APPLICATION FOR SPECIAL HOLDING TANK PERMIT

Application Date:____________________ Assessor's Parcel No.______________________

I,_______________________________________ being the owner or agent of the owner of the

property located at ____, California,

do hereby make application to Amador County Environmental Health Department for special

holding tank approval. The intended use will be____

This application is made with the understanding and agreement that approval, if granted, is subject to the following conditions:

The plans and specifications for the holding tank and its installation shall accompany this application for review by the Environmental Health Department. A permit must be issued prior to installation or use.

Holding tanks shall be structurally designed and constructed so as to be in conformance with the application standards for septic tanks set forth in the most recently adopted Uniform Plumbing Code.

The system shall be of water-tight construction.

Holding tanks shall be of sufficient capacity to accommodate at least a 72 hour continued filling beyond the activation of an audio-visual alarm that is activated by a level-sensing device.

The Environmental Health Department shall be notified at least 72 hours before the final inspection after tank construction. No backfilling may take place without written approval of the Environmental Health Department.

Holding tanks shall be pumped out at regular intervals and/or as required to prevent overflows and the contents removed to an approved septage disposal site by an Amador County Environmental Health Department permitted liquid waste hauler.

Before a holding tank permit is issued, a copy of the pumping and disposal contract must be submitted to the Environmental Health Department verifying the fact that such an approved waste hauler has been retained. If this contract is cancelled or changed by either party, the tank permitee must notify the Environmental Health Department within 48 hours.

A permit shall be issued upon approval of the stated use and design plans by the Environmental Health Department, satisfactory installation of the tank, and presentation of a satisfactory pumping contract.

Installation of low flow plumbing fixtures in the facility served by the holding tank is required at the time of holding tank construction.

The following fees are to be paid to the County of Amador within 30 days from the billing date:

1. Annual Renewal Inspection Fee of $150.00

In the event of failure of this system or any portion thereof, or in the event pumping is not done in accordance with this application, it is agreed that the Environmental Health Department shall have the right to enter upon the property and cause the tank to be pumped and its contents transported to an appropriate place of discharge. The County will hold the permitee liable for whatever costs are incurred.

Applicant agrees to hold the County of Amador, its officers, employees, agents, and servants harmless from any liability for personal injury or property damage brought by or on behalf of applicant or any third party for any costs which may be incurred as a result of any action taken pursuant to the terms of this application or any permit issued thereunder.

____
Signature of Owner

Owner of Premises:____________________ Occupant/User:____________________

Mailing Address:____________________ Mailing Address:____________________

Telephone No.:____________________ Telephone No.:____________________

Design and Construction Policies and Procedures

AT GRADE DISPOSAL SYSTEM DESIGN GUIDELINES

Because of the nature of their design, all at-grade designs shall be considered alternative systems.

SITE CRITERIA:

The "site" is all that area intended to function as the disposal bed site, 100% replacement area, and all area within fifty feet downslope of either or both of these areas. The following criteria apply to the "site" as described above.

Slope - Not to exceed 20%.

Soil Depth - Minimum 24" soil depth required.

Depth to Ground Water - Minimum 24" to highest anticipated ground water level. If there is any question about the presence of ground water, monitoring shall be required in compliance with Amador County Ground Water Monitoring Guidelines.

Perc Testing - Required for every design; minimum of three tests at 18" and three at 24".

Perc Rate - 60 mpi or faster at 18 inches.
- 90 mpi or faster at 24 inches.

Contour - Convex or flat (simple) OK. No designs on concave slopes.

DESIGN CRITERIA:

Application Rate - not to exceed 0.6 GPD/SF. Basal area for the purpose of determining application rate shall be considered as the length of the distribution lateral(s) multiplies by the length extending downslope from the lateral(s) to the downslope toe of the aggregate bed.

Bed Configuration - Maximize available length of contour (i.e. long, narrow beds preferred). All designs to be justified by Darcy's analysis of the disposal bed site and minimum of fifty feed downslope of the disposal bed. Disposal beds shall be constructed so as to provide a minimum of six vertical inches of aggregated below distribution lateral(s). Effective bed width (distance from lateral(s) to downslope aggregate toe) shall not exceed eight feet.

Distribution Laterals - Pressure dose required with cleanout risers accessible from surface. Cleanout risers shall be fitted with water tight, threaded caps which may be periodically removed for flushing. A sub-grade finish with valves and access risers to accommodate flushing is an acceptable alternative.

Orifices - Minimum 1/8 inch diameter orifices shall be spaced as close together as is feasible. The use of orifice shields is encouraged.

Bed Stacking - Permitted only when absolutely necessary. Must be justified by Darcy's.

Soil Cover - A minimum of 12 inches of soil cover over a siltation barrier of non-woven geotextile fabric is required. The mounded cover shall extend a minimum of five feet upslope and sideslope from the bed and a minimum of fifteen feet downslope from the toe of the aggregate bed. The downslope toe must at no time exceed a 3:1 slope to meet the native grade. All disturbed areas must be seeded, fertilized, and mulched to encourage the growth of an erosion control cover crop.

Ground Water Monitoring Wells - Minimum of one well upslope and two wells downslope of the disposal bed(s). Monitoring wells shall be a minimum of 4 inches diameter with non-cemented caps.

Inspection Pipes - Minimum of 2 inspection pipes per bed located at downslope toe of aggregate bed. Inspection pipes shall be so constructed so as not to be easily removed from the disposal bed, shall be 4 inches in diameter, and shall be fitted with non-cemented caps.

CONSTRUCTION CRITERIA:

At-grade disposal beds must not be constructed at times when soil moisture is excessive. Both designer and the Environmental Health Department must agree that the site is ready before construction may begin.

The site must be field staked by the builder and approved by the designer and this department before any construction begins. This is a good time to meet and coordinate flow of the project to ensure that all necessary inspections are called for. At this time materials such as drain rock, geofabric, etc. can be inspected and approved.

The builder then removes any excessive vegetation from the initial disposal bed site and then lays down a 4 to 6 inch thickness of medium concrete sand. A pass is then made on contour ripping this sand into the native soil to a depth of 12 inches. No wheeled equipment should then travel over any area so prepared before placement of protective materials such as drain rock, etc. to protect the prepared soil from compaction. All areas to be overlain by aggregate disposal beds shall be so prepared. All areas to be overlain by the soil cover shall be ripped on contour to minimize any interface between native soil and the cover.

The builder then lays on the drain rock to the depth, width, and length called for by the design. The disposal laterals are drilled and dry-assembled on the disposal bed(s), orifices pointing up. Joints are not cemented until after the pump test is complete.

The pump is run with all end caps removed to flush any debris from the laterals. Caps are then replaced and the pump test is witnessed by the designer and the Environmental Health Department.

Piping is rotated, if necessary, and cemented in place, any necessary orifice shields are installed. Drain rock is added if necessary per design specs. Geofabric applied and soil cover is put in place. All inspection pipes, ground water monitoring wells, and erosion control measures are constructed. A final grading inspection may then be performed by the designer and the Environmental Health Department.

BUILDING SEWER REQUIREMENTS

MATERIALS

Schedule 40 ABS pipe with cement welded joints. For alternate materials, consult the Amador County Environmental Health Department.

Pipe size shall not be less than the building drain. A 3 inch building sewer will need to be fitted with a 4 inch adapter at the inlet sanitary tee, which must be 4 inches. A building sewer may not be reduced in size over the direction of flow; an increase in size is acceptable.

CLEANOUTS

One cleanout within two feet of foundation (this is in the jurisdiction of the Building Department.)

One two way cleanout for every 100 feet of straight run of pipe.

One cleanout on the upstream side of any aggregate change in direction exceeding 135 degrees.

Cleanouts must extend to grade and be fitted with a removable, gas tight plug.

SEPARATION FROM OTHER STRUCTURES

Private water line - 1 foot minimum, all crossings at right angles, water line 1 foot above sewer.

Public water line - 10 foot minimum.

Buildings - 2 feet.

Property lines - within property boundary.

Water wells - 50 feet. This may be reduced to 25 feet if sewer pipe materials are approved for use within a building.

Perennial streams, ponds, lakes - 50 feet. Any required crossing should be designed by an engineer.

MINIMUM GRADE

1/4 inch per foot. Where necessary this may be reduced to 1/8 inch per foot only for sewer pipe 4 inches or larger.

ENVIRONMENTAL HEALTH DEPARTMENT

LAND USE AGENCY

810 COURT STREET JACKSON, CA 95642-2132 PHONE: (209) 223-6439 FAX: (209) 223-6228
email: ACEH@co.amador.ca.us

WET WEATHER TESTING

Installation of conventional leach lines in low areas subject to flooding or in areas where the groundwater rises to within five (5) feet of proposed disposal trench bottom is not permitted under Amador County Code. Evidence of seasonal saturation may include the presence of unusually dark or mottled soils, water loving vegetation, topography, or other factors. Mottling is an alteration of the soil color pattern which can be caused by anaerobic, saturated soil conditions.

Determination of depth to groundwater in areas that are known or suspected to have high seasonal groundwater must be made during the wettest time of the year. This determination may be made through soil profile excavations dug during the wettest portion of the year or by the installation of groundwater monitoring pipes during the dryer seasons and observation during the wet season. The locations, depths, and number of excavations or groundwater monitoring pipes shall be determined by the Environmental Health Department (the Department) at the time of construction. Monitoring pipes shall be installed in the proposed initial and replacement leach field areas. Groundwater monitoring pipes shall be constructed as shown in Figure A. The pipe(s) shall extend approximately 6 inches into, but in no event through, a restrictive horizon.

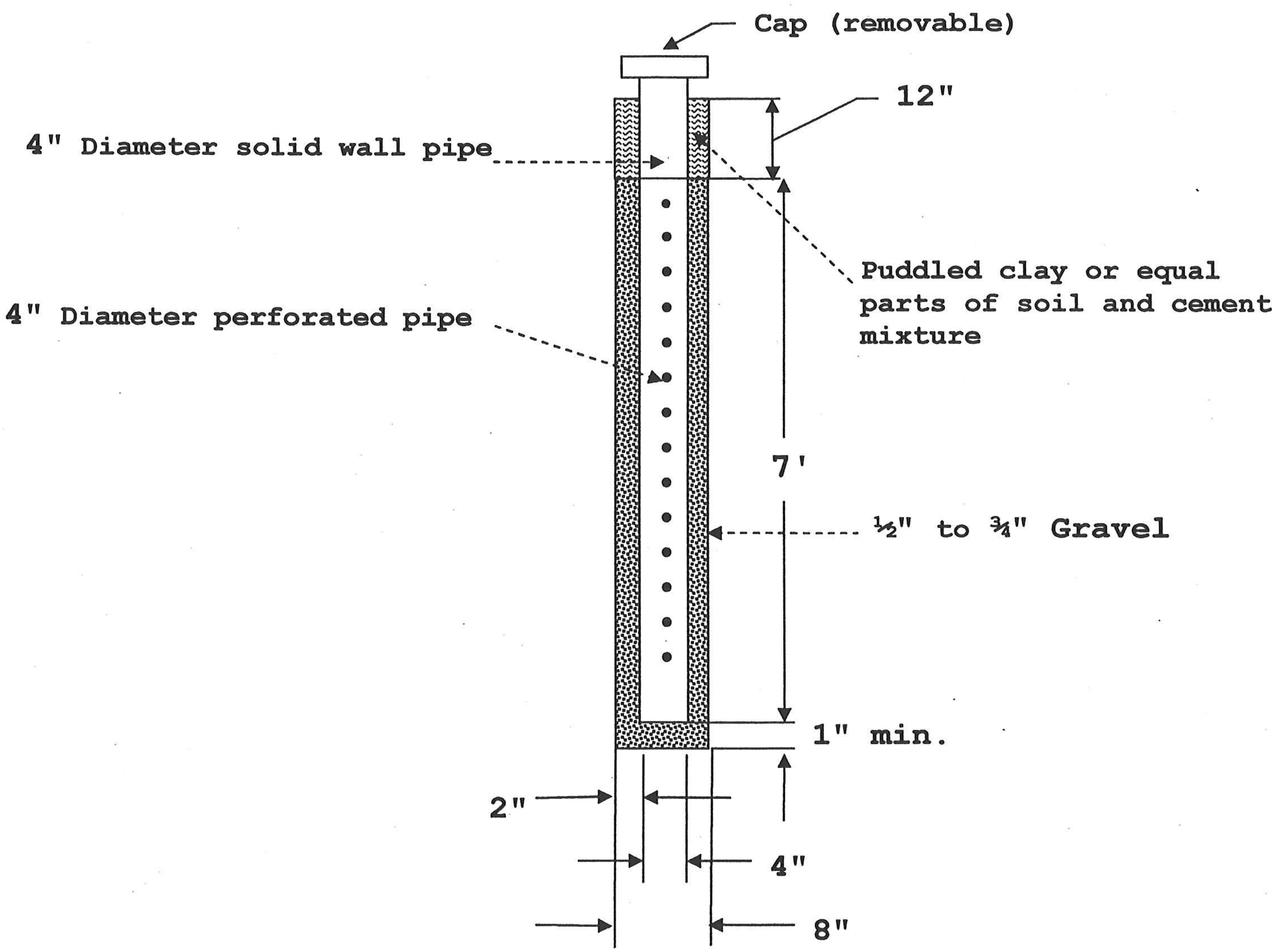
Wet weather testing may begin when the seasonal rainfall total, following July 1, is 60% of annual average for the area or when 10 inches of rain has fallen over the past 30 days. In areas where there is insufficient rainfall information, the Department shall use information from surrounding areas to determine the start date for monitoring. Wet weather testing may continue through the wet season until rainfall decreases significantly, typically March 15. Depending on weather patterns this date may be extended at the discretion of the Department.

Groundwater monitoring shall be performed by the Department at several intervals during the wet season until the season is over. The shallowest depth to groundwater noted during this monitoring will be the controlling criteria for disposal system design.

At elevations where snow covers the ground throughout much of the winter, testing shall not begin until there has been adequate snow melt to observe the ground surface and charge any perched groundwater bearing horizons.

Groundwater may sometimes by diverted away from an area by the use of an interceptor drain. A complete set of engineered plans from a qualified consultant must be presented to and approved by the Department prior to construction of an interceptor drain. After construction of the drain, wet weather testing must document that the depth to groundwater in the proposed leach field and replacement areas have been lowered and five feet of unsaturated soil exist between proposed trench bottom and highest groundwater, prior to proceeding with construction of the disposal system. If five feet of separation cannot be achieved, the site may be suitable for an engineered, alternative disposal system design.

TYPICAL OBSERVATION WELL FOR DETERMINING SOIL SATURATION



The above mentioned testing must be done during the wettest months of a normal rainfall year.

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email: ACEH@co.amador.ca.us

REQUEST FOR WINTER GROUNDWATER MONITORING

SEPTIC PERMIT #	**APN #**
FEE PAID:	**DATE PAID:**

Owner:	***Telephone:***
Mailing Address:	
Site Address:	
Directions:	

Due to concerns regarding groundwater levels on the subject parcel, wet weather observation of groundwater levels must be conducted before any determination can be made on the parcel's suitability for on-site sewage disposal.

Reliable observation may only be obtained when seasonal rainfall is 60% of the average annual rainfall or when 10 inches of rain has fallen in a 30 day period.

It should, therefore, be recognized that due to variations in precipitation patterns, no definite time frame can be established for the completion of groundwater monitoring.

No monitoring shall be done on a parcel until a valid sewage disposal application has been filed, this request form completed, and the monitoring fee paid.

Owner's Signature ______________________________ ***Date*** __________________

PLOT PLAN

WET WEATHER TESTING
WINTER GROUNDWATER MONITORING

APN:______________ LOCATION:____

____

PLOT SKETCH:

	Depth From Surface to Groundwater					
Date/Time Monitored	#1	#2	#3	#4	#5	#6

COMMENTS:____

____

____

#4.43

HYDRAULIC WASTEWATER LOADING RATES TO SOIL

E.J. Tyler*

ABSTRACT

Onsite wastewater infiltration rate into soil depends on the nature of soil clogging and soil characteristics. The rate of transmission of the infiltrated water through the soil away from the infiltration surface when a vertical flow restriction is present depends on the characteristics of the soil, the depth of the permeable soil horizons and the slope. A single table is presented to estimate design infiltration loading and hydraulic linear loading rates for onsite wastewater treatment systems using soil.
KEYWORDS: Septic systems, Wastewater infiltration, Wastewater loading, Soil water flow, Linear loading rate.

INTRODUCTION

The rate wastewater infiltrates soil from wastewater infiltration systems is limited by clogging layers and controlled by the nature of both the clogging layer and the soil (Bouma, 1975). Once in the soil, the added water must continue to move away from the infiltration surface. This flow is independent of the nature of the clogging layer and only dependent on the nature of the soil. Water moves away from the system following the water potential gradients. In soils with flow restrictions, water movement may become horizontal. Water movement away from the infiltration surface must be greater than the wastewater infiltration rate or the system will fail.

There have been many estimates of wastewater infiltration rates into soil. Infiltration rates for domestic wastewaters from septic tanks assuming around 570 L d^{-1} per bedroom (150 gpd/bedroom) are most frequently reported. Values are based primarily on experience. Some reported septic effluent rates have been reviewed by Keys, et. al 1998. Suggested infiltration rates for domestic wastewaters with reduced biochemical oxygen demand (BOD) are less common (Siegrist, 1987 and Tyler and Converse, 1994).

Hydraulic linear loading rate is the volume of wastewater that the soil surrounding a wastewater infiltration system can transmit far enough away from the infiltration surface such that it no longer influences the infiltration of additional wastewater. The concept of hydraulic linear loading rate was first introduced by Tyler and Converse (1984). Since that time, there

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has been little done to assign possible design values for hydraulic linear loading rate; however, limits have been put on infiltration width in an attempt to limit the hydraulic linear loading rate.

Therefore, a procedure to estimate values for hydraulic linear loading rates based on soil characteristics is needed. Since wasterwater infiltration rates are also based on soil characteristics the procedure should include wastewater infiltration rates and present the two design values together.

OBJECTIVES

1. Define wastewater infiltration into soil and water flow away from wastewater infiltration systems and
2. Present a procedure to estimate wastewater infiltration and hydraulic linear loading rates based on soil characteristics assuming a wastewater quality and volume.

WASTEWATER LOADING RATES

Wastewater movement into and through the soil depends on the interaction of the wastewater with the soil to create a clogging layer and on the hydraulic properties of the soil. Each type of flow is defined separately and the limiting flow is used for design.

Infiltration Loading Rates

Wastewater infiltration or loading rates define the rate wastewater enters the soil. When applying septic tank effluent, a clogging layer forms at the infiltrative surface. Clogging layers impede water infiltration and reduce the loading applied to far below the maximum infiltration rate of unclogged soil. Bouma (1975) explained the basis of wastewater infiltration into clogged soil. Since the water that passes the clogging layer also percolates through the soil then:

$$Q_c = Q_s = K_c \frac{(H_o + \Psi + z_c)}{z_c}$$

where Q_c is the flow through the clogging layer, Q_s is the wastewater flow through the soil, K_c is the hydraulic conductivity of the clogging layer, H_o is the wastewater ponding height above the infiltrative surface, Ψ is the soil moisture potential in the soil just outside the clogging layer and z_c is the thickness of the clogging layer. Wastewater infiltration into soil is dependent on the character of both the clogging and soil. Since soil is a factor in infiltration rate through a clogging layer, wastewater loading rates will vary from soil-to-soil with the same clogging. The differences in wastewater infiltration rates are related to soil characteristics defining pore sizes and pore size distribution. Texture, structure, and consistence each contribute information about soil pores. Also, the mineralogy of the clay fraction is important. Of the soil characteristics soil structure provides the most information. Therefore, commonly described soil characteristics can be used with knowledge of operating clogged systems to estimate design values for wastewater infiltration for different soils assuming standard domestic wastewater and design volumes of 570 L d^{-1} per bedroom (150 gpd/bedroom) or greater. A method for predicting loading rates for domestic septic tank effluent based on soil morphological descriptions was developed (Tyler et al., 1991).

In the absence of soil clogging, or in the presence of weakly developed clogging, as is likely when applying wastewaters of reduced organic strength or BOD compared to septic tank effluent, infiltration rates are higher than for clogged soil. The increase in infiltration loading rate for reduced strength wastewater and low BOD wastewater is not uniform or linear, and is much greater for soil with larger pores than for those with fine pores. Therefore, a single factor between loading rates for clogged and unclogged soils cannot be used. For example, sandy soil loading rates are much greater without clogging than for clogged soil while in clayey soils the loading rate difference is small. As with loading rates for clogged soil, loading rates for soil receiving wastewater of low organic strength are related to the pores and therefore the described soil morphology. A method for predicting loading rates for wastewaters of reduced organic strength wastewater based on soil morphological descriptions has been reported (Tyler and Converse, 1994).

Water Percolation and Hydraulic Linear Loading Rate

Once wastewater has infiltrated the soil, it moves without the direct influence of the clogging layer or a non-clogged infiltration surface. Water will move from a zone of higher potential to one of lower. In regions of moderate precipitation and with normal wastewater applications, some water will move downward. In a free draining soil, the added wastewater is not a problem; however, many soils have horizons of slow permeability that restrict downward water movement. If the wastewater application rate along with the natural waters exceeds the permeability of these horizons, episaturation will develop. Dissipation of the episaturation is by vertical movement through the underlying slowly permeable horizons and horizontally downslope beneath the ground surface in the shallow soil horizons. If the water is not dissipated from the zone of episaturation as fast as water is added, the system eventually fails hydraulically.

The maximum horizontal flow per unit length or hydraulic linear loading rate is dependent on the ability of the soil to transmit the water horizontally, the depth of soil for transmission and the slope of the induced surface of groundwater. It is assumed the depth available for transmission is above the restricting horizon and episaturation and below the infiltration surface. This is referred as infiltration distance. The slope is frequently the same slope as the ground surface but this should be estimated during site evaluation. The horizontal flow may be defined using Darcy's Law:

$$F = Kd\frac{dX}{dZ}$$

where F is the wastewater flow horizontally down slope for unit length of infiltration system, K is the horizontal saturated hydraulic conductivity of the soil horizons above the restricting horizon and episaturation, d is the depth of soil for horizontal transmission or the infiltration distance between the infiltration surface and the top of the restricting horizon or episaturation of wastewater down the slope, and dX/dZ is the slope of the groundwater surface often the same as the slope of the ground surface. Sites with deep permeable surface horizons do not have flow restriction and therefore other factors control the hydraulic linear loading rates. For sites with a shallow limiting flow horizon, the steeper the slope, dX/dZ, the greater the linear loading rate. Also, the deeper the shallow permeable horizons or infiltration distance, d, the higher linear loading rate. Sites with the greatest horizontal hydraulic conductivity in the surface horizon will have the greatest hydraulic linear loading rate.

Hydraulic linear loading rates may not be limiting to the design of wastewater infiltration systems, particularly those receiving domestic septic tank effluent. In some cases, the supply of oxygen needed to control soil clogging may be limiting. Supply of oxygen to infiltration systems through soil is discussed in a paper by Erickson and Tyler in this proceedings.

Saturated hydraulic conductivity needed to estimate design hydraulic linear loading rates is related to soil pore sizes and therefore related to field described soil characteristics similar to determining wastewater infiltration or loading rates. The same soil characteristics used to estimate infiltration rates are used as a part of determining hydraulic linear loading rates. The other site characteristics, including the slope and depth of permeable horizons, are also determined during the site evaluation. Since determining final system design is dependent on soil and site characteristics, the site evaluation is the single most important part of the design. If the site evaluation is done incorrectly, the rest of the design will be incorrect.

ESTIMATING HYDRAULIC LOADING RATES

Table 1 is for estimating wastewater infiltration into soil from septic tank effluent (>30 mg L^{-1} BOD) or low organic strength wastewater (<30 mg L^{-1} BOD) and hydraulic linear loading rates based on field described soil and site characteristics of texture, structure, consistence, horizon thickness, and slope. This table was prepared for field practitioners and is presented here as prepared. Therefore, the table contains units in common use. A similar table with metric units could be prepared.

The table is used only for soil horizons of very firm or weaker consistence. Soil horizons of stronger consistence than very firm consistence are not acceptable. Also, the table should not be used for soil horizons with smectitic mineralogy. All characteristics used while determining loading rates are collected by a soil scientist.

To estimate infiltration loading rates for wastewaters of either greater or less than 30 mg L^{-1} BOD or to determine hydraulic linear loading rate, soil characteristics related to infiltration or hydraulic conductivity are needed. Texture, structure, consistence, and mineralogy are most important. Since all design values are estimated from the same soil characteristics, only one table of values is needed. To use the table, the soil must have a consistence of very firm or weaker and clay mineralogy should not be smectitic. If these criteria are acceptable, then texture and structure are used. Abbreviations for soil textures are found in the first column to the left in Table 1. Abbreviations are nationally accepted soil science abbreviations of the

Natural Resource Conservation Service of the United States Department of Agriculture (Schoeneberger et al., 1998). Within the texture row for the horizon of interest, the soil structure of shape and grade are used to select the row containing the infiltration loading rates depending on the BOD of the applied wastewater. Finally in the same row, an array of hydraulic linear loading rates complete the remainder of the row. Since hydraulic linear loading rate is not dependent on the wastewater quality applied, these values are the same regardless of the application infiltration rate. Hydraulic linear loading rate is also related to the slope of the flow surface and the depth of flow. These values are from the site evaluation and are found to the right of the infiltration rate values at top of the table. Ranges of slope and infiltration distance or the thickness of the horizon are along the top. Hydraulic linear loading rate for a horizon is selected with the row identified by the texture and structure. This is done by selecting the slope of the horizontal flow horizon and then the depth of the horizon for horizontal flow. If there is more than one horizon, the contribution to horizontal flow of each horizon is used to determine the hydraulic linear loading rate. If only a portion of a horizon is transmitting water, only the infiltration distance or distance from the infiltration surface to the limiting condition is used.

Values for infiltration hydraulic loading rates and for hydraulic linear loading rates are estimates based primarily on experience. The logic and trends in values presented fit with the scientific basis and with experience. Further research and testing are needed to verify the values. Hydraulic linear loading rates are for domestic wastewater assuming 570 L d^{-1} per bedroom (150 gpd/bedroom). For other wastewater sources, use safety factors similar to those used for domestic wastewater. The design safety factor is imbedded in the design wastewater flow. Designers using actual wastewater flow rates should assume the values in the table for wastewater infiltration are 5 to 10 times higher than should be used when using actual flows.

Assume a site has a 7% slope on the limiting horizon. From the top of the limiting horizon to the bottom of the infiltration is 36 cm (14 inches). The horizon is a silt loam, abbreviation SIL, with weak, abbreviation 1, fine subangular blocky, abbreviation BK, structure that is friable and not smetitic. The infiltration loading rate for a wastewater with BOD >30 mg L^{-1} would be 16 L m^{-2} d^{-1} (0.4 gpd/ft^2) and 24 L m^{-2} d^{-1} (0.6 gpd/ft^2) if the BOD were <30 mg L^{-1}. The hydraulic linear loading rate is 11.4 L m^{-1} d^{-1} (3.0 gpd/ft) regardless of the wastewater type.

For design, there is no need to calculate areas. First determine the linear loading rate from Table 1. From the example above, with a linear loading rate of 11.4 L m^{-1} d^{-1} (3.0 gpd/ft) and a wastewater volume of 1700 L d^{-1} (450 gpd), divide the wastewater volume by the hydraulic linear loading rate to get the length of the system of 46 m (150 feet). The width of a trench is the hydraulic linear loading rate divided by the infiltration hydraulic loading rate. For septic tank effluent and a infiltration hydraulic loading rate of 16 L m^{-2} d^{-1} (0.4 gpd/ft^2), the width of the system would be 2.3 m (7.5 ft.). This width would be acceptable hydraulically but may not account for the oxygen demand.

Table 1. Infiltration rates in gal/d/ft^2 for wastewater of >30 mg L^{-1} or wastewater of <30 mg L^{-1} and hydraulic linear loading rates in gal/d/ft for soil characteristics of texture and structure and site conditions of slope and infiltration distance. Values assume wastewater volume of >150 gal/d/bedroom. If horizon consistence is stronger than firm or any cemented class or the clay mineralogy is smectitic, the horizon is limiting regardless of other soil characteristics. {© 2000 by E. Jerry Tyler, printed with permission}.

Soil characteristics			Infiltration loading rate, gal/da/ft^2		Hydraulic linear loading rate, gal/d/ft — Slope								
					0-4%			5-9%			>10%		
					Infiltration distance, inch			Infiltration distance, inch			Infiltration distance, inch		
Texture	Structure Shap	Structure Grad	>30 mg/L	<30 mg/L	8-12	12-	24-48	8-	12-	24-	8-	12-	24-
COS, S, LCOS, LS	--	0SG	0.8	1.6	4.0	5.0	6.0	5.0	6.0	7.0	6.0	7.0	8.0
FS,VFS,LFS,LVFS	--	0SG	0.4	1.0	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
CSL, SL	--	0M	0.2	0.6	3.0	3.5	4.0	3.6	4.1	4.6	5.0	6.0	7.0
	PL	1	0.2	0.5	3.0	3.5	4.0	3.6	4.1	4.6	4.0	5.0	6.0
		2, 3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/B	1	0.4	0.7	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
	K/G R	2,3	0.6	1.0	3.5	4.5	5.5	4.0	5.0	6.0	5.0	6.0	7.0
FSL, VFSL	--	0M	0.2	0.5	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/B	1	0.2	0.6	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
	K/G	2,3	0.4	0.8	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
L	--	0M	0.2	0.5	2.0	2.3	2.6	2.4	2.7	3.0	2.7	3.2	3.7
	PL	1,2, 3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/B	1	0.4	0.6	3.0	3.5	4.0	3.3	3.8	4.3	3.6	4.1	4.6
	K/G R	2, 3	0.6	0.8	3.3	3.8	4.3	3.6	4.1	4.6	3.9	4.4	4.9
SIL	--	0M	0.0	0.2	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/B	1	0.4	0.6	2.4	2.7	3.0	2.7	3.0	3.3	3.0	3.5	4.0
	K/G	2,3	0.6	0.8	2.7	3.0	3.3	3.0	3.5	4.0	3.3	3.8	4.3
SCL,CL SICL	--	0M	0.0	0.0	-	-	-	-	-	-	-	-	-
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/B	1	0.2	0.3	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4
	K/G	2,3	0.4	0.6	2.4	2.9	3.4	2.7	3.0	3.3	3.0	3.5	4.0
SC, C, SIC	--	0M	0.0	0.0	-	-	-	-	-	-	-	-	-
	PL	1,2,3	0.0	0.0	-	-	-	-	-	-	-	-	-
	PR/B	1	0.0	0.0	-	-	-	-	-	-	-	-	-
	K/G R	2,3	0.2	0.3	2.0	2.5	3.0	2.2	2.7	3.2	2.4	2.9	3.4

CONCLUSIONS

The principals of water movement through wastewater infiltration system clogging layers and saturated horizontal flow away from the zone of infiltration can be used to explain the flow of domestic wastewater into and through soil. However, application of principals does not provide working values for design of onsite wastewater treatment systems. Design hydraulic loading rate estimates based on logic and experience for domestic wastewater applications derived from field described soil and site characteristics are in a single table for use by onsite wastewater specialists.

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