SITE MODIFICATION GUIDELINES

AND RELATED APPENDICES

Appendix A	A Comparison of Grain-Size Limits in the Five Classification Systems
Appendix B	Partial and Full Cut-Down SAS
Appendix C	Detailed Schematic of a Mound System
Appendix D	Construction Procedures
Appendix E	Pressure Distribution
Appendix F	Pumping Chamber Minimum Requirements and Pump Installation Procedures

Developed per authority of Sections 601.7.3 and 601.8.4 of the *Sewage Disposal Regulations for Kent County, Michigan* – Rev. 2/95

KENT COUNTY HEALTH DEPARTMENT
ENVIRONMENTAL HEALTH DIVISION

PROGRAM GUIDELINE

PROGRAM:	Sewage Disposal - Private
SUBJECT:	Guidelines Concerning Site Modifications
AUTHORITY:	Section 601.7.3 and Section 601.8.4, Sewage Disposal Regulations for Kent County, Michigan
GUIDELINE NO. 3	EFFECTIVE DATE: May 13, 1984

I. PURPOSE:

In the process of responding to an "Application for Sewage Disposal Facility Permit," or when performing a Vacant Land Evaluation, existing site and/or soil conditions may be encountered that do not meet the requirements of the Sewage Disposal Regulations for Kent County, Michigan. However, through the use of certain modifications to the site it could be made acceptable.

The purpose of this Guideline will be to outline the types of unacceptable sites, soil conditions, and/or construction techniques that will not be considered for modifications. Further, this Guideline will outline in detail the types of modifications that can be done to overcome an impermeable soil condition or high groundwater condition.

II. GENERAL PROVISIONS AND PROCEDURES:

A. The following site conditions, soil conditions, and/or construction techniques, shall not be considered as acceptable by this Guideline:

1. Filling over the following types of soil/parent soils, and/or conditions:

   a. Unstable soils, i.e., peat or muck.
   b. Soils with a permeability range greater than 120 minutes per inch.
   c. Soils with water table less than 2.0 feet from natural grade.*

2. The enlargement of a conventional Soil Absorption System (SAS) without doing anything to remove or overcome an unacceptable condition.

3. The installation of an under-drain below the SAS.

4. The excavation of impermeable soils to a depth greater than 20.0 feet, and for which the permeable soils below are less than 4.0 feet in thickness, and/or show evidence of saturation.

*Will require amending Sewage Regulation (601.7.1).

B. Definition of Terms

1. Approved Permeable Fill Material

This term is defined as a clean granular fill as determined by the U.S. Department of Agriculture (see Appendix A). Further, when used in a cut-down type of SAS, the clean granular fill shall be washed.

2. Cut-Down System

A cut-down sewage disposal system is defined as one in which the original, poorly permeable soil beneath the SAS is removed, in part or in total, down to a well-drained permeable soil; the cavity remaining from the removal process is filled with an approved fill material. The length of the SAS shall be at least two times the width. When the impermeable soils can be penetrated within 6.0 feet of the natural grade, a full cut-down type of system shall be used. However, if the impermeable soils cannot be penetrated within 6.0 feet of the natural grade, a partial cut-down type of system shall be used; a cut-down system shall not be considered if the impermeable soils cannot be penetrated within 20.0 feet from the natural grade.

a. Full Cut-Down System - defined as a drain-bed or drainfield in which all of the impermeable soils below the system have been excavated, and the cavity filled with an approved fill material up to an elevation to allow for the installation of a conventional SAS. Refer to Appendix "B".

b. Partial Cut-Down System - defined as a drain-bed in which only a portion of the impermeable parent soils are excavated down to a permeable soil, and which the cavity, along with the entire floor area of the bed, are filled with an approved fill material. The fill material placed under drain-bed, in the excavated area, shall be at least 2.0 feet in depth. Refer to Appendix "B".

3. Elevated SAS

An elevated SAS is one in which the distribution piping or tubing is installed above the existing grade in a bed of permeable soil; effluent is discharged into the piping or tubing by either gravity flow, or an effluent pump. Refer to Appendex "C" for a descriptive drawing of a typical mound system.

C. Application of Systems in the Field

1. A cut-down sewage disposal system shall be used when the parent soils in the proposed SAS area have a permeability range greater than 60 min/inch, and such soils can be penetrated, providing downward drainage to an underlying well-drained permeable soil.

2. An elevated SAS shall be considered when there is a need to overcome either of the following conditions:

   a. A seasonal groundwater table less than 4.0 feet, but greater than 2.0 feet from the original grade, or

   b. A soil with a permeability range greater than 60 min/inch, but not more than 120 min/inch, and which cannot be penetrated within 20.0 feet from the original grade.

D. Inspection Requirements

The Director shall notify the applicant of the applicable inspection schedule. Because of the need to see that proper materials are used, and installation practices are adhered to, the Department may perform several inspections during the construction phase. Note, final grading is considered as part of the construction phase.

III. SPECIFIC DESIGN AND INSTALLATION CRITERIA FOR CUT-DOWN SEWAGE DISPOSAL SYSTEMS

A. Calculating the Total Infiltrative Area (TIA)

The TIA for a cut-down system shall be calculated, based upon the bottom, or floor area only; sidewalls shall not be considered as having any absorptive value; permeability value of 5 minutes or less will be assigned to the approved fill material.

B. Installation Requirements

1. Refer to Appendix "D" for specific installation requirements on the cut-down portion of the system.

2. Regarding the installation requirements on the drainage tubing, aggregate, grade, final, etc., refer to Article VI of the Sewage Disposal Regulations for Kent County, Michigan.

C. Site Requirements

A site proposed to be used for the installation of a cut-down system shall be in compliance with Sections 601.1 - 601.7 of the Sewage Disposal Regulations for Kent County, Michigan. Further, the permeable soil into which the cut-down will be made shall be at least 4.0 feet in depth, be continuous over a substantial area, and not show evidence of saturation.

IV. SPECIFIC DESIGN AND INSTALLATION CRITERIA FOR ELEVATED SOIL ABSORPTION SYSTEMS (ESAS)

A. Fill Material

The clean granular fill used in the construction of an ESAS will not need to be washed.

B. Geometry of the Absorption Bed

The absorption area within the filled area (mound) can either be a bed or a series of trenches. In most instances, a rectangular bed with the long axis parallel to the slope contour is preferred.

C. Location Considerations for Elevated SAS

1. Landscape Position - well-drained areas, level or sloping; crests of slopes or convex slopes are most desirable. Depressions, bases of slopes, and concave slopes are not to be used.

2. Slopes - 0 to 6 percent for soils with percolation rates slower than 60 min/inch. Slopes of up to 12 percent can be used when percolation rate is faster than 60 min/inch.

D. Sizing the Fill Area (Basal Area)

The size of the fill area, termed the basal area in this Guideline, is dependent on such factors as the permeability of the natural soils, the size and shape of the absorption area, original grade, etc. The basal area is defined as that portion of the SAS that starts on top of the existing soil/grade, supports the absorption bed (discharge area) at an elevation above the existing grade, and the set-back areas around the absorption bed. The basal area is determined by the percolation rate of the natural soils being filled over, and the corresponding minimum load rates specified in Table A of Appendix "E". Refer to Appendix "E" for a description of how to calculate the basal area.

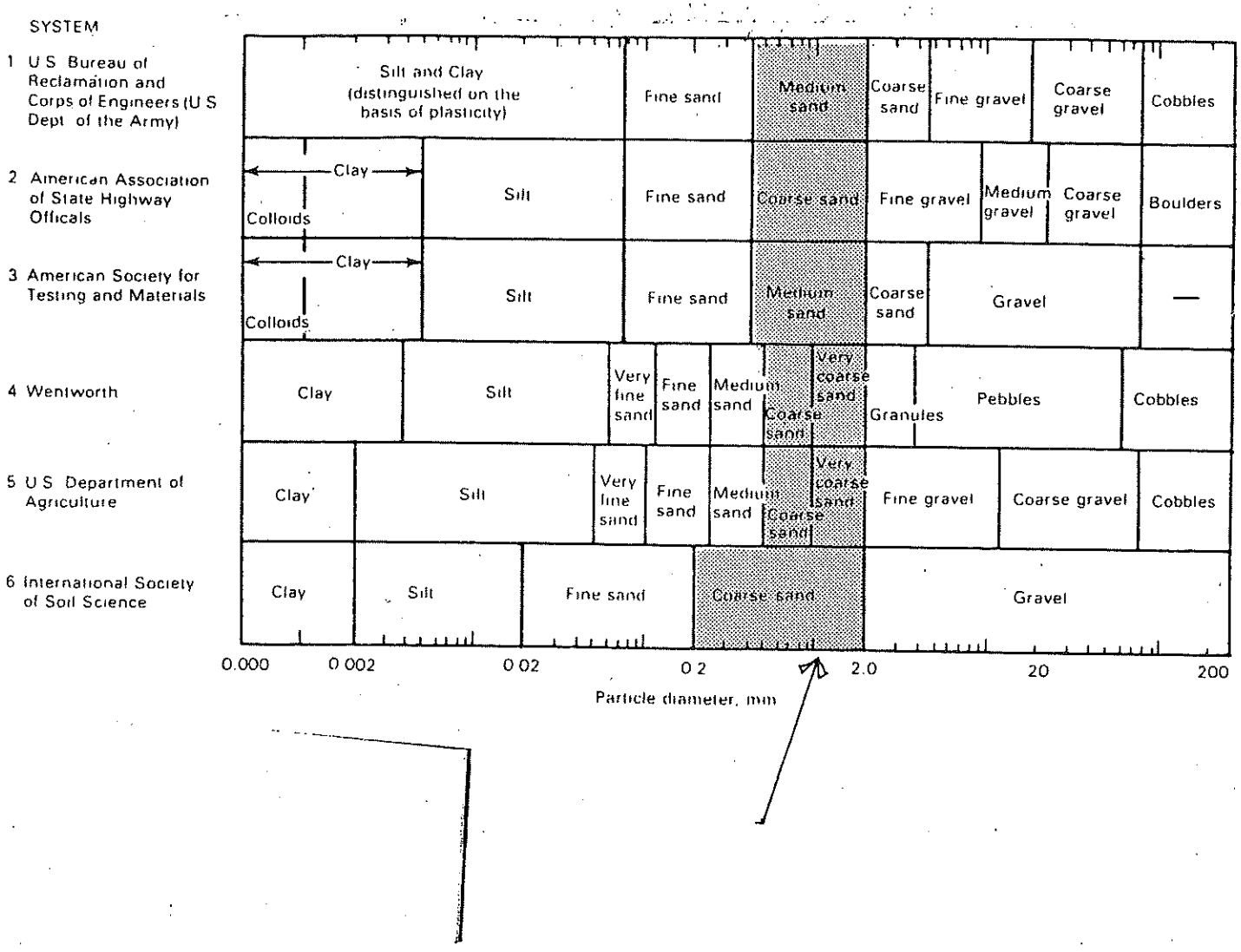
E. Sizing the Absorption Bed (Discharge Area)

The size of the absorption bed, termed the discharge area, placed on top of the fill material, shall be based upon the percolation rate of the fill material (5 min/inch). This would provide for an infiltrative area of 19.5 square meters (210 square feet) per bedroom (as prescribed by Table IV-C of the Sewage Disposal Regulations for Kent County, Michigan).

F. Pressure Distribution

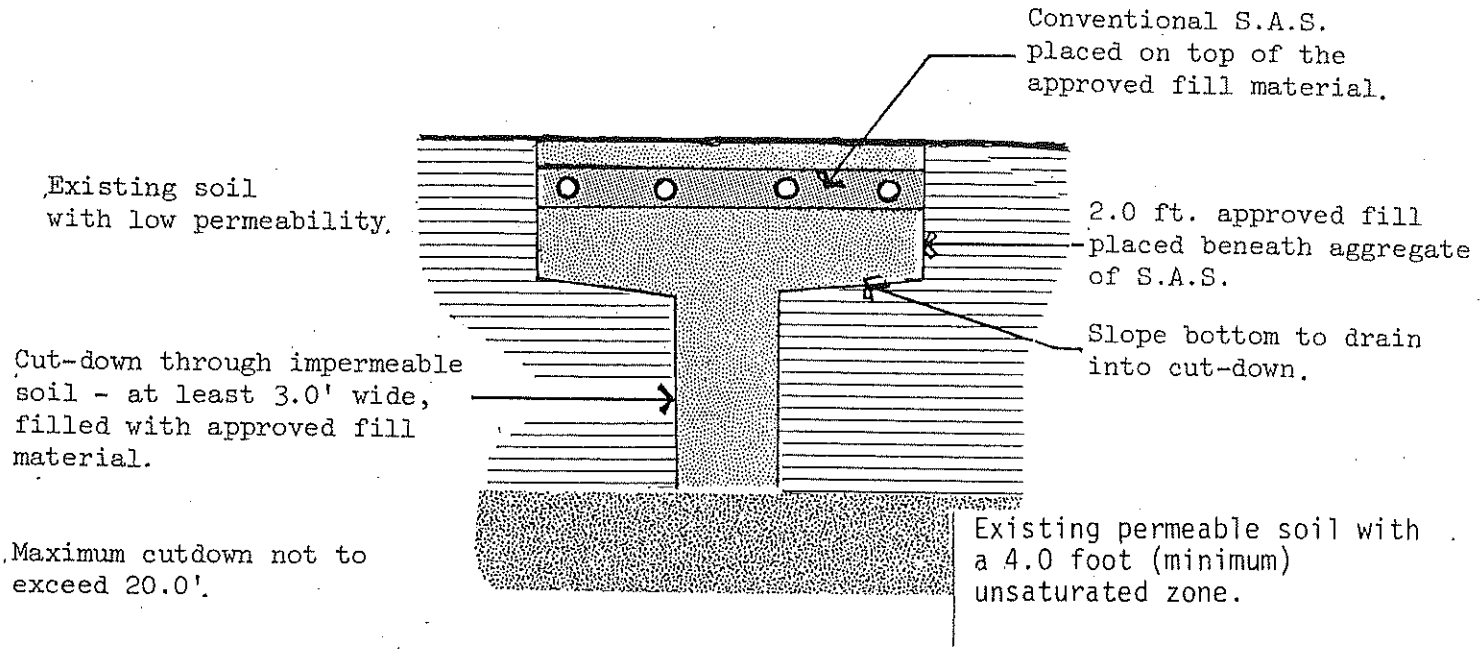
When an ESAS is used to overcome a slowly permeable natural soil condition, effluent will be discharged into the system by means of a pressure distribution network. Refer to Appendix "E" for specific sizing procedures; refer to Appendix "F" for specific installation and pump chamber requirements. Pressure distribution will not be required to be used in an ESAS installed to overcome a high groundwater table in permeable soil; gravity flow type distribution system will be permissable.

Name of Program Guideline:	Guidelines for Site Modifications	
Name of Appendix:	A COMPARISON OF GRAIN-SIZE LIMITS IN THE 5 CLASSIFICATION SYSTEMS	I.D. Code: Appendix A

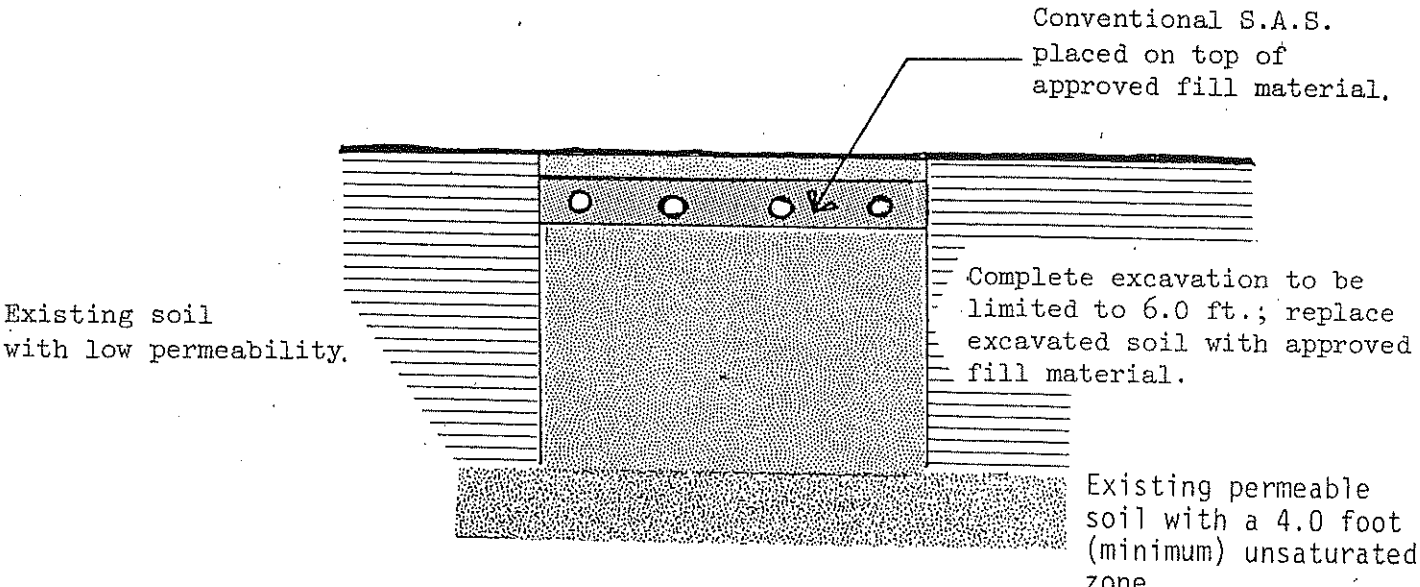


Program Guideline:	Guidelines for Site Modifications	
Name of Appendix:	PARTIAL AND FULL CUT-DOWN SAS	I.D. Code: Appendix B

PARTIAL CUT-DOWN S.A.S.*
(Cross-section, End-view)

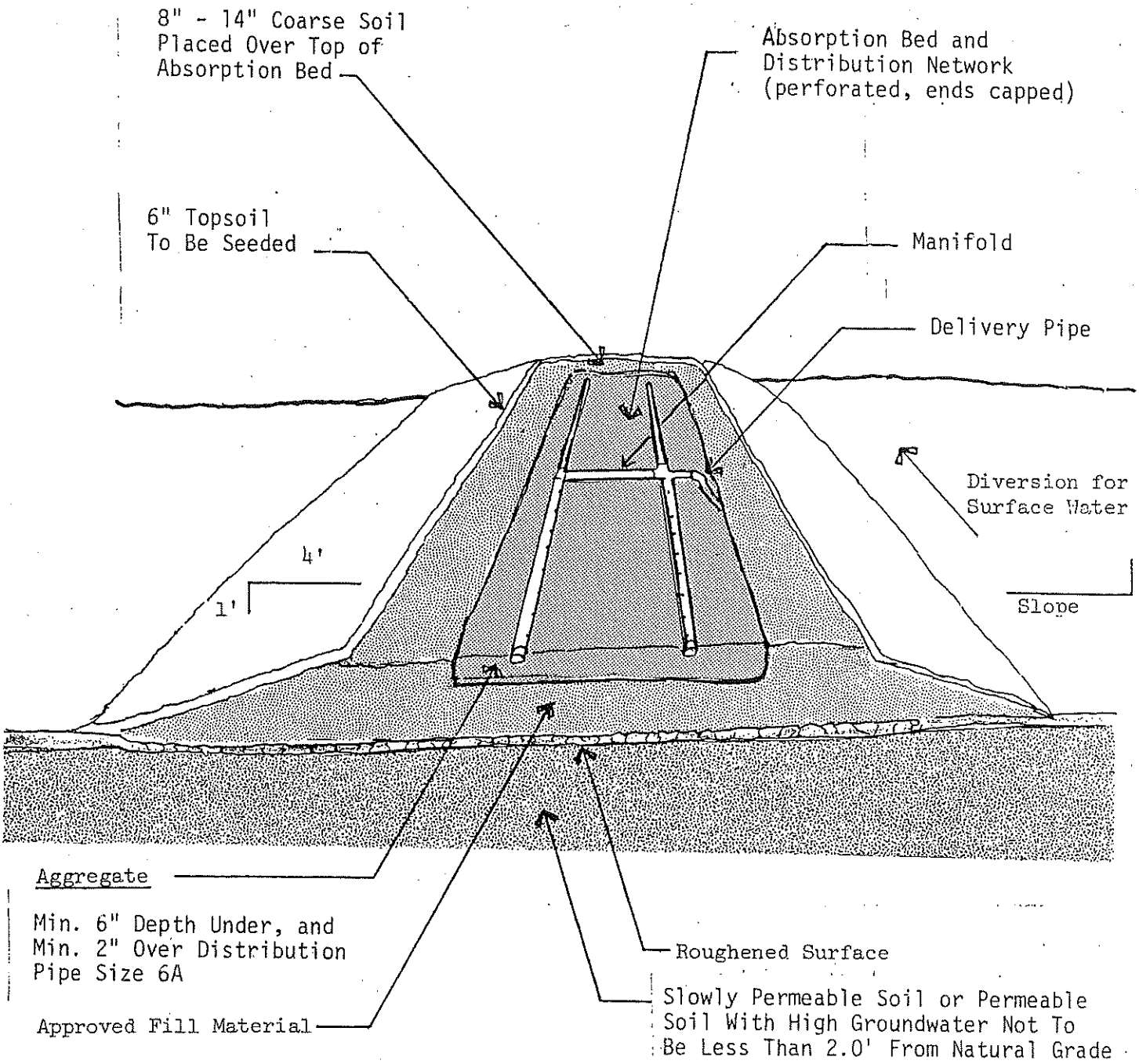


FULL CUT-DOWN S.A.S.*
(Cross-section, End-view)



* S.A.S.= Soil Absorption System

Name of Program Guideline:	Guidelines for Site Modifications	
Name of Appendix:	DETAILED SCHEMATIC OF A MOUND SYSTEM	I.D. Code: Appendix C



CONSTRUCTION PROCEDURES

The following procedures are recommended to be followed in the installation of an Elevated Soil Absorption System (ESAS). They are intended to protect the drainage characteristics of the parent soils and fill material; to insure that critical installation details are met.

A. Site Preparation

Step 1. Once the construction site has been identified by the sanitarian, it needs to be secured in such a manner that construction activity and vehicular traffic over the site is limited, in order to prevent damage to the soil structure.

Step 2. Cut and remove all surface vegetation, i.e. shrubs, bushes, plants, etc. in ESAS area. Trees should be cut at ground surface; stumps are to be left in place. Heavy sod shall be removed.

Step 3. Install the delivery pipe from the dosing chamber to the mound. Lay the pipe below the frost line, or slope in uniformly back to the dosing chamber so it may drain after dosing. Backfill and compact the soil around the pipe.

Step 4. Prepare the ESAS area by roughening or scarifying the ground surface with backhoe teeth.

B. Fill Placement

Step 1. Place the fill material on the upslope edges of the roughened or scarified area; minimize traffic on the downslope side.

Step 2. Move the fill material into place using a small-track tractor with a blade. Always keep a minimum of 6 inches of material beneath the tracks of the tractor to minimize compaction of the natural soil. The fill material should be worked in this manner until the height of the fill reaches the elevation of the top of the absorption bed.

Step 3. With the blade of the tractor, form the absorption bed. Hand level the bottom of the bed, checking it for the proper elevation. Shape the sides to the desired slope.

C. Distribution Network Placement

Step 1. Carefully place the coarse aggregate in the bed. Do not create ruts in the bottom of the bed. Level the aggregate to a minimum depth of 6 inches. (15 cm.).

Step 2. Assemble the distribution network on the aggregate; laterals should be laid level. If a pressurized system is used, the manifold should be placed so it will drain between doses, either out of the laterals, or back into the pump chamber.

Step 3. Place additional aggregate to a depth of at least 2 inches (5cm) over the pipe.

D. Final Cover

Step 1. Place 8 to 14 inches of coarse soil over the top of the bed.

Step 2. Place 6 inches (15 cm) of good quality topsoil over the entire mound surface.

Step 3. Plant grass over the entire mound using grasses adapted to the area. Shrubs can be planted around the base and up the side-slopes. Shrubs should be somewhat moisture tolerant, since the downslope perimeter may become moist during early spring and late fall. Plantings on top of the mound should be drought resistant.

Name of Program Guideline	Guidelines for Site Modification	
Name of Appendix:	PRESSURE DISTRIBUTION	I.D. Code: Appendix E

PURPOSE:

Uniform distribution of wastewater over the entire infiltrative surface of the fill area is necessary for the long-term, safe, operation of the system. To achieve uniform distribution, the volume of water passing out each hole in the drainage tile network must be uniform. This requires that the pressure in each segment of pipe be nearly equal. This is accomplished by balancing the head losses through proper sizing of the following: pipe diameter, hole diameter, and hole spacing. Further, it is important to properly size the discharge area and the basas area of the fill system.

This appendix will describe, in a step-by-step manner, the procedures to use in designing a pressure distribution network for a mound.

A. Mound Design and Dimensions

Step 1. *Calculate the Discharge Area, designated as "A" in Figure E-1, required to be provided under the distribution network.*

$$\text{Discharge area} = \frac{\text{average daily sewage flow/bedroom}^{(b)}}{\text{infiltration rate}^{(a)}}$$

$$= \text{gpd/bedroom} \div \text{gpd/ft.}^2$$

$$= \frac{150 \text{ gpd/bedroom}}{211 \text{ ft.}^2 \text{/bedroom}} \div 0.71 \text{ gpd/ft.}$$

i.e., 3 bedroom house requires 633 ft^2 of area under the distribution network.

Step 2. *Calculate the Basal Area, designated as "B" in Figure E-1, required to be provided under the discharge area.*

$$\text{Basal area} = \frac{\text{average daily sewage flow/bedroom}}{\text{infiltration rate}^{(a)}}$$

i.e., the basal area required for a mound on clay loam soil for a three bedroom house is...

$$= (3 \times 150 \text{ gpd}) \div 0.2 \text{ gpd/ft}^2$$

$$= 450 \div 0.2$$
$$2{,}250 \text{ ft.}^2$$

(a) Refer to Table A for rate.
(b) Section 604.5.1 of Sewage Disposal Regulation for Kent County, Michigan establishes value of 150 gal. per bedroom per day.
(c) Refer to Table A for rate.

A. Mound Design and Dimensions (continued)

Step 3. *Calculate the Length and Width of the Discharge Area, (see Figure E-2, measurements A and B in Top view). Note: the minimum width (A) is 6.0 ft., the maximum width is 10.0 ft.*

i.e. Discharge area = 633 ft.^{2}

Width = 10 ft/length = B

Area = A X B

633 = 10 X B

63 ft. = B

Step 4. *Calculate the Length and Width of the Mound (see Figure E-2, measurements L and W). The formula used in making this calculation will vary with each site because of existing grade conditions. Refer to the Dimension requirements contained in Figure E-2.*

B. Design of Discharge Network System

Concepts - The discharge network will usually consist of 1 to 3 inch (3 to 8 cm) diameter laterals, connected by a central or end manifold of equal or larger diameter. The laterals are perforated at their inverts with 7/32 to 1/2 (0.6 to 1.3 cm) diameter holes. The spacing between holes is 2 to 10 ft. (0.6 to 3.0 m).

The typical distribution network system for an elevated mound shall consist of two laterals with a center header. Although the specific diameter of the network piping, hole size, and spacing can vary, for the purpose of maintaining some consistency and standardizing our thought, there will be occasions in the following material where the Department has "established" a norm which it shall use in conducting further calculations.

Step 1. *In a typical mound, a two-pipe distribution network, serviced by a center header, is used. See Figure E-1 for example.*

i.e., in the example, the distribution network used would consist of two laterals, at 62 ft. each, 3 ft. on center. The center head would separate the laterals and thus provide 4 laterals at 31 ft. each.

B. Design of Discharge Network System (continued)

Step 2. *Determine the diameter of the laterals based upon the hole diameter to be used. See Table B for specific sizing requirements.*

i.e., for a 1/4" diameter hold, placed 3.0 ft. on center in a lateral that is 31.0 ft. in length, a 1¼ " diameter could be used.

Step 3. *Determine the gallon per minute (gpm) flow through a ¼" diameter hole. See Table C for this information. Note: a 2.0 ft head must be maintained in the pipe.*

i.e., according to Table C, a ¼" diameter hole with a 2.0 ft. head, will discharge 1.04 gpm.

Step 4. *Calculate the total discharge rate in all laterals.*

Total discharge rate = gpm/hole X number of holes/per lateral, X number of laterals

= gpm X 10 holes/lateral X 4 laterals

= 41.6 gpm.

Step 5. *Determine the size of manifold that will connect the laterals together. Refer to Table D.*

Step 6. *Calculate the total pumping head (feet in elevation) by using the following formula:*

Friction loss in delivery pipe & fittings(*)..... _____ ft.
Elevation difference between pump to lateral invert... _____ ft.
Distribution network pressure.(minimum)..... 2.0 ft.

Total Pumping Head _____ ft.

Step 7. *Select the pump that is able to discharge the minimum rate (gpm value obtained in Step 4.) at the calculated pumping head (ft. of head obtained in Step 6.).*

Step 8. *Determine the volume of dose that the pump will be set to deliver, so as to dose the discharge area with approximately 10 times the volume of the network distribution piping. Refer to Table C for a chart giving pipe capacities; refer to Table F to determine the minimum dose volume for given lateral diameter, lateral length, and number of laterals.*

(*) Refer to Table E

FIGURE E-1

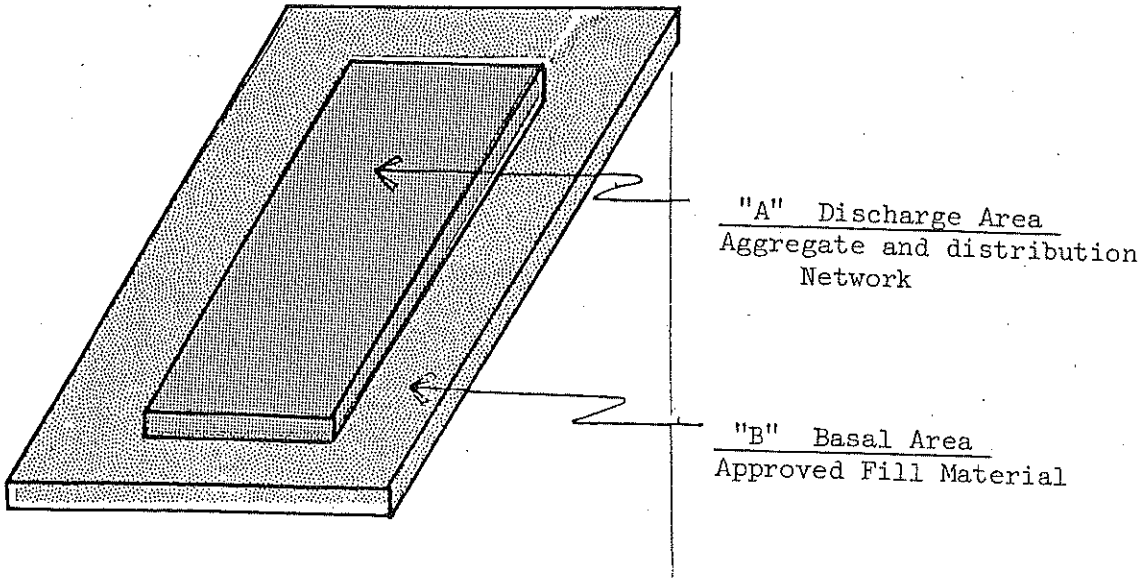
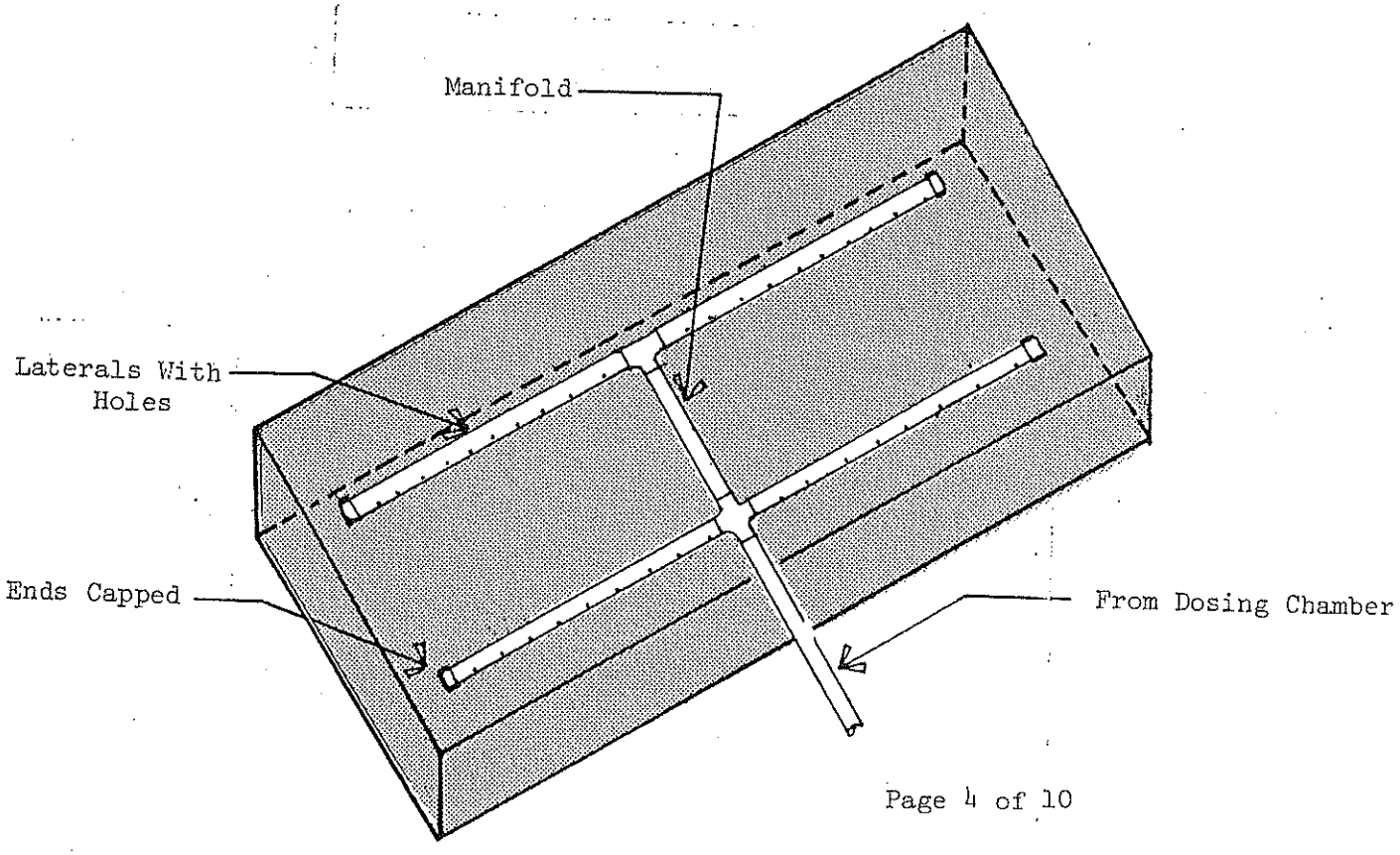
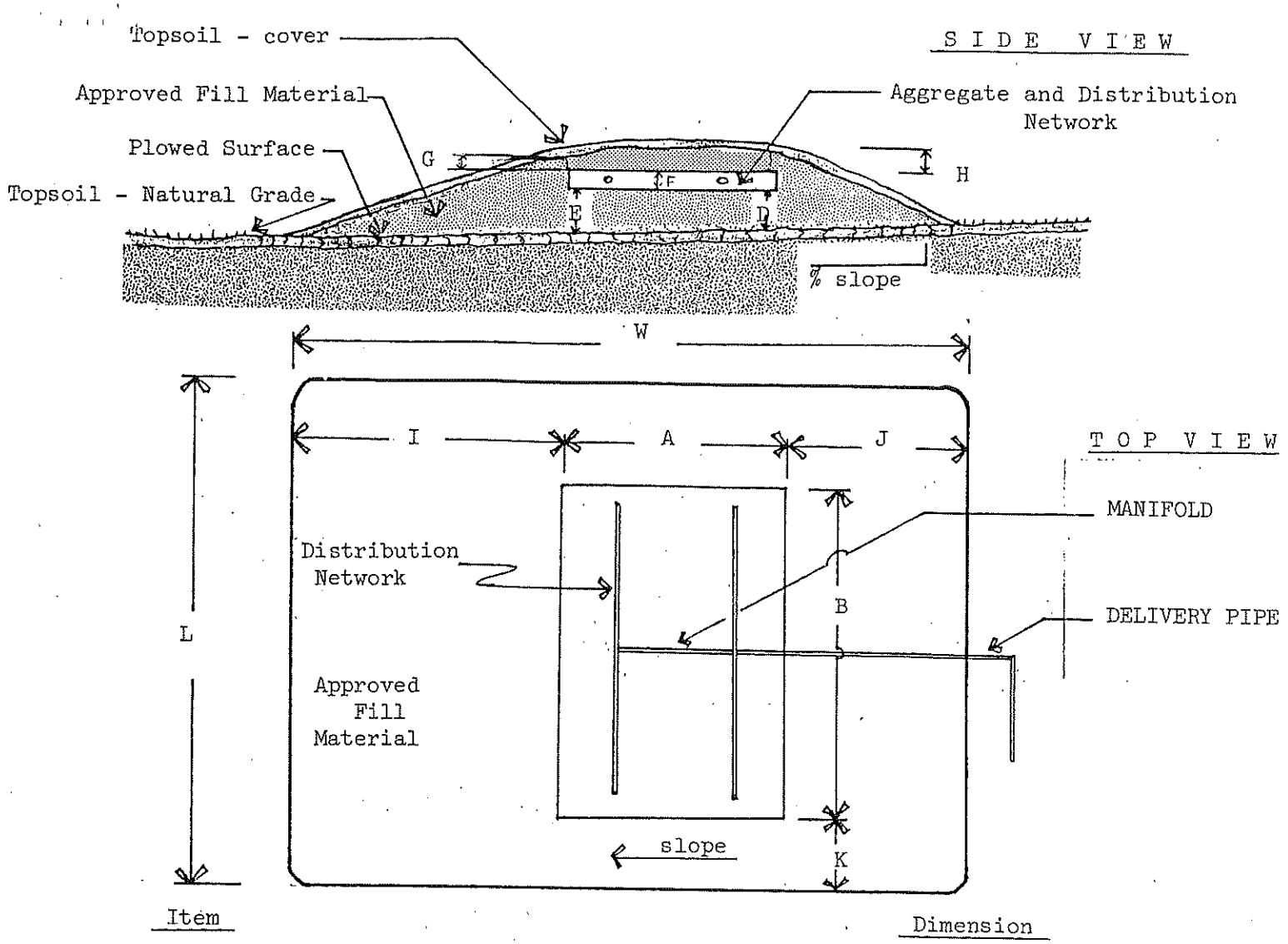


DIAGRAM OF A TYPICAL DISTRIBUTION NETWORK



MOUND DIMENSIONS



Item	Dimension
Mound Height:	
Fill Depth (D) ft	1 (min.)[a]
Absorption Bed Depth (F), in	9 (min.)
Cap at Edge of Bed (G), ft	1[b]
Cap at Center of Bed (H), ft	1.5[c]
Mound Perimeter	
Downslope Setback (I)	Depends on Soil Permeability
Upslope Setback (J), ft	10[c]
Sideslope Setback (K), ft	10[c]
Sideslopes	No steeper than 4:1

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a. On sloping sites, this depth will increase downslope to maintain a level bed. In shallow soils where groundwater contamination is a concern, the fill depth should be increased to 2 ft.

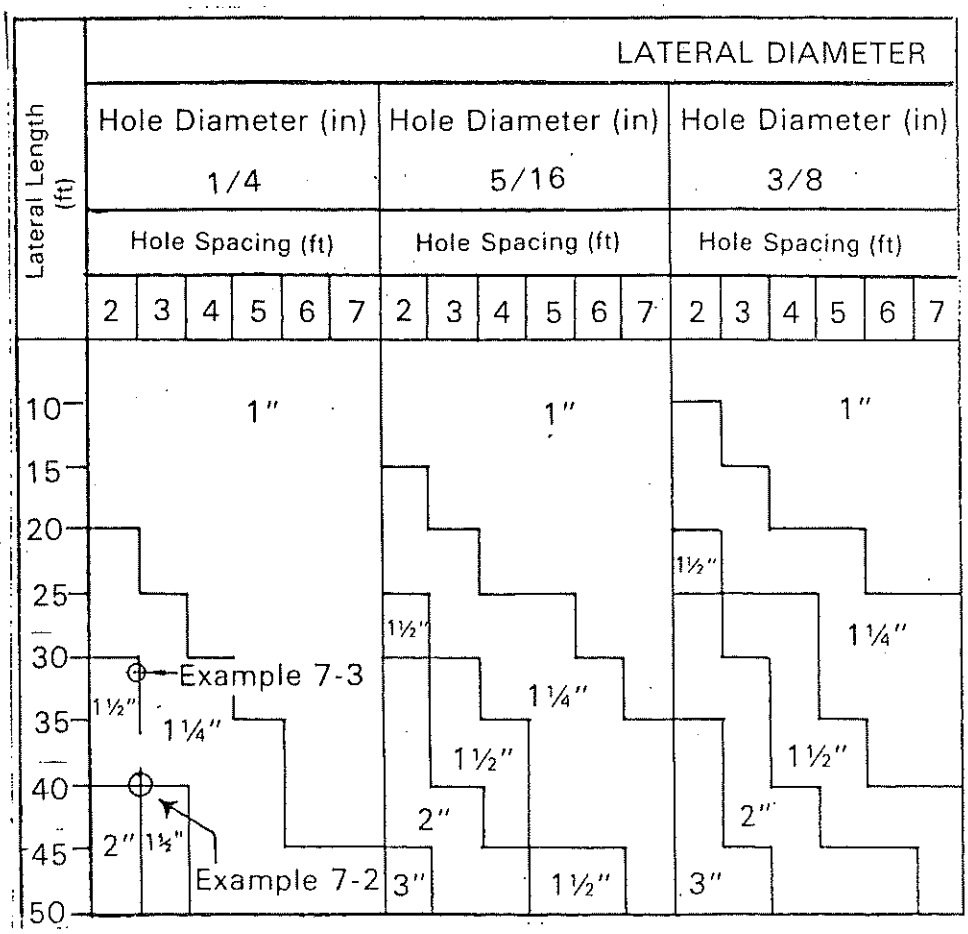
b. A 4-6 inch depth of quality topsoil is included.

c. Based on 4:1 side slopes. On sloping sites, (J) will be less if 4:1 side slope is maintained.

INFILTRATION RATES FOR DETERMINING MOUND BASAL AREA AND ABSORPTION BED

Natural Soil Texture	Percolation Rate Min/inch	Infiltration Rate $g/ft^2/day$
Coarse Sand; Gravel	5 or less	0.71
Sand; Loamy Sand	6 - 10	0.45
Sandy Loam	11 - 30	0.30
Silty Loam	31 - 45	0.25
Silt, Sandy Clay Loam	46 - 60	0.22
Clay Loams	61 - 120	0.2 or less

REQUIRED LATERAL PIPE DIAMETERS FOR VARIOUS HOLE DIAMETERS, HOLE SPACINGS, AND LATERAL LENGTH (FOR PLASTIC PIPE ONLY)



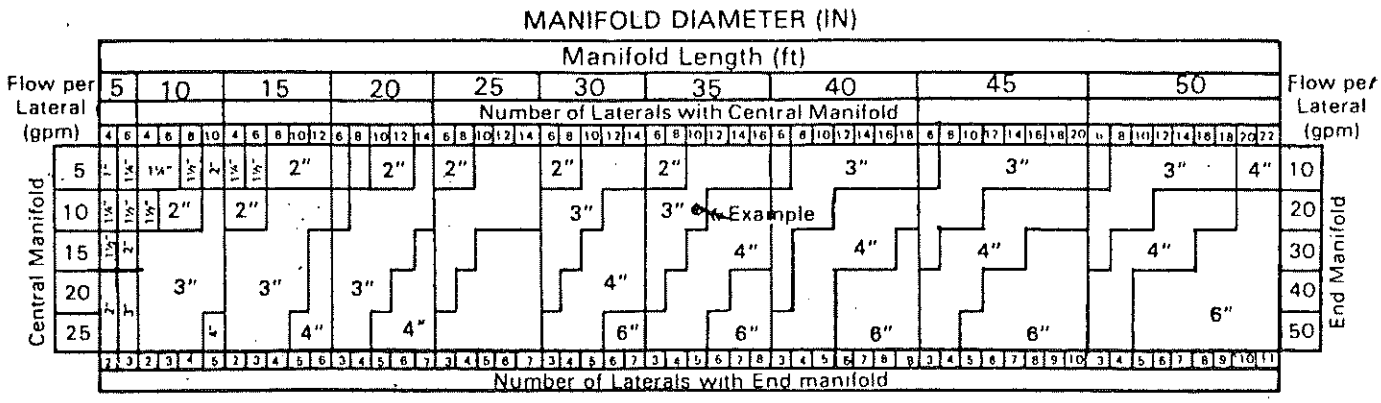
DISCHARGE RATES FOR VARIOUS SIZED HOLES AT VARIOUS PRESSURES (gpm)

Pressure		Hole Diameter (in.)			
ft.	psi	7/32	1/4	5/16	3/8
1	0.43	0.56	0.74	1.15	1.66
2	0.87	0.80	1.04	1.63	2.34
3	1.30	0.98	1.28	1.99	2.87
4	1.73	1.13	1.47	2.30	3.31
5	2.17	1.26	1.65	2.57	3.71

PIPE CAPACITIES

Diameter of Pipe in Inches	Volume in Gallons Per Ft.
½	0.010
1	0.047
1½	0.092
2	0.163
2½	0.255
3	0.367
4	0.652
5	1.02
6	1.47

RECOMMENDED MANIFOLD DIAMETERS FOR VARIOUS MANIFOLD LENGTHS, NUMBER OF LATERALS, AND LATERAL DISCHARGE RATES (FOR PLASTIC PIPE ONLY)



[a] Computed for plastic pipe only. The Hazen-Williams equation was used to compute headlosses through each segment (Hazen-Williams C = 150). The maximum manifold length for a given lateral discharge rate and spacing was defined as that length at which the difference between the heads at the distal and supply ends of the manifold exceeded 10 percent of the head at the distal end.

TABLE E

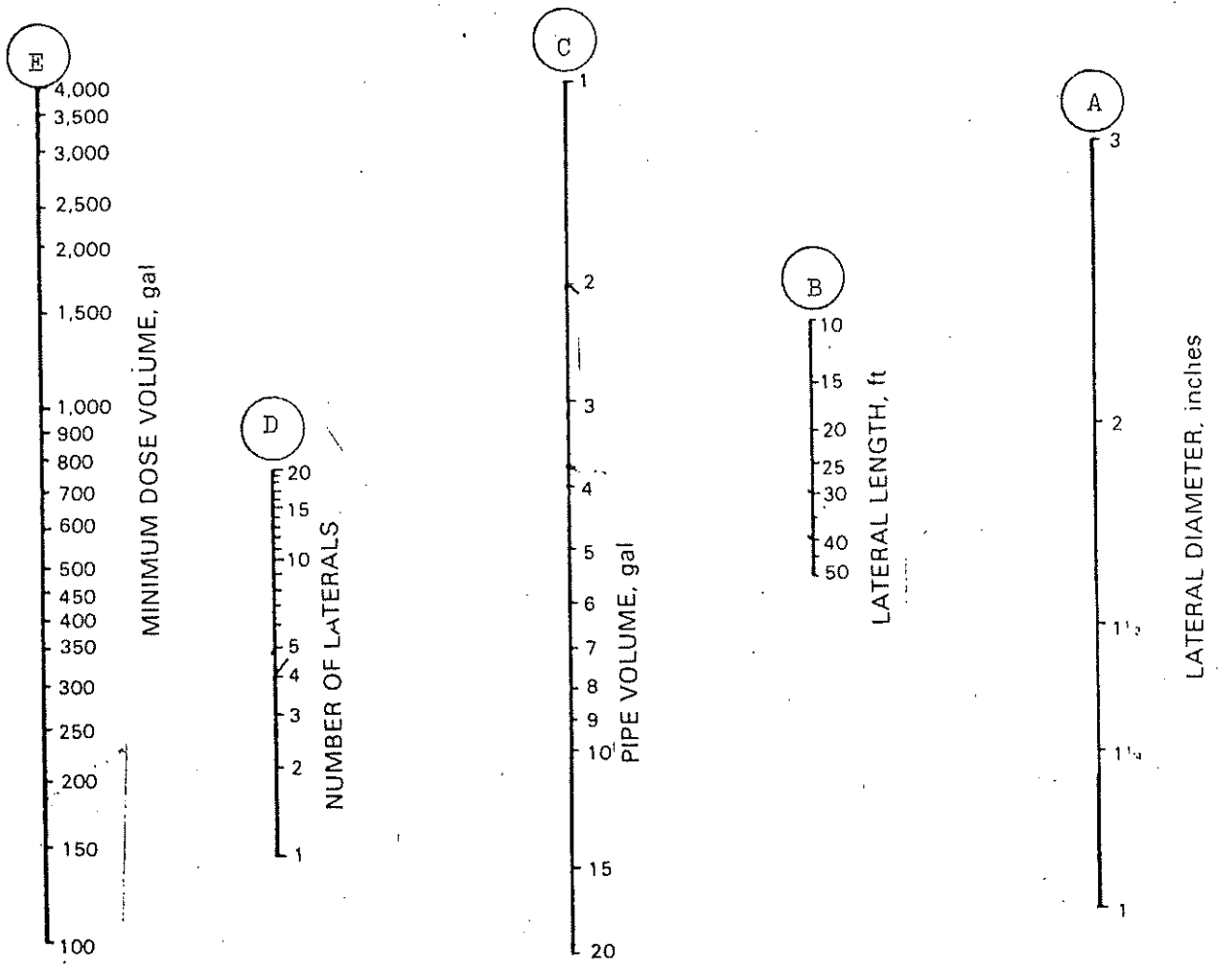
FRICTION LOSS IN SMOOTH WALL PLASTIC PIPE

(ft/100 ft)

Flow gpm	Pipe Diameter (in.) 1	1-1/4	1-1/2	2	3	4	6	8	10
1	0.07								
2	0.28	0.07							
3	0.60	0.16	0.07						
4	1.01	0.25	0.12						
5	1.52	0.39	0.18						
6	2.14	0.55	0.25	0.07					
7	2.89	0.76	0.36	0.10					
8	3.63	0.97	0.46	0.14					
9	4.57	1.21	0.58	0.17					
10	5.50	1.46	0.70	0.21					
11		1.77	0.84	0.25					
12		2.09	1.01	0.30					
13		2.42	1.17	0.35					
14		2.74	1.33	0.39					
15		3.06	1.45	0.44	0.07				
16		3.49	1.65	0.50	0.08				
17		3.93	1.86	0.56	0.09				
18		4.37	2.07	0.62	0.10				
19		4.81	2.28	0.68	0.11				
20		5.23	2.46	0.74	0.12				
25			3.75	1.10	0.16				
30			5.22	1.54	0.23				
35				2.05	0.30	0.07			
40				2.62	0.39	0.09			
45				3.27	0.48	0.12			
50				3.98	0.58	0.16			
60					0.81	0.21			
70					1.08	0.28			
80					1.38	0.37			
90					1.73	0.46			
100					2.09	0.55	0.07		
150						1.17	0.16		
200							0.28	0.07	
250							0.41	0.11	
300							0.58	0.16	
350							0.78	0.20	0.07
400							0.99	0.26	0.09
450							1.22	0.32	0.11
500								0.38	0.14
600								0.54	0.18
700								0.72	0.24
800									0.32
900									0.38
1000									0.46

TABLE F

NOMOGRAPH FOR DETERMINING THE MINIMUM DOSE VOLUME FOR A GIVEN LATERAL DIAMETER, LATERAL LENGTH, AND NUMBER OF LATERALS



DIRECTIONS TO USE CHART:

Select lateral diameter on line (A) and place straight edge from the size value to the lateral length on line (B) . Continue this line to line (C) to obtain the volume of the lateral. From this point on line (C) place a straight edge again from this point to the number of laterals, line (D) , comprised in the distribution network. Continue this line to line (E) to obtain the minimum dose volume, gallons.

Name of Program Guideline:	Guidelines for Site Modifications	
Name of Appendix:	PUMPING CHAMBER MINIMUM REQUIREMENTS AND PUMP INSTALLATION PROCEDURES	Appendix F

When septic tank effluent is required to be discharged into an Elevated Soil Absorption System (ESAS) by means of a pressurized distribution network, a pump is usually needed to provide the pressure. The installation of the pump in relation to the other components of the ESAS is a key in the effective operation of the system. The following guidelines are hereby established to provide uniformity of design and installation of pumping chambers and pump installations:

I. General Provisions

A. Pump Chambers

1. Capacity - The capacity (volume) of the chamber shall be adequate to provide for the following:

   a. Minimum capacity to provide for one complete dose of the ESAS as per Step 8 of Appendix "E" (Pressure Distribution) of the Site Modification Guidelines, and

   b. Total capacity of connecting piping (delivery pipe), and the dead space below the pump.

2. Connection Piping - Rigid pipe shall be used to connect the septic tank to the inlet of the pumping chamber. A corrugated, flexible type of pipe will not be permitted.

3. High Water Warning Device - It is strongly recommended that the pump chamber be equipped with some type of high water warning device to alert the user of an inoperative pump.

4. Inlet Elevations - The bottom of the inlet connection shall be above the maximum pumping level.

5. Materials - A pumping chamber shall meet the same requirements as a septic tank, specified in Section 603.3 of the Sewage Disposal Regulations for Kent County, Michigan.

6. Pump Installation/Maintenance Access - A pump chamber shall be equipped with an access opening at or slightly above finished grade. This access device, commonly called a riser, shall be at least 20 inches in diameter and be designed to prevent the entrance of ground or surface waters into the chamber.

B. Pump Installation

1. Check Valve - The placement of a check valve in this system is optional. If one is installed, it shall be placed in the chamber piping between chamber wall and the disconnection joint.

2. Discharge Piping - Rigid, Schedule #30 or #40 PVC pipe with solvent weld joints shall be used within the pump chamber.

3. Disconnection Joint - A disconnection joint, i.e., union, shall be placed below the access cover, accessible from ground surface, and on the horizontal portion of the discharge pipe.

4. Location - The pump shall be located directly below the access cover; it shall be mounted off the chamber floor, on cement blocks.

5. Materials - Only sewage effluent-handling pumps so designated by the manufacturer shall be used.

C. Delivery Pipe

1. Depth Below Grade - If a check valve is used, the delivery pipe shall be installed below the frost line.

2. Materials - Smooth wall, pressure rated plastic pipe with like fittings shall be used. Stainless steel clamps used where appropriate.