  
TP = 1 to 3 mg/l

# What is in wastewater

- Biodegradable organics
  - Total suspended solids
  - Nutrients
  - **Pathogens**
  - Inorganics
- Dysentery, hepatitis, gastroenteritis, typhoid fever,
- Bacteria
  - Viruses
  - Millions of pfu/100 ml

# Constituents are Removed Through ...

- Biological processes
- Chemical processes
- Physical processes

# Factors Affecting Removal

- Organic loading
- Hydraulic loading
- Hydraulic retention time
- Flow configuration
- Temperature
- pH

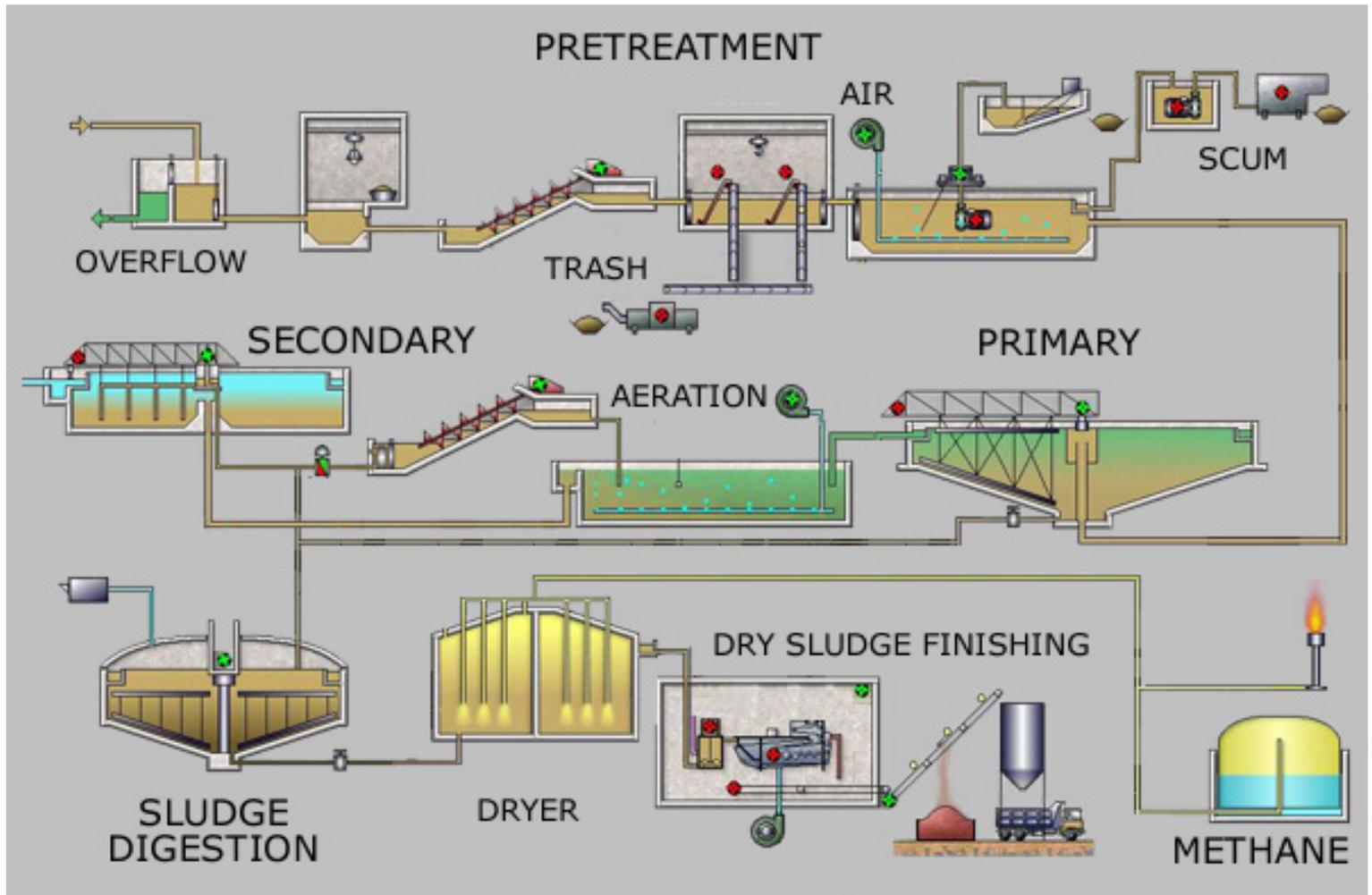
# Factors Affecting Removal, cont.

- Oxygen availability
- Grease and oil
- Inorganic solids (kitty litter, etc.)
- Toxins (cleaners, poisons)
- Medications/antibiotics

# Components of WW Treatment

- Collection
- Treatment
- ~~Disposal~~/Dispersal
  - It is a resource not a waste

# WWTP treatment

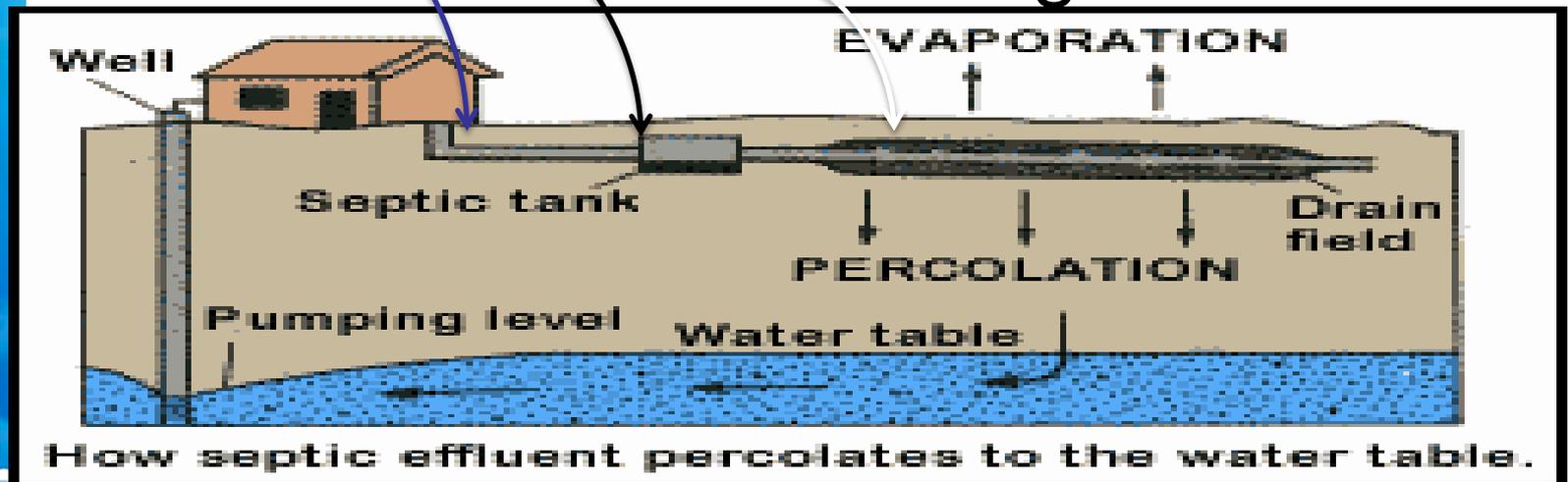


# On-site Treatment

Sewer Line = Collection

Septic Tank = Primary Treatment

Treatment & Dispersal =  
Process Treatment +  
Recharge



How septic effluent percolates to the water table.

# Septic Tank Primary Treatment

- Watertight and Structurally Sound
- Residency Time = Primary Treatment
- Differential Settling – Sinkers and Floaters



# On-site Treatment

- Soil Based

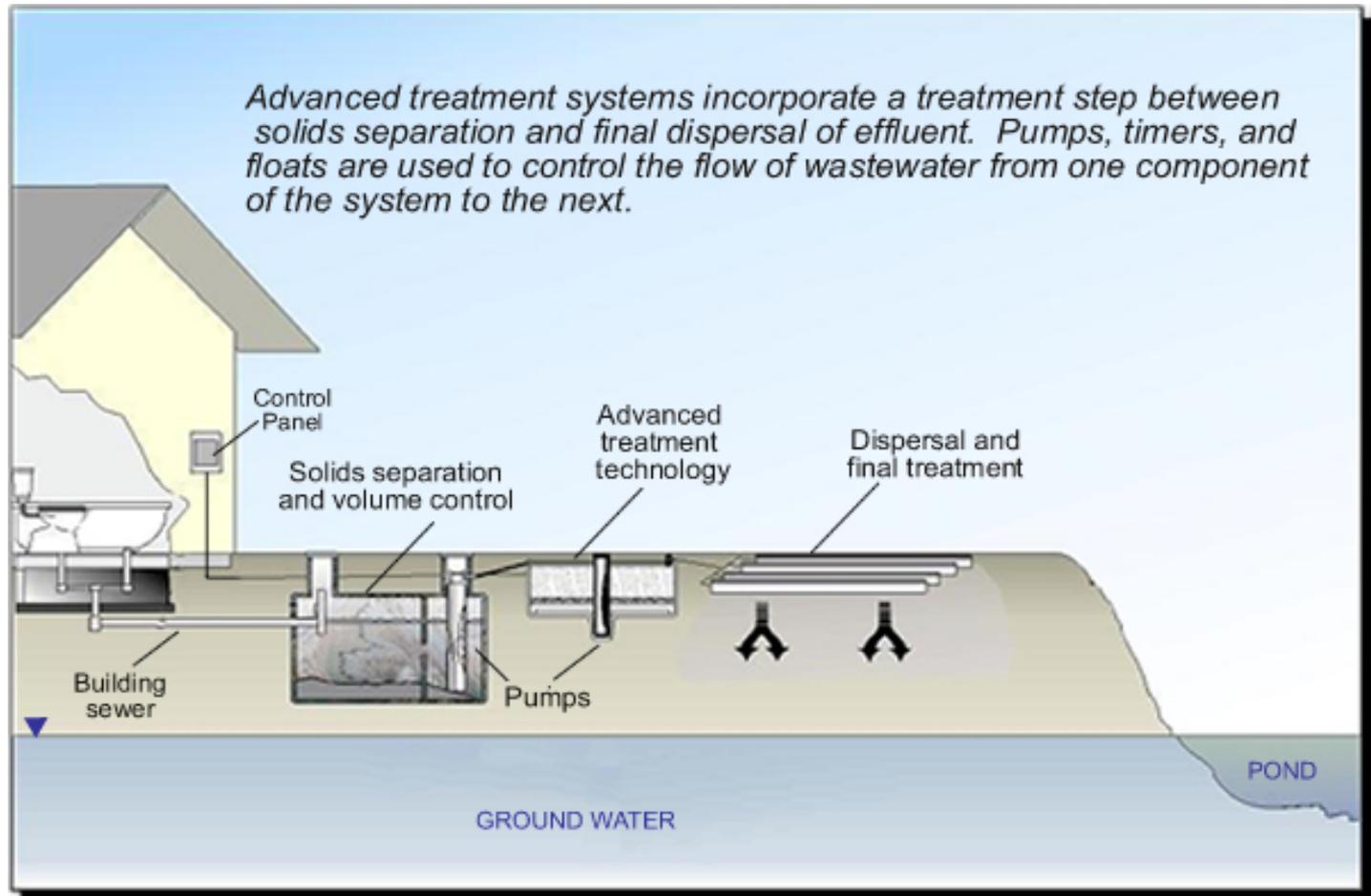


# Soil Based Treatment



# On-site Advanced Treatment

- Treatment



# Suspended Growth, Extended Aeration

- Microorganisms are suspended in liquid
- Microorganisms metabolize organic matter to  $\text{CO}_2$ ,  $\text{H}_2\text{O}$ , and cell mass
- Process generates activated sludge



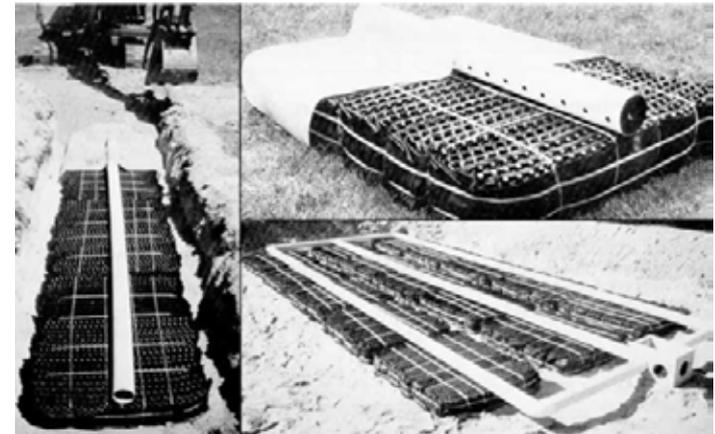
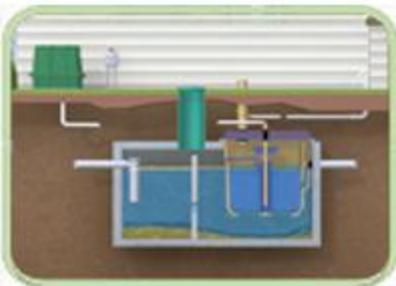
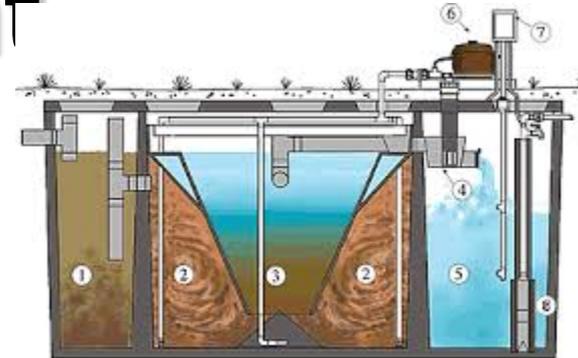
# Attached Growth

- Aerobic microbes attach and grow on media
- Wastewater flows across a zoogeal film created by microbes
- Microbes extract and digest soluble organic matter from the wastewater



# Onsite Advanced Treatment

- Treatment
  - BOD5 <30 mg/l
  - TSS <30 mg/l
  - TN & TP as required



# Permitting DWWT

- 44 Local Health Department Codes
  - Single and two family homes
  - Commercial domestic flow under 1,000 gallons per day
- Statewide Administrative Rules (Rules 560.401 to 560.428)
  - Subdivisions and Condominiums

# Permitting DWWT (cont)

- Michigan Criteria for Subsurface Sewage Disposal
  - Commercial domestic flow between 1,000 and 10,000 gallons per day
- Groundwater Discharge Permits
  - Flows above 6,000 gallons per day

# Groundwater Discharge Permits

- Approximately 250 permits for subsurface sanitary wastewater treatment systems.
  - 150 between 6,000 – 10,000 gallons per day
  - 100 greater than 10,000 gallons per day

# Rule 2204

Underlying requirements for all discharges, including those exempt from permit requirements.

# Rule 2204 Discharge Requirements

- Shall not be or not likely to be injurious to protected uses
- Shall not cause runoff to, ponding on, or flooding of adjacent property, shall not cause erosion, and shall not cause nuisance conditions
- Shall be located not less than 100 feet inside the property boundary, unless a lesser distance is approved by rule or specifically approved by DEQ.

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# Rule 2204 Discharge Requirements

- Shall be isolated from water supply wells
  - Rules 2211, 2213, 2215, 2216
    - 200 feet from Type I or Type IIa wells
    - 75 feet from Type IIb or Type III wells
    - 50 feet from domestic wells
  - Rules 2218
    - 2,000 feet from Type I or Type IIa wells
    - 800 feet from Type IIB or Tyle III wells
    - 300 feet from domestic well

# Rule 2204 Discharge Requirements

- Shall be consistent with surface water quality standards
- Shall not cause a facility under Part 201 of the NREPA

# Permit Exemptions – Rule 2210(a)

- Sanitary sewage if not mixed with other wastes if:
  - Less than 1,000 gallons per day and system is approved by health department having jurisdiction either under local sanitary code, or Michigan Subsurface Criteria
  - Less than 6,000 gallons per day and system designed and constructed under Michigan Subsurface Criteria and approved by local health department having jurisdiction

# Permit Exemptions – Rule 2210(y)

- A discharge determined by the DEQ to have an insignificant potential to be injurious based on the volume and constituents.
- DEQ shall follow public notice procedures
- DEQ may establish criteria, limitations, or conditions applicable to the discharge to ensure that it meets the terms for an exemption.
- Generally used for subsurface systems less than 20,000 gallons per day

# Rule 2211 Notification

Sanitary Sewage if the volume of the septic tank or tanks is 6,000 gallons or more or if the flow is more than 6,000 gallons per day, but less than 10,000 gallons per day if following provisions are complied with:

- Sanitary sewage is not mixed with other wastes
- System designed and constructed under Michigan Subsurface Criteria and approved by local health department having jurisdiction
- Discharge is monitored by a flow measurement device
- Discharger shall record average daily flow on a weekly basis and total annual flow. Report by January 31 of each year

# Rule 2216 Permits

Sanitary sewage, less than 20,000 gallons per day

- Rule 2216(2)(a) – constructed wetlands
- Rule 2216(2)(b) – alternative treatment systems providing similar quality effluent

If greater than 10,000 gallons per day, effluent monitoring and limits required under Rule 2232 for total inorganic nitrogen, phosphorus, sodium, chloride and pH.

# Rule 2218 Permits

- Few subsurface systems, generally larger volume, more complex discharges. Hydrogeological studies and groundwater monitoring required.

# Future of DWWT

- Per the Michigan Water Strategy
  - Need to set statewide minimum standards for systems based on risk levels.
  - Need to recognize all systems as infrastructure and manage appropriately based on potential risk.

# Contact Information

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