Designation: D 5925 – 96$^{\epsilon 1}$

Standard Practice for Preliminary Sizing and Delineation of Soil Absorption Field Areas for On-Site Septic Systems[1]

This standard is issued under the fixed designation D 5925; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Paragraph 1.6 was added editorially October 1998.

1. Scope

1.1 This practice covers procedures for estimating the dimensions and marking the boundaries of a soil absorption area for an on-site septic system involving residential-strength wastewater. It can also be used to estimate the dimensions of commercial on-site septic systems where wastewater strengths are similar to residential wastewater.

1.2 This practice can also be used for marking the boundaries of the area for a septic system constructed filter bed.

1.3 This practice can be used at any site where a potentially suitable or recommended field area has been identified in accordance with Practices D 5879 and D 5921.

1.4 Non-metric units remain the common practice in design and installation of on-site waste disposal systems, and are used in this practice. Use of SI units given in parentheses is encouraged, if acceptable to the appropriate permitting agency.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This practice offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 5879 Practice for Surface Site Characterization for On-Site Septic Systems[2]

D 5921 Practice for Subsurface Characterization of Test Pits for On-Site Septic Systems[2]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *clinometer*—an instrument for measuring inclination, as in topographic slope.

3.1.2 *constructed filter bed (CFB)*—for the purposes of this practice, material, usually of a sandy texture, placed above or in an excavated portion of the natural soil for filtration and purification of wastewater from an on-site septic system.

3.1.3 *on-site septic system*—for the purposes of this practice, any wastewater treatment and disposal system that uses a septic tank or functionally equivalent device for collecting waste solids and treats wastewater using natural soils, or constructed filter beds with disposal of the treated wastewater into the natural soil.

3.1.4 *potentially suitable field area*—the portions of a site that remain after observable limiting surface features, such as excessive slope, unsuitable landscape position, proximity to water supplies, and applicable setbacks, have been excluded.

3.1.5 *recommended field area*—the portion of the potentially suitable field area at a site that has been determined to be most suitable for an on-site septic system soil absorption field or filter bed based on surface and subsurface observations.

3.1.6 *soil absorption (SA) area*—an area of natural soil used for filtration and purification of wastewater from an on-site septic system.

3.1.7 *soil absorption field area (SAF)*—an area that includes soil absorption trenches and any soil barriers between the trenches. Also called a leachfield.

3.1.8 *soil absorption trench*—an excavated trench, usually 1.5 to 3 ft wide that receives wastewater for treatment. Also called a lateral or leachline.

[1] This practice is under the jurisdiction of ASTM Committee D18 on Soil and Rockand is the direct responsibility of Subcommittee D18.01 on Surface and Subsurface Characterization.

Current edition approved April 10, 1996. Published November 1996.

[2] *Annual Book of ASTM Standards*, Vol 04.09.

4. Significance and Use

4.1 This practice should be used in conjunction with a surface and subsurface site investigation to delineate a recommended field area that is adequate for any septic system that can reasonably be anticipated for the site. If actual design results in a smaller field area, the boundaries can be modified accordingly.

4.2 Staking and flagging procedures in the practice help prevent accidental disturbance of a recommended septic system field area by equipment traffic and other construction activities prior to installation of the system. Soil disturbance resulting in compaction from heavy equipment traffic or removal by excavation equipment usually invalidates the results of the surface and subsurface investigation that led to recommendation of a field area.

4.3 In the event of suspected disturbance or removal of natural soil in the recommended field area, soil elevation benchmarks established by this practice allow assessment of the actual extent of disturbance or soil removal.

4.4 This practice should also be used where topographic limitations create uncertainty as to whether a potentially suitable field area for a septic system will provide a large enough absorption area to treat anticipated wastewater flows. In such situations clear demarcation of the suitable areas will also provide greater assurance of proper system installation.

5. Field Equipment

5.1 A clinometer or hand level and rod that is marked in feet/metric increments and at the eye level of the investigator are used for measuring slope and delineating topographic contours. A compass may be useful for defining position of the field area. A single person can take measurements if the rod has a point that can be driven into the ground so that it stands vertically, as described in 7.1. An extendible surveyor's rod with a tripod can also be used by a single person and may facilitate the elevation benchmarking procedure described in 7.2.

5.2 A 100 ft tape or longer can be used to measure the length and width of the field area. A screwdriver or spike is also useful for anchoring one end of the tape when making measurements. Where there are no concerns about the adequacy of the available suitable area, pacing can be used as an alternative to a tape. In this case, the investigator should periodically check the accuracy of his or her pace against a known distance.

5.3 Stakes and flagging are used to mark the corners and other boundaries of the field area. Stakes can be of any material (wood, fiberglass, metal) that is durable enough to remain standing during the period from staking until installation of the system. If the area is to be mowed, the stakes should be tall enough and sturdy enough to prevent accidental damage to the stake or the mower. If there is any possibility that the stakes might be confused with other markers at the site, colored flagging coded for different purposes can be used. Generally, actual fencing is not required unless heavy equipment traffic is expected to run regularly by the area.

6. Procedure for Estimating Field Dimensions

6.1 Use this procedure for preliminary sizing of the area required for a soil absorption field or constructed filter bed for the purpose of staking a field areas as described in Section 7. This procedure should also be used whenever marginal site surface and subsurface conditions indicate doubt as to whether there is a large enough area that is suitable for an on-site septic system.

6.2 Factors that affect the soil absorption field (SAF) area requirements include wastewater quantity (typically expressed as gallons per day (gpd), loading rate (typically expressed as gpd/ft^2) that is derived from soil characteristics or percolation test results (see 6.3.3), and trench spacing, that determines the area of soil between absorption trenches.[3] Dividing Factor 1 by Factor 2 gives the total required soil absorption (SA) area.[4] The SA area plus the area represented by soil barriers between trenches yields the SAF area. In some jurisdictions the SA area may be determined by the number of bedrooms based on assumptions concerning wastewater flow and loading rates. Factors affecting the area required for constructed filter beds are the same as for soil absorption fields.

6.3 *Method for Estimating Soil Absorption Field Dimensions*—The method described here assumes residential-strength wastewater and includes tables that should be generally applicable to most parts of the United States. Alternative tables using other wastewater flow and soil loading rates can easily be developed. The method for estimating a SAF area involves the following steps: determining wastewater flow, determining soil loading rate, determining required SA area, determining the number of trenches and their length to provide the required SA area, and determining the width of the field based on the number of trenches.[5]

6.3.1 *Wastewater Flow*—Typically wastewater flow is determined by the number of bedrooms in a residence. 150 gpd per bedroom, recommended by U.S. EPA **(1)**,[6] is widely used. Table 1 includes rates of 150, 300, 450, and 600 gpd that correspond to a 1-, 2-, 3-, and 4-bedroom house, respectively. Some jurisdictions may use different loading rates (120 to 200 gpd per bedroom, 60 to 150 gpd per person). Reference **(2)** compiles design flow rates specified in state regulations in the United States.

---

[3] Other factors that may need to be considered include: wastewater strength (suspended solids, biological/chemical oxygen demand, nitrogen, phosphorus, etc.), potential for ground-water mounding under absorption trenches or constructed filter beds, and evapotranspiration. Standard loading rates based on soil characteristics or percolation test results usually assume residential-strength wastewater. Wastewaters with parameters that differ significantly from residential wastewater require special design procedures that are not addressed in this practice. Section 6.3.5 discusses situations where ground-water mounding analysis may need to be considered. In temperate climates evapotranspiration is usually not considered when determining the required SA area because it is zero during winter months. In areas where evapotranspiration is significant throughout the year, it may be possible to reduce SA area requirements. This requires a water budget analysis for the time of year when evapotranspiration is at a minimum and adjusting the field size accordingly. For example, if 20 % of the wastewater entering the soil could be expected to be transpired, the field size could be reduced by one-fifth.

[4] This actually gives only the absorption area of the bottom of the trench. Depending on the depth of effluent in a trench additional absorption area is provided by the sidewalls. Normal practice is to ignore this area when calculating required soil absorption area. However, some jurisdictions allow credit for sidewall area.

[5] This method can also be used to estimate field dimensions for grade soil absorption fields, and trench systems where the lower portions are filled with filter bed material.

[6] The boldface numbers given in parentheses refer to a list of references at the end of the text.

TABLE 1 Soil Absorption/Filter Bed Area Requirements for Different Wastewater Flow and Soil Loading Rates

Soil Loading, *R*		Wastewater Flow							
		150 gal/day		300 gal/day		450 gal/day		600 gal/day	
		Soil Absorption Area							
gal/day ft^2	ft^2 gal/day	ft^2	Square Root	ft^2	Square Root	ft^2	Square Root	ft^2	Square Root
0.2	5.0	750	...	1500	...	2250	...	3000	...
0.25	4.0	600	...	1200	...	1800	...	2400	...
0.3	3.3	500	...	1000	...	1500	...	2000	...
0.35	2.9	429	...	857	...	1286	...	1714	...
0.4	2.5	375	...	750	...	1125	...	1500	...
0.45	2.2	333	...	667	...	1000	...	1333	...
0.5	2.0	300	...	600	...	900	...	1200	...
0.6	1.7	250	16	500	22	750	27	1000	32
0.7	1.4	214	15	429	21	643	25	857	29
0.8	1.3	188	14	375	19	563	24	750	27
0.9	1.1	167	13	333	18	500	22	667	26
1.0	1.0	150	12	300	17	450	21	600	24
1.1	0.9	136	12	273	17	409	20	545	23
1.2	0.8	125	11	250	16	375	19	500	22

6.3.2 *Soil Loading Rate*—Increasingly, septic system design is being based on soil loading rates based on soil texture and structure as determined by subsurface site characterization as covered in Practice D 5879. Table 1 includes loading rates from 0.2 to 1.2 gpd/ft^2. Loading rates may also be determined by percolation test results **(3)**. Fig. 1 can be used to convert percolation rates measured as minutes per inch (mpi) to recommended SA area loading rates as suggested by U.S. EPA **(7)** and Winneberger **(4)**. If percolation test results are reported in inches/hour, convert to minutes per inch (mpi = 60/in./h). Soil loading rates are lower than the saturated hydraulic conductivity of soil in order to take into account reduced infiltration resulting from development of a biological clogging mat on absorption trench surfaces and to allow for unsaturated flow. Some jurisdictions may require consideration of climatic factors such as precipitation and evapotranspiration when determining soil loading rates for soil. Reference **(2)** compiles application rates defined in state regulations in the United States.

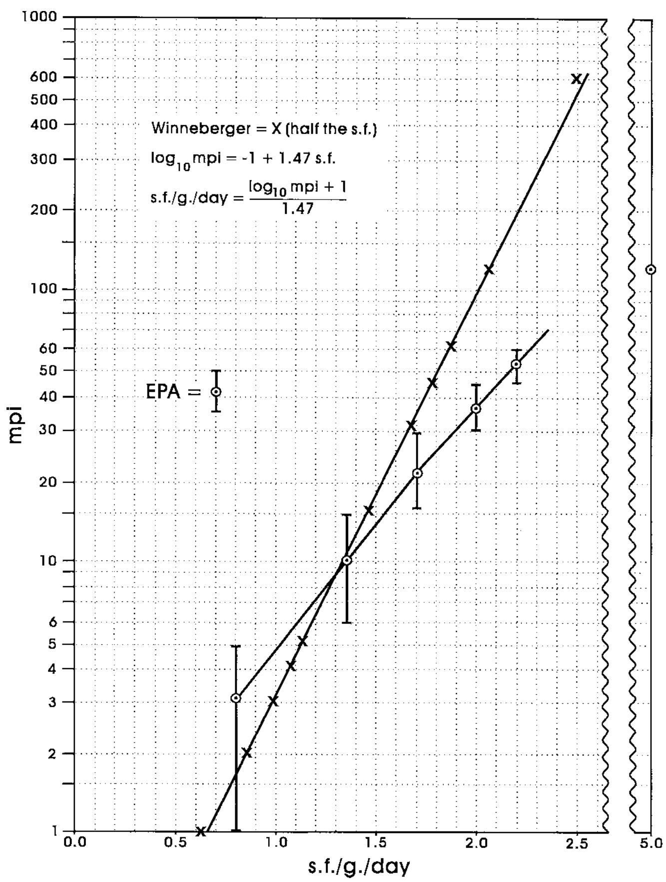

FIG. 1 EPA's and Winneberger's Recommendations for Absorptions Area (Square Feet per Gallon of Sewage per Day) Versus Measured Percolation (Minutes per Inch) (5)

6.3.3 *Soil Absorption Area*—Table 1 shows soil absorption areas required for commonly used wastewater flows and soil loading rates. If the applicable wastewater flow and soil loading rate is not included in Table 1, multiply the actual values determined in 6.3.1 and 6.3.2.

6.3.4 *Trench Width*—The width of a soil absorption trench determines how many square feet of soil absorption are available on the trench bottom per lineal foot of trench. Typical trench widths range from 1.5 to 3.0 ft **(5)**. Use the trench width that represents common installation practice in the area of the site.

6.3.5 *Number and Length of Trenches*—Use Table 2 to determine the possible combinations of number and length of trenches that will provide the soil absorption area determined in 6.3.3. For example, if the required soil absorption area is 600 ft^2, and the trenches are 3 ft wide, there are three possible configurations: (*1*) two trenches 100 ft long, (*2*) three trenches 70 ft long (that provide a little more than the required area),

TABLE 2 Trench Number and Length Chart

Trench Length	Number of Trenches					
	2	3	4	5	6	7
	3-Ft Wide Trench					
ft^2	ft^2	ft^2	ft^2	ft^2	ft^2	ft^2
45	270	405	540	675	810	945
50	300	450	600	750	900	1050
55	330	495	660	825	990	1155
60	360	540	720	900	1080	1260
65	390	585	780	975	1170	1365
70	420	630	840	1050	1260	1470
75	450	675	900	1125	1350	1575
80	480	720	960	1200	1440	1680
85	510	765	1020	1275	1530	1785
90	540	810	1080	1350	1620	1890
95	570	855	1140	1425	1710	1995
100	600	900	1200	1500	1800	2100
	1.5-Ft Wide Trench					
ft^2	ft^2	ft^2	ft^2	ft^2	ft^2	ft^2
45	135	203	270	338	405	473
50	150	225	300	375	450	525
55	165	248	330	413	495	578
60	180	270	360	450	540	630
65	195	293	390	488	585	683
70	210	315	420	525	630	735
75	225	338	450	563	675	788
80	240	360	480	600	720	840
85	255	383	510	638	765	893
90	270	405	540	675	810	945
95	285	428	570	713	855	998
100	300	450	600	750	900	1050

and (*3*) four trenches 50 ft long. Select the configuration that best fits the site, giving preferences for the configuration that minimizes the number of trenches.[7] This determines the length of the field for staking, as described in Section 7. Where the vertical separation between the bottom of the disposal component of the on-site septic system and a limiting layer is at or near the minimum allowed, ground-water mounding calculations may be required, especially if more than two or three trenches are required.[8]

6.3.6 *Width of Field*—Whenever two or more trenches are required, the width of a soil absorption field will be larger than for a single trench to account for the soil areas between trenches. Typically soil barriers range from 4.5 to 7.0 ft (7.5 to 10.0 ft on center). Table 3 shows field widths for different combinations of trench spacing, width, and number of trenches. Wider spacings may be required if potential for ground-water mounding is a concern. Use a trench width and spacing that represents common installation practices in the area of the site, and the number of trenches as determined in 6.3.5.[9] The width determined in this step represents the minimum width of the field area. Depending on site topography, requirements that trenches follow the contour may result in staked areas larger than the area indicated by multiplying length determined in 6.3.5 and the width determined in this step.

[7] Minimizing the number of trenches both simplifies installation and improves wastewater treatment by increasing soil oxygen availability and reducing ground water mounding.

[8] References that may be useful for ground-water mounding calculations in homogeneous horizontal aquifers include: (**(6)**—Chapter 4), **(7,8,9,10)** Chapter 13), (**(11)**—Section 5.7.2), (**(12)**—Section 4.3.2). The U.S. EPA ground-water mounding analysis procedures **(11,12)** are based on mound height analysis developed by Glover **(13)** and summarized by Bianchi and Muckel **(14)**. Finnemore **(15)** describes procedures for ground-water mounding calculations in layered horizontal aquifers, and for four types of sloping aquifers (uniform flow/homogeneous, uniform flow/layered, nonuniform flow/homogeneous, and nonuniform flow/layered).

[9] Where more than three trenches are required, the field can also be divided into two areas on either side of the wastewater distribution box in order to reduce ground water mounding. For example, an SAF area requiring six 3-ft wide trenches 75 ft long with a 6 ft soil barrier width could either be configured as an area 75 by 48 ft (six parallel trenches) or 150 by 21 ft (two areas on either side of the distribution box with three trenches). In the latter case, when staking the field area, the length should be increased to provide an additional soil barrier between the two field areas where the distribution lines will be laid.

TABLE 3 Soil Absorption Field Width Chart

NOTE 1—All units in feet except number of trenches.

Soil Barrier Width	Trench Distance on Center	Width	Number of Trenches					
			2	3	4	5	6	7
			Field Width					
ft	ft	ft	ft	ft	ft	ft	ft	ft
4.5	7.5	3.0	10.5	18.0	25.5	33.0	40.5	48.0
		1.5	7.5	13.5	19.5	25.5	31.5	37.5
5.0	8.0	3.0	11.0	19.0	27.0	35.0	43.0	51.0
		1.5	8.0	14.5	21.0	27.5	34.0	40.5
5.5	8.5	3.0	11.5	20.0	28.5	37.0	45.5	54.0
		1.5	8.5	15.5	22.5	29.5	36.5	43.5
6.0	9.0	3.0	12.0	21.0	30.0	39.0	48.0	57.0
		1.5	9.0	16.5	24.0	31.5	39.0	46.5
7.0	10.0	3.0	13.0	23.0	33.0	43.0	53.0	63.0
		1.5	10.0	18.5	27.0	35.5	44.0	52.5

6.4 *Method for Estimating Above-Grade Constructed Filter Bed (CFB) Dimensions*—Above-grade constructed filter beds typically require less area than soil absorption fields because soil loading rates are reduced by use of optimum filter material[10] and no soil barriers are required between trenches. To estimate dimensions of above-grade constructed filter beds, follow steps described in 6.3.1-6.3.3. In Table 1 the second column under each wastewater flow amount give the square root of the soil absorption area, which is the length in feet of a square providing the required filter area. If topography dictates a different shape, dividing the soil absorption area by the desired width or length provides the dimensions for staking.[11] Depending on the design of the constructed filter bed, additional area should be added to account for any berming around the margins of the filter bed.

7. General Procedure for Staking Field Area

7.1 The general procedure for marking the boundaries of a field area described here applies to a recommended field area where contours are parallel and do not curve significantly. Additional procedures for other topographic situations are described in Section 8. The procedure assumes that field width and length have been determined using the procedures described in Section 6. The procedure is written for a single person using a clinometer and rod (see 5.1). The procedure is somewhat simpler if two people are involved, one with the clinometer and the other with the rod because less walking back and forth is required for setting the rod and taking sitings. An alternative approach is to set the rod at benchmark point that is visible from the whole area, as described in 7.2, measuring relative elevations at each corner of the field area, and calculating slope gradients.

7.1.1 *Rectangular Field*—Fig. 2(*a*) shows the sequence for marking the corners of a rectangular field (any corner can be used as a starting point, and the sequence of steps can be modified as a matter of convenience): (*1*) Place stake and the rod at corner 1 and measure or pace along the contour a distance equal to the trench length (Corner 2); (*2*) sight back to the rod with the clinometer, and adjust position upslope or downslope if required to get a reading of zero (level); (*3*) place stake at Corner 2 and walk back to Corner 1; (*4*) measure or pace a distance equal to the field width upslope (or downslope) being sure to cross the slope at right angles to the contour (Corner 3); (*5*) place a stake at Corner 3 and site back to the rod with the clinometer to measure and record the slope; (*6*) go back to Corner 1, retrieve the rod and return to Corner 3; (*7*) place the rod at Corner 3 and measure or pace a distance equal to the trench length along the contour (Corner 4); (*8*) sight back to the rod with the clinometer, and adjust position upslope or downslope if required to get a reading of zero (level); (*9*) place stake at Corner 4, and measure or pace the distance between

[10] Some jurisdiction require sizing of CFBs based on the loading rate of the soil upon which the filter bed is constructed if the CFB is in direct contact with the natural soil.

[11] Constructed filter beds wider than ten feet tend to have inadequate oxygen supply in the soil below the center of the bed. Wider beds conserve space; narrower beds increase wastewater renovation performance and decrease ground-water mounding.

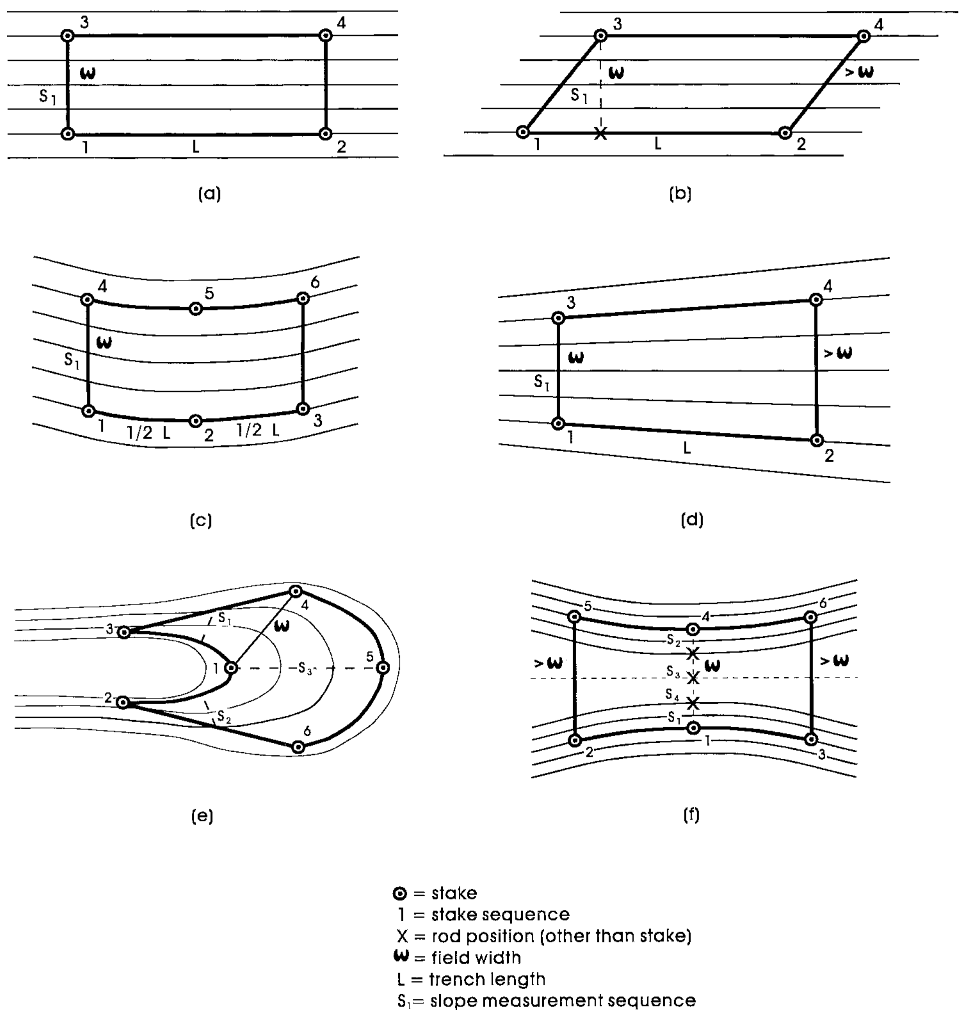

FIG. 2 Staking and Slope Measurement Sequences for Different Absorption Field Shapes and Topographic Settings

Corner 4 and Corner 2; (*10*) if the distance between Corner 4 and Corner 2 is equal to or greater than the distance between Corners 1 and 3, the procedure is completed; (*11*) if the distance between Corners 4 and 2 is less than the distance between Corners 1 and 3, move either stake to obtain the required field width and move Stake 1 or 3 accordingly so that lengths 1 and 2 and 3 and 4 are on the contour.

7.1.2 *Nonrectangular Field*—Fig. 2(*b*) shows the sequence for marking a field where the field boundaries do not meet at right angles. This situation may arise when limiting surface or subsurface features do not allow a square or rectangular field area. The steps are basically the same as for a rectangular field (see 7.1.1), except that in Step 4 it is necessary to measure or pace a distance equal to the field width from a point between Corners 1 and 2 such that the line connecting Corner 3 and Trench 1 and 2 is perpendicular (see Fig. 2(*b*)).

7.2 *Establishing Benchmark Elevations*—The elevation and location of corner stakes should be defined with reference to property lines or a permanent feature of the site. This allows relocating the field in the event that the markers delineating the field are removed, and determining whether the original land surface has been altered by excavation or fill if there is concern that the recommended field area has been subsequently disturbed.

7.2.1 A benchmark point, such as a property corner or other permanent landmark on the site should be selected for establishing the relative elevations of the recommended field area's corners. A benchmark point that allows direct horizontal siting on the rod with a clinometer or hand level from the highest and lowest points of the recommended field area is best. An extensible surveyor's rod with a tripod may facilitate establishing elevations on sloping sites. Setting the ground surface of the benchmark point as zero and subtracting the eye-level height of the observer from the height on the rod intersected by the horizontal siting (that is, zero gradient) gives the elevation relative to the benchmark ground surface. Since the upper and lower lengths of the field area are laid out on the contour, elevations of only one upper and one lower corner need to be established. For example, in Fig. 2(*a*) measuring the elevation relative to the benchmark at Points 1 and 3 will establish the lowest and highest elevations of the field.

7.2.2 At a minimum, one corner of the field area should be located accurately with respect to the benchmark used to determine elevations and compass readings taken to define the position of the other corners.

8. Special Topographic Situations

8.1 Fig. 2(*c*) through 2(*f*) illustrate shapes of fields that result when contours are either not parallel or curve significantly.[12] Special considerations in marking field areas in these situations are described below. Special considerations in measuring slope are covered in 8.2.

8.1.1 *Parallel Curving Contours (see* Fig. 2*(c)*—Where contours are parallel, staking procedures are basically the same as described in 7.1.1, except that it is helpful to place additional stakes along the contour to delineate the field boundaries more clearly, as shown in Fig. 2(*c*).

8.1.2 *Diverging Contours (see* Fig. 2*(d)*—Where contours are not parallel, the procedures are the same as described in Section 7.1.1, with the proviso that it is essential that the starting point for staking be at the location where contours are closest together. Failure to do this will result in the field width being less than the required amount at the other end of the field.

8.1.3 *Strongly Curving Contours (see* Fig. 2*(e)*—The noseslope of narrow ridgetops generally have strongly curving contours which often quickly converge away from the noseslope to form slopes that a too steep to be suitable for soil absorption fields. This requires use of additional stakes as described in 8.2, but the staking sequence is different as shown in Fig. 2(*e*). Slope measurements in this situation should be measured at the point they are steepest, which will usually be at Stakes 4 and 6 in Fig. 2(*e*).

8.1.4 *Saddle (see* Fig. 2*(f)*—Normally convex contours are considered unfavorable topographic positions for soil absorption fields because subsurface flow concentrates in such areas. On narrow ridgetops this is not as much of a concern as in other landscape positions, but special care is required when marking such areas. As shown in Fig. 2(*f*) the staking sequence begins where the saddle is narrowest, and proceeds accordingly.

8.2 *Fields With Unequal Lateral Lengths*—Where site surface and subsurface conditions do not allow delineating a soil absorption field with trenches of equal length, alternative designs, such as serial trenches or a pressure distribution system, may be feasible. The procedures described in the previous section can be adapted by first calculating the total linear feet of trench that is required. This can be obtained by dividing soil absorption area (see 6.3.3) by the trench width. Trenches of varying lengths can then be staked out on the contour until the required total length of trenches is reached.

8.3 *Measuring Slope*—Where the contours of the slope on which a soil absorption field is staked are evenly spaced (see Fig. 2(*a*), 2(*b*), and 2(*c*)) slope measurements can be taken over the full width of the field. In these situations, a single slope measurement (S_1) along the distance w is adequate for documenting compliance with any applicable slope restrictions. A single slope measurement where contours diverge (Fig. 2(*d*) is also adequate, provided the measurement is taken where contours are closest together.

8.3.1 *Single Slope Break*—The rod should be positioned at the point a slope changes and the slope measured above and below the rod. If the field area is on a slope close to the maximum allowed, and spacing of contours changes over the width of the field, measure the maximum slope rather than the average to demonstrate compliance with any applicable slope limitations. For example, Fig. 3 illustrates how taking an average reading over a distance of 50 ft can give the mistaken impression that the slope is suitable. In this example, if a field area had been staked out and only the average slope measured, half of the field area would have been out of compliance.

8.3.2 *Complex Slope Breaks*—Complex slopes may require moving the rod a number of times to adequately characterize slope. With strongly curving contours (see Fig. 2(*e*) several slope measurements may be required to determine maximum slope (S_1 and S_2) and another to measure minimum slope (S_3). Measuring maximum slope in a topographic saddle (see Fig. 2(*f*)) requires measuring slope on both sides (S_1 and S_2). In this case the rod can be left at Stake 1 and Stake 4 and slope measurements taken from the top of the ridge or any break before the top of the ridge. If there is a slope break before the top of the ride, the rod should also be placed at the top of the ridge and slopes measured from the break on either side (S_3 and S_4).

9. Report

9.1 The locations of all stakes used to delineate the recommended field area and all slope measurements should be recorded on the sketch map developed for the site investigation report (see Section 8 in Practice D 5879). If the sketch map is not drawn accurately to scale, the following information should be provided on the sketch map: the distance and compass direction from the benchmark point (see 7.2) to one corner of the field, length of each side of the field, and compass directions of each side. As an alternative to compass directions, distances from each corner to property boundaries or other permanent landmarks on the site can be noted.

10. Keywords

10.1 field investigations; preliminary investigations; septic systems; site characterization; site investigations

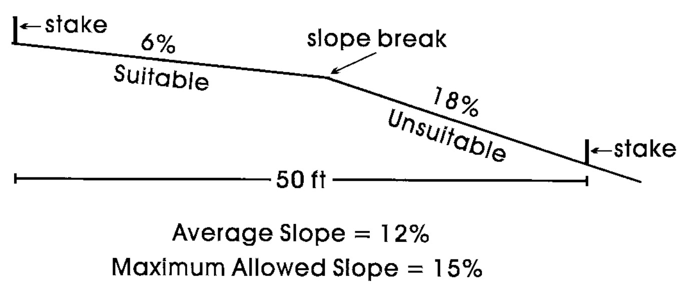

FIG. 3 Slope Measurements for Soil Absorption Field Areas Should Include Maximum Rather Than Average Slopes

[12] If the limiting depth identified in Practice D 5921 is deep, some departure of trenches from the contour may be acceptable. For example, if the allowed variation in trend depth were 18 to 36 in., there could be as much as a 1.5 ft difference in elevation from one end of the trench to the other at the ground surface. Any departures from staking along the contour should be documented and justified.

REFERENCES

(**1**) U.S. Environmental Protection Agency, *Design Manual: Onsite Wastewater Treatment and Disposal Systems*, EPA/625/1-80-012, 1980.

(**2**) National Small Flows Clearinghouse (NFSC), *Location and Separation Guidelines from the State Regulations*, NFSC, West Virginia University, P.O. Box 6064, Morgantown, WV 26506-8301, 800/624-8301, 1995.

(**3**) National Small Flows Clearinghouse (NFSC), *Application Rates and Sizing of Fields from the State Regulations*, NFSC, Morgantown, WV, 1995.

(**4**) Winneberger, J. T., *Septic Tank Systems*, Butterworth Publishers, Stoneham, MA, 1984.

(**5**) Perkins, R. J., *Onsite Wastewater Disposal*, Lewis Publishers, Chelsea, MI, 1989.

(**6**) Canter, L. W. and Knox, R. C., *Septic Tank Systems Effects on Ground Water Quality*, Lewis Publishers, Chelsea, MI, 1985.

(**7**) Finnemore, E. J., "Estimation of Ground-Water Mounding Beneath Septic Drainfields," *Ground Water 31(6)*, 1993, pp. 884–889.

(**8**) Finnemore, E. J. and Hantzsche, N. N.," Ground-Water Mounding Due to On-Site Sewage Disposal," *J. Irrigation and Drainage Engineering, ASCE 109(2)*, 1983, pp. 199–210.

(**9**) Hantush, M. S., "Growth and Decay of Groundwater-Mounds in Response to Uniform Percolation," *Water Resources Research 3(1)*, 1967, pp. 227–234.

(**10**) Kaplan, O. B., *Septic Systems Handbook*, Second Edition, Lewis Publishers, Chelsea, MI, 1991.

(**11**) U.S. Environmental Protection Agency, *Process Design Manual: Land Treatment of Municipal Wastewater*, EPA/625/1-81-013, 1981.

(**12**) U.S. Environmental Protection Agency, *Process Design Manual: Land Treatment of Municipal Wastewater, Supplement on Rapid Infiltration and Overland Flow*, EPA/625/1-81-013a, 1984.

(**13**) Glover, R. E., *Mathematical Derivations as Pertaining to Ground Water Recharge*, USDA Agricultural Research Service, 1961.

(**14**) Bianchi, W. C. and Muckel, C., *Ground Water Recharge Hydrology*, ARS 41-161, USDA, Agricultural Research Service.

(**15**) Finnemore, E. J., "Water Table Rise in Layered Soils Due to Onsite Sewage Disposal," In *On-Site Wastewater Treatment (Proc. 7th Int. Symp. on Individual and Small Community Sewage Systems), ASAE Publ. No. 18–94*, American Society of Agricultural Engineers, St. Joseph, MI, 1994, pp. 200–208.