WDEQ Subdivision Program

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11/05/03

http://deq.state.wy.us

What is a subdivision?

W.S. 18-5-302 (a)(vii):

…the creation or division of a lot, tract, parcel or other unit of land for the immediate or future purpose of sale….for residential, recreational, industrial, commercial or public uses…

http://legisweb.state.wy.us

Purposes of WDEQ Subdivision Review

1. Ensure safe and adequate potable water supply for lot owners

2. Ensure safe and adequate wastewater disposal for lot owners

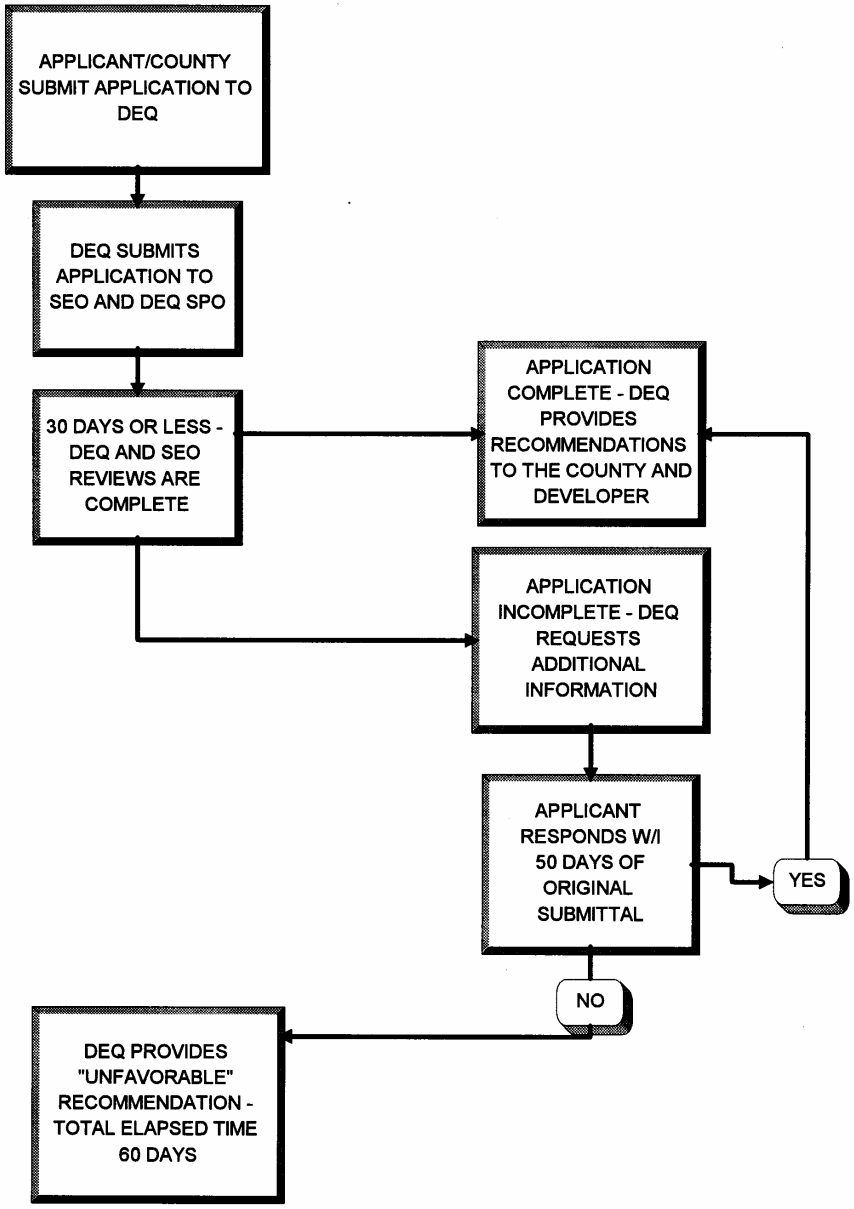
3. Protect ground and surface waters from effluent pollution (nitrates, pathogens including bacteria and virus')

Purposes of WDEQ Subdivision Review

4. Avoid costly taxpayer financed retrofitting of improperly installed on-site or centralized systems

5. Fulfill requirements of W.S. 18-5-306

WDEQ Timeline Flowchart



WDEQ Conclusions/Recommendations

- Made to the Board of County Commissioners
- Board decides to accept or reject
- Conclusions/recommendations are put on the plat for potential buyers to review

Exemptions for DEQ review:

- Gift or sale to "family" members
- Lots 35 acres or larger
- Land divisions by court order (eminent domain)
- Easements, rights-of-way, cemetery lots
- Located within incorporated cities and towns
- Re-alignment of property boundaries
- Each Board of County Commissioners may exempt DEQ from reviewing up to 5 lot subdivisions (13/23 so far)

Subdivision Water and Sewer combinations

- On-site water, on-site sewer
- On-site water, centralized sewer
- On-site wastewater, centralized water
- Centralized water, centralized sewer

Connection to an existing centralized water supply and/or sewage system

- Letter required from the system stating that they can and will provide water and/or sewer service to the new subdivision

- Evidence that the centralized system is incompliance with existing federal and state laws (e.g. EPA, NPDES)

On-Site Water Supply Systems

- Determine aquifer and use class
- Water quality must be acceptable with or without treatment
- On-site well(s) will not be adversely impacted by proposed sewage system(s) - 2 year travel time
- Upgradient and downgradient pollution sources do not pose a problem

Classification of Groundwater
(WDEQ Chapter 8)

- **By ambient water quality**

  Class I (potable) TDS< 500 mg/L

  Class II (agriculture) TDS< 2,000 mg/L

  Class III (livestock) TDS < 5,000 mg/L

  Class IV (A) TDS < 10,000 mg/L

  Class IV (B) TDS > 10,000 mg/L

- **By use**

  Potable use is always Class I

  Use can be determined by SEO permit

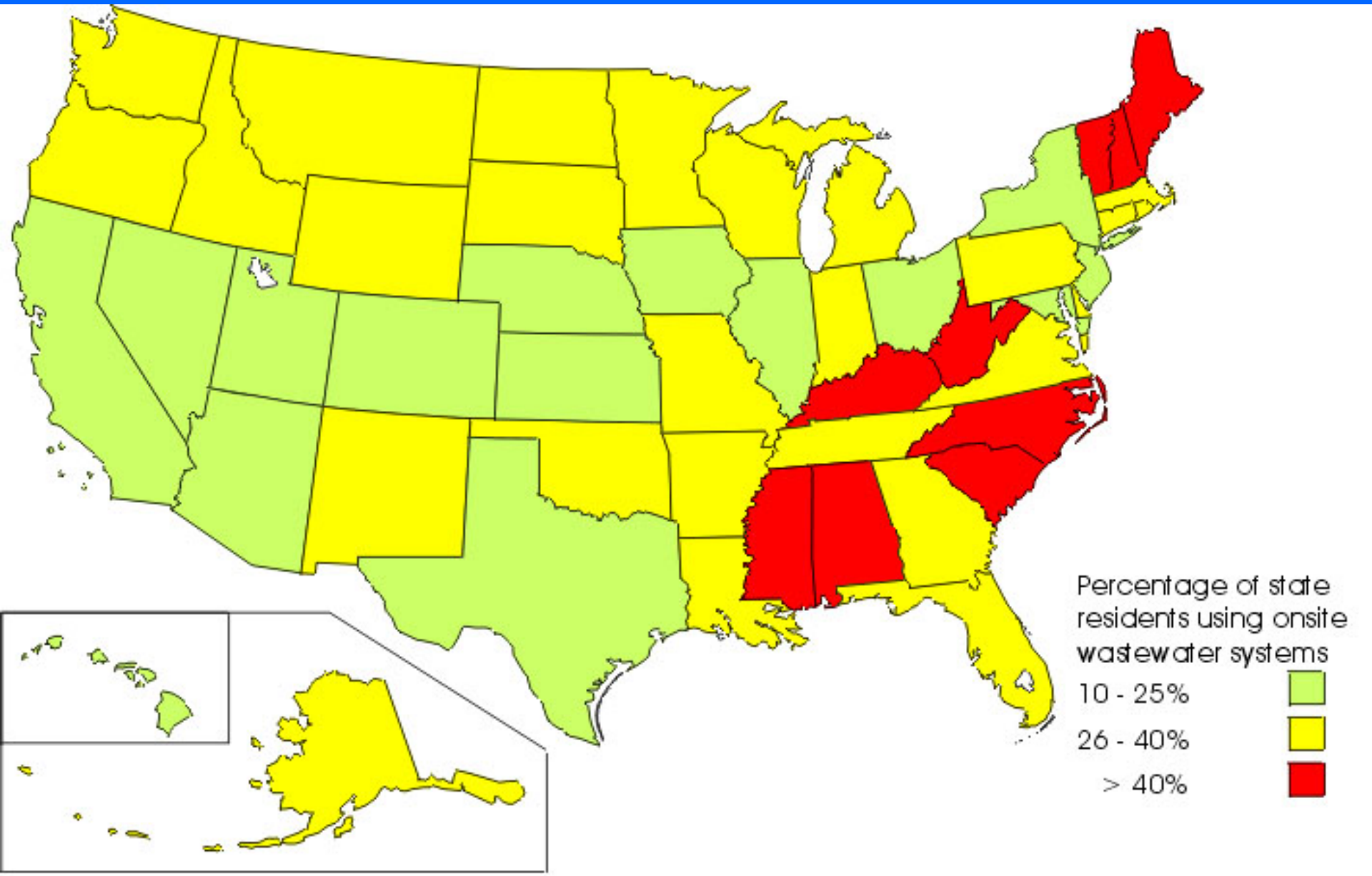
Water Quality Analysis

- TDS
- NO_3
- Total COL
- SO4
- Ca
- Mg
- Na
- Cl
- Fe
- Zn
- Pb
- Fl
- Mn
- Cu
- As
- pH
- Others deemed necessary

Water Quantity/Rights

- The State of Wyoming constitutionally owns all waters of the State
- An engineering/geologic report forwarded to State Engineer's Office for review of Water Quantity and Water Rights
- Contact: Mike Ebsen 777-6166

On-site Systems in the U.S.



Source: U.S. Census Bureau, 1990

The two essential tasks of on-site wastewater systems:

- **Purification** – remove the bad stuff:
  - Organic matter (BOD)
  - Pathogens – virus, bacteria
  - Nutrients
  - Household chemicals and other pollutants

- **Dispersal** – safely return effluent to the environment

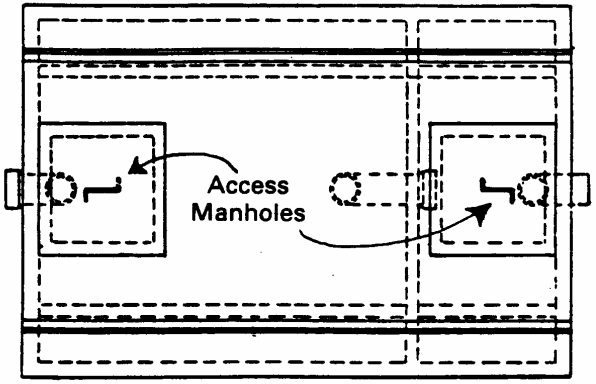
On-site Wastewater systems

- Soil percolation tests
- Impermeable layers & shallow water table
- Setback distances (wells, property boundaries)
- 2 year travel time (bacteria & virus')
- Nitrate loading calculations (unconfined/semi aquifers)

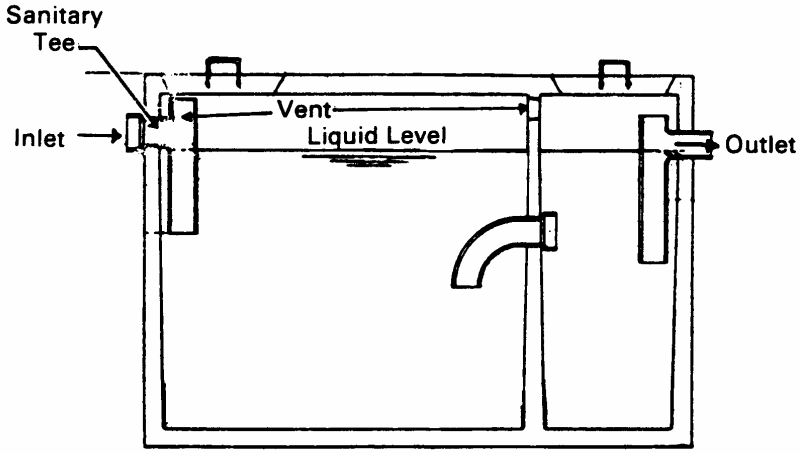
Special Circumstances

- Septic Systems discharge greater than 2,000 gpd require a UIC permit – or multiple septics within a 5 acre circle under the same ownership
- Commercial septic system requires a UIC permit
- Surface discharges to creeks/streams requires a NPDES permit
- DEQ may delegate the subdivision review program to any County that is technically proficient

Typical Two-Compartment Septic Tank

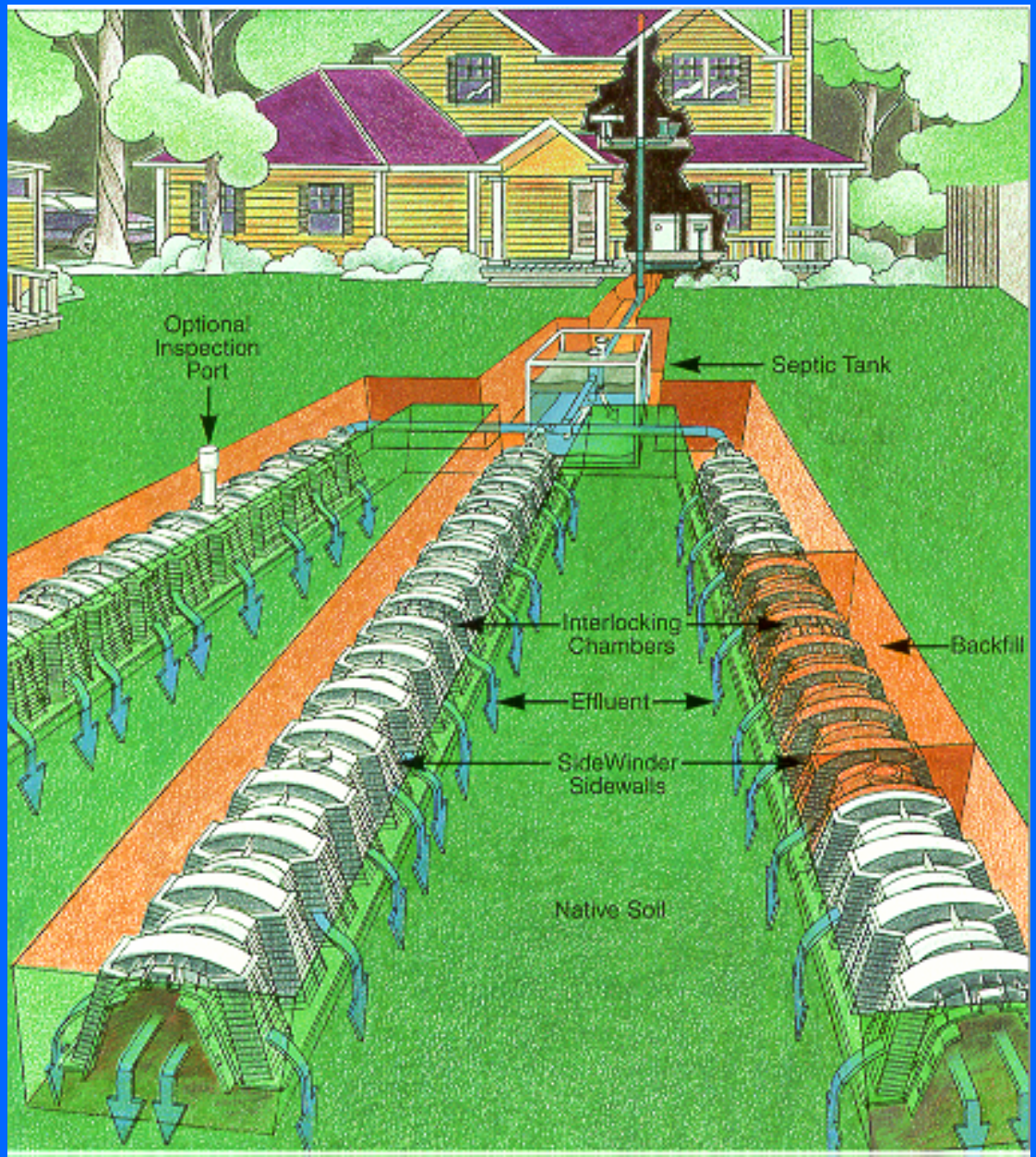


Plan

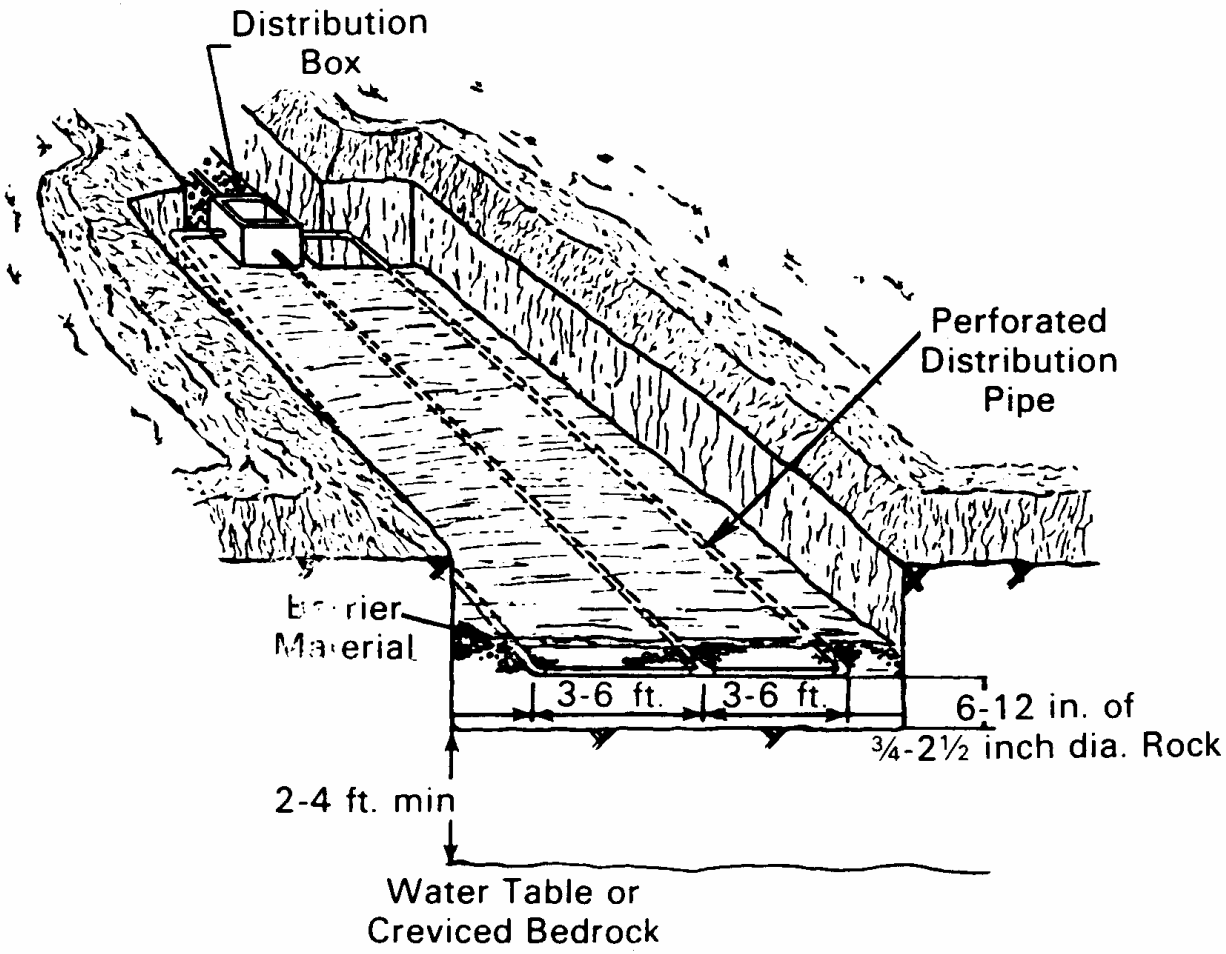


Longitudinal Section

Chamber Cross-Section



Typical Bed System



Tank with Mound System Cross-section

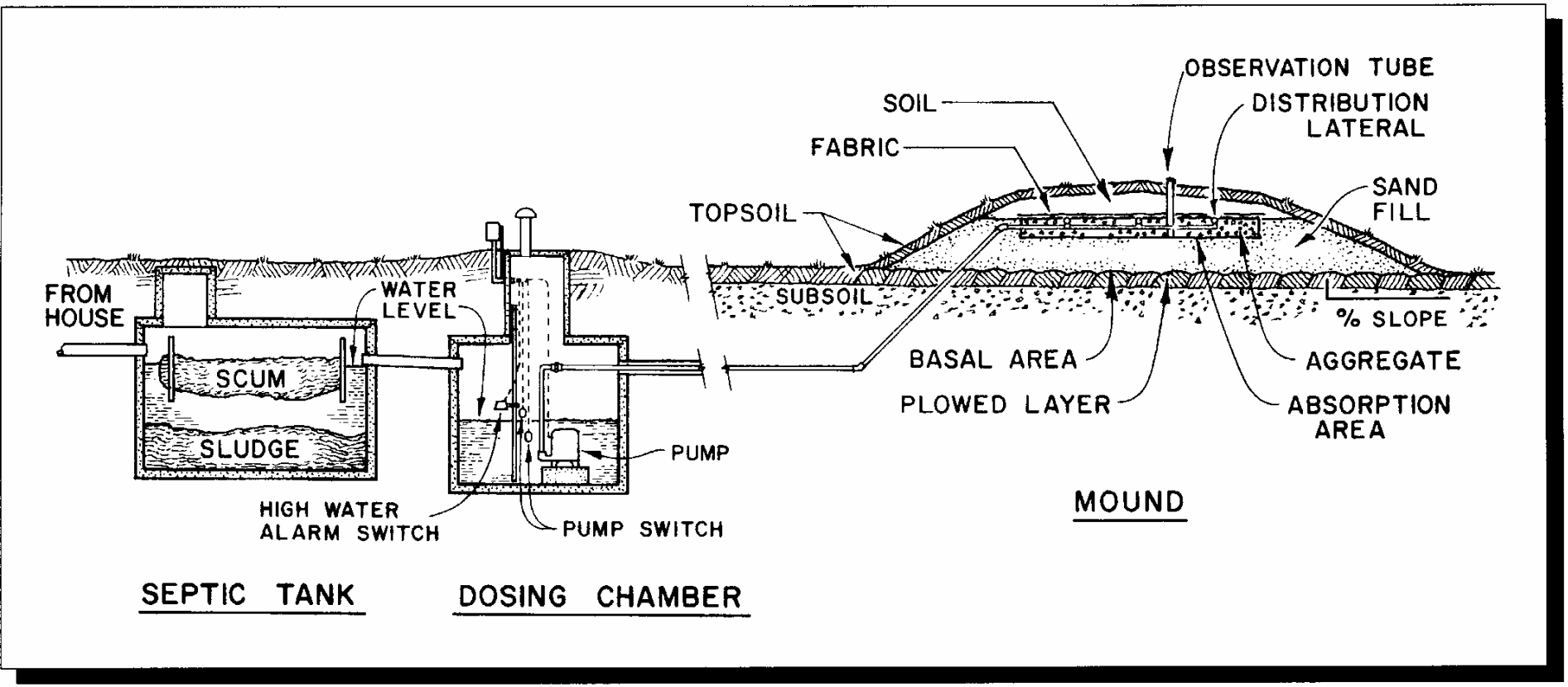


Figure 1: Schematic of a Wisconsin Mound System

Mounded Systems (Advantages)

- Allows septic systems in high water tables or shallow bedrock
- No direct discharges to surface waters
- Little excavation required
- Used in most climates
- Can be used as “enhanced” systems w/modification

Mounded Systems (Disadvantages)

- Higher costs for construction and use
- Mound location may limit land use
- Possible leakage outside of mound
- Requires pumps or siphons
- Aesthetically displeasing

Estimated Number of Years to Pump Septic Tank
(Rule of Thumb)

	Number of People in Household					
Tank Size (gal)	1	2	3	4	5	6
1000	12.4	5.9	3.7	2.6	2	1.5
1500	18.9	9.1	5.9	4.2	3.3	2.6
2000	25.4	12.4	8	5.9	4.5	3.7

Pump more frequently with garbage disposal

Source: Montana State University

Ch 23 Required Appendices

- **Wehrmann mass balance nitrate loading model (Appendix A)**
- **2 year ground water travel time between wells and leachfields (Appendix B)**
- **Public supply nitrate loading w/i well capture zone (Appendix C)**

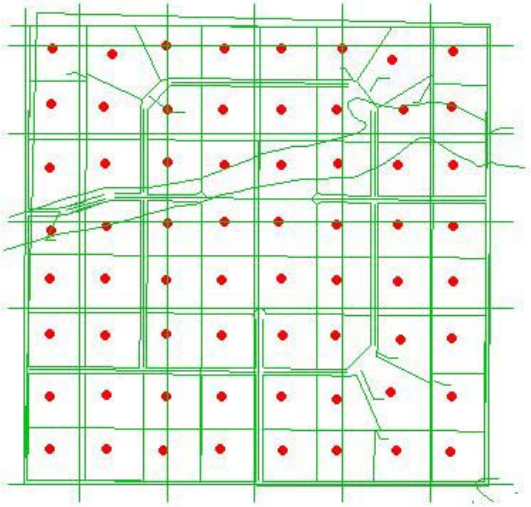
(Spreadsheets and example problems are found on WDEQ website…)

Appendix A Analysis

(Wehrmann Nitrate Loading Analysis)

$$Co = \frac{VbCb + ViCi + VsCs - VpCp}{(Vb + Vi + Vs - Vp)}$$

Septic System Locations

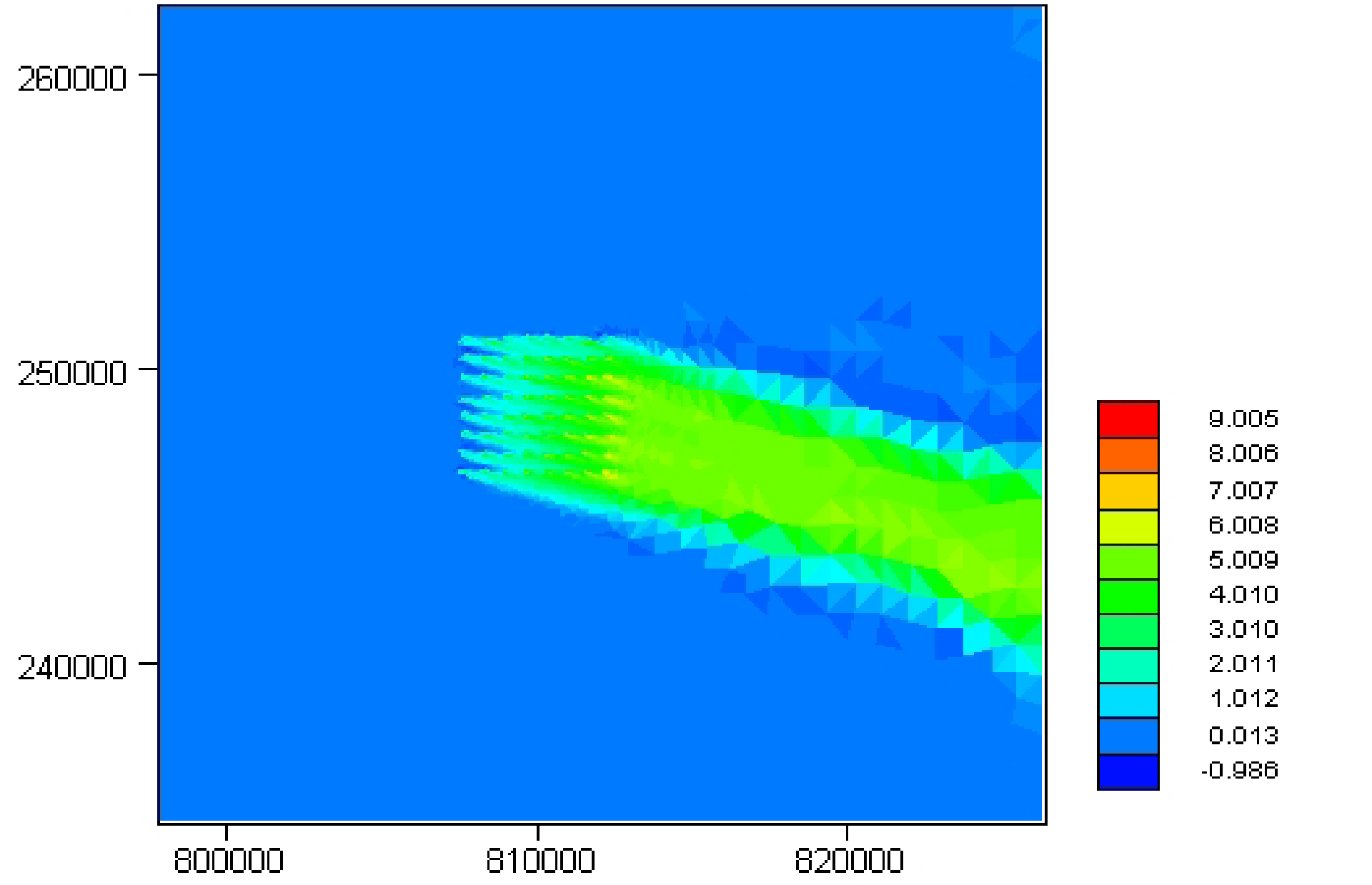


2000 0 2000 4000 Feet

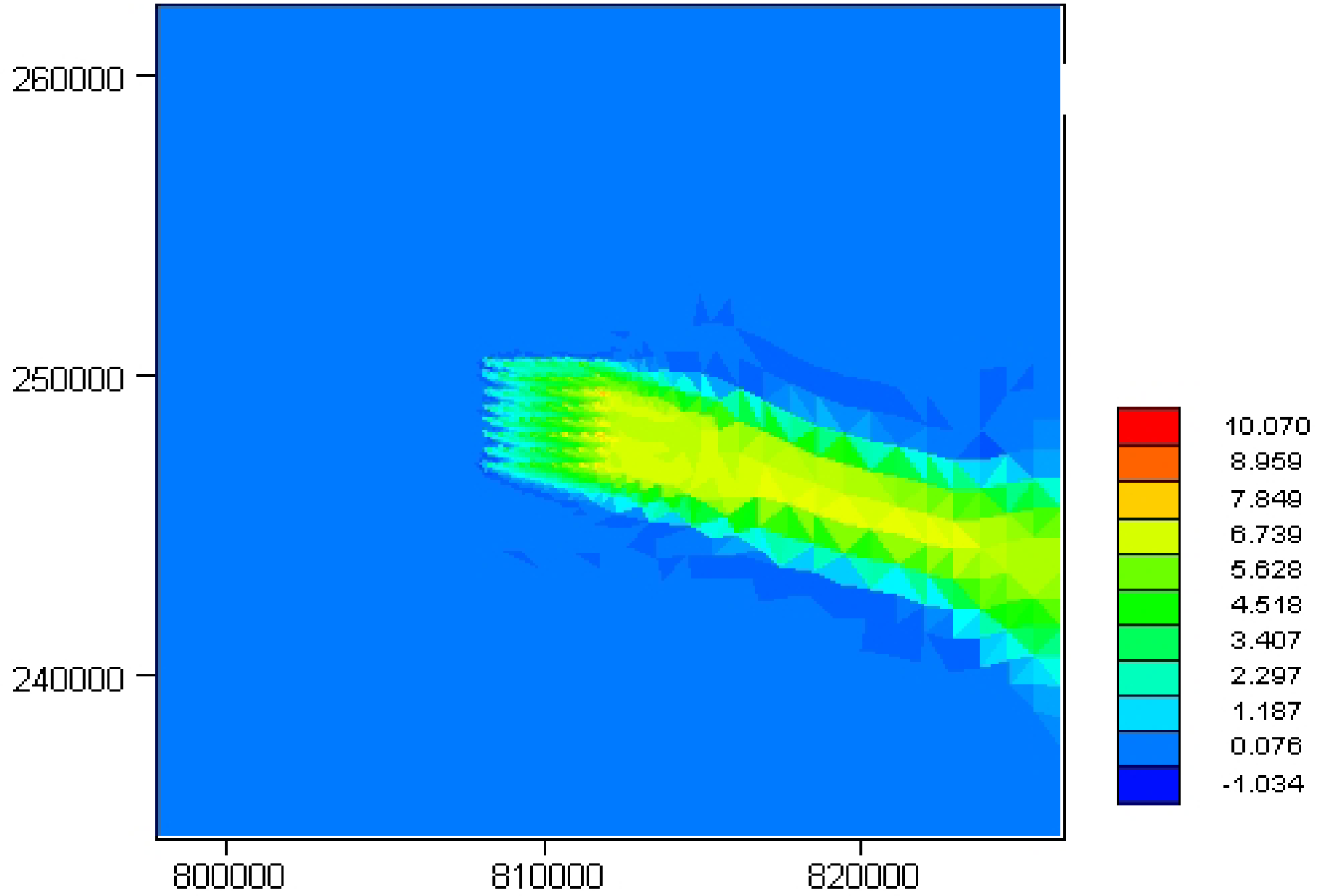
Plat Map
Septic System Locations

N
W E
S

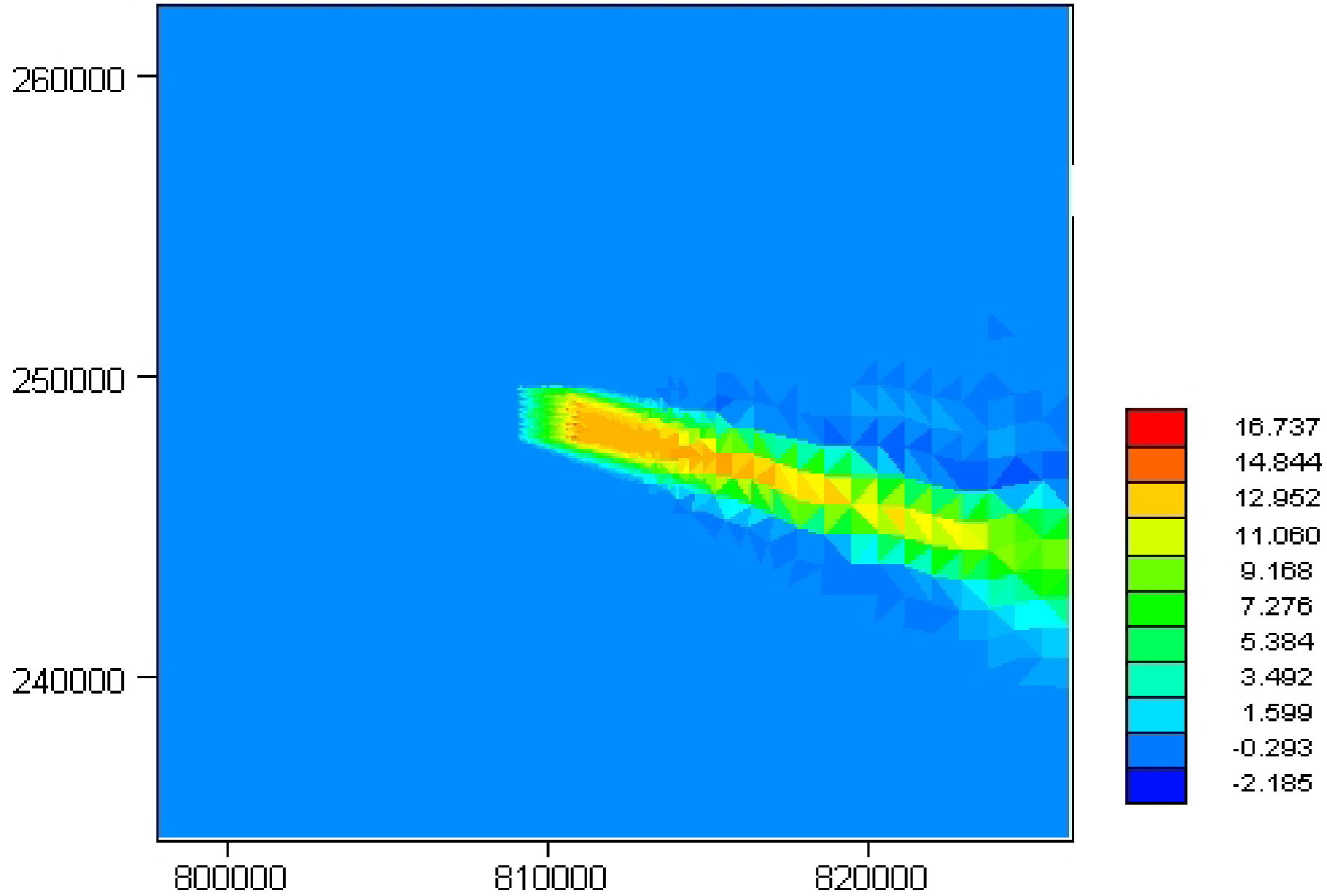
Steady-State Nitrate Concentrations (mg/L) for 64 septic systems on 10 acre lots

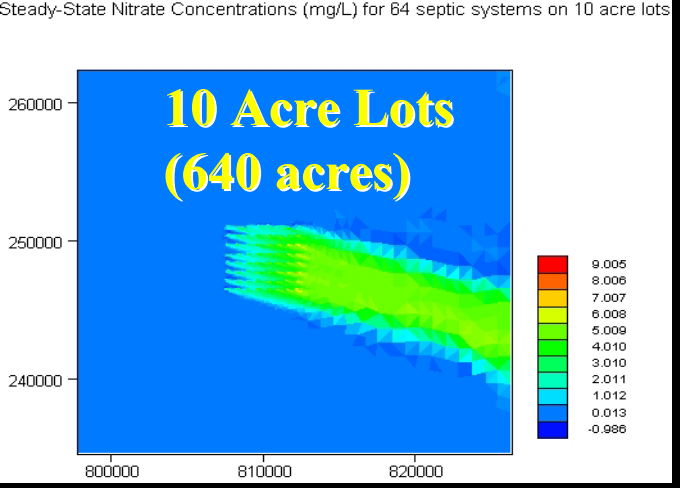


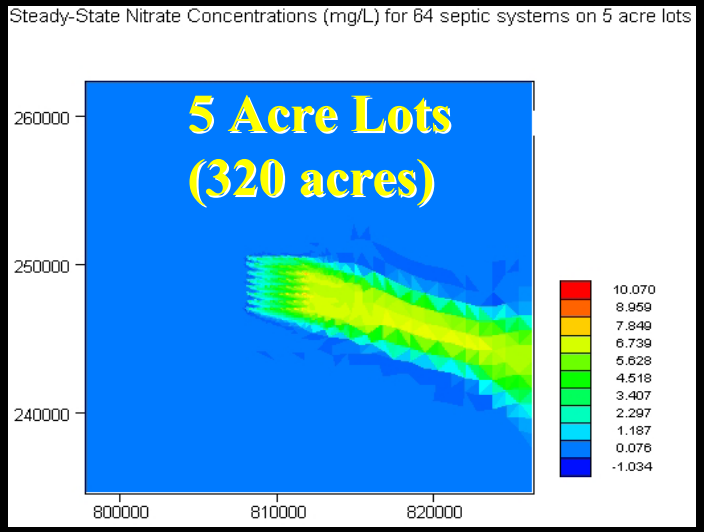
Steady-State Nitrate Concentrations (mg/L) for 64 septic systems on 5 acre lots

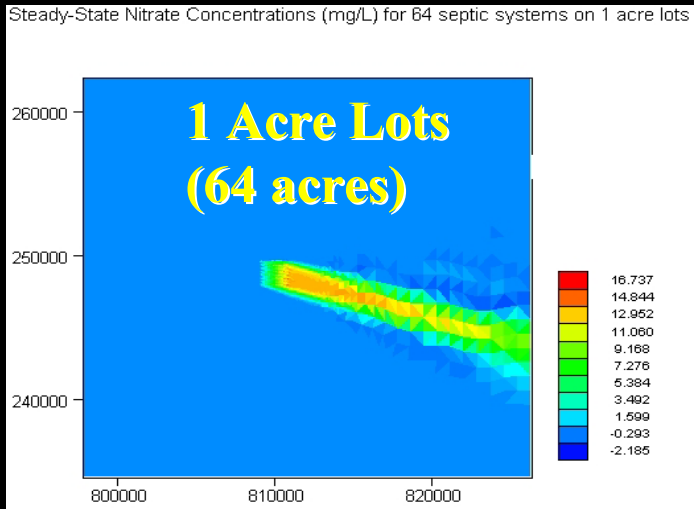


Steady-State Nitrate Concentrations (mg/L) for 64 septic systems on 1 acre lots




Steady-State Nitrate Concentrations (mg/L) for 64 septic systems on 10 acre lots
10 Acre Lots
(640 acres)
260000
250000
240000
800000
810000
820000
9.005
8.006
7.007
6.008
5.009
4.010
3.010
2.011
1.012
0.013
-0.986


Steady-State Nitrate Concentrations (mg/L) for 64 septic systems on 5 acre lots
5 Acre Lots
(320 acres)
260000
250000
240000
800000
810000
820000
10.070
8.959
7.849
6.739
5.628
4.518
3.407
2.297
1.187
0.076
-1.034


Steady-State Nitrate Concentrations (mg/L) for 64 septic systems on 1 acre lots
1 Acre Lots
(64 acres)
260000
250000
240000
800000
810000
820000
16.737
14.844
12.952
11.060
9.168
7.276
5.384
3.492
1.599
-0.293
-2.185

Appendix B Analysis

(Minimum Isolation Distance Analysis)

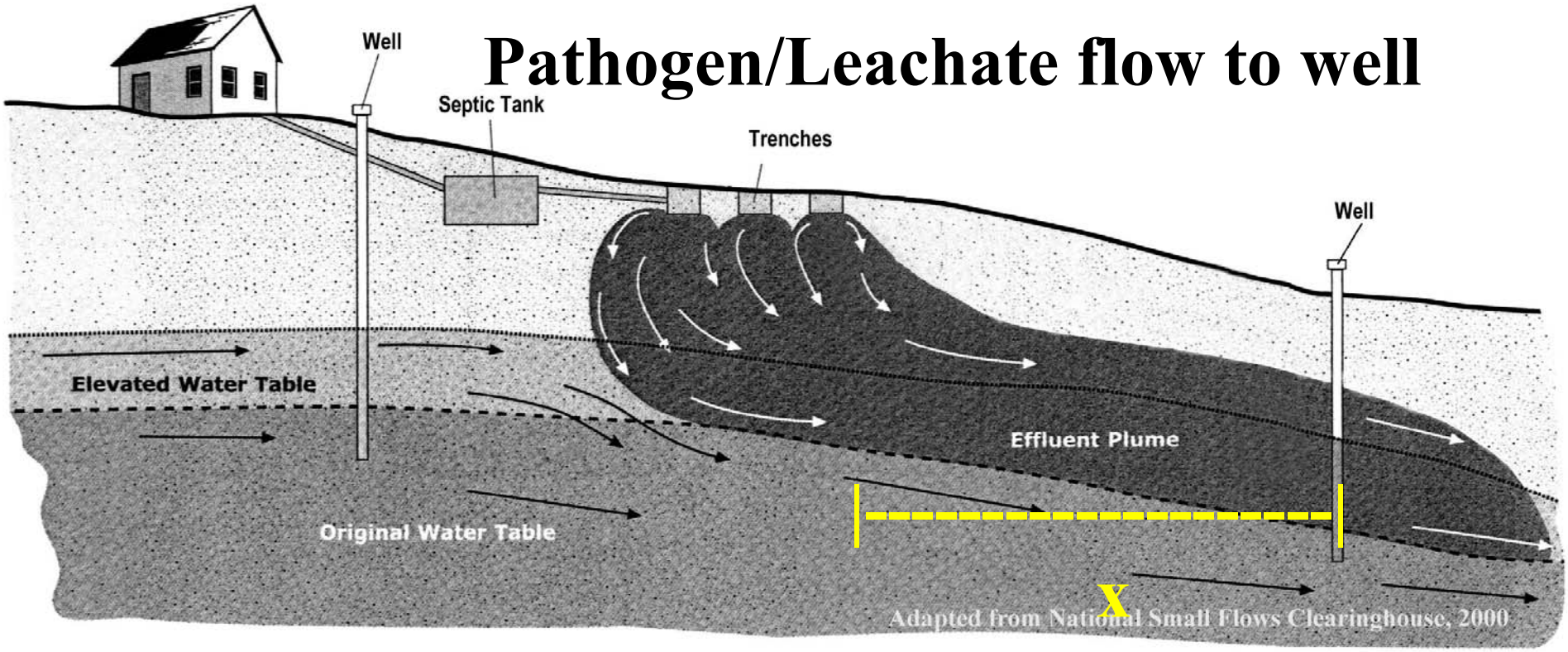
Vertical Travel Time

$t_1 = d * \theta / 0.5(\alpha)$

2 year Horizontal Travel Time Distance

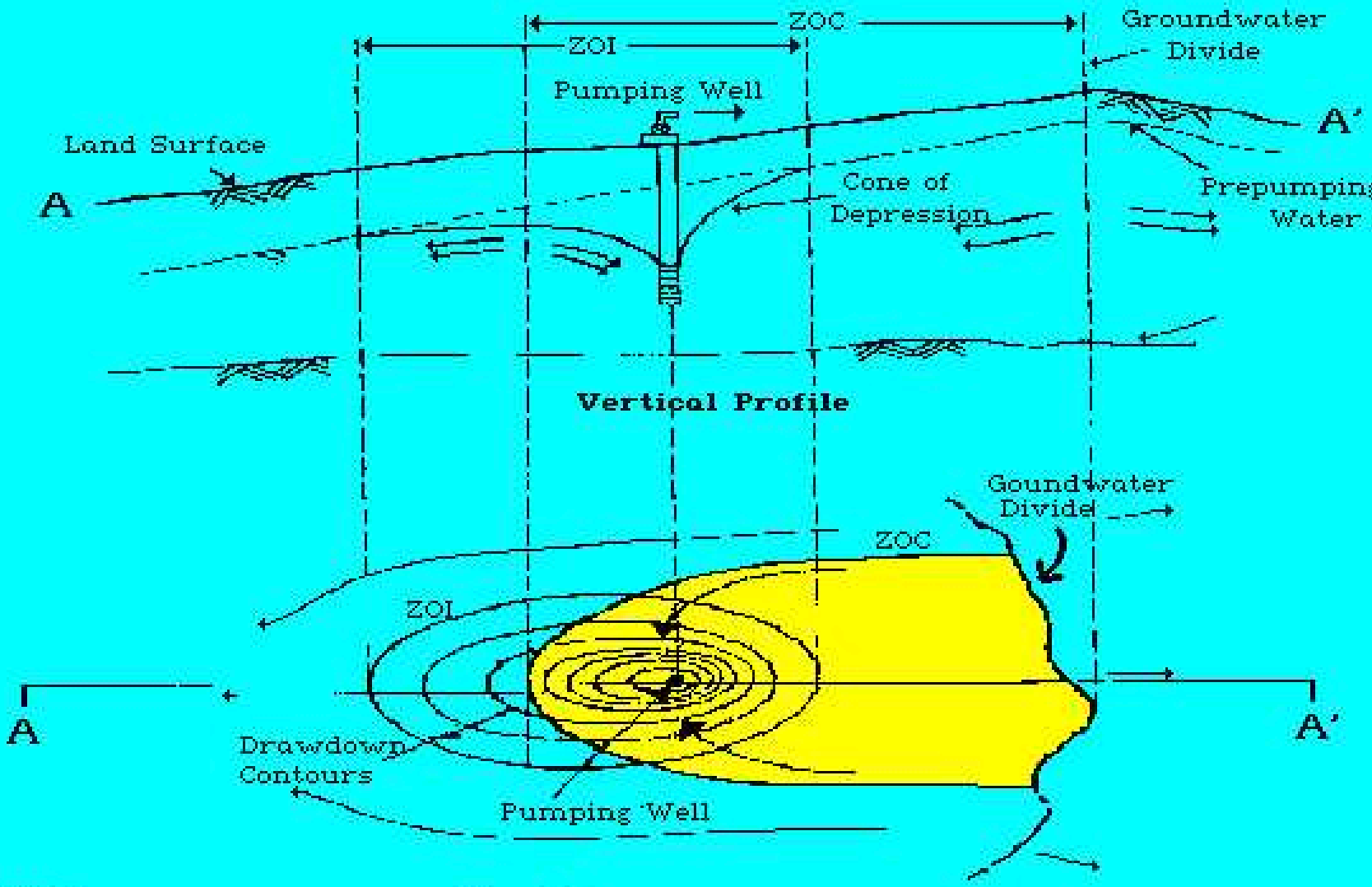
$x = ((730 \text{ days} – (t_1 * 365)))(Ki/n)$

Pathogen/Leachate flow to well



Appendix C Analysis

See Chapter 23 for equations


ZOC
ZOI
Groundwater Divide
Pumping Well
A'
Land Surface
A
Cone of Depression
Prepumping Water Leve
Vertical Profile
Goundwater Divide
ZOC
ZOI
A
A'
Drawdown Contours
Pumping Well
Plan View
LEGEND:
Water table
Groundwater flow direction
ZOI Zone of Influence
ZOC Zone of Contribution
NOT TO SCALE

Alternative to Increasing Lot Sizes or Isolation Distances?

Use ‘Enhanced’ (On-site) Wastewater Systems!

Types of Common Enhanced Wastewater Systems:

- Disinfection (chlorinators, UV)
- Aerobic treatment units
- Wetland treatment
- Sand or synthetic filters *

* Recommended by DEQ

Enhanced Wastewater Systems:

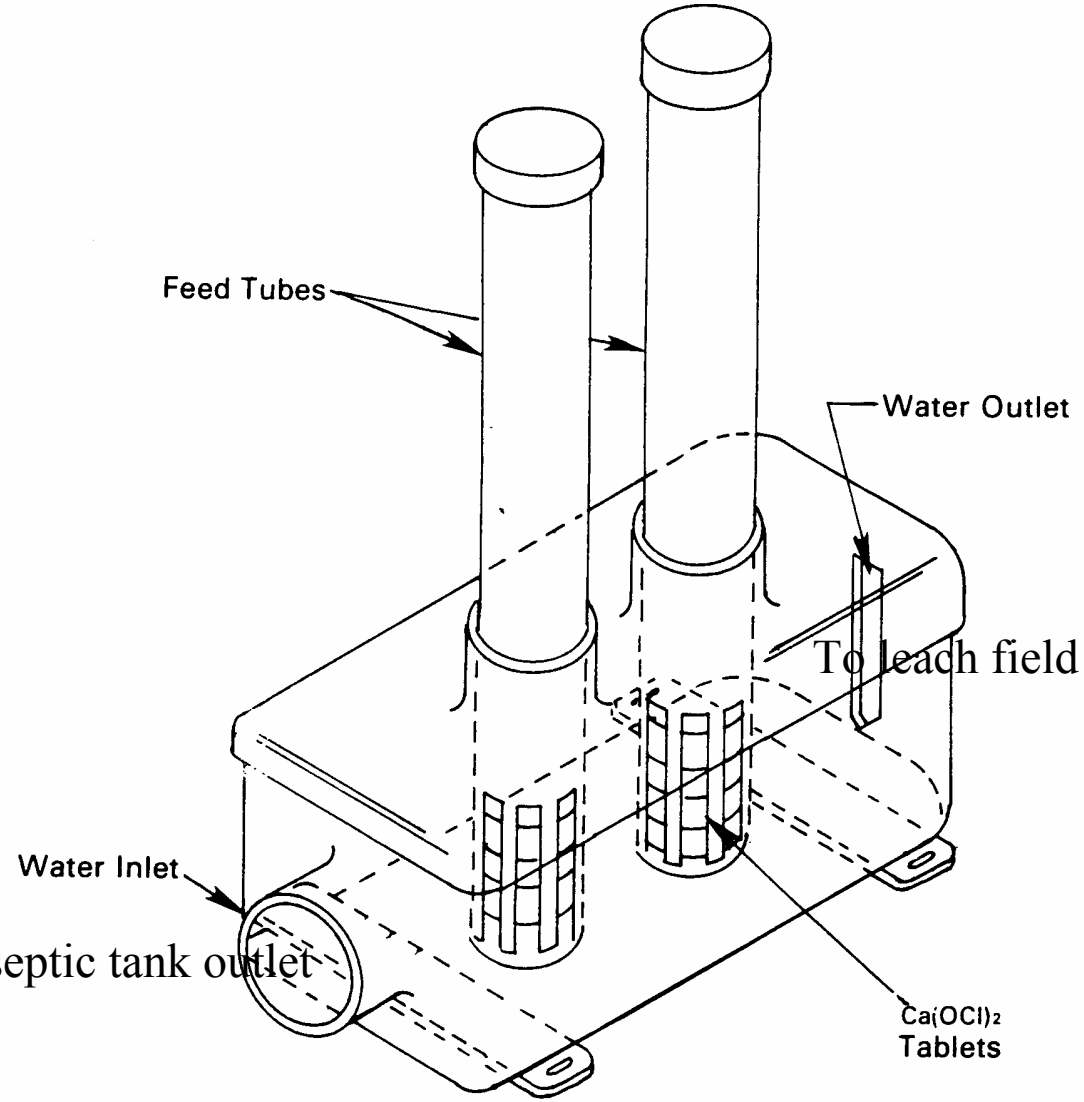
- Where lots are too small to treat leachate (e.g. nitrates > 10 mg/L at property boundary)
- Faults, fractures, karst
- Shallow ground water, wellhead protection areas
- 2 year travel distance between wells and leachfields (i.e. high hydraulic conductivities)

Enhanced Wastewater Systems (Chapter 23 Treatment Standards):

- Fecal Coliform < 800 colonies/100 mL
- Total Kjeldahl Nitrogen < 25 mg/L

Note: standards must be met prior to leachfield treatment

Stack Feed Chlorinator



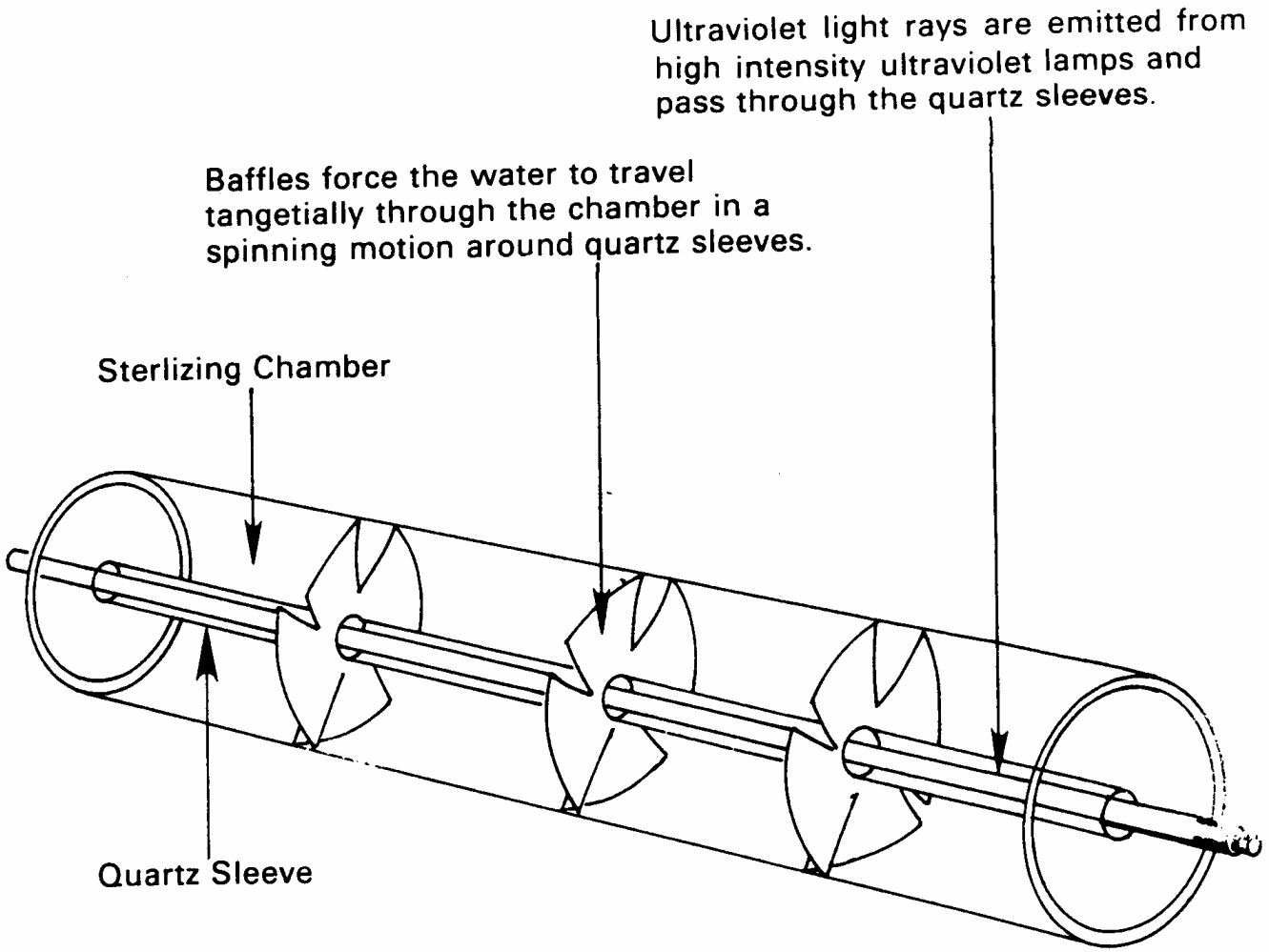
Stack Feed Chlorinator (Advantages)

- Cost effective treatment
- Reliable disinfection of microorganisms
- Eliminates noxious odors

Stack Feed Chlorinator (Disadvantages)

- Chlorine residuals are toxic to biota
- Highly corrosive
- May pose long-term problems in the environment (kills natural soil bacteria)

UV Sterilizing Chamber



Typical sterilizers employ one to twelve lamps per sterilizing chamber.

Ultraviolet Disinfection (Advantages)

- Effective inactivating most microorganisms
- Eliminates handling hazardous chemicals
- User friendly
- UV in contact with wastewater for short time

Ultraviolet Disinfection (Disadvantages)

- Low doses may not kill all microorganisms
- Organisms can repair themselves (mutate)
- Tubes develop slime & reduce effectiveness
- Difficult to penetrate dark wastewater
- Can be costly

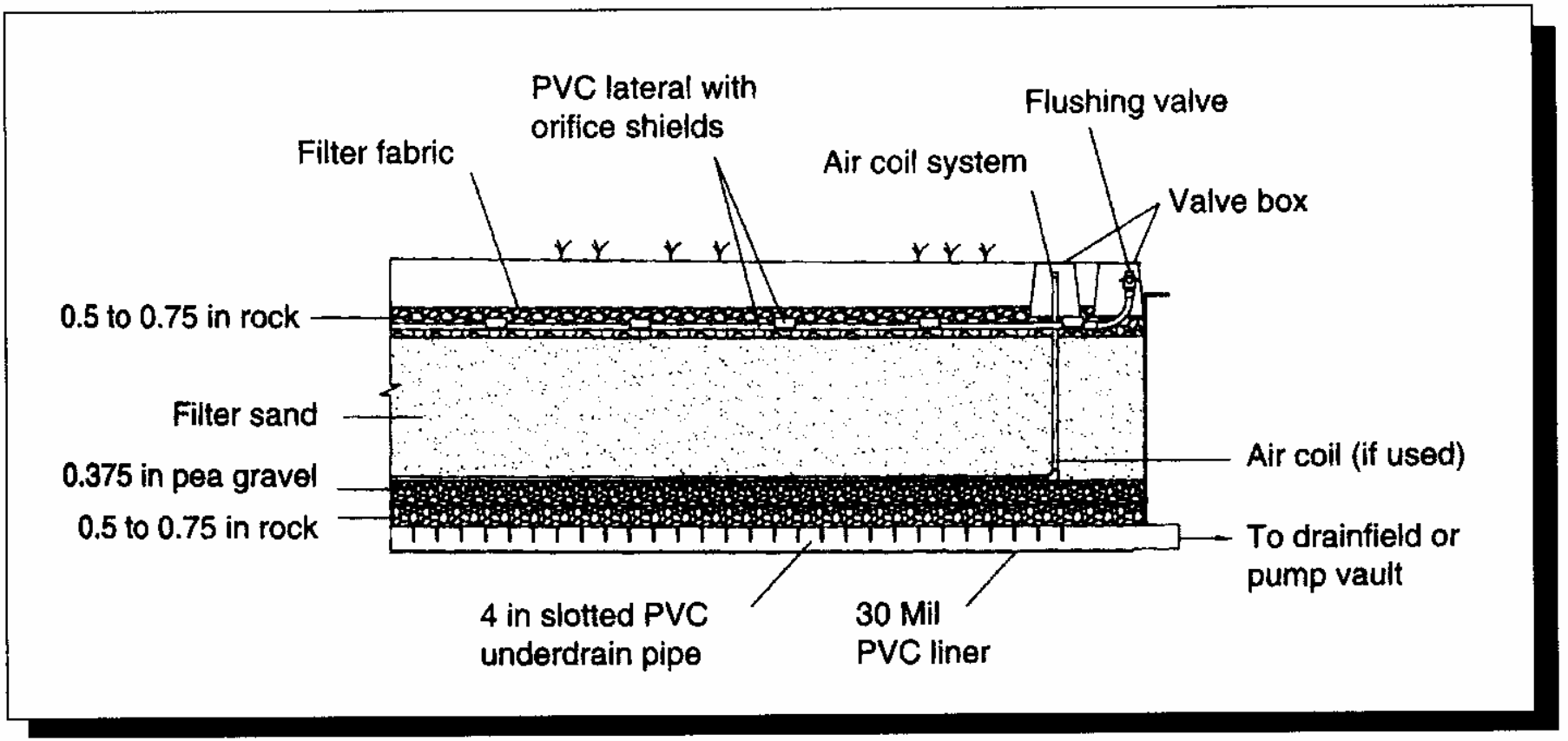


Figure 1: Typical Cross Section of an Intermittent Sand Filter

Intermittent Sand Filters (Advantages)

- Low energy consumption
- No chemicals required
- Moderately low cost
- Low maintenance

Intermittent Sand Filters (Disadvantages)

- Regular maintenance (pump systems)
- Design may need to consider cold weather
- More land area is required

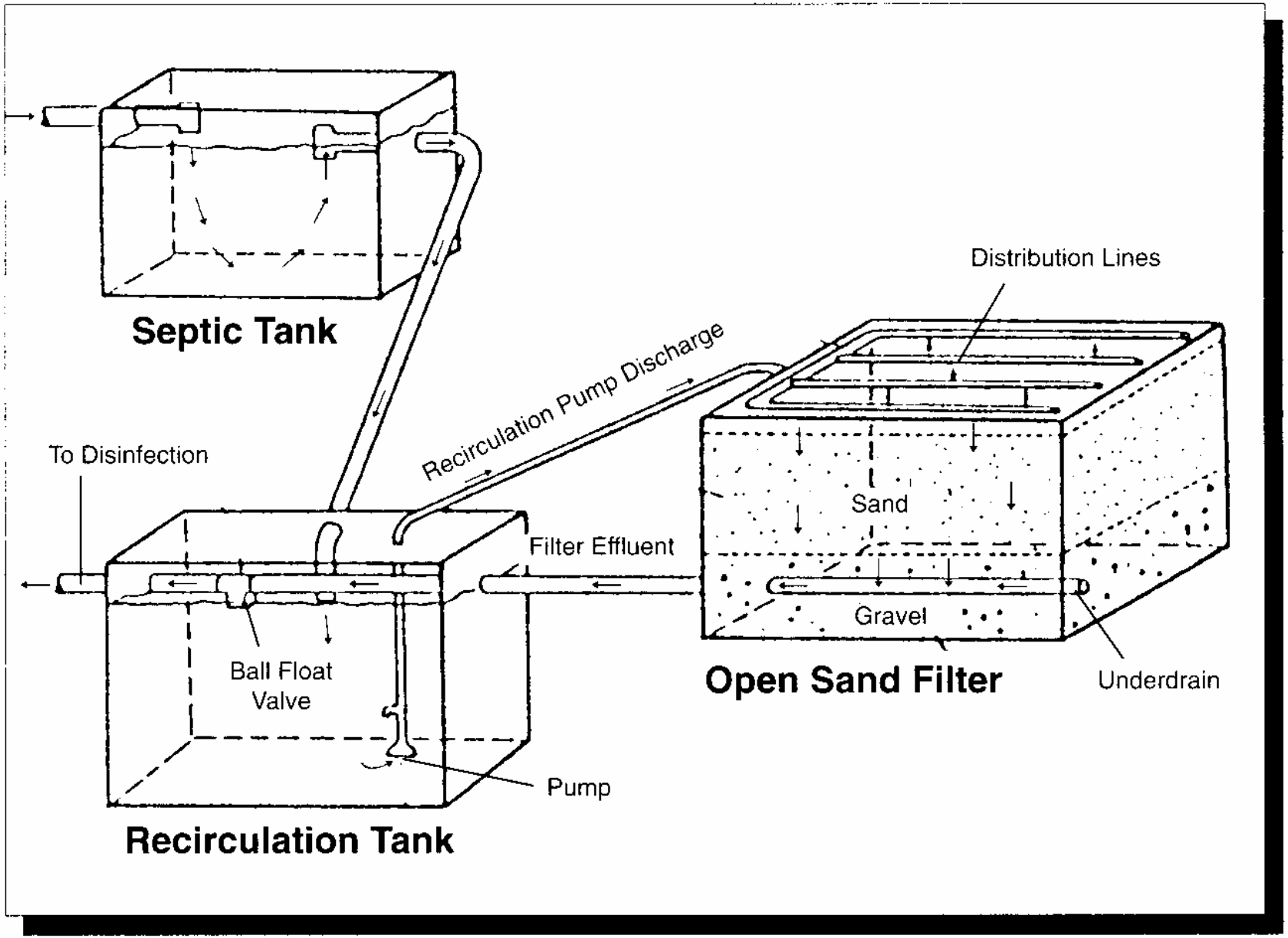


Figure 1: Typical Recirculating Sand Filter System

Recirculating Sand Filters (Advantages)

- 95% removal of organic material
- Reduction in nitrogen
- Easy maintenance
- No chemicals required

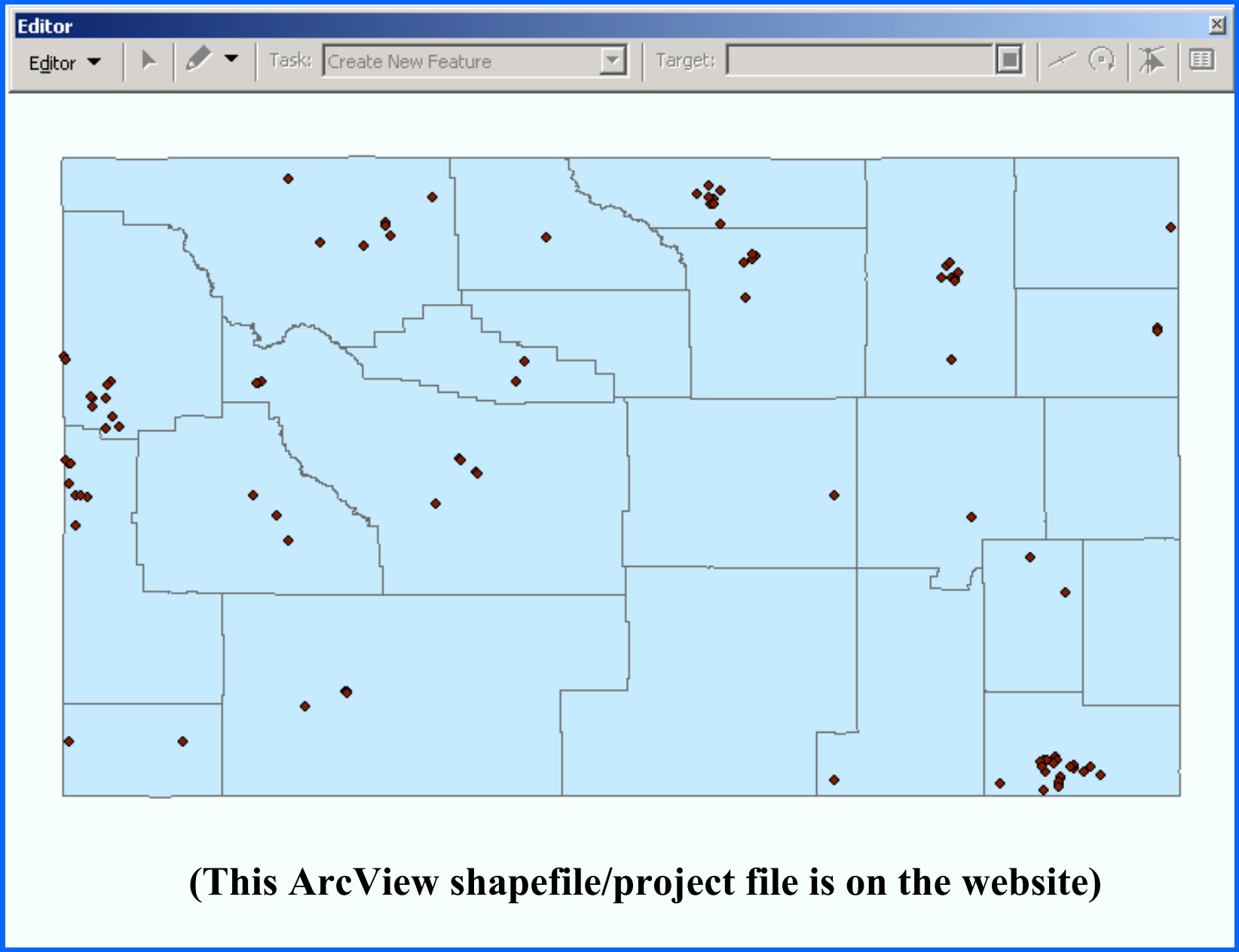
Recirculating Sand Filters (Disadvantages)

- Weekly maintenance is required for systems with pumps and controls
- Costlier than conventional
- Design must address cold weather concerns

On-Site Septic System Approximate Costs

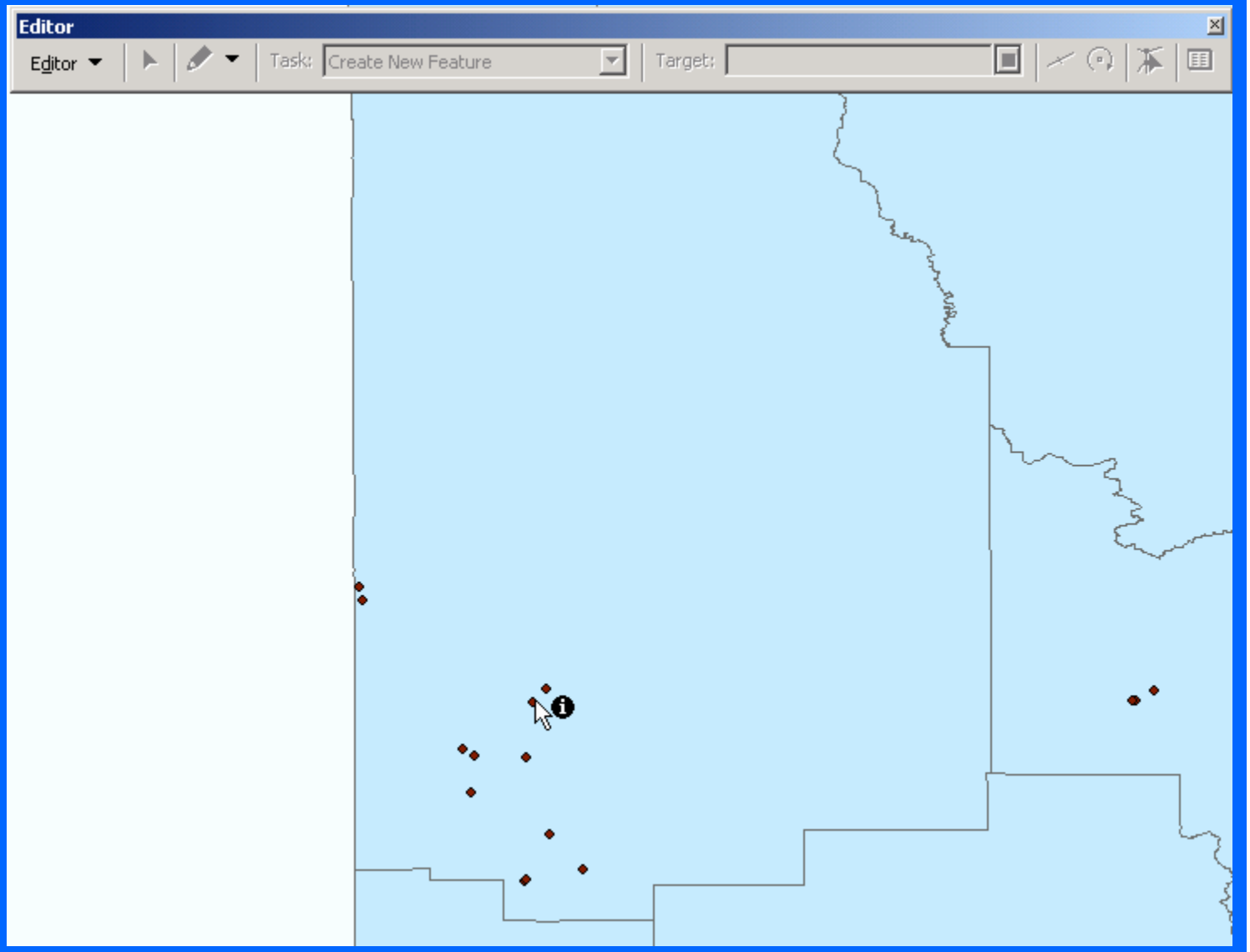
Wastewater System	Total Nitrogen (TKN) % removal	Fecal Coliform % removal	Cost Statewide	Cost Teton County	Annual O & M Costs
Conventional	30%	Varies	$3.5 - $5K	$10K	$50
Mounded	45-85%	Varies	$7.5-$10K	$15-$20K	$100
Intermittent Sand Filter	90-98%	99%	$10K	$20-$35K	$125
Re-circulating Sand Filter	98-100%	99%	$15-$20K	$30-$40K	$200

WDEQ Subdivisions Available Data



(This ArcView shapefile/project file is on the website)

Point and click



Field	Value
ID	985024
COUNTY	Teton
X	-110.765762
Y	43.574805
S_T_R	S28,T42N,R116W
SUB_NAME	Elk Ridge Subdivision
AQUIFER	Quaternary
CONFINE	u
ELEV_AVE	6340
STAT_DEPTH	40
ELEV_STAT	6300
K	401
N	0.15
I	0.005
ZYR_ZOC	138
SEO_WELL_I	UNK
WELL_NAME	42-116-21abd01
DATE_SAMPL	8/10/1991
TDS_WELL	176
NO3_WELL	0.3
COL_WELL	
SO4_WELL	11
CA_WELL	42
MG_WELL	8.1
NA_WELL	7.2
CL_WELL	3.9
FE_WELL	0
ZN_WELL	0
PB_WELL	0
FL_WELL	0.4
MN_WELL	0
CU_WELL	0
AS_WELL	0
PH_WELL	7.6
SE_WELL	
SAR_WELL	0.3
PERC_RATE	10
ONSITE_WEL	Y
ONSITE_SEP	Y
CEN_WATER	N
CEN_SEWER	N
CEN_NAME	N/A
PWS_ID	N/A
DATE_APPR	3/25/1999
MN_LOTSIZE	3.1
MX_LOTSIZE	5.3

Example problems, journal articles, and spreadsheets:

http://deq.state.wy.us/wqd/pollution.asp

Questions?

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(307) 777-5623