DESIGN CRITERIA FOR SOIL ABSORPTION SYSTEM

Introduction

Septic tanks change the composition of raw sewage but the effluent still contains many pollutants and harmful organisms and is not suitable for direct discharge to the environment. Final treatment of the septic tank effluent occurs in the soil absorption system which is designed to filter and oxidize most suspended solids and bacteria. Nitrifying bacteria found in the top few feet of the soil facilitate the use of nitrogen compounds as plant nutrients. If the absorption system is kept shallow, the root system of the vegetative cover can penetrate the system and take up much of the phosphates and nitrogen compounds. This will minimize the potential for phosphate or nitrate contamination of the groundwater. This vegetative cover will also aid in ridding the system of some of the water load by transpiration. **Note:** All soil absorption systems shall be proceeded by an adequately sized septic tank.

Location of The Absorption Field

The absorption field should be located in areas where good grass cover is possible. Areas of seasonal flooding and slopes of greater than 25 per cent (25 feet per 100 feet) should be avoided. The bottom of the field shall be at least four feet above the seasonal high water table or bedrock and surface waters should be diverted from the vicinity of the subsurface disposal system. Absorption systems should never be built under driveways, walkways, parts of buildings, etc. and such structures should never be constructed over any portion of an existing or planned on-site wastewater treatment system. MINIMUM DISTANCES FROM WATER SOURCES, STRUCTURES AND PROPERTY LINES SHALL BE OBSERVED (See Table 2 Minimum Horizontal Distance Requirements).

Calculation of Sewage Flow

1. Where gallons per day can be obtained by measurement of existing conditions, such data should be used.
2. For new facilities Table 3 Quantities of Wastewater should be used as a guide to represent design flow.
3. To calculate the sewage flow for dwellings and mobile homes, use two persons per bedroom.
4. In no event may the system be designed for a lesser capacity than the anticipated maximum daily sewage flow or treatment requirements of the sewage or wastewater in the system.

Sizing

1. For a system treating and disposing of effluent through a soil absorption system, the method for calculating minimum absorption area shall be based upon the amount of suitable soil and the capacity of the soil to absorb liquids as established by the percolation test or minimum requirement per bedroom and upon design criteria and construction standards for such type of absorption system as set forth in the Administrative Procedures for Private Wastewater Systems.
2. Absorption Area: The minimum absorption area in square feet (A) for a private sewage disposal system shall be determined as a function of the design flow of sewage in gallons per day (Q), and the percolation rate in minutes per inch (t), according to the formula:

$$A = \frac{Q \times t}{5}$$

Note: Where the percolation rate is found to be faster than five minutes per inch in soils of sandy texture, the minimum value of the "t" for use in this formula shall not be less than "5".

3. If an excessive amount clay is found during construction additional percolation tests should be performed and the field sized using the percolation test results. With clay being present relocation of the absorption field may be required.

Typical Absorption Trench and Absorption Bed System

An absorption trench or absorption bed should be of sufficient width and length or dimension to provide the required absorption area. The bottom of the trench or bed should be level.

Note: Refer to Innovative/Alternative Section for other trench or bed systems.

Trenches:

1. A minimum of 2 trenches of near equal length is required and neither trench should be longer than 100 feet in length.
2. The trench should be 24 or 36 inches wide and no deeper than 36 inches.
3. A perforated distribution pipe should be placed the entire length of the trench with the holes down and should be surrounded by clean, graded gravel, rock or material of equal efficiency.
4. The rock may range in size from 1/2 inch to 2 1/2 inches in diameter.
5. The rock should be placed at least 6 inches below the pipe and at least 2 inches above the pipe making a minimum of 12 inches. (See Diagram 3 Absorption Trench and Bed Cross-Section).
6. There should be at least 6 feet of undisturbed soil between trenches.
7. The perforated pipe for gravity distribution should be no less than 4 inches in diameter and be rigid enough to maintain the level through out the trench.
8. The perforated pipe should be as level as possible or with a drop of not more than 4 inches in a 100 foot.
9. The terminal ends of the lines should be capped unless looped or air vented.
10. If tile or other open joint pipe is used, the upper half of each joint should be covered to prevent the entrance of outside graded material.

Beds:

1. The bed should be wider than 36 inches and no deeper than 36 inches.
2. The perforated pipe should be surrounded by clean, graded gravel, rock or material of equal efficiency.
3. The rock may range in size from 1/2 inch to 2 1/2 inches.
4. The rock should be placed at least 6 inches below the pipe and at least 2 inches above the pipe making a minimum of 12 inches (See Diagram 3 Absorption Trench and Bed Cross Section).
5. The distance between parallel perforated lines should not exceed 6 feet and a perforated line should be located within 3 feet of each sidewall of the bed.
6. The perforated pipe for gravity distribution should be no less than 4 inches in diameter and rigid enough to maintain the level throughout the bed.
7. The perforated pipe should be looped at the ends.

General:

1. The top of the gravel should be covered with a layer of hay, straw, untreated building paper, or similar pervious biodegradable material. An impervious or non-biodegradable covering shall not be used.
2. A final cover of soil suitable for vegetation at least 10 inches deep should be placed from the top of the pervious covering to the finished surface grade of an absorption trench or absorption bed.

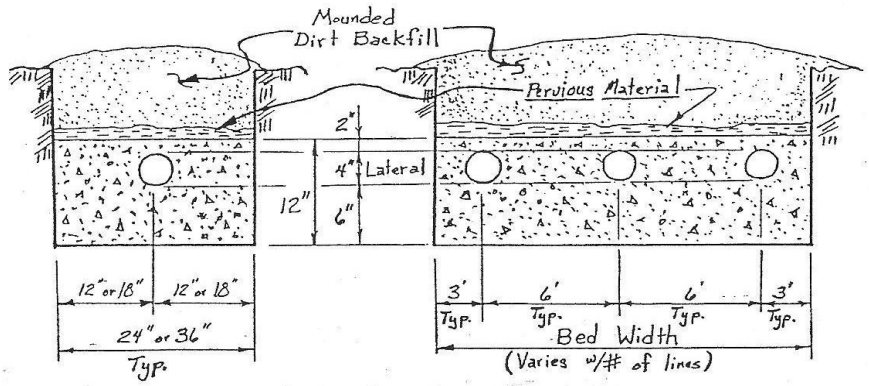
3. The final cover should be graded to deflect runoff water away from the disposal area. Machine tamping, rolling or hydraulic compaction of final cover should not be permitted, however, hand tamping may be allowed where necessary to stabilize the soil to prevent erosion or the intrusion of extraneous water.
4. The length of an absorption trench or seepage bed may be calculated by allowance for the sidewall area of additional depth of gravel in excess of 6 inches below the bottom of the distribution pipe according to the following formula:

$$L = \text{Length required prior to adjustment} \times \frac{(W+2)}{(W+1+2d)}$$

Where: W = width of trench in feet
d = depth of gravel below distribution pipe in feet
(See Table 5 Chart for Increased Gravel Depth Under Lateral Pipes).

DIAGRAM 3
ABSORPTION TRENCH AND BED CROSS SECTION

Trench Bed



Mini-System

A mini-system may be considered for disposal of wastewater from sinks, lavatories, showers or other gray water disposal. Mini-systems shall be used in conjunction with approved conventional disposal systems for human excreta. The standard design requirements for conventional septic systems prescribed by these construction standards shall apply, except that:

1. Design shall be based on a minimum volume of wastes **not** containing human excreta, or 25 gallons per day per person. Three days retention time shall be provided for each mini-system tank.

2. Construction materials shall be such that the tank will remain water tight.
3. Percolation tests should be conducted and the minimum size of the absorption area shall be calculated in accordance with these construction standards.
4. The building drain and sewer leading to the septic tank shall be a **maximum** of two inches in diameter to preclude a later tap for a water closet (toilet).

Gravelless Lateral Field

Gravelless Lateral Fields shall use corrugated polyethylene tubing encased in a soil filter protective wrap. The inside diameter should be either 8 inches or 10 inches. One foot of 8 inch tubing will equal one foot of 24 inch trench and one foot of 10 inch tubing will equal one foot of 36 inch trench. The Gravelless system shall be installed per the manufacturer's installation guide.

Inspection ports extending 12 inches above ground level are required for monitoring purposes. The end plates of each tube shall be constructed of plastic, made by the manufacturer of the tubing.

Chamber Systems

A chamber system shall be of sufficient width and length or dimension to provide the required absorption area and be installed to meet manufacturers specifications utilizing end caps designed for the chamber. The bottom of the trench shall be level.

1. Chamber trenches shall be separated by six (6) feet of undisturbed soil.
2. Fill the sidewall area to the top of the louvers by pulling soil from trench sides with a shovel. Be sure the fill covers the louvers. Pack down the fill by walking along the edges of the trench. This is an important step that assures correct structural support.
3. Risers shall be installed at the end of each lateral run extending 12 inches above ground level.
4. The soil covering the wastewater system shall be mounded upon completion of the system for a period of approximately two years.
5. Systems requiring more than one distribution line shall utilize distribution boxes with speed levelers or the equivalent.

Privy

A privy shall be built to include: fly-tight construction, a superstructure affording complete privacy, an earth mound around the top of the vault and below floor level, which slopes downward away from the super-structure base, a floor and riser of concrete or other impervious material, and with seats and covers of easily cleanable materials, venting shall be fly-proofed with No. 16 or tighter mesh screening. If a vault is used it shall be no less than 1000 gallons.

Innovative/Alternative Systems

Where no sewer is available or where conventional onsite wastewater disposal is not possible, innovative/alternative systems and systems not included in these construction guidelines may be submitted to the NWLEPG. The NWLEPG may require the system to be designed by a Kansas licensed professional engineer and ask for review by the Kansas Department of Health and Environment. Examples of alternative systems are: Mound, Evapotranspiration, Aerobic, etc.

Trench and bed systems utilizing new techniques other than the typical systems described in the Typical Absorption Trench and Bed System section may be used but sized the same as the typical systems. Variance in sizing shall be approved by the NWLEPG. Examples of such systems are the corrugated, fiberglass system, half round clay tiles, or half round concrete systems.

REQUIREMENTS FOR WASTEWATER STABILIZATION PONDS

Introduction

Due to limited absorption capacity of the soil in many areas of Kansas, the septic tank-lateral field systems described in these guidelines will not absorb the quantities of wastewater produced in our modern homes. Properly located, designed, constructed, and operated waste stabilization ponds may provide a possible solution where public sewers are not available. Ponds should not be considered unless percolation tests indicate rates slower than 1 inch of fall per hour (60 min per inch).

There are some drawbacks to a waste stabilization pond that should be considered before choosing this alternative. One is that ponds require more area than many people realize. Another is that they require considerably more maintenance. The pond area needs as much or more care than a lawn. Occasionally there can be operational problems and for some people, an aesthetic drawback to waste stabilization ponds. Since ponds contain raw sewage it is necessary to fence the pond for health and safety reasons. When estimating costs remember to consider the fencing and the seeding of the dikes. Sometimes it is necessary to control erosion of the compacted clay soil. In addition, if rock or sandy soil is encountered during construction, the costs can be much more than expected.

Plans

1. All applicable county or city/county requirements shall be met prior to construction.
2. The designs shown in these guidelines are not suitable for use at schools, institutions, or commercial businesses such as motels, restaurants, camps or trailer parks. Facilities for such establishments shall be designed by a Kansas Registered Professional Engineer. All waste stabilization ponds for the following described situations require a permit from Kansas Department of Health and Environment (KDHE):
   a) receive over 1000 gallons per day,
   b) serve more than one property,
   c) receive industrial waste, or
   d) discharge effluent.
3. A single-family pond should not be considered if septic tank/lateral field systems are feasible. If public sewer connection or a septic tank/lateral field is not feasible then a waste stabilization pond may be considered.
4. Before considering the installation of a pond, one should consider the following factors:
   a) The area required by a pond ranges from 5,500 to 10,000 square feet depending on the pond type.
   b) Ponds require routine maintenance of dikes, fencing and vegetation.
   c) Older ponds will fill with solids and may require the removal of those solids to prolong the ponds life. This is done by dewatering and removing the sludge, both require proper disposal. (See section on Disposal of Septage.)
   d) Some ponds require abandonment which requires dewatering and sludge removal as well as filling in the excavation.

Site

1. Conduct a preliminary site evaluation to determine the probable location for the facility. Note any conditions which could adversely affect construction, such as wells, public water supply, sandy soil, etc. A high water table or saturated zone near the surface of the ground would be an example of a prohibitive condition. Use all available site specific information, such as site history soil profiles, Soil Conservation Service Soil Survey and so forth.

2. Determine the percolation rate of the soil using the procedure described in the falling head percolation test. It is the percolation rate near the bottom of the test holes that is important.
3. Compare the results with your county Soil Conservation Service Soil Survey to see if the percolation test results are in general agreement. Large differences should be reconciled by further testing and examination of soil characteristics by someone knowledgeable in soil texture and structure and any factors which affect hydraulic conductivity.
4. Each county in Northwest Kansas has two recommended pond sizes (M-40 & M-45) for household wastewater disposal. The smaller pond should be used if the house has three bedrooms or less or if it serves five persons or less. The larger pond is for houses having four or five bedrooms and serves six or more persons. If there is any question about size, use the larger size. Other pond sizes are listed in Table 7 but are reserved for high water use households or multiple households and require KDHE approval.

WASTEWATER STABILIZATION POND SIZES

Pond Dimensions				Storage Capacity			
"A"	"B"	"X"		(cu. ft.)		(gallons)	
Pond Type			(Depth)	1.5'	5'	1.5'	5'
M-40	10'	52'	3.0	295	2,375	2,210	17,770
M-45	10'	59'	3.5	321	2,760	2,400	20,650

Note: See the Construction section for general specifications of dike construction. Diagram 5 shows the general layout of a wastewater stabilization pond in plan and section views.

5. Ponds shall be separated from other areas by distances equal to or greater than those shown below.

WASTEWATER STABILIZATION POND MINIMUM DISTANCES

Area	Minimum Separation
House it serves	100 ft.
Other residential structures	250 ft.
Applicant's private water supply well	100 ft.
* Property lines, including right-of-way	100 ft.
Public water supply well	100 ft.
Public water transmission lines	25 ft.

*** Note:** Placing the pond too close to a property line might limit the options of where an adjoining owner could locate a well. The neighboring property owner may sign a waiver which would allow the placement of the facility as close as 50 feet to the property line. Public roadways (total right-of-way) may be considered part of the separation if necessary. However, neither the pond or the dikes may be placed on any public access or utility easement.

Construction

1. The bottom level of the pond shall be at least 4 feet above the minimum groundwater level.
2. All outside dike slopes are to be three and one half (3 1/2) feet horizontal to one 1 foot vertical. Inside slopes are determined by the pond type used. (See Diagram 5 or Table of Waste Stabilization Pond Sizes.)
3. Minimum dike berm (top) width is to be four (4) feet.
4. Minimum dike freeboard (distance between water level and top of the dike) is to be two (2) feet. This makes the total dike berm height (7) feet above pond bottom.
5. Pond retention dikes should be above the 100-year flood plain.

6. The inlet pipe is to be of rigid, freeze-breakage resistant material such as steel, P.V.C., or A.B.S., and provide a capped cleanout at the nearest upsewer point where the flowline will be above the maximum pond water level. The minimum slope of the inlet pipe is to be 1/8 inch per foot with the piping outlet opening one (1) foot from the pond bottom. A 2 ft. sq. concrete splash pad or equivalent shall be placed under the outlet end of sewer pipe to prevent washout of the clay barrier.
7. When the pond excavation penetrates or terminates in either a rock strata or a porous (sand or gravel) strata, the excavation shall be extended a distance of one foot on both the bottom and side slopes. The area of supplemental excavation shall be filled with a non-permeable earthen material to limit seepage from the pond to a maximum value of 1/4 inch per day. This may be accomplished by using a clay soil which is free of rocks. If a clay soil is not available, the fill soil should be mixed with bentonite clay at the manufacturer's recommended rate and then compacted.
8. Surface drainage shall be diverted around the pond. (See Diagram 5 for example of diversion drainage.)
9. The builder shall smooth the dikes so that no clods, rocks, or ruts will interfere with a mower.
10. For erosion control, a groundcover shall be established on the dike. This groundcover should be a short-rooted perennial such as bluegrass, fescue, brome or crown vetch and must a maintained regularly during the growing season.
11. The entire pond area shall be fenced with a minimum 4 ft. high woven or welded wire fencing with 2-inch x 4 inch maximum openings. The fence may be installed no closer than three feet from the inside edge of the top of the dike. In addition, a double strand of barbed wire or electric fence is recommended if the facility will be accessible to livestock. The pond must be adequately fenced to prevent entrance of unauthorized personnel and livestock. All of the area within the pond enclosure should be regularly mowed.
12. A gate of sufficient size (minimum 4 ft. width) and located to accommodate the entrance of a mower shall be provided. This gate shall provide the same degree of resistance to entry as the fence and kept locked.
13. Roof drains may be discharged to the sewer system to aid in maintaining minimum water levels provided there is a control arrangement which can divert this water from the pond during times of high water.
14. If public sewers become available to the property, connection shall be made to the public sewer. The pond shall be abandoned by dewatering and pushing in the dikes and returning the area to the contours it had before construction of the waste stabilization pond. To dewater, the irrigation procedures for Emergency Overflow Procedures in these construction guidelines may be used.
15. Single-family ponds that are not constructed, operated and maintained according to county or city/county requirements are subject to being declared public health nuisances by the local boards of health (KSA 65-159) and prosecuted by the county attorneys (KSA 65-160).
16. Ponds are subject to all addendum of the Kansas Department of Health and Environment water quality regulations.
17. Specifications for pond sizes are listed in Diagram 5 or may be picked up at the Northwest Local Environmental Planning Group (NWLEPG).

Operation and Maintenance

1. All of the area bounded by the outside bottom edge of the dikes (or the fence where there is no dike) shall have a good stand of groundcover established and maintained on it. This grass should be a short-rooted perennial such as blue, fescue, or brome. Once this vegetation is established it shall be regularly maintained during the growing season and

under no circumstances shall trees or tall weeds be allowed to develop in the dike area. Vegetation shall not be allowed to grow higher than six inches.

2. Water vegetation shall be controlled. All trees and weeds, such as cattails and duckweed, should be removed as soon as the first ones develop in the water. Mosquito production is directly proportional to the amount of such vegetation. Essential air circulation is reduced, the pond's seal can be destroyed, and organic overloading can occur and evaporation can be reduced when such vegetation is allowed to get out of control. Pulling weeds out by hand is generally the best method. They should be removed from the water so that they do not contribute to the organic loading and filling of the pond. Herbicide use should be avoided when possible, as improper use can cause temporary system failure. If herbicides must be used, call your county extension agent for the latest advice on what product to use. Follow the manufacture's recommendations and avoid spillage or drift that would kill the grass on dikes.
3. The water depth shall be maintained between 1 1/2 and 5 feet. The pond should not be allowed to go dry during continuous use as this will stop the digestion of the wastewater. To help maintain the minimum depth in dry weather, roof drains may be directed into the sewer line. However, this should be considered a temporary condition and the drain water redirected during times of high water in the pond. Areas of little rainfall or times of low household water usage may require that additional water be pumped into the pond to maintain a minimum water level.
4. Any damage to the dikes shall be repaired by reshaping the area to the original plan and then establishing a good stand of groundcover on the worked areas. Among the most common causes of dike damage are settling, erosion and rodent burrowing. Surface water shall be diverted around the pond so it will not contribute to the hydraulic loading of the pond or create an erosion problem.
5. Essential features of the pond, such as the fence, gate and pipe shall be maintained in the condition called for in the original plans and specifications.

Emergency Overflow Procedure

One method often suitable for preventing overflow is to use some of the pond water for irrigation. This irrigation water must be distributed so all water is absorbed into the ground without runoff. The preferred irrigation area is plowed cropland. Care should be taken to minimize the taking of fresh or untreated sewage and sewage solids within the irrigation water; the intake should be suspended about midway in the water's depth. One alternative is to have the excess sewage hauled away by licensed system cleaner.

Note: For dewatering and irrigation requirements, see section on Proper Septage Disposal.

Irrigation is not to be considered a normal operating procedure but rather an emergency procedure to be used on rare occasions. If the threat of overflow persists, other measures must be taken such as enlargement of the existing pond or construction of an additional cell.

DIAGRAM 5

WASTEWATER STABILIZATION POND LAYOUT (PLAN & SECTION)

WASTEWATER STABILIZATION POND SIZES

	Pond Dimensions			Storage Capacity			
	"A"	"B"	"X"	(cu. ft.)		(gallons)	
Pond Type			(Depth)	1.5'	5'	1.5'	5'
M-40	10'	52'	3.0	295	2,375	2,210	17,770
M-45	10'	59'	3.5	321	2,760	2,400	20,650

Note: See the Construction section for general specifications of dike construction. Diagram 5 shows the general layout of a wastewater stabilization pond in plan and section views.