2002
JACKSON COUNTY MISSOURI
DEPARTMENT OF PUBLIC WORKS
ENVIRONMENTAL HEALTH DIVISION

ON-SITE SEWAGE DISPOSAL RULES AND REGULATIONS

JACKSON COUNTY DEPARTMENT OF PUBLIC WORKS
ENVIRONMENTAL HEALTH DIVISION
103 NORTH MAIN
INDEPENDENCE, MISSOURI 64050
(816) 881-4530

Effective Date: April 22, 2002

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLES

TABLE OF CONTENTS

DETAILS

The Director may approve an alternative method of sewage disposal. Notice of public hearing on any proposed rule or regulation, shall be advertised in at least one (1) newspaper having general circulation within the county, at least fifteen (15) days before the hearing.

RULES AND REGULATIONS GOVERNING
THE INSTALLATION OF
PRIVATE ON-SITE WASTE TREATMENT SYSTEMS

Section 1. Private Waste Treatment System

1.1 Objective

To provide an adequate and efficient individual wastewater disposal system, which is designed, constructed and operated in a manner that avoids contaminating any existing or future water source or supply, and not to create a public health concern or nuisance.

1.2 General

A. The individual sewage disposal system shall consist of a sealed sewage service line, proper treatment devices as required by specific regulation, and an appropriate, adequate and safe method of contained disposal. Discharge off the property is prohibited.

B. Situations offering unconventional or unusual conditions may possibly utilize alternative methods of disposal, provided the proposed design is reviewed and determined acceptable by the department.

C. Systems designed by professional engineers. All individual on-site sewage-disposal systems shall be designed by an engineer registered in the State of Missouri. A minimum of two (2) copies of the design plan shall be submitted to the department for review. Design plans must be approved before construction of the system begins. System installations shall be inspected and approved by the department before backfilling.

D. Revised plans. Departmental review of individual design proposals as submitted may require modifications, additions, eliminations or general changes to achieve regulation compliance, as determined by the review process. All changes or modifications must be approved by the department prior to the actual installation.

E. Plan Availability

1. One set of plans bearing the department's stamp of approval shall be maintained at the project site during construction of any private disposal

system.

2. Revisions. Any person who proposes modifications or changes the locations or design of an on-site sewage disposal system must submit to the department a revised design plan approved by the engineer who submitted the original design plan. All changes must be approved by the department prior to the installation.

F. Percolation test and soil borings (if determined necessary) will be required on each individual lot less than five (5) acres or in platted subdivisions proposing polishing pond systems. Polishing pond system designs subject to these conditions will only be considered for approval where percolation rates are in excess of 120 minutes per inch or where the presence of a high water table or bedrock would prohibit the installation of an absorption-type system.

G. Note: Commercial or industrial flows of 3,000 gallons per day or greater must be regulated by Missouri State Department of Natural Resources.

.3 Location and Installation

A. Location and installation of the sewage disposal system shall be such that, with reasonable maintenance, it will function in a sanitary manner and will not create a nuisance, health hazard or endanger the safety of any domestic water supply. Consideration shall be given to the size and shape of the lot, slope of natural and finished grade, depth of ground water, depth of rock and proximity of existing or future water supplies, and possible expansion of the system.

B. All lots platted subsequent to January 1, 1995, shall be a minimum of three (3) acres in size and contain a minimum of 15,000 square feet of suitable land designed for on-site sewage treatment.

1. Existing lot sizes of a minimum 20,000 square feet may be approved if the following criteria is provided for by a registered professional engineer and determined to be acceptable.

a. Complete drainage and grading plans showing final contours of development.

b. Existing and proposed structures or any physical feature locations.

c. Soil studies for each lot (percolation test and soil borings), the type and location of the proposed on-site sewage disposal system, and replacement area for future use.

d. Soil studies as described in Section B. l.C, may also be required for lot sizes in excess of three (3) acres, if the departments preliminary review reveals severe soil conditions existing in the immediate area, or if suitable lot area has been greatly decreased by natural conditions.

e. All preliminary material as specified in Section B. 1. may also be requested for proposed subdivision plat review if determined necessary by the department.

f. Holding tank facilities may be necessary or required on non-conforming properties due to inadequate area, poor soil conditions, existing failures or any other restrictive conditions.

g. Subdivisions proposing lot sizes less than three (3) acres may be approved provided they are served by a centralized sewage treatment system.

2. Centralized Sewage Treatment System - Centralized Sewage Treatment Systems may be provided for if the plans and discharges are reviewed and approved by the Missouri Department of Natural Resources and Jackson County Public Works Department.

a. Proposed subdivision plat review that determines, due to extensive drainage concerns, poor or inadequate soil conditions, sub-terrain restrictions (bedrock, water tables or hardpan), that centralized sewage treatment would be the only suitable method of waste water disposal. In such cases, plan review and discharge approval must be issued by the Department of Natural Resources prior to subdivision plat approval consideration.

C. Individual waste water disposal systems shall not be located closer to any water supply than the minimum distance shown in Table #1.

D. Installations in low swampy areas, areas with a high water table (permanent, fluctuating or seasonable), areas with ledge rock, bedrock, hardpan or areas which are subject to flooding are not acceptable.

E. Depressions, gullies, drainage ways and erosional areas shall be avoided. Neither the septic tank, pumping chamber nor absorption field shall be located in such areas.

F. The proposed on-site area shall be protected from soil disturbance by heavy equipment. Removal or compaction of the top soil especially during wet weather, may destroy the sites suitability for an absorption system.

1. As soon as the absorption area has been designated, it shall be flagged, roped off and "quarantined" from construction traffic. Proposed system corner staking shall be provided for by the applicants design plan engineer for on-site sewage disposal systems.

2. No site preparation or construction work shall occur if the soil in the proposed absorption area is wet.

3. The site should be cleared of brush and small trees.

4. Provisions shall be made for intercepting or diverting surface water away from the absorption area, septic tank and pumping chamber. This can be done with grassy swales, open ditches or curtain drains.

G. A soil absorption system shall not be installed in a floodway. Soil absorption systems in the flood fringe shall not be installed unless written approval is received from the department.

1. Type of system shall be determined on a basis of location, topography, soil permeability, ground water level, ledge or bedrock.

2. Groundwater, bedrock and slowly permeable soils. There shall be a minimum of two feet of suitable soil between the bottom of the soil absorption system and high groundwater, ledge rock, bedrock or hardpan. Soil having a percolation rate of 120 minutes per inch or less shall exist for the depth of the proposed conventional soil absorption system. There shall be a minimum depth of 48 inches of suitable soil from the original grade for a conventional soil absorption system to high groundwater, ledge rock, bedrock or hardpan.

3. Percolation rate - trench systems. A conventional subsurface soil absorption system of the trench type shall not be installed where the percolation rate for any one of the three tests is more than 120 minutes for water to fall one inch. The slowest percolation rate shall be used to determine the absorption area.

4. Non-conforming site conditions. The department shall be contacted for approval of replacement systems where site conditions do not permit systems in accordance with the rules and regulations. Alternates for the disposal of effluents emanating from existing structures may be accomplished by means other than those outlined in the rules and

regulations provided written approval is obtained from the department. Detailed plans and specifications shall be submitted to the department for review and consideration.

5. Winter installation. Installation of soil absorption systems during periods of adverse weather conditions is not recommended. A soil absorption system shall not be installed if the soil at the system elevation is frozen. Snow cover must be removed from the soil absorption area before excavation begins. Snow must not be placed in a manner that will cause water to pond on the soil absorption system during snow melt. Inspection of systems installed during winter conditions shall include inspection of trench or bed excavation prior to placement of gravel and inspection of back fill material at the time of its placement.

   Excavation material may be used as back fill for the system if it is not frozen.

6. Discharge off the property at any time, for any reason, under any condition is strictly prohibited.

H. The system shall be designed to receive all sanitary sewage (bathroom, kitchen and laundry) from the dwelling. Footing or roof drainage shall not enter any part of the system. Note: "Gray Water" from the laundry may be discharged to a separate on-site system.

1.4. Materials

A. Materials used in the installation of a septic tank and an absorption system shall be durable, new, sound and not subject to corrosion or deterioration.

1.5 House Sewer

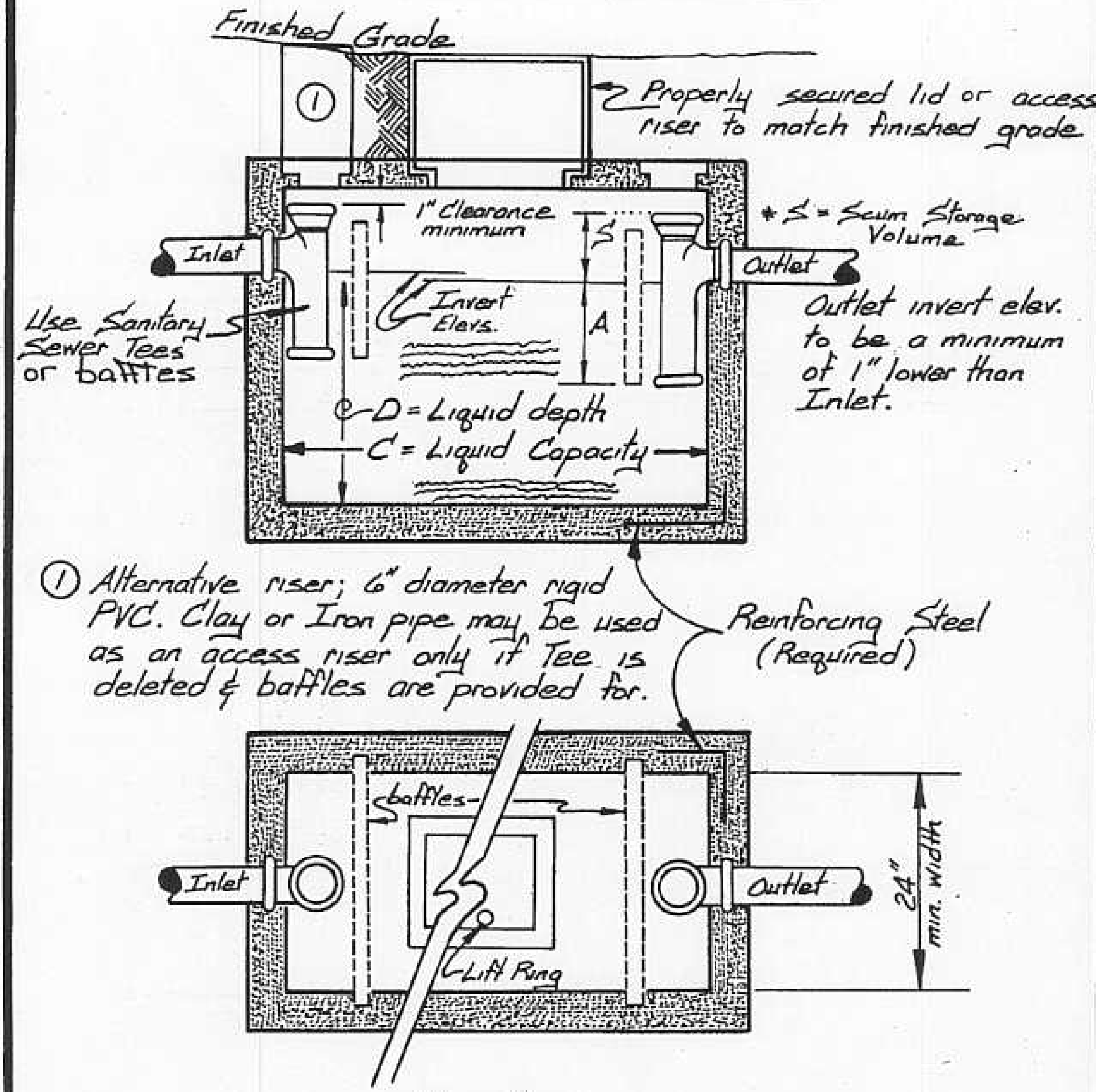
A. House sewage lines shall be a minimum of schedule 40 PVC material or a rated equivalent.

B. The house sewer line shall have watertight joints. It shall be on a grade of not less than 1/8 inch per foot. Ells or bends of 90 degrees will not be acceptable.

   Clean-outs shall be installed every 100 feet in solid waste sewer lines.

DETAIL #1

SINGLE COMPARTMENT SEPTIC TANK



Plan View

A = 40% of the liquid depth "D"
D = Not less than 30"
C = Liquid capacity
S = Not less than 15% of liquid capacity "C"

Section 2. Septic Tank - (See Detail #1)

2. Design shall provide adequate volume for settling, for sludge and scum storage and access for cleaning. An access riser shall extend up to the finish grade with a properly secured lid or cap. An alternative riser consisting of a six inch diameter PVC, clay or iron pipe may be used as an access riser but only if located on the inlet end of the septic tank when a tee is not used and an inlet baffle is provided for. Septic tanks shall be water tight, durable, sound and not subject to corrosion. Septic tanks should be pre-cast concrete, any other material shall receive written approval from the department.

Table #1

Minimum Safe Distance in Feet

From	Septic Tank	Polishing Pond	To Absorption System	Non Perforated Sewer or Effluent Lines
*Cistern	50	50	100	25
Well	50	100	100	50
Property Line	25	75	25	10
Foundation Wall	10		10	--
Water Lines	10	10	10	10
Recreational Waters, Lakes, Ponds, Rivers, Streams & Creeks	50	75	50** (to apparent high bank)	25
Wet Weather Drainage ways, Ditches, Swales, etc,	25	75	50 (to apparent high bank)	

* The distance figure may be changed if cistern elevation is higher than the septic tank or absorption system, etc., Public Works Department may waiver distance.

** Except polishing ponds. Point of polishing ponds overflow or discharge must travel across undisturbed ground for a minimum of 100 feet.

A. Individual aeration systems will be accepted as a satisfactory means of primary. and secondary treatment. Only models having received the National Sanitation Foundation Seal of Approval or equivalent shall be authorized. Effluent from individual aeration systems and septic tanks shall be provided with further treatment consisting of one of the following:

1. Subsurface Disposal
2. Holding Tank - Holding Tank Agreement Required
3. Wisconsin Sand Mound

4. Low Pressure Pipe System

B. Effluent from aeration systems may, as an alternative to one of the above means of treatment, be further treated by discharge into a polishing pond.

C. A fail safe signal device shall be installed on all aeration systems which will provide a recognizable visual or audible warning to the user that the plant is malfunctioning.

D. Holding tank sizing. The minimum liquid capacity of a holding tank shall be provided for single family dwellings per Table 2. Items E & G as listed shall appear on the engineer's design plan.

Table #2 HOLDING TANK CAPACITIES - HOUSEHOLD

Number of Bedrooms		Total Gallons
1-	150 gpd	2,000
2-	300 gpd	2,000
3-	450 gpd	2,000
4-	600 gpd	2,400

MINIMUM HOLDING TANK CAPACITIES - COMMERCIAL

Gallons per day	Total Gallons
+ 600 gpd	3,600
+ 750 gpd	4,800

Note: Commercial or industrial flows of 3,000 gallons per day or greater must be regulated by Missouri State Department of Natural Resources.

E. Warning device. A high water alarm device shall be installed in holding tanks so that it activates one foot below the inlet pipe. This device shall either be an audible or illuminated alarm. Visual alarms shall be conspicuously mounted.

F. An access riser shall extend up to the finish grade with a properly secured or locked lid. The access riser shall be of sufficient size to permit a person access to the warning controls and for pumping of the tank.

G. Holding Tank Agreement.
Owner agrees to keep records of dates when holding tank was pumped along with who pumped the tank, name and address of approved site where discharge was taken. Further the owner agrees to authorize a representative of the Jackson County Environmental Services Division to enter upon the property at any reasonable time to routinely inspect the holding tank system. Should the inspection reveal the need for pumping, the owner agrees to have the holding tank pumped within 24 hours after being so notified in writing by a representative of the Jackson County Public Works Department.

Septic tank. Liquid capacity shall be based on the number on bedrooms proposed, or that can be reasonably anticipated in the dwelling and shall be at least that shown in Table #3. Septic tanks shall be of sufficient capacity to operate with 48 hour retention of all sewage flow.

Table #3

Minimum Septic Tank Capacity

Number of Bedrooms	Minimum liquid capacity below invert (gallons)
4 or less	1,500
Each additional bedroom, add	250

Note: The capacities in Table #3 provide for the plumbing fixtures and appliances commonly used in a single family residence (automatic sequence washer, mechanical garbage grinder and dishwasher included).

The liquid depth of the tank should be approximately the same dimension as the width.

No tank or compartment thereof shall have an inside horizontal dimension less than 24 inches.

Inlet connection shall be submerged or baffled to divert incoming sewage toward bottom of the tank.

Outlet connections of the tank and of each compartment thereof shall be submerged or baffled to obtain effective retention of scum and sludge.

Scum storage volume (space between the liquid surface and the top of inlet and outlet devices) shall not be less than 15 percent of the required liquid capacity.

Outlet baffles and baffles between compartments, including pipe fittings used as baffles, shall extend below the liquid surface a distance equal to approximately 40 percent of the liquid depth of the tank. They also shall extend upward to within one inch of the underside of the cover.

When a partition wall is used to form a multi-compartment tank an opening in the partition wall may be used provided the minimum dimension is four inches, and the midpoint of the opening is below the liquid surface a distance approximately equal to 40 percent of the liquid.

When multi-compartment tanks are used the volume of the first compartment shall be a minimum of two-thirds of the required size as outlined in Table #3.

The tank shall be constructed so that gases, generated in the tank, can easily flow back to the main building stack.

The inlet shall be at least on inch above the outlet.

The inlet and outlet devices shall be accessible for inspection through properly placed manholes, hand holes or an easily removable cover.

Sufficient soil shall be provided over the top of the septic tank to permit grass growth and to control odors. The minimum depth below finish grade shall be six inches. It is recommended that top of sewage tanks be no more than two (2) feet below ground level.

Section 3. Subsurface Absorption Field

3.1 Under no circumstances shall soil absorption of sewage effluent be considered when subterranean formations might carry the liquid in a manner which will endanger water sources.

3.2 Location of the absorption field should be in an unobstructed area and shall comply with the minimum distances given in Table #1.

Note: When existing wells are involved in coarse soil formations, the 100 foot distance from the water supply may be increased.

3.3 Minimum absorption area (total bottom area of trenches) of the absorption field shall be determined from the result of percolation tests. The trench bottom area required shall be determined from Table #4. A minimum of four (4) percolation tests shall be made in the immediate area proposed for use as an absorption field. Temperature will affect the results and extremely hot or cold conditions should be avoided.

3.4 Area required: The number of square feet of trench bottom can be determined from Table #4. The minimum width of trench shall be twenty-four inches (24") and the maximum width of trench shall be thirty-six inches (36").

3.5 Sizing the absorption area. A minimum of 150 gallons per bedroom shall be used to size the absorption area. Sizing of the absorption area will also depend upon the slowest percolation rate from tests conducted.

A. Required sizing criteria, corresponding to percolation rates as indicated in Table #4, will also apply for alternative absorption systems such as graveless pipe, trench structures and absorption beds. Reduction factors will not be considered.

If the department's review indicates that such a proposal is non-beneficial for immediate or surrounding site conditions, a revised conventional design will be requested.

B. Consult Sec. 3.14-B for split absorption field requirements.

C. Percolation tests are required to determine the hydraulic conductivity of the existing soil conditions.

D. Soil borings are required to determine depth of soil horizons, impermeable layers and restrictive zones such as bedrock or water tables.

Table #4

Subsurface Absorption Fields (Minimum Required Trench Bottom Area Per 100 Gallon Flow)

Time in minutes for water to fall one inch during final test period.	Sq. Ft. of trench bottom required for each 100 gallons waste flow.
5 minutes	108
10 minutes	144
15 minutes	180
20 minutes	215
25 minutes	250
30 minutes	285
35 minutes	320
40 minutes	355
45 minutes	390
50 minutes	425
55 minutes	460
60 minutes	495
65 minutes	536
70 minutes	576
75 minutes	619
80 minutes	660
85 minutes	701
90 minutes	743
95 minutes	784
100 minutes	825
105 minutes	866
110 minutes	908
115 minutes	949
120 minutes	990

Note: The areas in Table #4 provide for plumbing fixtures and appliances common in residential use, automatic sequence washer, mechanical garbage grinder and dishwasher included. A separate absorption trench is recommended to accept the discharge from the automatic clothes washer when economically feasible, Also refer to Section 3.14-B for further sizing requirements.

3.6 Percolation test requirements. Percolation tests shall be conducted by a professional engineer that is registered in the State of Missouri and who has successfully completed a certification by the state to conduct percolation tests.

A minimum of four (4) percolation tests shall be conducted within the proposed on-site sewage disposal absorption area.

3.7 A. The results of percolation tests may be subject to verification by the Public Works Director. The department may require that percolation tests be reconducted under department supervision.

B. Winter soil testing. Soil testing should be done only when weather and light conditions make accurate evaluation of site conditions possible. Soil testing attempted under winter conditions is difficult and precautions shall be observed.

C. Percolation tests that are unprotected shall be conducted only on days when air temperature is 20° F. or higher. The bottom of the percolation test hole shall be at least 12 inches below frost depth. If water freezes in the test hole at any time, the test data shall be void.

3.8 Soil Boring Requirements

A. General. Soil borings shall be conducted by a engineer registered in the State of Missouri or a soil scientist in the proposed system area when the Jackson County, Missouri Soil Survey Interpretation record sheets or on-site evaluations indicate that a high water table, perched or apparent, may exist less than six feet in depth or that the depth to bedrock or ledge rock is less than five feet. Borings shall extend at least two feet below the bottom of the proposed system. Borings shall be of sufficient size and extend to determine the soil characteristics to on-site waste disposal. Bore hole data shall be used to determine the suitability of the soils at the site with respect to the zones of seasonal or permanent soil saturation, and depth to bedrock. Borings shall be conducted prior to percolation tests to determine whether the soils are suitable to warrant percolation tests and if suitable, at what depth percolation tests shall be conducted. The use of power augers for soil borings is prohibited.

Note: Backhoe borings are preferable to borings augured or dug by hand.

B. Number. There shall be a minimum of one suitable boring per soil absorption site. More soil borings may be necessary for accurate evaluation of a site.

1. Depth of borings. Borings shall be constructed to a depth of at least two feet below the proposed depth of the system.

2. Reports. Regardless of the number of borings evaluated and conditions observed in borings, all soil information derived from borings shall be reported.

3. Location. Each bore hole shall be accurately located and referenced to the horizontal reference point.

   a. Soil description. Soil profile descriptions shall be written for all borings. The thickness in inches of the different soil horizons observed shall be indicated. Horizons shall be differentiated on the basis of color, texture, soil mottles or bedrock. Depths shall be measured from the ground surface.

   b. Soil mottles. Zones of seasonal or periodic saturation shall be estimated at the highest level of soil mottles. The department may require a detailed description of the soil mottling on a marginal site. The abundance, size, contrast and color of the soil mottles should be described in the following manner.

      Abundance. Abundance shall be described as few if the mottled color occupies less than two percent of the exposed surface; common if the mottled color occupies from two to twenty percent of the exposed surface; or many if the mottled color occupies more than twenty percent of the exposed surface.

      2. Size. Size refers to length of the mottle measured along the longest dimension and shall be described as fine if the mottle is less than 5 millimeters; medium if the mottle is from five to 15 millimeters; or course if the mottle is greater than 15 millimeters.

      3 Contrast. Contrast refers to the difference in color between the soil mottle and the background color of the soil and is described as faint if the mottle is evident but recognizable with close examination; distinct if the mottle is readily seen but not striking, or prominent if the mottle is obvious and one of the outstanding features of the horizon.

      4. Color. The color(s) of the mottle(s) shall be given.

   c. Observed groundwater. The depth of the groundwater, if present, shall be reported. Observed groundwater shall be reported at the level groundwater reaches in the soil borehole, or at the highest level of sidewall seepage into the boring. Measurements shall be made from ground level. Soil above the water level in the boring shall be checked for the presence of soil mottles.

   d. Color patterns not indicative of soil saturation.

1. One foot exceptions. Soil profiles that have an abrupt textural change with finer textured soil overlying more than four feet of unmottled, loamy sand or courser soils can have a mottled zone in the finer textured material. If the mottled zone is less than 12 inches thick and is immediately above the textural change, then a soil absorption system may be installed in the loamy sand or courser material below the mottled layer. If any soil mottles occur within the sandy material, then the site shall be unsuitable.

4. Other soil color patterns. Soil mottles can occur that are not due to zones of seasonal or periodic soil saturation. Examples of such soil conditions not limited by enumeration are:

   a. Soil mottles formed from uneven weathering material.

   b. Deposits of lime in a profile derived from highly calcareous parent material.

   c. Light colored silt coats deposited on soil ped faces.

   d. Soil mottles that are usually vertically oriented along old or decayed root channels with a dark organic stain usually present in the center of the mottled area.

5. Reporting exceptions. A registered professional engineer with the State of Missouri or soil scientist shall report any mottled soil condition. If soil mottles are observed that may not be due to soil saturation, the soil tester still shall report such condition and may request a determination from the department on the acceptability of the site.

   a. Bedrock. The depth to bedrock except sandstone shall be established at the depth in a soil boring where greater than 50 percent of the weathered in-place material is consolidated.

3.9 All trenches in an absorption field shall comply with Table #5.

Table #5

Conventional Subsurface Absorption System (Minimum and Maximum Absorption Field Construction Details)

Items	Unit	Max.	Min.
Slope of trench bottoms	in. /100 ft.	6	0
Number of lateral trenches			2
Length of trench	feet	100	20
Width of trenches	inches	36	24
Distances between trenches	feet	N/A	10
Depth of lines	inches	36	12
Slope of lines	in. /10 ft.	1/4	0
Depth of coarse material:			
Under pipe	inches		6
Over pipe	inches		2
Under pipe located within 10 feet of trees	inches		12
Size of coarse material	inches	2 ½	1
Depth of back-fill over coarse material	inches	30	12
* Absorption trench depth	inches	42	18

* Minimum trench depth may be waived by the Public Works Director

3.10 Fields in flat areas. In locations where the slope of the ground over the absorption field is relatively flat (6 inch fall or less in any direction within field area) the use of a distribution box will be required. The end of trenches should be tied together to provide for a continuous flow. Trench bottoms shall be in accordance with Table #5. Also see distribution box layout for level distribution, Detail #2.

3.11 Location. The absorption trenches shall follow natural contours in sloped areas. The trenches should be dug fifteen (15) feet apart and under no circumstances shall they be dug closer than ten (10) feet apart.

3.12 Fields on sloping ground. A conventional soil absorption system shall not be located on a land slope greater than 20 percent.

A. In locations where the ground over the absorption field area slopes (fall greater than six inches in any direction within field area) a system of serial distribution trenches following the contours of the land may be used. The trenches will be installed at different elevations, but the bottom of each individual trench should be level throughout its length.

B. Trenches shall be connected with a water tight overflow line in such a manner that a trench will be filled with sewage effluent to the depth of the gravel before the effluent flows to the next lower trench. A distribution box with separate tight lines to each absorption trench will be accepted. Absorption trenches shall be of the same length.

C. The overflow line shall be four (4) inch watertight non-perforated rigid pipe with direct connections to the distribution lines in adjacent trenches.

D. There shall be undisturbed earth between trenches. Overflow lines shall rest on undisturbed earth. Overflow pipe trenches shall have no gravel placed in them.

E. For example of field construction, see Detail #3 and Detail #3a.

F. Altering slopes. In some cases, areas with slopes exceeding those specified in Section 3.12 may be graded and reshaped to provide soil absorption sites. Care must be taken when altering any natural landscapes. Successful site altering may be accomplished in accordance with the following:

Soil test data shall show that a sufficient depth of suitable soil material is present to provide the required amount of soil over ledge rock, bedrock, and groundwater after alteration.

*2. There shall be a minimum of ten (10) feet of natural soil between the edge of a system area and the down-slope side of the altered area. See Detail #4.

* Except LPP system where five (5) feet of natural soil between the edge of a system area and the down-slope side of altered area. (See Section 10.5.A.)

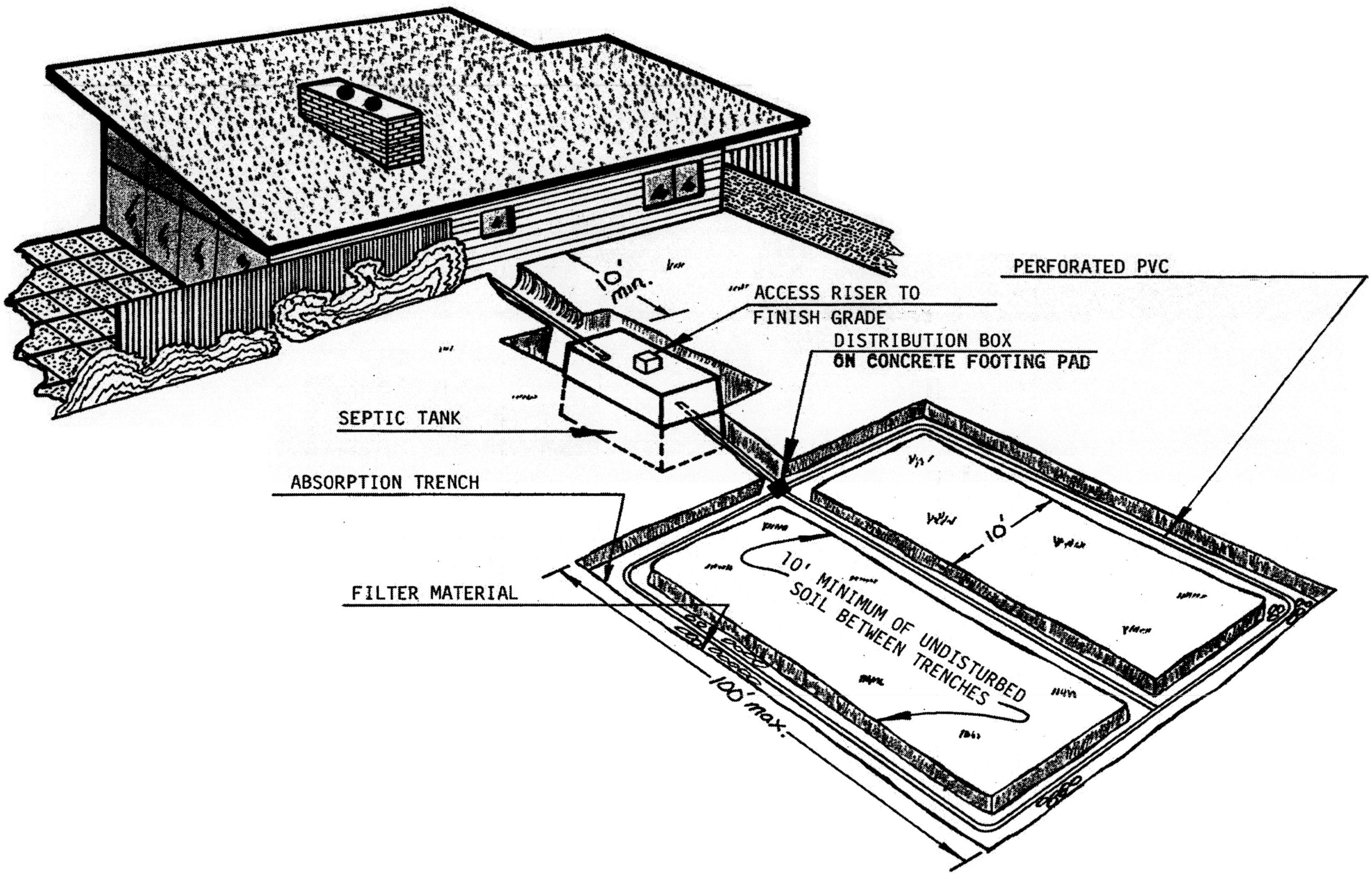
3. All altered slope areas shall be altered such that surface water drainage will be diverted away from the system. In some cases this may require the use of grassed waterways or other means of diverting surface waters. All disturbed areas shall be seeded or sodded with grass and appropriate steps must be taken to control erosion. See Detail #4.

3.13 Effluent from the septic tank shall be conducted to the absorption field through a water tight line. Tees, whys or other distributing devices may be used.

A No single absorption trench shall exceed one hundred (100) feet in length. When multiple lines are used, all lines shall be of the same length.

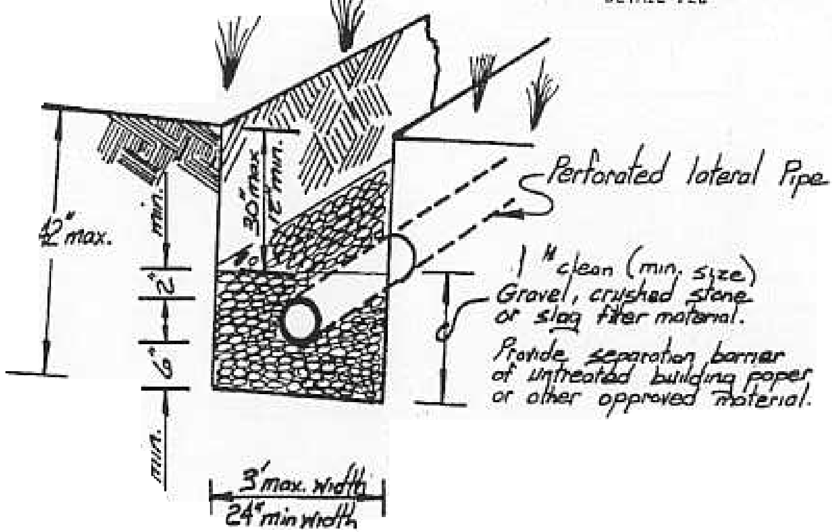
DETAIL #2

TYPICAL ABSORPTION FIELD INSTALLATION FOR LEVEL TOPOGRAPHY



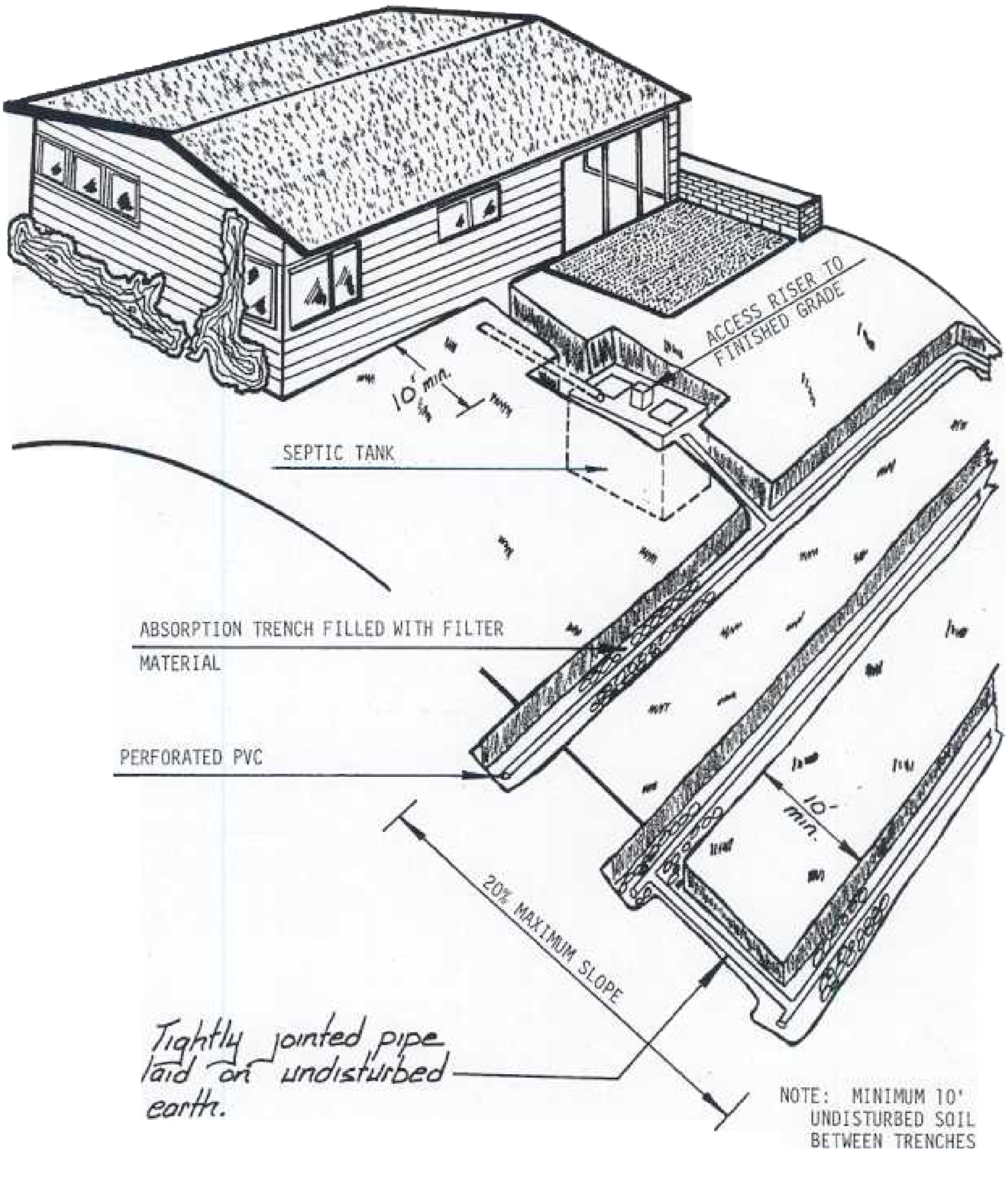
ABSORPTION TRENCH

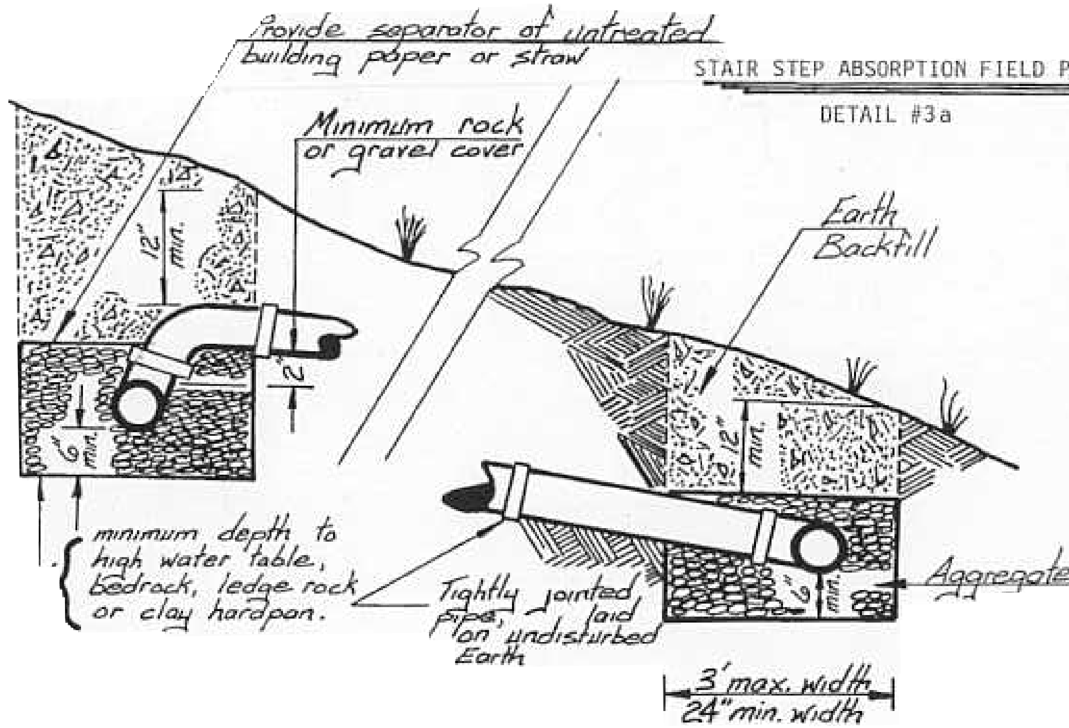
DETAIL #2a



DETAIL #3

TYPICAL ABSORPTION FIELD INSTALLATION ON SLOPING TOPOGRAPHY





STAIR STEP ABSORPTION FIELD PROFILE

DETAIL #3a

3.14 Dosing or Pumping Chambers

A. Material and construction. Dosing and pumping chambers shall be pre-cast concrete. Any other material shall receive written approval from the department. Dosing or pumping chambers shall be water tight, durable, new, sound and not subject to corrosion. (See Detail #5.)

B. Conventional absorption field designs proposing in excess of 500 linear feet of trench are required to be either split by utilizing a mechanical alternating device such as a valve or flow diverter, or dosed by pump injection to the prescribed volumes indicated by 3.14D. Divided absorption field proposals must provide for a 25 percent increase of absorption area on each portion of the split.

C. Method. Dosing may be accomplished by the use of either siphons or pumps.

D. Dosing rates shall have a discharge capacity of at least 1/3 to ½ of the estimated daily waste flow.

E. Lateral fields. The dosing chamber and equipment should deliver, per operating cycle, a volume equal to 70 percent of the total volume of distribution pipe. The tight line leading to the field from the dosing chamber shall not be considered a part of the distribution system.

F. Dosing or pumping chambers shall have a minimum capacity of 500 gallons with emergency overflow relief provided.

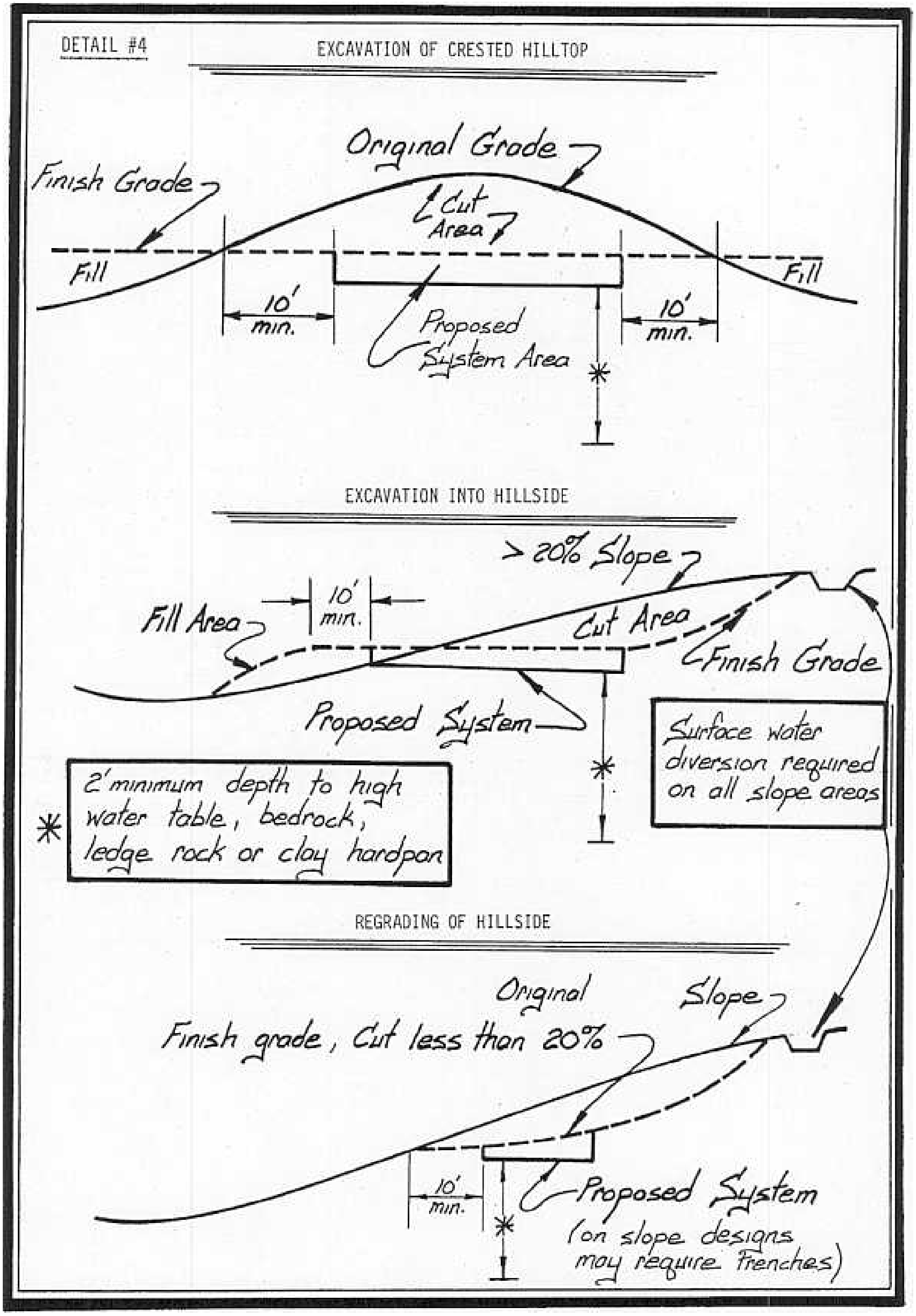
G. Dosing or pumping chambers shall be provided with an access riser to extend up to the finish grade for pump and controls maintenance. Access riser lids shall be properly secured or locked. The access riser shall be of sufficient size to permit a person access to the pump and controls.

H. A high water warning device shall be installed on pumping or dosing chambers so that it activates below the overflow lateral outlet. The device shall be either an audible or illuminated alarm. Visible alarms shall be conspicuously mounted.

I. An overflow absorption lateral shall be provided on dosing tanks and shall be a minimum of 50 feet x 2 feet wide. This will provide the user with a stand by facility until the pump, controls, etc., are repaired or during power outages. See 3.14N concerning conditions where overflow lateral may be eliminated.

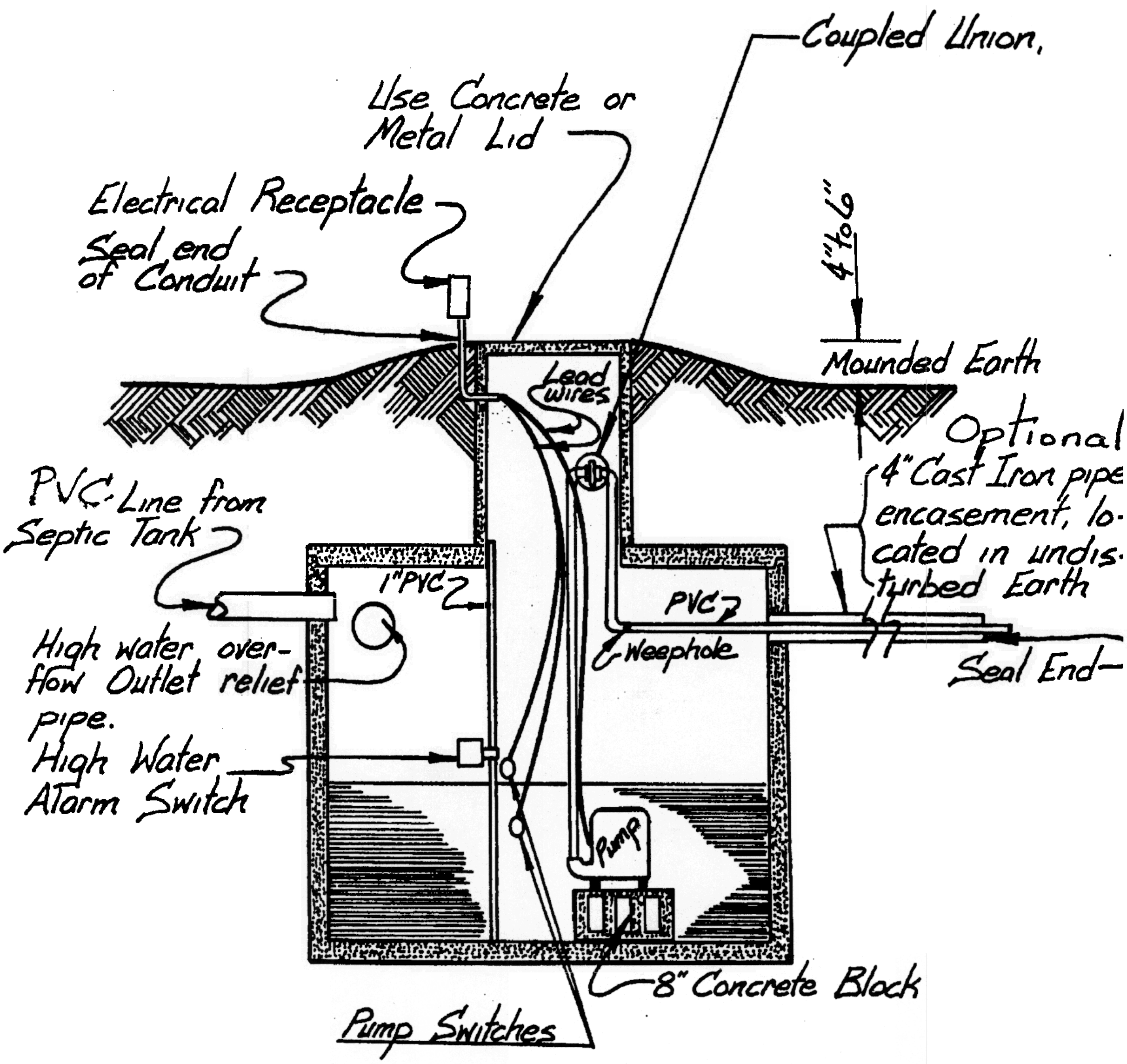
J. When pumping to a distribution box, a flow director device shall be provided inside the distribution box.

K. A back-flow preventer device may be used in circumstances where drainback could create a siphon if drainback volume is not desired. In such cases, sufficient soil cover will be necessary to protect the supply line from freezing.


DETAIL #4
EXCAVATION OF CRESTED HILLTOP
Original Grade
Finish Grade
Cut Area
Fill
Fill
10' min.
10' min.
Proposed System Area
*
EXCAVATION INTO HILLSIDE
> 20% Slope
10' min.
Fill Area
Cut Area
Finish Grade
Proposed System
*
Surface water diversion required on all slope areas
* 2' minimum depth to high water table, bedrock, ledge rock or clay hardpan
REGRADING OF HILLSIDE
Original Slope
Finish grade, Cut less than 20%
10' min.
*
Proposed System (on slope designs may require trenches)

DETAIL #5

TYPICAL PUMP CHAMBER DETAIL



L. Pump controls must be selected which give flexibility in adjusting the on/off depth. This adjustment is necessary because of the (a) different sized tanks used and (b) the different dosing quantities for the various sized systems. Without this flexibility, dosing quantity and rates cannot be adjusted, thus resulting in too small a dose or too large a dose.

M. Siphons. Siphons can be designed where sufficient elevation exists between the treatment system and the siphon chamber. However, the siphon must be designed to deliver the same flow rate at the same head at the system as a pump system.

N. Emergency pump chamber over flow lateral can be eliminated provided adequate tank size can provide for 48 hour power failure retention.

Pipe used under driveways or other areas subject to heavy loads shall be installed to withstand the imposed loads and shall be watertight. Such sections shall not be considered in determining the effective absorption area.

Distribution pipe shall be of durable new material. Corrugated perforated pipe with holes may be used although smooth wall perforated pipe is recommended. The use of foundation drain tile is prohibited.

Effective barrier. Untreated paper, straw or some similar material approved by the Public Works Director shall be placed over the gravel before back-filling to prevent back-fill from sealing the voids in the gravel.

Filled Areas.

A. A soil absorption system shall not be installed in a filled area unless written approval is received from the department.

B. Placement of fill does not guarantee approval for installation of a soil absorption system. When evidence is made available showing that the filled area does meet the code requirements with regard to this area, departmental approval may be granted. This, in effect, would support application for a system designed in fill.

C. Soil test. Soil borings and percolation tests shall be conducted before filling to determining soil textures and depth to bedrock, high ground water or impermeable soil.

D. Site and soil requirements. Bedrock, high ground water and impermeable soil. Sites that have a minimum of 24 inches of soil over bedrock, high ground water or impermeable soil may be filled with the same soil texture as the natural top soil in an attempt to overcome the site limitation. The fill material shall not be of a finer texture than the natural soil. Fill consisting of a sandy loam or loamy sand texture is recommended.

E. Fill placement. Vegetation and top soil shall be removed prior to filling and must be incorporated evenly into the underlying natural soil. It is very important that no sharp interface remain between the natural and imported soil layers. Before applying the tilled fill to the absorption area, the ground surface must be tilled with a small plow or cultivator. Fill should be applied with a minimum of wheeled traffic on the area, and the area tilled again to ensure even mixing. A very small tractor should be used to spread the material around and to provide a convex shape to the area. There should be no low spots or depressions, and the final shape should shed, rather than accumulate rain water.

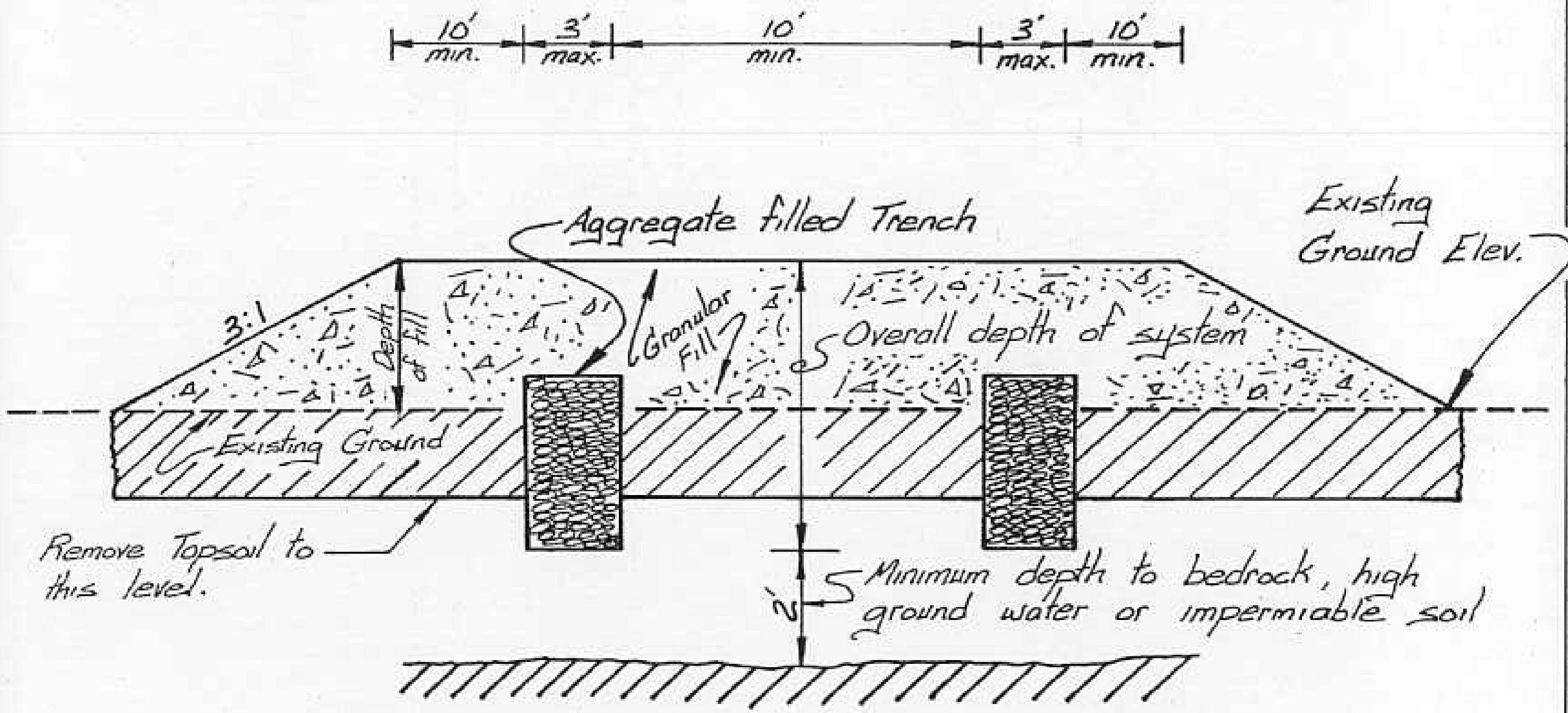
F Inspection of fill. Fill quantity and its placement shall be inspected and approved by the applicants design engineer. The applicants design engineer shall notify the department in writing when the fill material and its placement has been inspected by him and has been properly compacted and is stabilized.

G. Design requirements/size. A filled area shall be large enough to accommodate a shallow absorption system. The size of the area that must be filled is determined by the percolation rate of the natural soil. When any portion of the system is in the fill, the fill shall extend a minimum of ten (10) feet* beyond all sides of the system before the slope begins.

H. Side slope. Slopes at the edge of the filled areas can be a maximum of 3 to 1 ratio, provided the ten (10) feet* separation distance is maintained. (See Detail #6)

* Except where LPPS is to be utilized then a minimum of five (5) feet can be approved.

DETAIL #6 FILLED SYSTEM



Side slope. Slopes at the edge of the filled areas can be a maximum 3 to 1 ratio, providing the 10 foot separating distance is maintained.

Section 4.0 Minimum submitting design plan requirements for septic tank and conventional lateral field installations.

A. Location of percolation test and soil borings in relation to the proposed on-site system location.

B. Location of the combined total for primary and future replacement area of 15,000 sq. ft. minimum.

C Contours.

1 The minimum scale for design plans shall be 1" = 20'.

2 Contours must be shown to at least seventy-five (75) feet from the residence or building and system. These must be accurate, proposed finished contours must also be shown and should be drawn to scale. The contours shall be referenced to an on lot bench mark, however, it is not necessary to correlate your contours to Mean Sea Level.

a. Contours, original grade. Ground slope with two foot contours for the original, undisturbed grade elevation.

b. Contours, altered sites. Ground slope with two foot contours for the grade elevation of the entire area of the sewage disposal system after alteration of the landscape.

D. Location and lowest finished floor elevation of proposed residence or building.

E. Bench mark. Elevation location and designation specified.

F. Distance, size and type of house sewer line from the residence or building to the septic tank.

1 Home sewer outlet elevation.

G. Size of septic tank. Access riser provided to finish grade.

Septic tank inlet elevation.

Dosing or pumping chamber. If a dosing or pumping chamber is to be utilized see rules, regulations and minimum submitting design plan requirements for dosing and pumping chambers and submit with conventional septic tank and lateral field design.

1 Give the distance, size and type of the tight line to the pumping chamber from septic tank.

J. Septic tank outlet elevation.

K. Distance, size and type of tight line from the septic tank to the distribution box or tees.

L. Distribution box, inlet, tee or valve elevation.

  1 If a stair-step type layout is being utilized, provide for the first overflow flow line elevation.

M. Size of the absorption field.

N. Trench bottom elevations. All trench bottom elevations on serial distribution layouts.

O. Depth of absorption trenches.

P. Width of absorption trenches.

Q. Length of absorption trenches.

R. Size and type of lateral pipe. Perforated smooth wall PVC recommended.

S. Depth of crushed rock under lateral pipe.

T. Depth of crushed rock over lateral pipe.

U. Size of crushed rock.

V. Type of protective barrier between finish rock and backfill.

W. Depth of backfill to finish grade.

X. Distance from absorption field to nearest property line.

Y. Show trenches to be following contours.

  1 Show the distance between absorption trenches.

Z. Location of cisterns or wells in relation to the disposal system.

AA. Surface water diversion on systems located on slopes. Diversion of down spouts or foundation sump pump discharge away from the disposal system.

Section 5.0 Dosing or pumping chamber minimum submitting design plan requirements.

A. Dosing or pumping chamber size in gallons, length, width and depth to the outlet in inches (inside dimensions).

B. Bottom of dosing or pumping chamber elevation.

C. Dosing or pumping chamber inlet elevation.

D. Type and size of pump pedestal.

E. Type, size and model number of pump to be used.

1. Pump performance curve.

F. Type and size of the pressure line and its total length.

G. Location of the quick disconnect union and back flow preventer device on the pressure line, back flow preventer devices are required when design does not provide for flow back after the pump shuts off. A pump check valve may be acceptable.

H. Total elevation head. The elevation difference between the pump and the final systems invert.

1. Friction head.

I. The dosing frequency.

J. Pump discharge rate or dosing quantity gallons/dose.

K. Distance between pump on and off floats, inches.

1. Type of pump controls to be used.

L. Distance between pump on float and high water warning device float.

M. Pump line outlet elevation.

N. Overflow absorption lateral elevation.

O. When dosing to the distribution box, the supply line shall have a 90° ELL placed on it inside the distribution box and shall be directed toward the bottom of the distribution box. All lines entering or existing in the distribution box shall be properly sealed to the distribution box.

Section 6.0 Polishing ponds. Polishing pond systems can be utilized to serve properties where results of soil testing reveal unacceptable conditions for the installation of a soil absorption system. Refer to Section 1.2.F for details.

Preparation of the polishing pond site. Remove all trees, stumps, trash, brush, sod, large roots, perishable material and loose soil from the area. Strip topsoil from the site area and deposit in storage piles. Top soil may be used on the back slopes as a top dressing. After the stripping operation, scarify the ground surface within the foundation area to provide a bond between the foundation and the earth fill.

Construction of dikes. Be sure that the earth fill material does not contain any appreciable concentration of vegetation, roots, large rocks, frozen soil, or other foreign substances. Moisture content should be sufficient for good compaction. Place the fill material in approximately six inch layers that extend over the full width and length of the dikes. Compact each layer by the operation of earth moving equipment. If the moisture content of the fill material is deficient add water to the fill material and thoroughly mix and compact prior to placing additional fill. If the moisture content of the fill material is excessive, do not use the fill material until it has dried to proper moisture content.

Berm slopes. The inner face slope and back slope of the berm construction should never be steeper than 3 to 1, a flatter 4 to 1, slope should be used on berm backslope construction when possible or when necessary for structure stabilization. Embankments shall be designed and constructed to facilitate mowing and maintenance.

Core trenching. A core trench is usually not necessary since these ponds are only five (5) feet in depth. A core trench may be necessary if ponds are located on steep slopes or soil is not suitable for proper compaction. Acquisition of off site material may be necessary in some occasions.

Overflow pipes or small spillways. An overflow pipe or small spillway may be installed if the effluent from the polishing pond can be retained on the property and will not discharge onto adjacent properties. The overflow pipe or small spillway shall be placed at or slightly above the proposed four (4) foot water level. See double asterisks (**) in Table 1. (If the outfall is located closer than 100 feet, the effluent must be piped by gravity or pumped to another area of the property for disposal). Polishing ponds shall be located a minimum of seventy-five (75) feet from drainage ways, lakes, ponds, rivers or creeks. If after the polishing pond is put into operation and it becomes evident that the owner cannot maintain the pond effluent on the property (despite minimum distances referred to in this section and Section 6.9), other methods for polishing pond overflow disposal shall be implemented.

Inlet pipe from treatment unit. The inlet pipe into the polishing pond shall be placed above the overflow level or may enter the pond below the operating level if secured to a concrete block located one (1) foot above the pond bottom. At no time shall the polishing pond be higher than the treatment unit unless pumping is utilized.

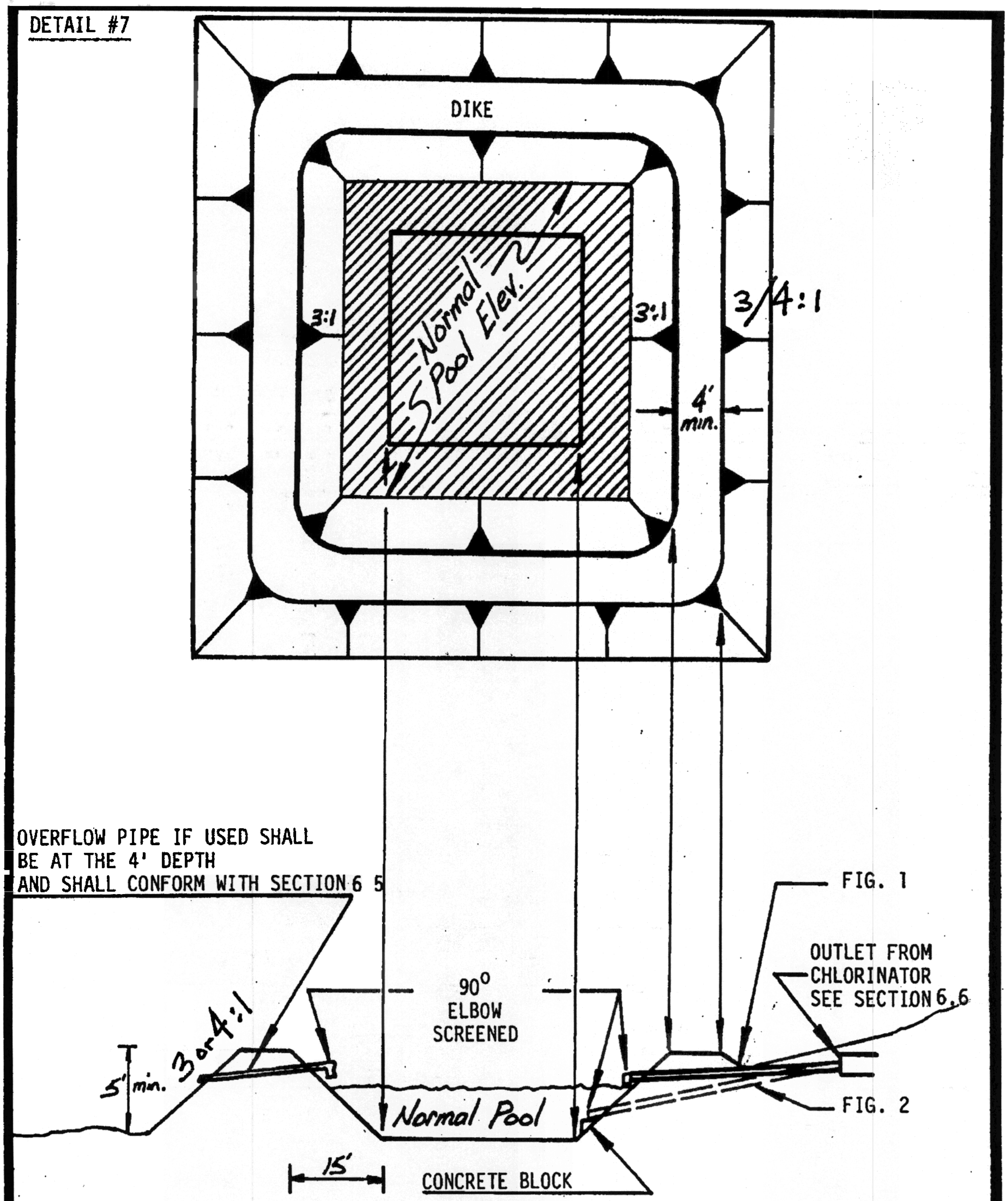


FIG. 1 THE DISCHARGE LINE FROM THE CHLORINATOR MAY ENTER THE POLISHING POND ABOVE THE OVERFLOW LEVEL, PROVIDING IT IS A MINIMUM OF 6-INCHES ABOVE THE OVERFLOW LEVEL.

FIG. 2 THE DISCHARGE LINE MAY ENTER THE POND BELOW THE OPERATING LEVEL IF SECURED TO A CONCRETE BLOCK ONE FOOT ABOVE POND BOTTOM.

TYPICAL POLISHING POND

DETAIL #8

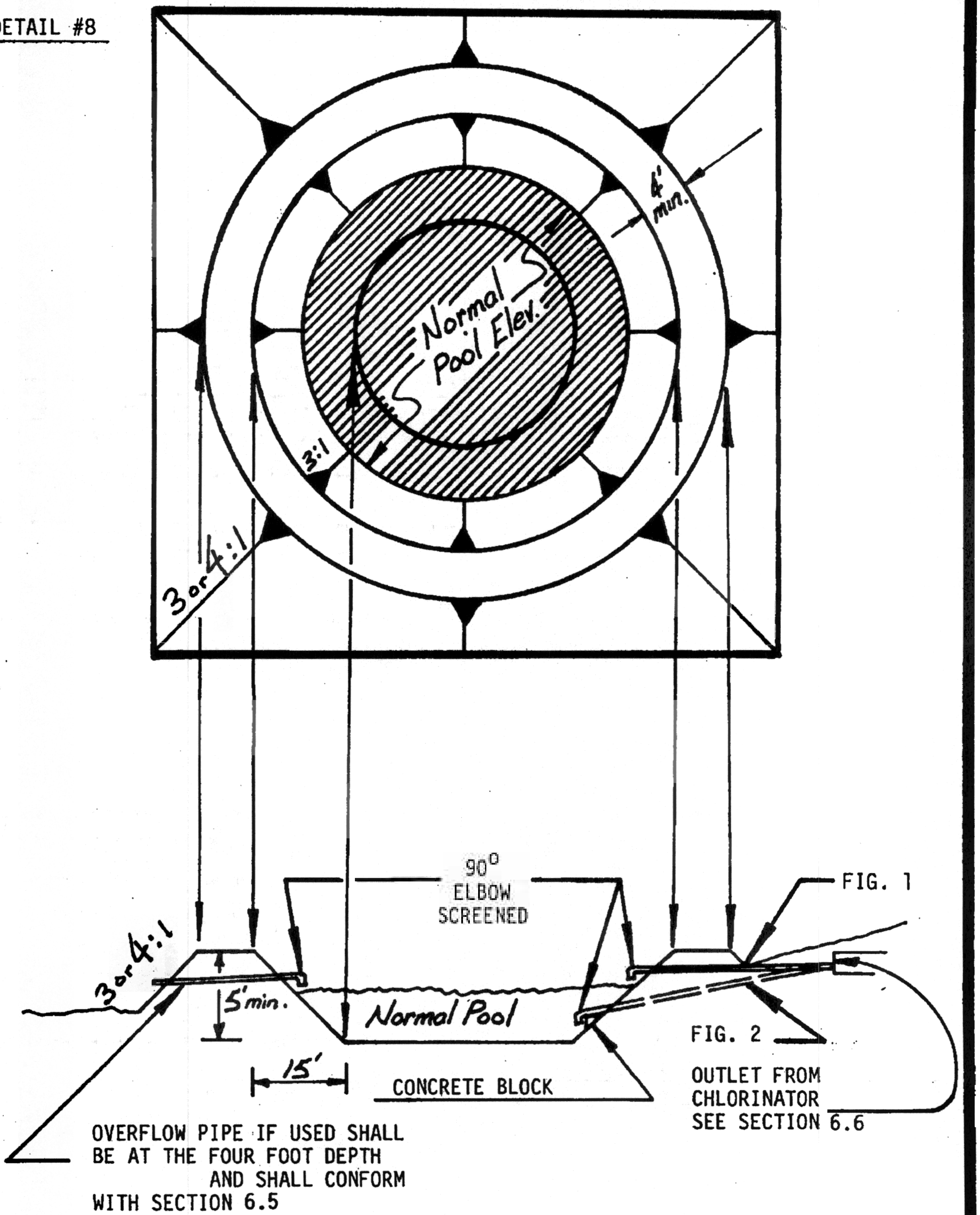


FIG. 1 THE DISCHARGE LINE FROM THE CHLORINATOR MAY ENTER THE POLISHING POND ABOVE THE OVERFLOW LEVEL PROVIDING IT IS A MINIMUM OF 6-INCHES ABOVE THE OVERFLOW LEVEL.

FIG. 2 THE DISCHARGE LINE MAY ENTER THE POND BELOW THE OPERATING LEVEL IF SECURED TO A CONCRETE BLOCK ONE FOOT ABOVE THE POND LEVEL.

TYPICAL POLISHING POND

NFS approval. Polishing ponds will be required to utilize NFS approved, or equivalent, aeration sewage treatment units and a chlorinator prior to discharging into a polishing pond.

Mosquitoes. To prevent mosquito development, keep the waters edge and pond body itself clear of vegetation.

Pond location. The polishing pond should be a minimum of 100 feet from the house it serves and 200 feet from any other residence. Polishing ponds shall be a minimum of 75 feet from the top of berm center line to the closest point of the nearest property line. The backslope toe of embankment should not be any closer than ten (10) feet to any property line. The pond site should permit an unobstructed wind blow across the pond. Polishing ponds shall be located a minimum of 75 feet from the berms center line to apparent high banks of creeks, lakes, rivers, as well as wet weather creeks, ditches, drainage ways, swales, etc. See Table #1.

Private water supplies. Private water supplies shall be located a minimum of 100 feet from the polishing ponds.

Water depth. The pond water operating depth is usually be between two (2) feet and three (3) feet. Following construction of the pond and prior to being operational, the pond should be filled to a two (2) or three (3) foot water depth to activate the sealing process.

Seeding. The dike or berm shall be seeded with densely-growing, short rooted perennial grass such as blue, fescue or brome.

Maintenance. The following maintenance is required.

A. Keep aquatic weeds under control.

B. Mow the grass along the water edge.

C. Maintain the two (2) to three (3) feet depth.

D. No discharge off the property.

E. Treatment units to maintain efficient operational status.

Sizing requirements. Polishing pond areas will be determined by the permit applicants, engineered design plan. Surface area for a three (3) foot operational depth shall be no smaller than 450 square feet per 100 gallons/flow at a total daily usage of 150 gallons per bedroom.

Freeboard. A two (2) foot freeboard is recommended above the maximum pond operating level; at no time shall there be less than one (1) foot freeboard. See Polishing Pond Detail #7 and Detail #8.

Polishing pond system designs can be accepted without percolation test results, on platted five (5) acre tracts or larger, if so desired by the owner.

Fencing. The polishing pond shall be enclosed with a fence conforming to the following conditions:

A. The fence shall be at least four (4) feet in height.

B. The fence shall be welded, woven, or chain link material with no smaller than fourteen (14) ga. wire. Cattle or hog panels can be substituted with a tee post being used for a line post.

C. Fence posts shall be pressure-treated wood, galvanized and/or painted steel. Fence posts shall be driven, tamped or set in concrete. Line posts should be at least eighteen (18) inches deep and shall be spaced no more than ten (10) feet apart. Corner posts should be at least twenty-four (24) inches deep and shall be properly braced.

D. The fence shall be of sound construction with no gaps or openings along the bottom.

E. The fence shall be no closer than the center of the berm to the water's edge at the three (3) foot deep operating level. Fence setbacks should not exceed thirty (30) feet from the water's edge.

F. A properly hinged four (4) foot high gate or comparable materials shall be installed and provided with an effective latching device. The gate should be thirty-six to forty-eight (36 - 48) inches in width to accommodate maintenance and mowing equipment.

G. The fence must be completed prior to occupancy of the dwelling.

Section 7. Minimum submitted design plan requirements for polishing pond systems. The minimum scale for design plans shall be 1" = 20'.

A. Location of percolation test and soil borings (if required) in relation to the proposed polishing pond system location.

B. Contours. Contours must be shown to at least seventy-five (75) feet from the residence or building and system. These must be accurate, proposed finished contours must also be shown and should be drawn to scale. The contours shall be referenced to an on lot bench mark, however, it is not necessary to correlate your contours to Mean Sea Level.

1. Contours, original grade. Grade slope with 2-foot contours for the original, undisturbed grade elevation.

2. Contours, altered sites. Ground slope with 2-foot contours for the grade elevation of the entire area of the sewage disposal system, after alteration of the landscape.

C. Location and lowest finished floor elevation of proposed residence.

D. Bench mark. Elevation, location and designation specified.

E. Distance, size and type of house sewer line from the residence or building to the aeration tank.

1. Home sewer outlet elevation.

F. Size and type of aeration tank.

G. Aeration tank inlet elevation.

H. Pumping chamber. If a pumping chamber is to be utilized, see rules and regulations and minimum submitting design plan requirements for dosing and pumping chambers (Sec. 3.14; Sec. 5.0) submit with polishing pond system design.

1 It is recommended that the pumping chamber be placed before the chlorination unit or chamber. This would allow for the chlorination unit or chamber to be placed in or above the pond dike resulting in gravity flow of chlorinated effluent discharge to the proposed pond.

2. Distance, size and type of tight line from the aeration unit to the pumping chamber.

3. Pumping chamber inlet elevation.

4. Pumping chamber outlet elevation.

5. Distance, size and type of pressure line from the pumping chamber to the pond inlet device or chlorination unit.

6. Show backflow preventer device and its location on pressure line if polishing pond is at a higher elevation than pumping chamber.

Distance, size and type of effluent line from the final treatment tank to the pond inlet.

I Aeration tank outlet elevation.

1 Chlorinator outlet elevation.

K. Polishing pond inlet elevation.

L. Size of polishing pond.

1. Bottom area.
2. Three foot operating area.
3. Maximum pond operating area.
4. Inner dike area.
5. Maximum depth of cut to pond bottom.

M. Polishing pond bottom elevation.

N. Polishing pond maximum operating level elevation.

O. Inner and outer bank or dike slopes.

P. Location of polishing pond spillway or overflow pipe.

1. Spillway or overflow pipe elevation.
2. Direction of drainage from overflow pipe or spillway.

Q. Top of pond dike elevation.

R. Distance from center of polishing pond berm to the nearest property line.

S. Show toe of berm location.

T. Location of cisterns or wells in relation to polishing pond system.

U. Diversion of surface water run-off away from the polishing pond, provide diversion ditch flow line elevations.

V. Provide for fencing in accordance with Sec. 6.17

Section 8. Sand Mounds

8.1 Soil and Site Requirements

A. Table #15 give the soil and site factors which restrict the installation of the mounds for slowly permeable soils, shallow permeable soils over pervious bedrock, and permeable soil with high water tables. The restricting factors are (a) percolation rates, (b) depth to pervious rock, (c) depth to high water table, (d) depth to impermeable soil layer or rock strata, (e) depth to 50 percent by volume of rock fragments, (f) slope and (g) topograph factor.

B. Percolation rates. Percolation rates are used to determine the suitability of the soil for accepting effluent. For slowly permeable soils, percolation tests are run at a depth of 20-24 inches from the natural surface, except in cases where a more slowly permeable horizon exists above this depth. In that situation, the more slowly permeable horizon is the deciding factor. Mound systems are suitable for these slowly permeable soils if the percolation rate is 60-180 min/in, for shallow permeable soils, the percolation rate is 3-60 min./in. For permeable soils with high water tables, a percolation test is run at a depth of 20-24 inches below the natural surface. Mounds are suitable for these permeable soils with high water tables if the percolation rate is 3-60 min./in.

C. Depth to pervious rock. A minimum of 12 to 24 inches of unsaturated natural soil is required beneath the mound.

D. Depth to high water table. High ground water, including perched water tables, shall be a minimum of 24 inches beneath the soil surface in order to provide adequate disposal and purification. For permeable soils with high water tables, a percolation test is run at a depth of 20-24 inches below the natural surface. Mounds are suitable for these permeable soils with high water tables if the percolation rate is 3-60 min./in.

Table #15 Soil and Site Factors That Restrict Mound Systems

Restricting Factors	Soil Group		
	Slowly Permeable Soils	Permeable Soils With Pervious Bedrock	Permeable Soils With High Water Tables
Percolation Rate	60 - 180 min/in	3-60 min./in	3-60 min./in.
Depth to pervious rock	24 in.	12 in.	24 in.
Depth to high water tables	24 in.	24 in.	24 in.
Depth to impermeable soil layer or rock strata	24 in.	24 in.	24 in.
Depth to 50 percent by volume rock fragments	24 in.	24 in.	24 in.
Slope	6%	12%b	12% b

1. Percolation test depth at 12 inches and 24 inches for slowly permeable shallow soils and high water table soils, respectively, unless there is a more restrictive horizon above. If perched water table is at 24 inches, test depth should be held to 12 inches.

2. For percolation rate of 3-29 min./in., maximum slope is 12 percent, 30-60 min./in., maximum slope is six percent. For percolation rates of 61-120 min./in., maximum slope equals three percent. For percolation rates of 121-180 min./in., mound must be designed with no more than two percent gradient slope.

   E. Depth to 50 percent by volume rock fragments - Depths greater than 12 to 24 inches, must be used if the soil beneath the mound contains more than 50 percent by volume of rock fragments.

   F. Slopes. The crusted site is the most desirable because the mound can be situated such that the effluent can move laterally down both slopes. The mound should be placed upslope and not at the base of the slope. On a site where there is a complex slope, (two directions), the mound should be situated such that the liquid is not concentrated in one area down-slope. Upslope runoff shall be diverted around the mound.

G. Sites with trees and large boulders. Generally, sites with large trees, numerous smaller trees or large boulders are unsuitable for the mound system because of difficulty in preparing the surface and the reduced infiltration area beneath the mound. If no other site is available, then it is recommended to cut the trees off at ground level, leaving the stumps. A larger mound area may be necessary if too many stumps are involved, so sufficient soil is available to accept the effluent.

H. Site preparation. Trees must be cut level with the ground, excess vegetation should be cut and removed. The site is then plowed with a mold board plow 7-8 inches deep with the plowing done perpendicular to the slope. Chisel plowing may be used in place of mold board. Roto tilling is not recommended, as it breaks up the soil structure too much. A rough surface should be left in fine textured soils.

Once the site is plowed, all traffic must be kept off. The fill material can be deposited on the top with a backhoe or pushed on from the side, preferably the upslope side, using a track type tractor, keeping six inches of fill beneath the tracks. At not time should ruts be made in the plowed area. The fill should be placed immediately after site preparation to avoid the possibility of precipitation falling on the plowed area.

Traffic on the down slope side of the mound should be minimal to reduce compaction. All work should be performed from the ends and upslope side, especially on fine textured soils.

8.2 Fill Material

A. Below absorption area. It is not necessary to screen the sand to a given specification. Table #16 is included to give the evaluator an idea of what is acceptable and what is not. The table includes sieve analysis for good, bad and marginal fills. Medium coarse sand is recommended.

The design infiltration rate for medium coarse sand texture is 1.2 gal./ft.^{2} /day. This infiltration rate considers that a crusting layer will occur after a period of use.

B. Above the absorption area. The cap (area above the bed or trenches) should be a finer textured soil to allow plant growth due to a higher water holding capacity and increased runoff due to its more dense nature. Good quality top soil should be placed to a depth of six inches over the entire mound to promote good vegetation cover.

8.3 Mound Design

The design of the mound is based upon the expected daily waste water volume and the soil characteristics. It must be sized such that it can accept the daily waste water flow without surface seepage and the basal area which is the natural soil area beneath the mound, must be sufficiently large to conduct the effluent into the underlying top soil. The system must also be designed to avoid encroachment of the water table into the mound.

The design of the mound includes six major steps which are: (1) daily waste water load, (2) design of the absorption area within the mound, (3) dimensioning the mound,(4) checking the basal area requirements (natural soil-fill interface), (5) design of the distribution network and (6) sizing the pumping system. Each step will be discussed.

A. Daily waste water load. The daily flow shall be 150 gal./day/bedroom.

B. Design of absorption area.

1 Sizing the absorption area. The size of the absorption area is dependent upon the type of fill material and the daily waste water flow. For medium coarse sand texture, the recommended design infiltration capacity is 1.2 gal./ft.^{2} /day. (See preceding section on fill material.)

2. System configuration. The absorption area within the mound can be in the form of trenches or beds. The location of the water table and soil permeability will dictate to some extent if a trench or bed is used. Encroachment of the ground water into the mound of high water table sites must be considered in the design.

For slowly permeable sites, the encroachment of the ground water is more severe than on permeable sites. Bed widths should not be greater than 10 feet wide. For shallow permeable soils over creviced or porous bedrock, either configuration could be used. If a bed is selected it could be square or rectangle.

The trenches and beds must be located perpendicular to the slope so as not to concentrate the effluent into a small area as it moves laterally down slope. Sufficient length must be provided, so all the effluent infiltrates into the natural soil before it reaches the toe of the mound.

The bottom of the absorption area within the bed and trenches must be level and at the same elevation, so one area of the bed or one trench is not overloaded.

TABLE #16 EXAMPLES OF SAND SIEVE ANALYSES IN PERCENT OF ACCEPTABLE AND UNACCEPTABLE SANDS FOR MOUNDS IN JACKSON COUNTY, MISSOURI.

Sample No.	USDA CLASSIFICATION Gravel > 2mm	Very Coarse Sand 1-2mm	Coarse Sand .5-1mm	Medium Sand .25-.5mm	Fine Sand .1-.25mm	Very Fine Sand .05-.1mm	Silt and Clay < .05mm	COMMENTS
	%	%	%	%	%	%	%	
1	9	6	22	51	11	0	1	good fill
2	5	0	27	51	13	1	1	good fill
3	0	16	16	39	34	4	1	good fill
4	46	13	12	14	6	2	7	unacceptable - too coarse
5	40	15	17	18	7	1	2	unacceptable - too coarse
6	0	0	7	33	55	4	1	unacceptable - too fine
7	2	0	1	4	30	10	53	unacceptable - too fine
8	18	3	8	30	24	4	15	poor to fair - judgement [a]
9	23	15	22	20	10	6	4	poor to fair - judgement [a]

[a] SAMPLE 8 IS A MARGINAL FILL BECAUSE OF THE MANY FINES. SAMPLE 9 IS A MARGINAL FILL BECAUSE IT HAS TOO MUCH COARSE MATERIAL. BOTH OF THESE WOULD BE JUDGEMENT DECISIONS. IF ACCEPTABLE FILLS WERE CLOSE BY, THESE TWO FILLS WOULD NOT BE RECOMMENDED. IF ACCEPTABLE SANDS WERE A GREAT DISTANCE AWAY, THEN THEY COULD BE USED.

C. Mound Dimensions

1. Mound height. The mound height consists of the fill depth (D and E). The trench or bed depth (F), and the cap and top soil depth (G & H).

   The fill depth is dependent upon purification capabilities and varies for a given site. A minimum unsaturated flow depth of two feet of soil is needed for proper purification of the effluent. This depth can consist of the natural soil and medium coarse sand texture fill.

   When the water table is greater than two feet beneath the soil surface, a minimum of one foot (D) of fill is necessary.

   For shallow permeable soils over creviced bedrock, the fill depth (D) is a minimum of two feet where the natural soil depth is at the minimum of 24 inches.

   a. The bed or trench depth (F) should provide some water storage within the aggregate. A minimum of six inches of aggregate should be placed beneath the distribution pipe with two inches above the pipe. This will give a depth (F) of approximately nine inches. Clean, non-deteriorating 1 inch stone shall be used.

   b. The cap and top soil (H & G). The depth at the center (H) must have a minimum of 1.5 feet of cap and top soil. For a three-parallel trench system, this needs to be increased to two feet to give sufficient slope. At the outer edge of the gravel (G), the cap and top soil needs to be at least one foot deep. Good quality top soil six inches deep must be placed over the entire mound, which provides for good vegetative cover.

2. Mound width and length. The length and width of the mound is dependent upon the length and width of the absorption area, mound depth and side slopes of the mound. Side slopes should be no steeper than 3:1. The mound length runs perpendicular to the slope, because the bed or trench length must be perpendicular to the slope so the effluent is not concentrated in one area, but spread out along the slope.

   The mound length consists of the end slope (K) and the bed or trench length (B). The mound width consists of the upslope width (J), the trench or bed width (A), the spacing between the trenches (C), and if trenches are used, the downslope (I). On sloping sites, the downslope width (I) will be greater than on a level site if a 3:1 side slope is maintained. Table 17 gives the slope correction for slopes from zero up to 12 percent slopes with a 3:1 side slope.

Table #17 Down and Upslopes Correction Factors

Slope %	Downslope (I) Correction Factor	Upslope (J) Correction Factor
0	1.0	1.0
2	1.06	.94
4	1.14	.89
6	1.22	.86
8	1.32	.80
10	1.44	.77
12	1.57	.73

D. Basal area. The basal area is the natural soil-fill interface of the mound.

The basal area required will be dependent upon the soil and site conditions. For level sites, the total basal area beneath the mound can be used. For sloping sites, the only basal area considered for design is the area beneath and downslope of the bed or trenches. It includes the area enclosed by B x (A + C + I). The upslope and end slopes will transmit very little of the effluent. The percolation rate of the natural soil will determine how much area is required. For the following percolation rates, the design loading rates are:

3-29 min./in.	1.2 gal./ft.2/day
30-59 min./in.	.74 gal./ft.2/day
60-119 min./in.	.24 gal./ft.2/day
120-180 min./in.	.21 gal./ft.2/day - .08 gal./ft. 2/day

If sufficient basal area is not available for the given design and site conditions, then additional fill is required to make the mound wider for a level site or the fill is used to extend downslope width (I) on a sloping site until sufficient area is available. For mounds on slowly permeable sites with 3:1 side slopes, it may be necessary to extend this width.

TABLE #18 Sand Mound

Design criteria for a mound for a one bedroom home on 0 to 6% slope with loading rates up to 150 gal/day for slowly permeable soil.

PARAMETER	SYMBOL	UNITS	SLOPE % 0	2	4	6
Trench Width	A	Ft	3	3	3	3
Trench Length	B	Ft	42	42	42	42
No. of Trenches			1	1	1	1
Mound Height	D	Ft	1	1	1	1
	F	Ft	0.75	0.75	0.75	0.75
	G	Ft		1	1	1
	H	Ft	1.5	1.5	1.5	1.5
Mound Width	J	Ft	11*	8	8	8
	I*	Ft	11	15	15	15
	W	Ft	25	26	26	26
Mound Length	K	Ft	10	10	10	10
	L	Ft	62	62	62	62
Lateral Length	P	Ft	20	20	20	20
Lateral Diameter	-	In	1	1	1	
No. of Holes Per Lateral**		-	9	9	9	9
Hole Spacing		In	30	30	30	30
Hole Diameter		In	1/4	1/4	1/4	1/4

Additional width to obtain required basal area.

** Last hole is located at end of lateral which is 15" from other hole.

TABLE #19 Sand Mound

Design criteria for a mound for a two bedroom home on 0 to 6% slope with loading rates to 300 gal/day for slowly permeable soil.

PARAMETER	SYMBOL	UNITS	SLOPE %			
			0	2	4	6
Trench Width	A	Ft	3	3	3	3
Trench Length	B	Ft	42	42	42	42
No. of Trenches	-	-	2	2	2	2
Trench Spacing	C	Ft	15	15	15	15
Mound Height	D	Ft		1	1	1
	E	Ft	1	1.4	1.7	2.1
	F	Ft	0.75	0.75	0.75	0.75
	G	Ft	1	1	1	1
	H	Ft	1.5	1.5	1.5	1.5
Mound Width		Ft	12	8	8	8
		Ft	12	20	20	20
	W	Ft	42	46	46	46
Mound Length	K	Ft	10	10	10	10
	L	Ft	62	62	62	62
Lateral Length	P	Ft	20	20	20	20
Lateral Diameter	-	In	1	1	1	
No. of Holes Per Lateral**		-	9	9	9	9
Hole Spacing		In	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	15	15	15	15
Manifold Diameter	-	In	2	2	2	2

** Last hole is located at end of lateral which is 15" from other hole.

TABLE #20 Sand Mound

Design criteria for a mound for a three bedroom home on a 0 to 6% slope with loading rates of 450 gal/day for slowly permeable soils.

PARAMETER	SYMBOL	UNITS	SLOPE %			
			0	2	4	6
Trench Width	A	Ft	3	3	3	3
Trench Length	B	Ft	63	63	63	63
No. of Trenches	-	-	2	2	2	2
Trench Spacing	C	Ft	15	15	15	15
Mound Height	D	Ft	1	1	1	
	E	Ft	1	1.4	1.7	2.1
	F	Ft	.75	.75	.75	.75
	G	Ft	1	1	1	
	H	Ft	1.5	1.5	1.5	1.5
Mound Width	J	Ft	12*	8	8	8
	I*	Ft	12	20	20	20
	W	Ft	42	46	46	46
Mound Length	K	Ft	10	10	10	10
	L	Ft	83	83	83	83
Lateral Length	P	Ft	31	31	31	31
Lateral Diameter		In	1-1/4	1-1/4	1-1/4	1-1/4
No. of Hole Per Lateral**		-	14	14	14	14
Hole Spacing		In	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	15	15	15	15
Manifold Diameter***	-	In	2	2	2	2

* Additional width to obtain required basal area.

** Last hole is located 27" from previous one.

*** Diameter dependent upon size of pipe from pump and inlet position.

TABLE #21 Sand Mound

Design criteria for a mound for a four bedroom home on a 0 to 6% slope with loading rates of 600 gal/day for slowly permeable soils.

PARAMETER	SYMBOL	UNITS	SLOPE %			
			0	2	4	6
Trench Width	A	Ft	3	3	3	3
Trench Length	B	Ft	56	56	56	56
No. of Trenches	-	-	3	3	3	3
Trench Spacing	C	Ft	15	15	15	15
Mound Height	D	Ft	1	1	1	1
	E	Ft	1	1.7	2.3	3.0
	F	Ft	.75	.75	.75	.75
	G	Ft	1	1	1	1
	H	Ft	2	2	2	2
Mound Width	J	Ft	12	8	8	8
	I*	Ft	12	20	20	20
	W	Ft	57	61	61	61
Mound Length	K	Ft	12	12	12	14
	L	Ft	80	80	80	84
Lateral Length	P	Ft	27.5	27.5	27.5	27.5
Lateral Diameter	-	In	1-1/4	1-1/4	1-1/4	1-1/4
No. of Holes Per Lateral**		-	12	12	12	12
Hole Spacing		In	30	30	30	30
Hole Diameter	-	In	1/4	1/4	1/4	1/4
Manifold Length	R	Ft	30	30	30	30
Manifold Diameter***	-	In	2	2	2	2

** Last hole is located at end of lateral which is 15" from previous hole.

*** Diameter dependent upon size of pipe from pump and inlet position.

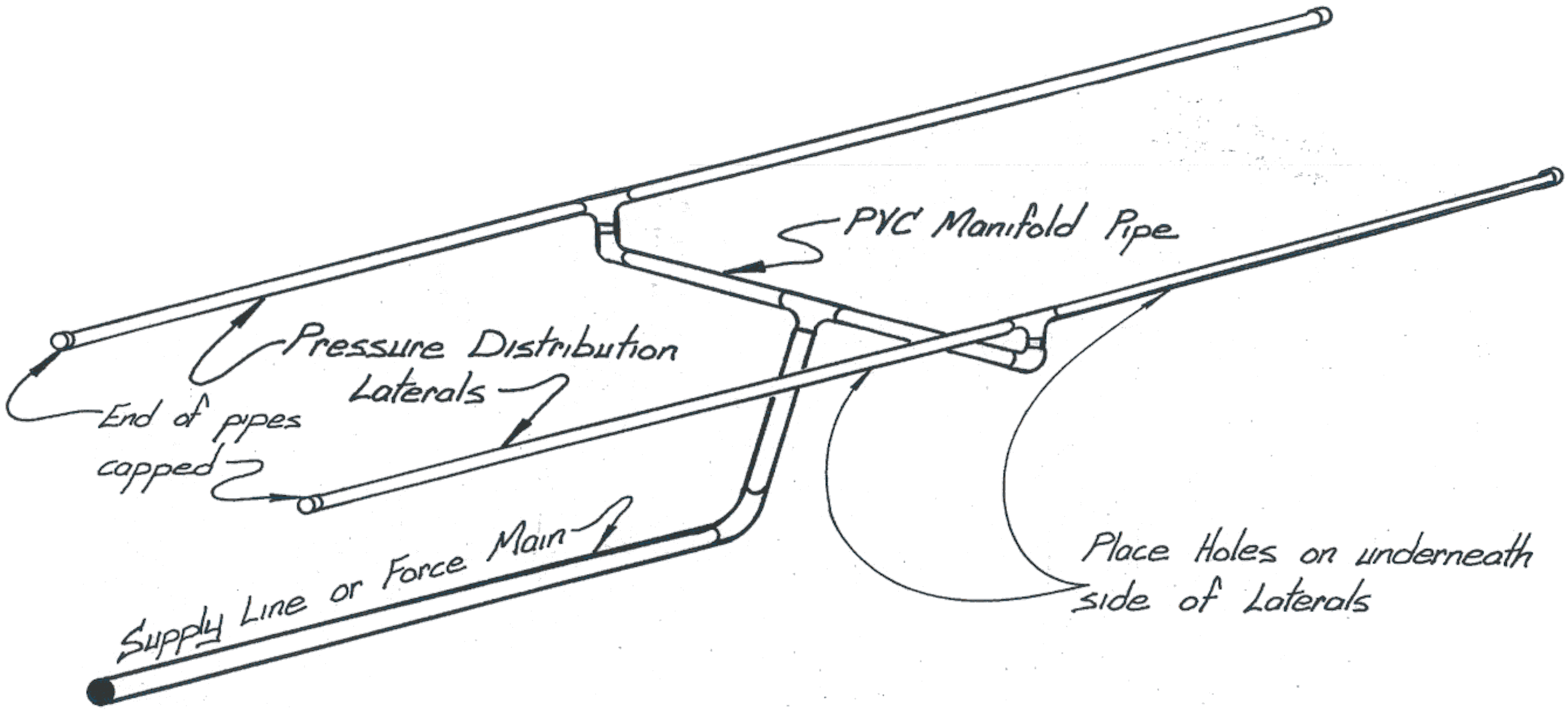
8.4 Distribution system. Detail #23 shows a typical distribution system for a mound. For a trench system, one lateral is sufficient per trench and for a bed system up to three laterals are used. Lateral spacing is a maximum of three feet for beds for small mounds only (1 to 5 bedrooms sized systems), pipe diameters will vary depending on the length of bed or trenches. Table #22 gives the allowable lateral lengths for three pipe diameters, three perforation sizes, and two perforation spacings. Tee-tee construction of manifold to laterals is preferred, but cross to cross construction is satisfactory. Manifold diameters of 2 to 3 inches are normally used in mounds for homes. The system must be designed and placed so that the laterals and manifold drain after every dosing. If the mound is downslope of the pumping chamber, then the manifold must be on top so the manifold drains.

8.5 Pumping systems. The components of the pumping system consists of the pumping chamber size, pump size, pump controls and alarm system (Detail #24). The objective is to design the system so a given quantity of effluent can be dosed at a given frequency. Dosing frequency of two to four times daily is recommended.

Table #22 Allowable Lateral Lengths (feet) for Three Pipe Diameters, Three Perforation Sizes, and Two Perforation Spacings

Perforation Spacing (inch)	Perforation Diameter (inch)	Pipe Diameter		
		(1 in.)	(1-1/4 in.)	(1-1/2 in.)
30	3/16	34	52	70
	7/32	30	45	57
	1/4	25	38	50
36	3/16	36	60	75
	7/32	33	51	63
	1/4	27	42	54

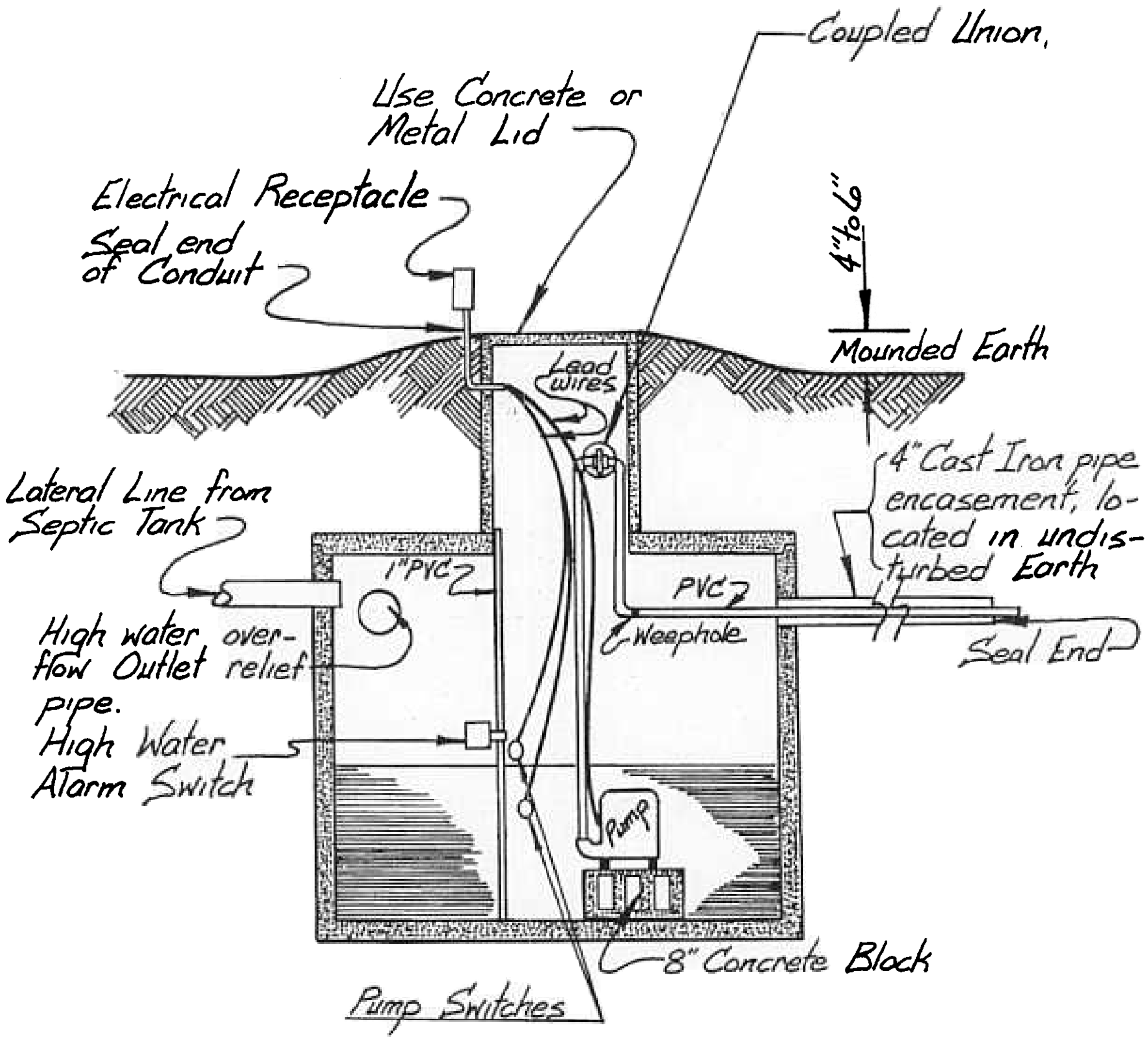
DETAIL #23



PRESSURE DISTRIBUTION NETWORK DESIGN

Detail #24

TYPICAL PUMP CHAMBER DETAIL



8.6 The dosing volume shall be at least 10 times the lateral pipe volume. This will minimize differences in discharge volumes from first to last orifices in laterals during filling. Table #24 can be used to estimate the void volume for various diameter pipes. If this dose volume is greater than given in Table #23, it shall be used, otherwise the value given in Table #23, shall be used.

Table #23 Recommended Dosing Quantity for Various Sized Homes

Home Size No. of Bedrooms	Dosing Quantity* Gal./Dose
	50
2	75
3	115
4	150
5	200

Each system needs to be checked to see if this is at least ten times the lateral void volume.

8.7 Pumping Chamber

A. Detail #24 gives a cross-section of a typical pumping chamber. The volume should be sufficient to provide the desired dosing volume, space for controls, space for setting the pump on a pedestal, and extra volume for flow-back after pump shuts off. Pumping chamber shall be a minimum of 500 gallons. An easy pump disconnect shall be used for easy pump removal when pump fails.

B. An overflow absorption lateral shall be provided on all dosing systems and shall be a minimum of 50 feet x 2 feet wide. This will provide the user with a stand-by facility until the pump, controls, etc., are repaired or during power outages.

Table #24 Void Volume for Various Diameter Pipes

Diameter Inch	Volume Gal./Ft. Length
1	.041
1 1/4	.064
1 ½	.092
2	.164

C. Pump selection is based on its pump performance curve. The total head is equal to:

1. The elevation difference between pump and lateral invert.
2. Friction loss in pipe between pump and distal end of lateral.
3. Pressure head at the distal end of lateral of two foot.

Table #26 can be used to determine head at the supply end of the laterals, and the pump size for various sized perforations with 30-inch hole spacing and laterals spaced three feet apart in beds or trenches three feet wide. As can be seen, as pressure at the supply end increases, pump capacity in gpm of absorption area increases. If the pump cannot supply the needed capacity, then the pump performance curve will go to equilibrium with the distribution system demand curve by following the selected curve.

The recommended pressure at the distal end of the lateral is two feet. Using the two feet of pressure at the distal end of the lateral Table #26 shows that the pressure at the supply end of the lateral is 2.5 feet for the three perforation sizes considered.

Table #25 gives the necessary pump capacity for two different perforation sizes for various sized systems.

Table #27 is used to determine the friction loss in the pipe between the pump and the inlet to the distribution system. For a given flow rate, length of pipe and pipe diameter, the friction head can be determined.

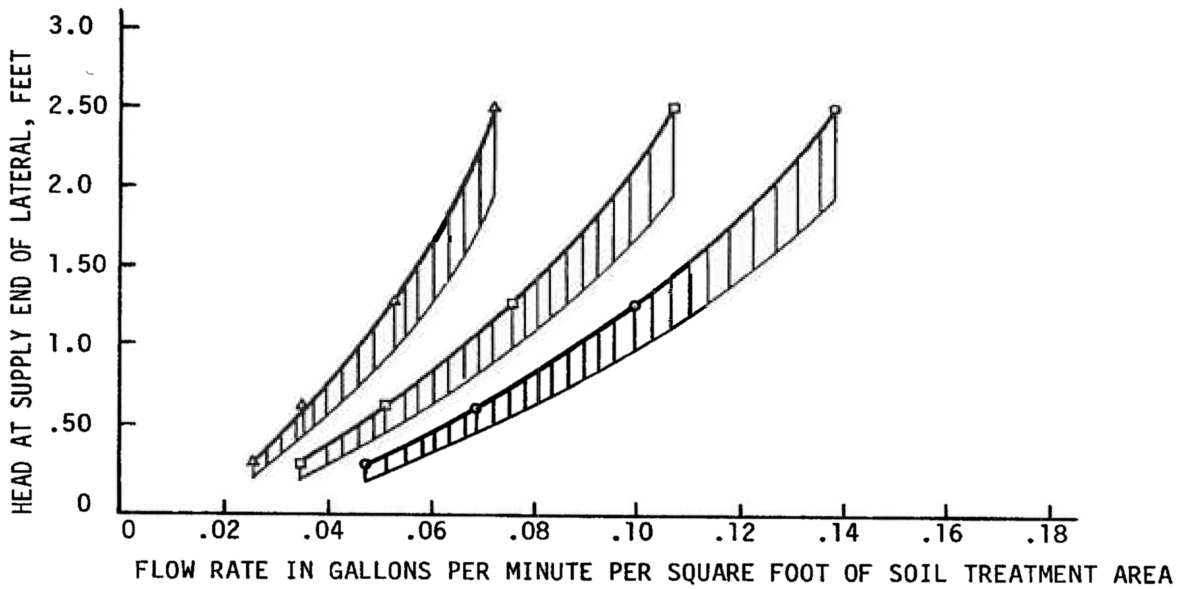
Check valves should be removed from the pump unless otherwise designed, so the manifold and pipe will drain back into the chamber or be shown below frost line. Otherwise, freezing will occur in the manifold.

Table #25 Pump flow for various sized mounds using a 7/32 inch and 1/4 inch diameter, perforations for a pressure of 2.5 feet at the supply end of the lateral. Laterals are spaced three feet apart with perforations spaced 30 inches apart. (Based on curves in Table #26).

Home Size No. Bedrooms	Absorption Area For Distribution System	Pumping Capacity[a] 1/32 in. ori/dia.	1/4 in. ori/dia.
	ft.^{2}	gpm	gpm
1	125	15	20
2	250	28	36
3	375	41	54
4	500	54	70
5	525	68	90

a) Pump capacity required for the total pressure head which includes elevation difference, friction loss and desired pressure in lateral.

Table #26 FLOW RATE VS. HEAD FOR PERFORATION SPACING OF 30 INCHES AND LATERAL SPACING OF THREE FEET, THE LOWER CURVE FOR EACH PERFORATION REPRESENTS THE HEAD AT THE DISTAL END OF THE LATERAL.



Table# 27 Friction Loss in Schedule 40 Plastic Pipe

Flow	Pipe Diameter (in.)								
	1	1-1/4	1-1/2	2	3	4	6	8	10
	ft/100 ft								
gpm									
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				0.05	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		
125						0.85	0.12		
150						1.17	0.16		
175						1.56	0.21		
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

Velocities in this area become too great for the various flow rates and pipe diameter

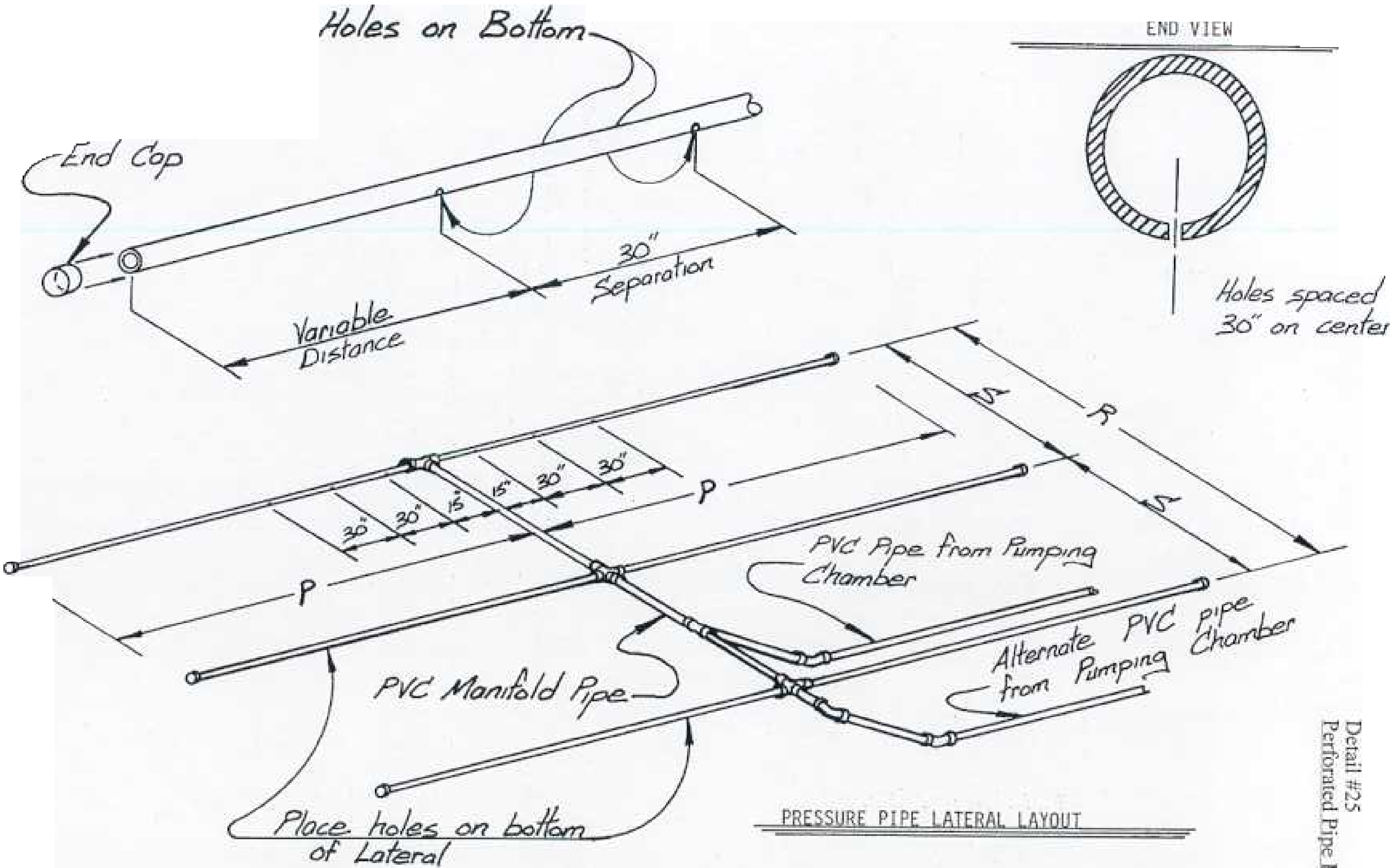
D. Pump and alarm control. The control system for the pumping chamber consists of a control for operating the pump and an alarm system to detect when the system is malfunctioning.

E. Electrical and alarm system. A high water warning device shall be installed on pumping or dosing chambers so that it activates below the over flow lateral outlet. This device shall be either an audible or illuminated alarm. If the latter, it shall be conspicuously mounted.

F. Siphons can be designed where sufficient elevation exists between the mound and the siphon chamber. However, the siphon must be designed to deliver the same flow-rate at the same head at the distribution system as a pump system. The distribution system, consisting of manifold and laterals, must be designed so they drain after each siphon, otherwise freezing will result in the manifold. This can easily be done by placing the manifold above the laterals.

G. A one-fourth inch hold shall be drilled in the pressure line when the mound is located lower than the pump outlet to prevent inadvertent siphoning.

H. If geological conditions such as a high water table or bedrock exist, the installation of an overflow lateral would not be feasible. As an alternative, a 1000 gallon pump chamber with the omission of an overflow lateral is acceptable.



Detail #25
Perforated Pipe Detail

The distribution system for a mound. One lateral is placed down the center of each trench as shown on plan views. Note alternate inlet positions. The variable distance between the last hole and the next to last hole will range between 15 to 30 inches depending upon the length of trench. Distribution system must be arranged so manifold and laterals drain after each dose.

Section 9. Minimum Design Plan Requirements for Sand Mounds Minimum scale for design plans shall be 1" = 20'.

A. Two copies of the plot plan showing the distance from the septic tank and mound to the well or cistern, lot lines, buildings, streams, lakes, etc. The mound shall be situated in such a manner so that the distribution laterals are laid perpendicular to the slope.

B. Two copies showing cross section of the pumping or dosing chamber. Indicate the gallons per minute pumped, gallons pumped per cycle, size of pumping or dosing chambers and spec sheet of pump. Indicate what the actual vertical lift will be from the base of the pump to the distribution lines within the mound. Indicate friction loss, pressure head and dose volume.

*C. Two copies showing the cross section of the filled area, type and size of fill used.

*D. Two copies of the pipe layout indicating the distance between the distribution lines, the length of the distribution lines, diameter, and size of holes and spacing between holes. Indicate that permanent markers are at the end of each pipe lateral and provide diameter of lateral pipe.

*E. Two copies of the plan view of the mound indicating the size of the mound and where the distribution line will be located within the mound.

**F. Two copies of the report on soil borings and percolation tests.

G. An on-site investigation by the department will be made before this office will review the proposed design plan. (Suggest onsite investigation at time of percolation tests and borings are taken in order to expedite plan review.)

H. Contours must be shown to at least seventy-five (75) feet from the residence or building and system. These must be accurate. Proposed finished contours must also be shown and should be drawn to scale. The contours shall be referenced to an on lot bench mark, however, it is not necessary to correlate your contours to Mean Sea Level.

Contours, original grade - Ground slope with two foot contours for the original, undisturbed grade elevation.

2. Contours, altered sites - Ground slope with two foot contours for the grade elevation of the entire area of the sewage disposal system area after alteration of the landscape.

I. Location of the proposed on-site system replacement area.

J. Location of perc test and soil borings in relation to the proposed on-site mound installation.

K. Bench mark.

L. All inlet and outlet elevations.
Main house sewer elevation at the foundation wall.
Mound bottom elevation.
Manifold elevation.
Distribution pipe elevation.
Finish top of mound elevation.

M. Distance and diameter of the supply line.

N. Length and diameter of the manifold.

O. Type of protective barrier.

P. Depth of mound cap.

Q. Surface water diversion away from system and mound area.

R. Type of grass to be planted on mound.

* Information can be copied directly from sand mound manual - minor changes may be necessary.

** Check conventional on-site regulations to determine if soil borings are needed.

Section 10 Low Pressure Pipe Systems

Site and soil requirements for LPP systems. The suitability of an LPP system for a given site is determined by the soil, slope and available space, as well as by the anticipated waste flow.

A. Space requirements. The distribution network of most residential LPP systems occupies from 1,000 square feet to 5,000 square feet of area depending on the soil permeability and design waste load. In addition, an area of equal size must be set aside for future repair or replacement of the system. (See Detail #32).
Space between the existing lateral lines is not a suitable repair area, unless the initial spacing between lines is 10 feet or wider.

B. Soil requirements. An LPP system should be situated on the best soil and site on the lot. A minimum of 24 inches of usable soil is required between the bottom of the absorption field trenches and any underlying restrictive horizons, such as consolidated bedrock or hardpan, or to the seasonally high water table. LPP trenches can be placed as shallowly as eight to twelve inches deep, giving a minimum soil-depth requirement to 32 to 36 inches. The soil must be of suitable or provisionally suitable texture, structure and permeability. In some cases where the depth to the seasonal water table or restrictive horizons is less, a modified LPP may be installed using imported fill. Their design and construction are covered in Section 10.5.

C. Topography. Low-pressure distribution fields located on slopes require special design and installation procedures Section 10.4. The distribution field of any LPP system should be at an elevation equal to or higher than the pumping chamber. If the field must be lower than the pump tank, then the system must be designed to ensure that effluent cannot leave the pump chamber when the pump is turned off.

Design of an LPP Area.

A. Size of the absorption area.

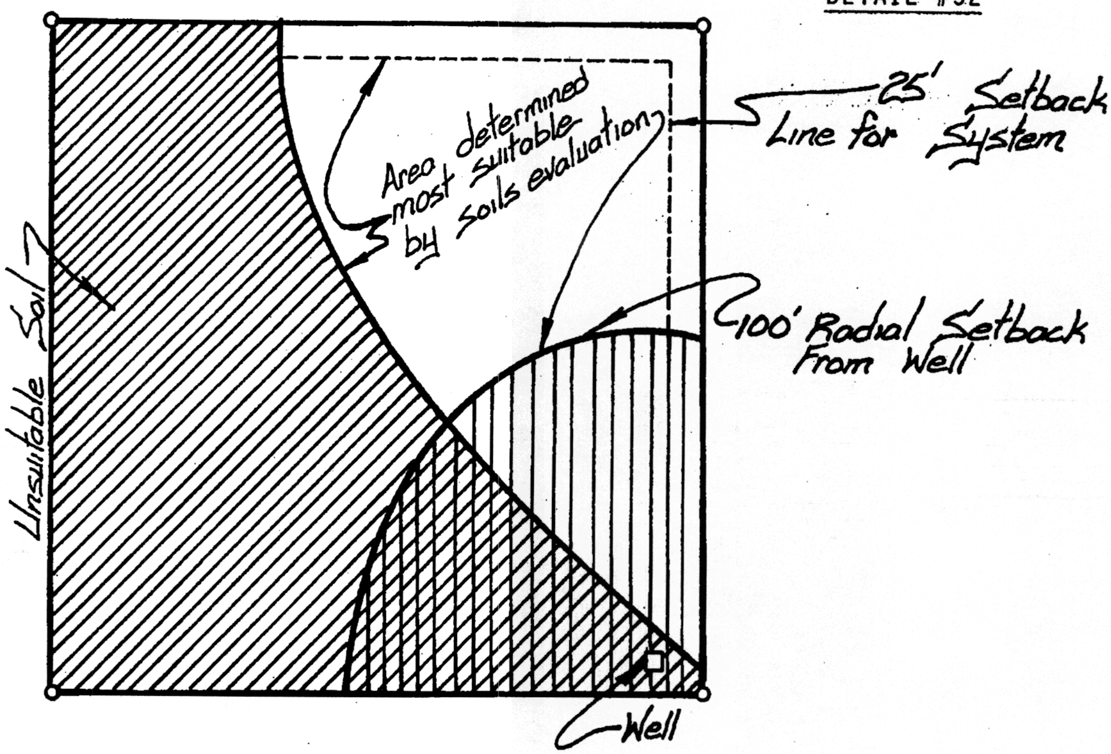
Daily waste water flow of 150 gallons per day/bedroom.

2. Maximum loading rate (see Table #28).
3. Total area: Daily waste water flow divided by maximum loading rate.
4. Length of distribution line is equal to:

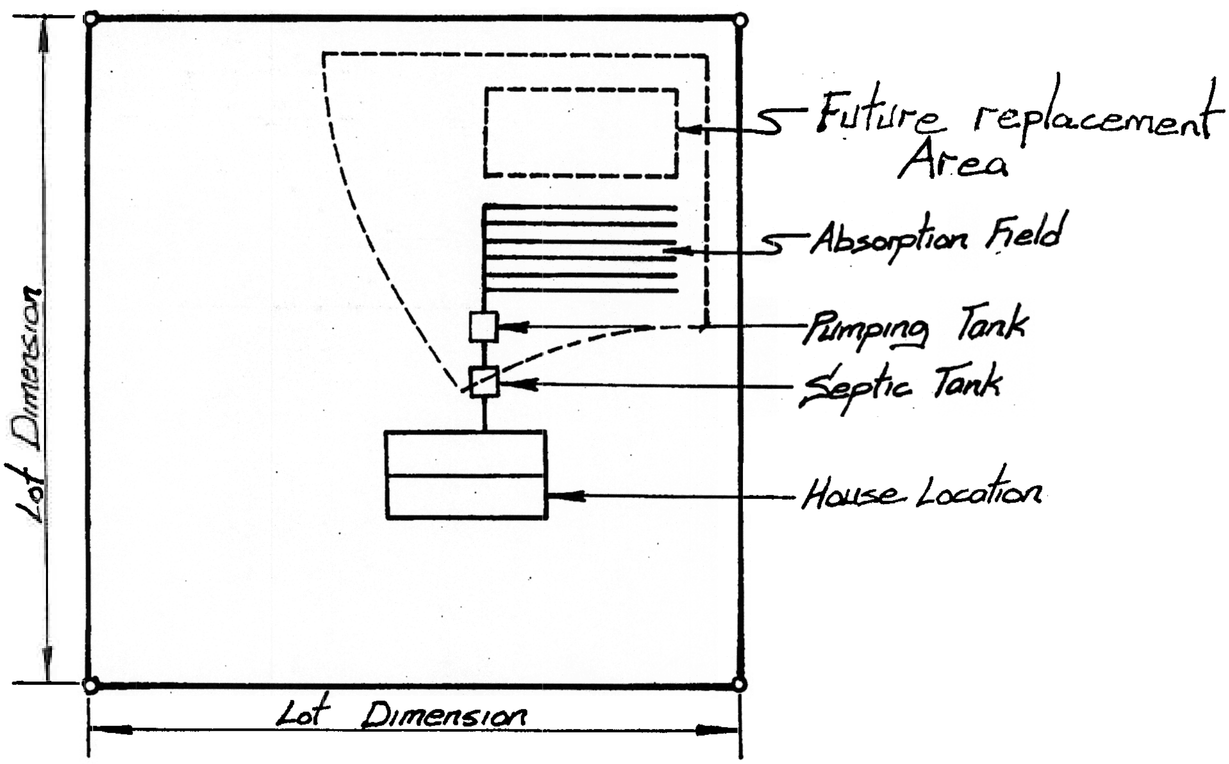
    a. Spacing between lines must be five feet or more to prevent overloading. Divide total area by five to obtain the total length of the distribution lines.

LOCATE SUITABLE AREAS ON SITE

DETAIL #32



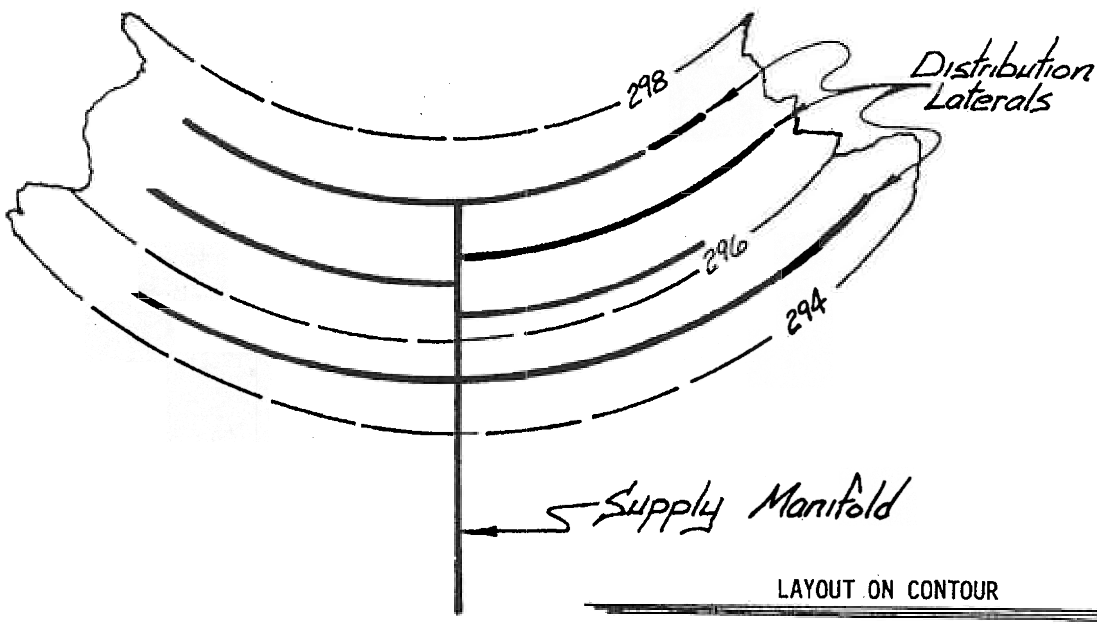
SPECIFY LOCATION OF SYSTEM



LAYOUT OF SYSTEM

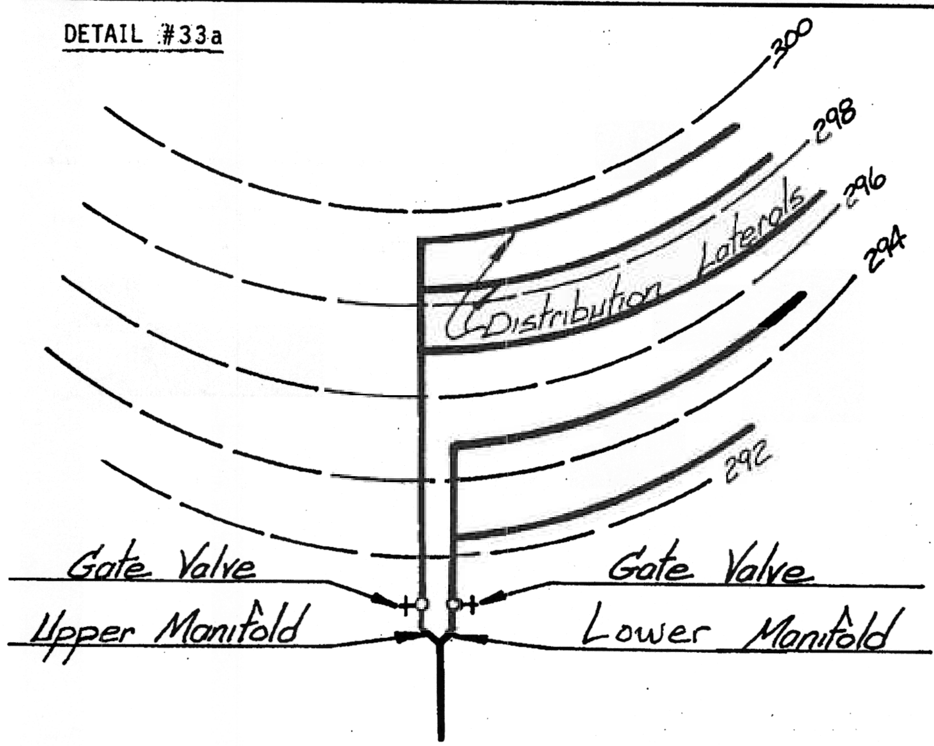
DETAIL #33

LAYOUT OF LPP SYSTEMS ON SLOPES



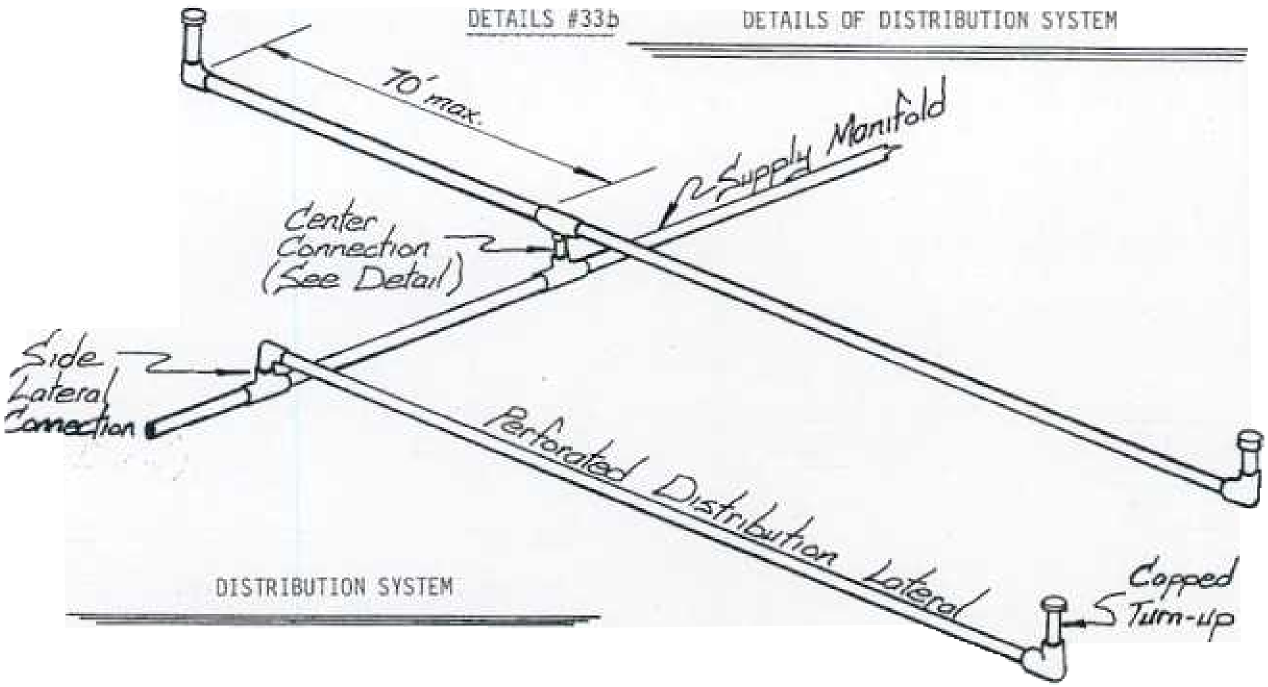
LAYOUT ON CONTOUR

DETAIL #33a

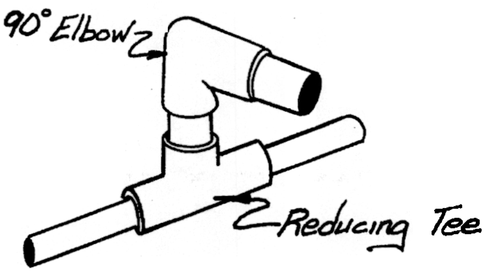


SPLIT MANIFOLD LAYOUT ON CONTOUR

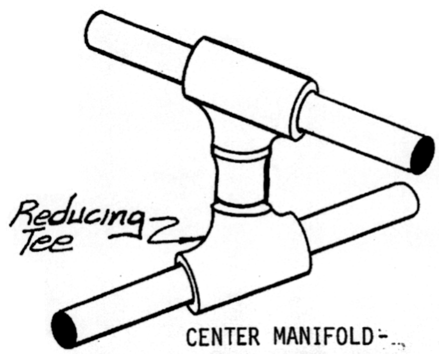
DETAILS #33b DETAILS OF DISTRIBUTION SYSTEM



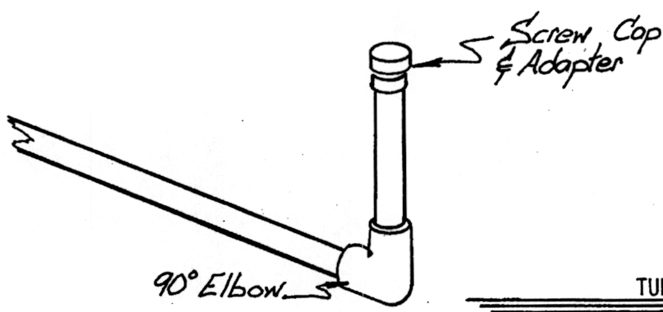
DISTRIBUTION SYSTEM



SIDE MANIFOLD-LATERAL CONNECTION



CENTER MANIFOLD-
LATERAL CONNECTION



TURN UP

Table #28 <u>Maximum Loading Rates for LPP Systems Based on Soil Texture and Permeability</u>

	Permeability Min./Inch	Maximum Loading Rate* gpd/ft.
Sand, loamy sand	20	0.50 - 0.40
Sandy loam, silt loam	20 - 40	0.40 - 0.30
Sandy clay loam, clay loam	40 - 60	0.30 - 0.20
Silty clay loam, sandy clay	60 - 90	0.20 - 0.10
Silty clay, clay	90 - 120	0.10 - 0.05

* These loading rates should be used only for calculating the size of LPP systems and drip irrigation alternative systems and not for other types of systems.

B. Size of septic tank (see Section 2.2 for septic tank size and septic tank requirements). If an LPP is being installed to replace an existing conventional septic system, only one additional tank (the pump chamber) must be installed. However, the existing septic tank must be pumped out before installing the LPPS. The existing septic tank shall be provided with an access riser for pumping of sludge and scum in the future.

It is recommended for a new LPPS design that an aerobic treatment unit without chlorination be provided to further reduce the introduction of suspended solids into pressure lines and absorption trenches.

C. Size of pumping chamber. (See Section 3.14 for size of chamber and pumping chamber requirements).

D. Shape of absorption field. When selecting the best shape to fit in the desired location, lines must be placed on the contour. Also, lines shall not extend more than 70 feet from the manifold (supply line) due to excessive friction loss. When using larger distribution lines, the manifold must be placed in the center of the distribution system rather than along the side.

E. Landscaping and drainage. All landscaping, filling and site drainage to be done before and after the LPP installation and shall be shown on the submitted design plan.

F. Gravel. Gravel size is limited to 1 inch clean.

G. Supply manifold. The manifold joins each lateral through a short riser pipe connecting a reducing tee on the manifold to a elbow or tee on the lateral (Detail #33b). This assembly places each lateral pipe about six inches higher than the supply manifold and helps prevent the back-flow of effluent from a higher lateral to a lower lateral. Because the lateral line is now several inches higher than the manifold, the manifold requires a trench six inches deeper than the laterals. In the special case of pumping downhill, the laterals are placed lower than the manifold. (See Detail #34)

The supply manifold trench shall have no gravel placed in it.

Lateral lines. The lateral trenches are usually cut 18 inches deep absorption trench widths are to be four to six inches. The depth of a given lateral trench should be uniform from the manifold to the end of the lateral. In no case should the trench bottom be allowed to slope away from the manifold. The lateral trench must not extend more than one or two feet beyond the end of the lateral pipe. Small earthen dams are placed at the beginning of each lateral trench, and at 20-foot intervals thereafter, to help maintain uniform distribution of effluent along each trench. The dams can be tamped into place or left uncut from the soil (Detail #35). Lateral trench bottoms are then lined with six inches of gravel.

The PVC pipes should be laid out and cut to proper lengths for the lateral lines. Holes are then drilled (in a straight line). The first hole in each lateral should be drilled two to three feet from the manifold; the last hole should be drilled two to three feet from the end of the lateral. Holes must not coincide with the earthen dams. Holes are only drilled through one side of the pipe. If the drill bit should go through both sides, or if a hole is drilled in the wrong place, it can be sealed by wrapping with duct tape. Lateral pipes are placed holes down in the trenches. A short turn-up with a capped end is at the end of each lateral (Detail #35). The capped end must be brought up above or flush with the final grade. As the trench is backfilled, the turn-up may be placed inside a short length of four or six inch PVC or terra cotta pipe to protect is from lawn mower damage, while still providing each access.

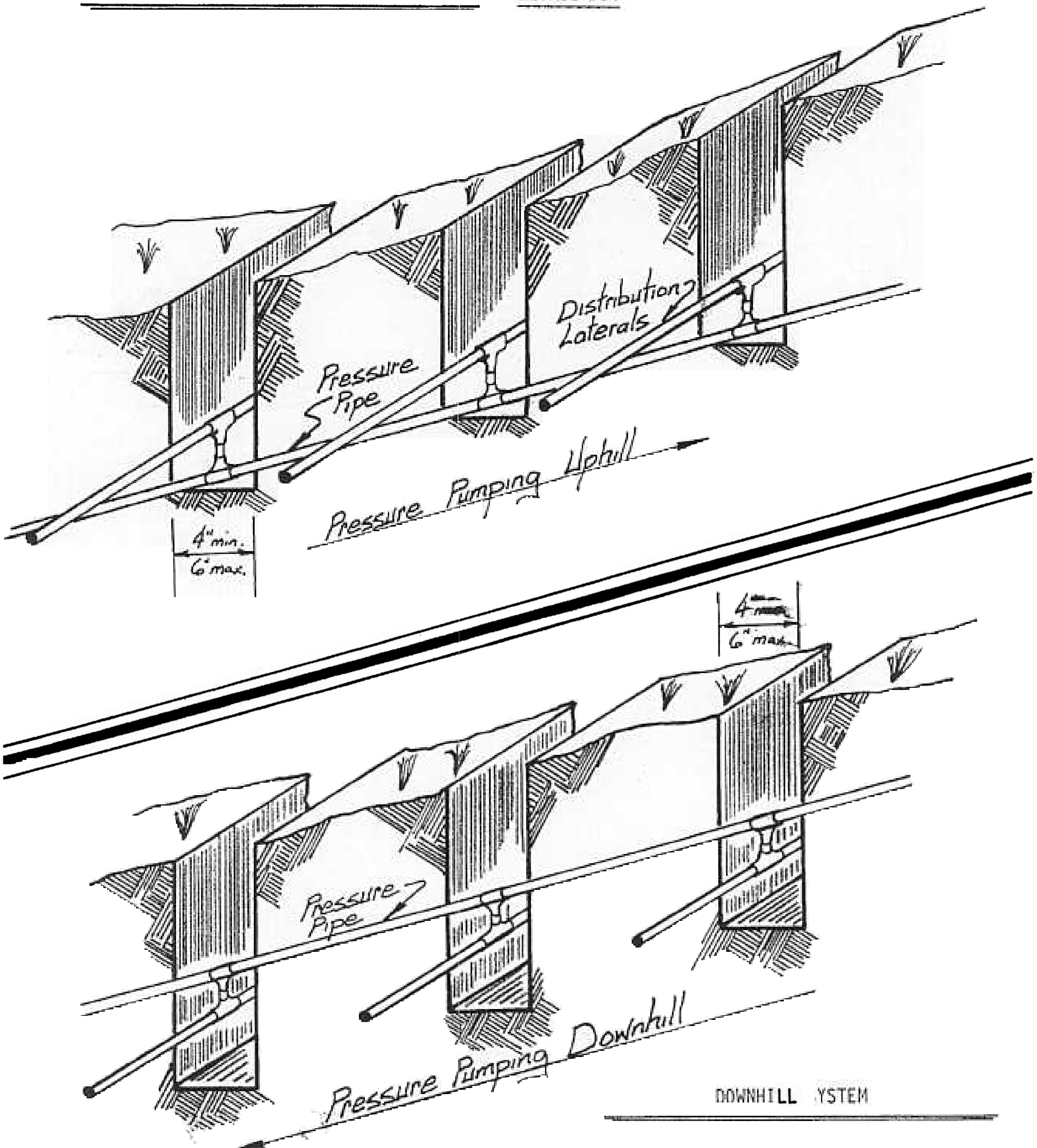
After the lateral lines are in place and leveled, they are covered with another two to four inches of gravel. The earthen dams in the lateral trenches and near the manifold must be tightly tamped, from the trench bottom to the ground surface. Straw, etc., shall be placed on top of the rock before backfilling. Finally, the trenches are backfilled with top soil. Turn-ups should then be cut to appropriate lengths, fitted with caps and (if desired) protected with short segments of four or six-inch PVC or terra cotta.

I. Gate or globe valve. The gate or globe valve must be installed in the supply line (within the pump chamber) to allow final adjustment of the pressure. If effluent will be pumped downhill, a 1/4 inch siphon-breaker hole must be drilled in the bottom of the supply line before it leaves the pump tank.

J. Pressure head adjustment. The pressure head must be adjusted to match that specified in the design. The pressure head is measured, as the height liquid will rise above the turn-up elbow when the pump is running. To adjust the head:

UPHILL SYSTEM

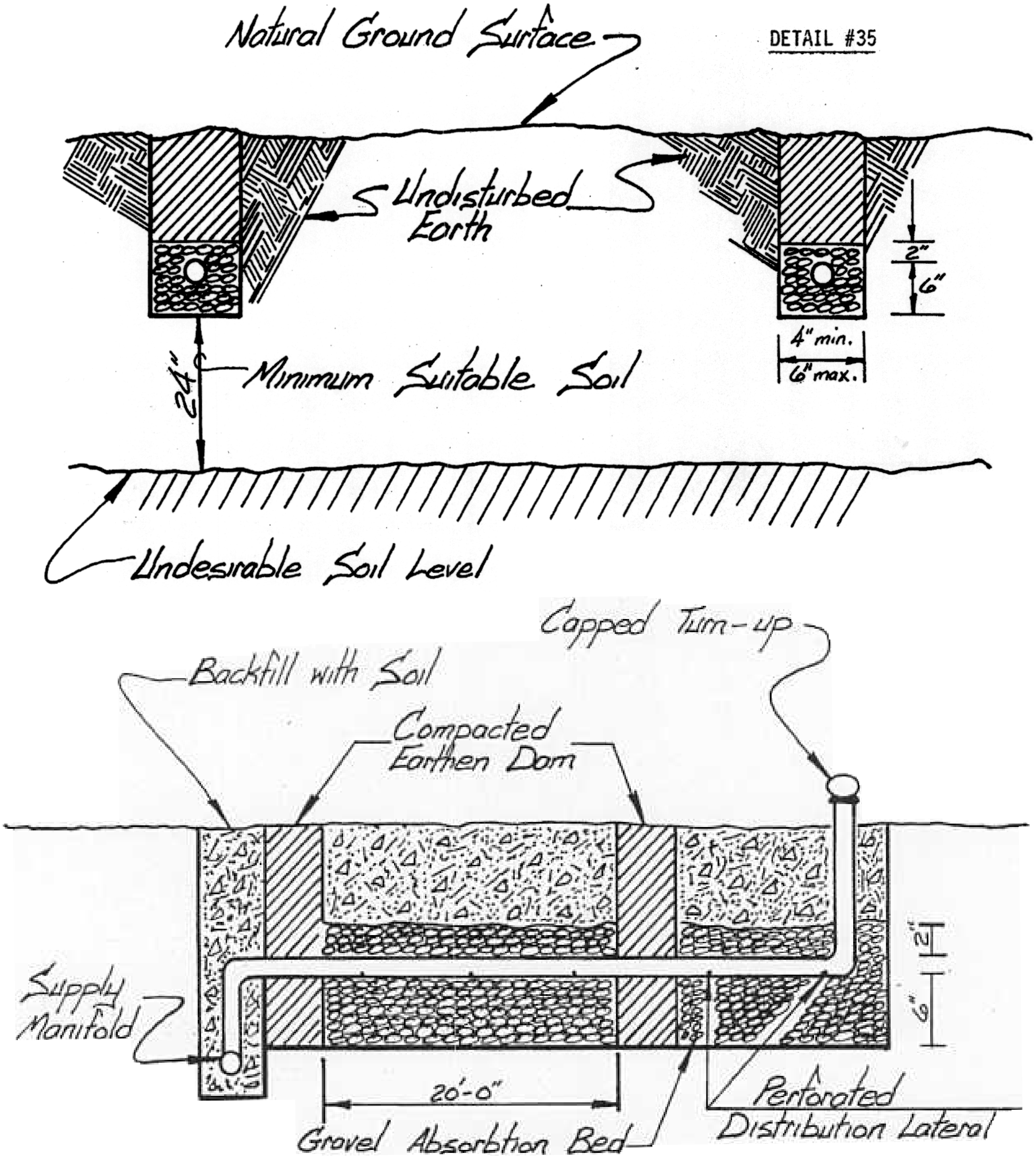
DETAIL #34



DOWNHILL SYSTEM

MANIFOLD PLACEMENT ON SLOPES

DETAIL #35



DETAILS OF ABSORPTION TRENCHES

1. Glue a four foot length of pipe (preferable clear) to a threaded adapter that will screw onto the turn-up adapters.

2. Replace the turn-up cap with the pipe and adapter.

3. Turn the power on to allow liquid to rise in the pipe.

4. Adjust the gate or glove valve in the pumping tank until the effluent reaches the desired height in the pipe. Remember to include the distance below the ground surface to the lateral line when measuring the height.

10.3 Dosing and Distribution System Design

The purpose of low-pressure dosing is to provide uniform distribution of septic tank effluent over the entire soil-absorption system. This is best achieved at a pressure head of two to four feet (0.9 to 1.7 psi). The proper dosing involves balancing the size of the distribution system with the dosing volume, pumping capacity, desired pressure and flow rate.

A. Dosing rate. The dosing rate depends on the pressure head and the size and number of holes in the distribution lines. Pressure head can range from two to four feet for adequate performance; holes must be 1/8 inch or greater in diameter, and hole spacing can range from three to five feet. On sloping lots, it may be necessary to have holes as small as 3/32 inch and spacing greater than five feet, in a part, but not in all of the system. The best starting values for calculation are a 5/32 inch hole diameter, five-foot hole spacing and three feet of pressure head.

Step 1. Calculate the number holes. Number of holes equals length of line/hole spacing.

Determine the flow rate per hole per Table #29.

Calculate total dosing rate. Is equal to the flow per hole times number of holes.

For systems where the absorption field is at a lower elevation than the pump, a 1/4 inch siphon-breaker hole must be drilled in the supply line in the pumping tank. An extra two gallons per minute must be added to the pumping rate to compensate for flow through the siphon-breaker hole.

Table #29. Flow Rate as a Function of Pressure Head and Hole Diameter in Drilled PVC Pipe

Pressure Head		Hole Diameter (inches)				
		3/32	1/8	5/32	3/16	7/32
FEET	PSI	Flow Rate (gpm)				
	0.43	0.10	0.18	0.29	0.42	0.56
2	0.87	0.15	0.26	0.41	0.59	0.80
3	1.30	0.18	0.32	0.50	0.72	0.98
4	1.73	0.21	0.37	0.58	0.83	1.13
5	2.16	0.23	0.41	0.64	0.94	1.26

B. Pump selection. A good quality effluent pump must be provided and must have enough power to pump effluent at the calculated flow rate against the total head (resistance) encountered in the distribution system. The total head is the amount of work the pump must do to overcome elevation (gravity) and friction in the system at the specified pressure and flow rate. Total head equals elevation head plus pressure head plus friction head.

Elevation head is the difference in elevation from the pump to the end of the manifold. Remember that the pump will be four feet or five feet below ground level in the pumping chamber.

Pressure head is the pressure required for even distribution and is usually specified between two and four feet.

Friction head is the loss of pressure due to friction as the effluent moves down the pipes. Pipe friction is estimated using Table #30. When estimating pipe friction, use the length of the supply manifold, but not the lateral lines. Add 20 percent to the pipe friction estimate to account for friction loss in joints and fittings. Note that friction loss varies with pumping rate as well as with pipe length and diameter.

The total head must be calculated to select the proper size pump.

Step 1. Computer friction head.
Step 2. Calculate total head.
Step 3. Select a pump of proper capacity. (Required gallons per minute at minimum total dynamic head.)

Regardless of qualifying criteria, an absolute minimum of 400 lin. ft. of distribution pipe or 2,000 sq. ft. of primary absorption area is required.

Individual site conditions requiring in excess of 400 lin. ft. of absorption trench will be subject to the minimum sizing criteria as indicated in Table #28, Sec. 10.2.

Total treatment tank capacity for low pressure system operation shall be no less than 2,000 gallons combined. A 1,500 gallon septic tank capacity, and minimum 500 gallon pump chamber with emergency provision is required. Emergency overflow provisions can be eliminated if so desired, or required by adverse condition, provided pump chamber size is increased to a minimum size capacity of 1,000 gallons.

Table #30. Friction loss per 100 feet of PVC pipe.

		Pipe diameter (inch)				
Flow		1-1/4	-1/2	2	3	4
gpm		Friction Loss (ft.)				
	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	1.4	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	Velocities in this area become too great for the various flow rates and pipe diameters.			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

C. Dosing volume. The minimum dose to provide adequate distribution depends on the size of the supply and lateral network.

Step 1. Calculate minimum dosing volume. The minimum volume is the sum of the supply network volume and five times the volume of the lateral lines. The volume of the lines is calculated using Table #31. Dosing volume is V-dose = V-supply + 5 (V laterals).

Step 2. Select dosing volume. This volume to be larger than the minimum of Step #1.

Step 3. Compute the depth of effluent pumped per dose. Dosing depth = (V dose/V tank) x liquid depth of tank.

Table #31 Storage Capacity Per 100 Foot of PVC Pipe

	Storage Capacity	
Pipe Diameter	160 psi	Schedule 40
Inches	Gallons/100 Feet	
1	5.8	4.1
1-1/4	9.0	6.4
1-1/2	12.5	9.2
2	19.4	16.2
3	42.0	36.7

D. Check valve. Any effluent which remains in the supply and lateral lines of a properly designed system will drain back to the pumping chamber when the pump shuts off. A check valve may be needed to prevent a return flow to the pumping chamber. In general, a check valve should only be used if the total storage volume of the pipes is greater than one-fourth of the total daily waste flow. In the few instances where a check valve is necessary, it shall be installed with threaded fittings in the pump chamber to provide easy access for maintenance.

E. Float controls. Pump controls must be provided which give flexibility in adjusting the on-off depth.

F. Alarm system. A high water warning device shall be installed inside the pump chamber so that it activates below the overflow lateral outlet. This device shall be either an audible or illuminated alarm. If the latter, it shall be conspicuously mounted.

10.4 LPP Design and Installation on Sloping Ground

The system must be carefully planned to obtain even distribution of effluent throughout the absorption area. The pressure head on each line is different, due to a different elevation. Each foot of elevation difference changes the pressure head by one foot. Also, perched water moving downslope onto the system and effluent moving from the upper trenches to the lower trenches can cause overloading. Pumping uphill or downhill to the absorption field can create additional problems. This chapter highlights changes in the design procedure, which are necessary when designing LPP systems on slopes.

A. Layout. The procedure places careful emphasis on the following points:

1. Lateral trenches must be placed on contour and earthen dams installed as needed to ensure even distribution of effluent in each trench (Detail #33)

2. The effects of slope can be lessened by making systems as long and narrow as possible across the contour (Detail #36)

3. Systems with more than four feet of elevation difference between the highest and lowest laterals cannot be designed with a single manifold. Separate manifold for the upper and lower lines must be used (Detail #33a). Each manifold must have it's own pressure-control valve (gate or globe) for pressure adjustment.

4. Interceptor or curtain drains are often necessary to divert water moving from uphill.

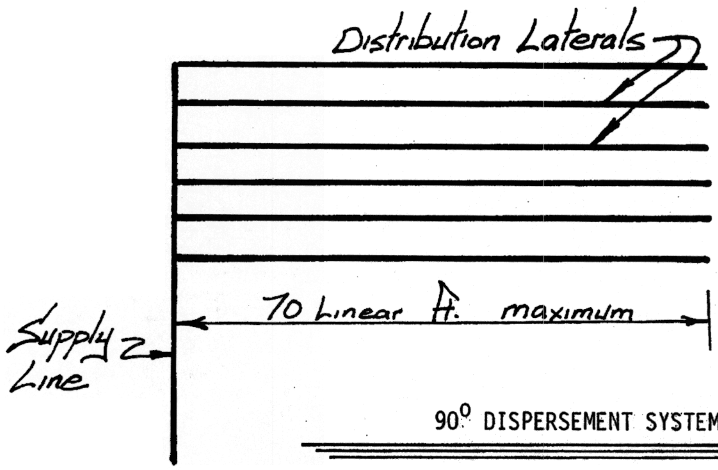
5. When it is necessary to pump downhill, distribution lines shall be in deeper trenches than the supply manifold. (Detail #34b)

6. Installation on-slopes greater than 30 percent is not recommended unless installation is to be done entirely by hand.

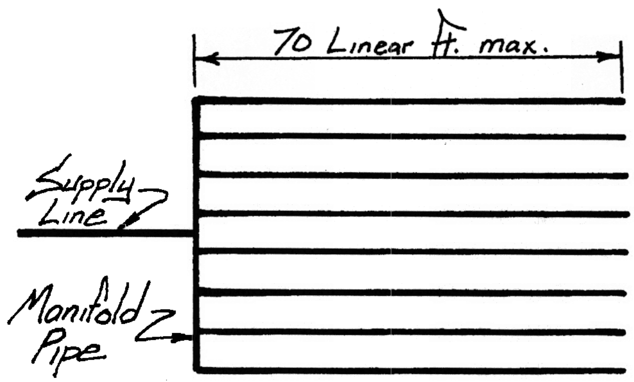
B. Dosing and distribution. The design must compensate for differences in elevation head in order to achieve uniform distribution. The load on each line must be individually calculated. All the loads are then balanced by modifying the design of individual lines where needed.

DETAIL #36

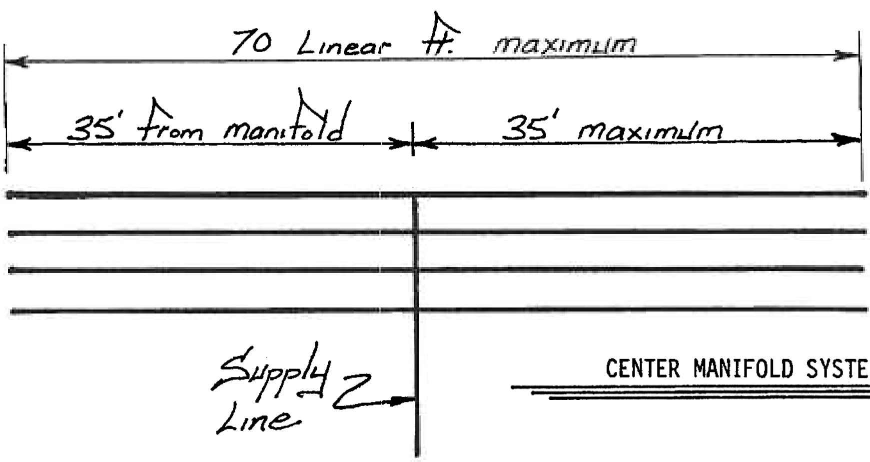
THREE SUGGESTED PATTERNS FOR LPP DISTRIBUTION FIELDS



90° DISPERSEMENT SYSTEM



90° MANIFOLD SYSTEM



CENTER MANIFOLD SYSTEM

Determine dosing rate:

Step 1. Measure and record the elevation of each line.

Step 2. Round-off each elevation to the nearest half foot.

Step 3. Compute the difference in elevation of each line from the highest line.

Step 4. Determine the pressure head on each line. First select the pressure head for the highest line. Then add the elevation difference (Step 3) to determine the pressure head on the lower lines.

The pressure head shall not exceed five feet of any of the lines. If it does, several modifications can be made. If suitable space is available, redesign the system, making it longer and narrower, thus covering less of a range in elevation. Remember, that the lateral length is restricted to 70 feet or less, and the spacing is five feet or more.

Note: Total pressure line length from an individual manifold connection shall not exceed 70 L.F.

As another option, lower the selected pressure head on the highest line and recalculate the heads on the remaining lines. The head on the highest line shall be no less than one foot and is best at two feet.

Finally you can split the line into two or more manifolds. This is discussed in detail later in this chapter.

Step 5. Check to see if the pressure head exceeds five feet on any lines.

Step 6. Determine the flow rate per hole for each line using Table #29, and the pressure heads calculated above.

Step 7. Determine the flow rate for each line.

The flow rate shall be balanced to within ten percent among lines on the same manifold. It is wise to reduce the flow even lower in the lowest lines, because they receive an additional hydraulic load from downstope effluent movement from the upper lines.

Often the lengths of lateral lines vary. Some may be shorter than others to avoid obstacles such as large trees, rocks or complex slopes. When this is the case, the flow rates of the lines cannot be directly compared. Rather, the flow rates per foot of line must be calculated and these compared.

Step 8. Balance flow rate among lines. This can be done either by changing the number of holes or changing the size of the holes. The flow to low lines can be reduced by increasing the hole spacing to greater than five feet or reducing the hole size to as small as 3/32 inch. But these sizes and spacings must not be used for an entire system.

Step 9. Calculate total dosing rate. Add two gallons per minute if a siphon breaker is needed.

The remaining steps in the design LPP systems for sloping ground are the same as that for level ground (Section 10.0).

C. Design of split manifold systems. A split manifold system is used when the elevation difference between the lowest and highest lines exceeds four feet. The supply line is split into two or more manifolds, each connected to a subsystem of distribution laterals. (Detail #33a) Each manifold is equipped with a gate or globe valve so the pressure heads on the subsystems can be adjusted separately, this allows each subsystem to act as an independent system although they may be operated from the same pump.

Step 1-5 The procedure in the previous section is followed.

Step 6. Split the system into two subsystems.

Step 7. Repeat steps 1through 5 independently for each subsystem.

Follow the procedure of steps six through nine in the previous section to balance the flow rates and determine dosing rates.

10.5 Modified LPP Systems Using Fill

Sites with a restrictive horizon or a seasonally high water table within 24 inches of the surface are not suitable for a standard LPP system. Many are not suitable for a standard LPP system. Many are not suitable for any soil absorption, waste-treatment system. Some sites can be used for waste treatment, if the soil is supplemented with fill that has been carefully selected and added.

The soil must have suitable or provisionally suitable texture, structure and permeability. After the addition of fill, trenches are placed as shallowly as three inches to four inches into the natural soil. The design and installation of the modified LPP are discussed.

A. Modified LPP design. The only difference between designing a modified and standard LPP is the calculation of the fill requirements. The volume of the fill needed is the area to be filled multiplied by the depth of fill. The area to be filled is the absorption field plus a five-foot buffer around the edges.

Step 1. Calculate area to be filled. Add ten feet to the length and width of absorption area to allow for buffer space.

Step 2. Calculate the volume of fill needed in cubic yards.

The remaining design steps follow the procedure of Sections 10.2 and 10.3.

B. The fill must have a sandy loam or loamy sand texture. The fill shall not be hauled or worked wet.

As with all absorption systems, the site must be protected from traffic. Prior to incorporating the fill, brush and small trees should be removed and the soil surface loosened, using a cultivator or garden plow. It is very important that the soil be worked only when dry. Working damp or wet soil can cause compaction and sealing, leading to failure of the system.

Fill is moved to the system using a front-end loader, being careful to avoid driving on the plowed area. The first load of fill is pushed into place, using a very small crawler tractor with a blade or a roto-tiller with a blade. The fill is then tilled into the first few inches of natural soil to create a gradual boundary between the two. Failure to do this could ruin the system by forming a barrier to water movement at the soil-fill interface. Subsequent loads of fill are placed on the system and tilled until the desired height is reached. The site shall be shaped to shed water and be free of low spots before proceeding.

Section 11 Minimum Submitted Design Plan Requirements for Low Pressure Pipe Systems. The minimum scale for design plans shall be 1" = 20'.

A. Location of percolation tests and soil borings in relation to the proposed on-site low pressure pipe system location.

1 Daily waste water flow.

B Location of the proposed on - site system replacement area shall be equal size or larger than original absorption area.

C. Contours.

1. Contours must be shown to at least seventy-five (75) feet from the residence or building and system. These must be accurate. Proposed finished contours must also be shown and should be drawn to scale. The contours shall be referenced to an on lot bench mark. However, it is not necessary to correlate your contours to Mean Sea Level.

a. Contours, original grade. Ground slope with two foot contours for the original, undisturbed grade elevation.

b. Contours, altered sites. Ground slope with two foot contours for the grade elevation of the entire area of the sewage disposal system area after alteration of the landscape.

D. Location and lowest floor elevation of proposed residence or building.

E. Bench Mark. Elevation, location and designation specified.

F. Distance, size and type of house sewer line from the residence or building to the septic tank.

House sewer outlet elevation.

G. Size of septic or treatment tank.

1. Septic tank inlet elevation.

2. Septic tank outlet elevation.

H. Dosing or pumping chamber. If a dosing or pumping chamber is to be utilized, see rules, regulations and minimum submitting design plan requirements for dosing and pumping chambers and submit with the LPP system design.

I. Give the distance, size and type of the tight line to the pumping chamber from septic tank.

J. Provide:

1. Elevated head.

2. Friction head.

3. Pressure head.

4. Total head.

5. Pump requirements GPM at foot of head.

K. Check valve or back flow preventer device needed.

L. Effluent loading rate.

M. Size of absorption system.

N. Total length and width of trenches.

1 Depth of trenches.

2. Trench bottom elevations. (All individual trench elevations on sloping sites.)

O. Trench spacing.

P. Total length of laterals. Lateral diameters. Lateral configuration.

Q. Length of supply line.

R. Supply line diameter.

S. Number of manifolds and manifold placement, manifold diameter and storage volume.

T. Lateral hole sizes.

U. Lateral hole spacing.

V. Number of holes.

W. Flow per hole.

X. Dosing volume.

Y. Storage volume in distribution lines.

Z. Storage volume in supply line.

AA. Total storage volume.

BB. Size of crushed rock.

Depth of rock under lateral pipes.

2. Depth of rock over lateral pipes.

Type of barrier between rock and backfill interface.

Length of lateral pipe turn-ups.

Distance from absorption field to nearest property line.

FF. Individual trenches follow contours.

Location of cisterns or wells in relation to disposal system.

Surface water diversions away from system and absorption field area.

II. Length, width and location of pumping chamber overflow lateral. This lateral to be installed in accordance with the department's conventional system rules and regulations.

Data on hole size, spacing, pressure head and flow must be listed for each line for systems where lines are at different elevations (such as sloping lots).

Section 12. Aggregate Specifications

Aggregate used for absorption trenches, rock mounds, Wisconsin sand mounds and low pressure pipe systems, shall conform to the following requirements as specified.

Composition: Locally produced coarse aggregate of 1" in size shall be limited to crushed limestone meeting the gradation qualities as specified in the table below.

TABLE #32

REQUIRE GRADATIONS OF COARSE AGGREGATES

Maximum Size Sieve	Percentage Passing 1-1/2"	1"
2"	100%	
1-1/2"	95 - 100%	100%
1"		95 - 100%
3/4"	35 - 70%	
½"		31 - 60%
	10 - 30%	
No. 4	0 - 5%	0 - 5%
		0 - 2%

2. No coarse aggregate shall contain more than 1.5% of material finer than No. 200 sieve as determined by test (ASTM-C-117).

3. The variation in percentage between any two successive sieves shall be limited to 1/10 of the percentage of the same size material contained in the gradation.

4. Coarse aggregate used for bedded and distribution purposes shall not contain more than the following percentages by weight of deleterious material.

Soft Fragments	5% (ASTM C-235)
Clay shale, clay, coal and lignite	1.5% (paragraph 2)

Note: The sum total of all deleterious material shall not exceed five percent.

Section 13.0 Trench Structure

The trench structure product is also an optional material for graveless type absorption systems. Sizing requirements as indicated in Section 3.3.

Installation procedures are subject to inspections by the department prior to any backfill operations.

Section 14.0 Drip Irrigation

Sizing requirements will be subject to the loading rates as specified in Table #28 Sec. 10