INDIANA STATE DEPARTMENT OF HEALTH
SANITARY ENGINEERING

GUIDANCE DOCUMENT
AT-GRADE SYSTEMS

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Siting, Design, and Construction Criteria
May 6, 1996

INDIANA STATE DEPARTMENT OF HEALTH

AT-GRADE SYSTEMS

The at-grade soil absorption system is an alternative on-site wastewater disposal system acceptable for certain sites where soils are unsuited for subsurface soil absorption systems. These systems may be considered for use in Indiana under the provisions of ISDH Rule 410 IAC 6-10 and Bulletin S.E. 13 for commercial projects and ISDH Rule 410 IAC 6-8.1-31(g) for a one or two family dwelling (residential).

The system consists of a septic tank(s), dosing tank containing submersible effluent pump(s), and an absorption area constructed above existing grade. The absorption area consists of an aggregate bed placed above a tilled surface which disperses the effluent in the upper 24 inches of permeable natural soil below original grade. A pressure distribution network which receives effluent pumped from the dosing tank is installed in the aggregate bed.

From our review of the at-grade soil absorption system concept, and experience with its installation and use, the ISDH will continue to approve its use on an individual site basis. In addition, the ISDH will release the review of individual residential at-grade systems to local health departments whose staff members are prepared to undertake such review under the provisions of Rule 410 IAC 6-8.1 and this publication.

All of the following provisions must be met for approval of an at-grade system:

I. Minimum Required Site Conditions:

(A) At-grade systems may be constructed if all of the following site conditions are met:

(1) Sufficient area exists for an appropriately sized and configured system while maintaining all necessary separation and setback requirements.

(2) The site on which the system is to be built has a slope of six (6) percent or less.

(3) The topographic position of the site on which the system is to be built is convex, hill slope, or flat. If surface and subsurface drainage can be diverted around the site, a toe slope position can be utilized.

(4) There are no soil horizons within (24) inches from the ground surface which have a loading rate of less than twenty-five hundredths (0.25) or more than one and twenty-hundredths (1.20) gallons per day per square foot as determined from the appropriate table of Estimated Hydraulic Loading Rates in the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable.

(5) Any seasonal high water table at the site of the proposed system can be lowered to at least twenty-four (24) inches or more below the surface.

(6) The separation distance from the absorption field up slope to any dwelling, building foundation, in ground swimming pools, other permanent structures, roads, driveways, and parking areas shall be at least 25 feet.

The separation distance down slope from the absorption field site to any dwelling, building foundation, in ground swimming pools, other permanent structures, roads and driveways shall be at least 50 feet unless the soil loading rate on which the system is designed is equal to or greater than 0.75 gpd/ft^2 and the slope of the site is less than two (2) percent. In that event, the separation distance may be reduced to 25 feet. If a perimeter or interceptor drain is installed down slope of the absorption field between the absorption field and the dwelling, etc., then the down slope separation distance may be reduced, except that it shall not be less than 25 feet.

The perimeter or interceptor drain which may be required for site drainage may be placed within the 25 foot separation distance, if permitted by the perimeter drain separations distances of ISDH Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable, but shall be no closer to the system than 10 feet.

If any portion of the dispersal area will be on property other than that on which the system is installed, an easement or other legally executed document will be required for the other property which will protect the dispersal area from any of the prohibited construction.

II. Location:

(A) At-grade systems shall be located in accordance with the minimum provisions of the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable, including:

(1) All at-grade systems shall be located in accordance with the separation distances of the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable.

(2) At-grade systems shall not be wholly or partly located in a drainage way.

(3) At-grade systems shall not be constructed in areas where surface drainage or run-off will have an adverse effect on the system, unless the surface run-off can be effectively diverted around the system.

(4) At-grade systems shall not be constructed in the 100 year floodway of any creek, river, stream or tributary thereof. Any at-grade system constructed within any floodway fringe shall have the infiltrative surface (gravel/soil interface) of the system on the surface of natural, undisturbed soil above the flood elevation of any flood having a peak discharge equaled or exceeded on the average of once in any one hundred (100) year period.

(5) At-grade systems shall not be constructed in areas subject to ponding.

III. Absorption Area Square Footage Criteria:

(A) The minimum absorption area (in square feet) required for each at-grade system shall be based on the following:

(1) For commercial sites the minimum absorption area (in square feet) shall be determined by multiplying the estimated flow (gallons per day) per unit from the table of Estimated Wastewater Flows in the current edition of Bulletin S.E. 13 times the number of units per establishment divided by the estimated Hydraulic Loading Rates for Mounds (gpd/ft^2). If the daily peak design flow is greater than or equal to two thousand (2,000) gpd, the loading rate used for this computation shall be the loading rate of the most restrictive horizon within six (6) inches of the soil surface or the average of the loading rates within twenty-four (24) inches of the soil surface, whichever is more restrictive. If the daily peak design flow is less than two thousand (2,000) gpd, the loading rate used for this computation shall be the loading rate of the most restrictive horizon within twenty-four (24) inches of the soil surface.

(2) For residential sites the minimum absorption area in square feet shall be determined by multiplying the number of bedrooms and bedroom equivalents by 150 gallons per day divided by the Loading Rates for Above Ground Systems from Rule 410 IAC 6-8.1-51. If the daily peak design flow is less than two thousand (2,000) gpd, the loading rate used for this computation shall be the loading rate of the most restrictive horizon within twenty-four (24) inches of the soil surface. If the daily peak design flow is greater than or equal to two thousand (2,000) gpd, the loading rate used for this computation shall be the loading rate of the most restrictive horizon within six (6) inches of the soil surface or the average of the loading rates within twenty-four (24) inches of the soil surface, whichever is more restrictive.

(3) On level sites the absorption area shall be the entire area under the aggregate bed. On sloping sites, the absorption area shall be the area which is covered by aggregate underneath and down slope of the distribution lateral(s), not including any area up slope of the highest lateral.

IV Design And Construction Criteria:

(A) General:

(1) The site evaluation procedures outlined in the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable, shall be followed.

(2) All septic tank(s) shall meet the minimum requirements of the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable.

(3) All piping shall meet the minimum requirements published by the ISDH in its *LIST OF ACCEPTABLE PIPE*.

(4) The dosing tank, pump, floats, and alarms shall meet the minimum requirements of the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable.

(5) Drainage necessary for surface diversion or for water table modification shall meet the minimum provisions of the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable.

(6) The at-grade system site as well as the down slope dispersal area shall be staked out and protected from vehicular traffic.

(7) The at-grade system must be designed and constructed so that its longest axis is located along the contour. The at-grade dimensions should be as long and narrow as possible for the site.

(8) At-grade systems shall not be constructed in clayey soils during periods of wet weather when the soil is sufficiently wet at the depth of installation to exceed its plastic limit. This includes those soils classified as sandy loam, silt loam, loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. For the purpose of this publication, the plastic limit of a soil shall be considered to have been exceeded when the soil can be rolled between the palms of the hands to produce threads one-eight (1/8) inch in diameter without breaking apart and crumbling.

(9) Special caution shall be taken to prevent wheeled and tracked vehicles from compacting the area selected for placement of the absorption system before, during and after construction of the system, especially during wet weather. Precaution is especially important where clayey soils are involved. This includes those soils classified as sandy loam, silt loam, loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. Alteration of soil structure by movement of vehicles may be grounds for rejection of the site and/or the system.

(10) Vegetation at the at-grade site which would hinder construction must be cut and removed.

(11) The delivery pipe from the dosing tank to the manifold shall be installed prior to plowing the at-grade site.

(12) The area underneath the aggregate bed and extending at least five feet on all sides shall be plowed to a depth of seven (7) to eight (8) inches, parallel to the contour, with a moldboard or chisel plow. If a moldboard plow is used, it shall have at least two (2) bottoms (shares) and the soil shall be turned up slope, making only one pass across the area. If a chisel plow is used, two passes parallel to the contour of the site are required.

(13) The aggregate used in the gravel bed shall meet the minimum requirements of the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable. The minimum depth of aggregate below the lateral(s) shall be six (6) inches throughout the entire length and width of the bed. There shall also be at least two (2) inches of aggregate above the laterals, extending a minimum of six (6) inches beyond the ends of the laterals. Each aggregate bed shall be constructed so that the top of the aggregate is uniformly level along its length.

(14) The aggregate bed shall be covered with a geotextile fabric which meets the minimum requirements of the current edition of Bulletin S.E. 13 or Rule 410 IAC 6-8.1, whichever is applicable.

(15) Aggregate beds shall not be less than four (4) feet nor more than ten (10) feet in width on sites with slopes less than or equal to two (2) percent; aggregate beds shall not be less than four (4) feet nor more than twelve (12) feet in width on sites with slopes greater than two (2) percent. If more than one (1) aggregate bed must be constructed, each bed shall be provided with proportionate loading so that equal application of effluent per square foot of aggregate bed is obtained in each of the beds. The separation distance between multiple beds shall be no less than the width of the beds, except that the separation distance shall not apply to beds constructed end to end.

(B) Pressure Distribution Network:

(1) A pressure distribution network shall be used for at-grade systems. The pump shall be sized and its controls set to deliver four (4) doses each day, each dose being approximately one-fourth (1/4) of the daily design flow, while maintaining an in-line residual pressure of two and five-tenths (2.5) to three (3.0) feet of head in the distribution lateral at the highest elevation in the soil absorption system during pumping.

(2) The pressure distribution network must drain between doses. If the delivery pipe drains to the distribution network, the dose volume shall be the dose calculated using subsection (B)(1), above. If the delivery pipe drains back to the dosing tank, the dose volume shall be the dose calculated using subsection (B)(1), above, plus the volume contained in the delivery pipe and manifold.

(3) Each pipe connected to the manifold of a subsurface pressure distribution system shall be counted as a separate distribution lateral. The length of an individual lateral shall not exceed fifty (50) feet from manifold to end cap. In order to avoid lateral lengths greater than fifty (50) feet in a single bed, multiple pumps and equally divided and alternately dosed pressure distribution networks should be used.

(4) With aggregate beds at equal elevations, variable manifold sizing is not necessary for proportionate loading. When the aggregate beds within a soil absorption system are at different elevations, proportionate loading and equal

application of effluent per square foot of aggregate bed shall be achieved by variable manifold sizing. When variable manifold sizing is required, the soil absorption system shall be dosed from the up slope side of the aggregate bed at the highest elevation.

(5) Each lateral shall have one (1) row of holes spaced at three (3) feet on centers.

(6) The laterals in the pressure distribution network shall be level along their length and shall be parallel to the long axis of the aggregate bed.

(a) On sites with slopes of less than or equal to two (2) percent, there may be multiple laterals per bed, parallel to the long axis of the bed. The distance between laterals shall not be less than twenty-four (24) inches nor more than thirty-six (36) inches. Each lateral shall be no closer than one (1.0) foot and no greater than one and one half (1 ½) feet from the sides of the aggregate bed along the length of the lateral. The holes along the two parallel distribution laterals within the bed for a sloping site shall be offset by one half (½) of the distance of the hole spacing interval in order to provide optimal distribution of wastewater.

(b) On sites with slopes of greater than two (2) percent the laterals must be positioned at the up slope edge of the aggregate bed while maintaining six (6) inches of aggregate between the lateral and the soil surface. There shall be at least one and one-half (1.5) feet of aggregate, as measured from the soil surface directly below the lateral, to the up slope edge of the aggregate bed in order to support the lateral and to satisfy the angle of repose of the aggregate. On these sites the aggregate bed up slope from the lateral shall not be utilized in calculating the minimum required square footage of absorption area. For pressure distribution networks utilizing an end feed concept there shall be two (2) laterals per aggregate bed. For pressure distribution networks utilizing a center feed concept there shall be four (4) laterals per aggregate bed. The distance between laterals shall be no more than one foot and the holes along the parallel distribution laterals shall be offset by one-half (½) of the distance of the hole spacing interval in order to provide optimum distribution of effluent.

(7) The holes in the laterals shall be placed in the aggregate bed facing down and all burrs shall be removed from the edges of the holes.

(8) The hole size in the laterals shall be one-fourth (1/4) inch.

(9) The end of each lateral shall be capped and an one-fourth (1/4) inch hole drilled in the upper half of the end cap and all burrs shall be removed from the edges of the hole.

(10) The minimum inside diameter of the delivery pipe shall be one and one-half (1 ½) inches; the maximum inside diameter of the delivery pipe shall be four (4) inches.

(11) Friction losses in the delivery pipes and manifold when plastic pipe is used shall be determined from the table titled *FRICTION LOSSES IN PLASTIC PIPE*, on page 9 of this publication.

(12) The manifold pipe diameter shall be the same as the delivery pipe diameter, unless variable manifold sizing is used to provide proportionate loading and equal distribution of effluent between beds. The minimum inside diameter of the manifold shall be one and one half (1 ½) inches; the maximum inside diameter of the manifold shall be four (4) inches. The table titled *Manifold Diameters for Various Manifold Lengths, Number of Laterals and Lateral Discharge Rates (for Plastic Pipe Only)*, on page 10 of this publication will assist in determining manifold diameters.

(13) The minimum inside diameter of the distribution laterals from the manifold shall be one (1) inch; the maximum inside diameter of the distribution laterals shall be three (3) inches. The maximum lateral length shall be 100 feet.

The distribution lateral piping diameter shall be determined from the following table:

MINIMUM LATERAL DIAMETERS

Lateral Length	Lateral Size
≤ 25 ft.	1 inch
26 - 40 ft.	1 1/4 inch
41 - 55 ft.	1 ½ inch
56 - 84 ft.	2 inches
84 - 100 ft.	3 inches

(14) The perforation discharge rate shall be determined in accordance with the formula $Q = 11.78(d^2)(\sqrt{H})$, where "Q" = the volume of the flow from the pipe in gpm, "d" = the diameter of the hole in the pipe in inches, and "H" = the in-line head, in feet, at the hole. The following table gives the discharge rate at varying heads using this formula:

PERFORATION DISCHARGE RATE IN GPM AT VARYING HEADS
FOR EACH 1/4 INCH DIAMETER HOLE

In-Line Head (feet)	Perforation Discharge Rate (GPM)
1.5	0.90
2.0	1.04
2.5	1.17
3.0	1.28
3.5	1.38
4.0	1.47
4.5	1.56

(15) Pump selection for at-grade soil absorption systems shall be based on the manufacturers pump curves for the required pump discharge rate (in gallons per

minute) at the total dynamic head imposed on the pump. The pump discharge rate is the sum of the discharge rates for all of the laterals. The discharge rate for each lateral is the total number of holes in the lateral times the perforation discharge rate for a one-quarter (1/4) inch perforation from the calculations from subsection 14, above.

(16) The system shall maintain an in-line residual pressure of at least two and five-tenths (2.5) feet of head during pumping.

(17) All joints, including the end cap, shall be made in accordance with ASTM D 2235 - 88 for ABS piping and ASTM D 2855 - 83 for PVC piping and shall withstand the pressures exerted on them.

(C) Final Cover Criteria:

(1) The entire at-grade soil absorption system shall be crowned to promote surface runoff away from the system. At least a 3:1 slope shall be maintained on all sides of the soil absorption system.

(2) The entire at-grade shall be covered with a minimum of six (6) inches of a clayey textured subsoil with an additional six (6) inches of topsoil covering the clayey textured subsoil.

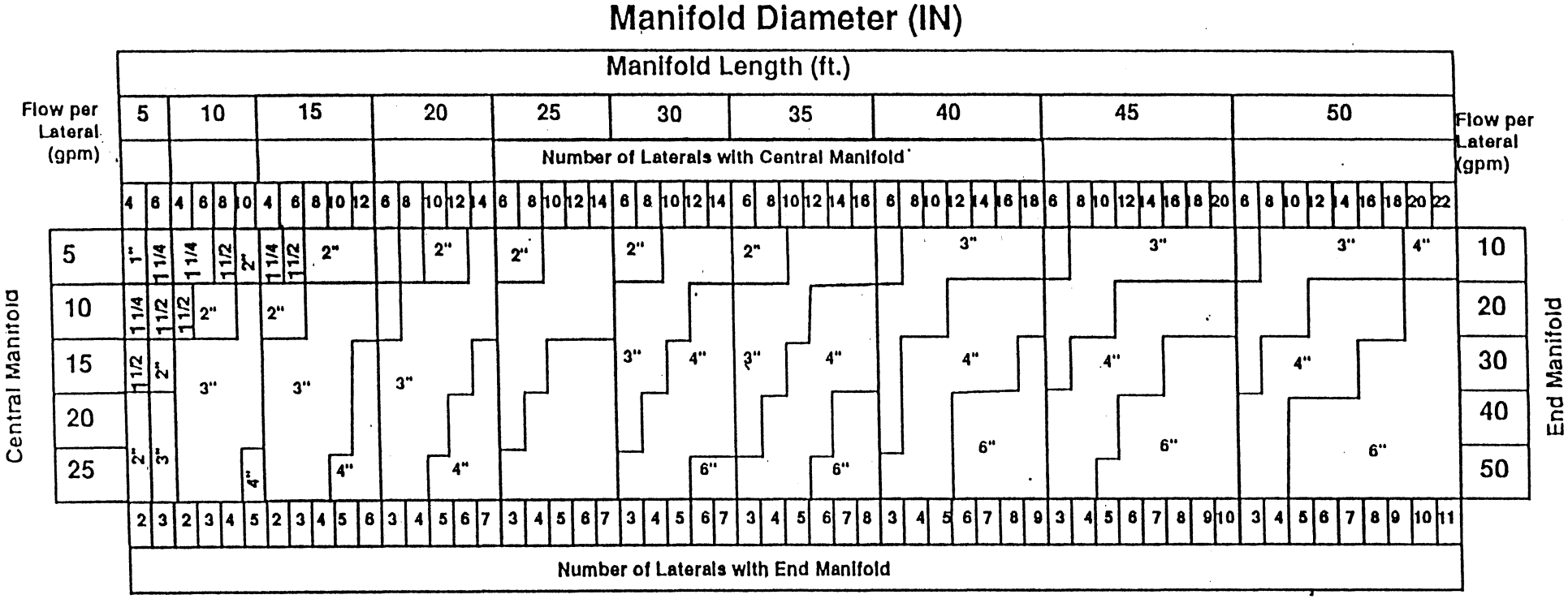
(3) The at-grade system shall be seeded or sodded with grasses and legumes adapted to the area. If the at-grade is seeded, the at-grade shall be protected by a cover of straw, burlap, or some other material that will protect it against erosion until a vegetative cover develops.

FRICTION LOSSES IN PLASTIC PIPE

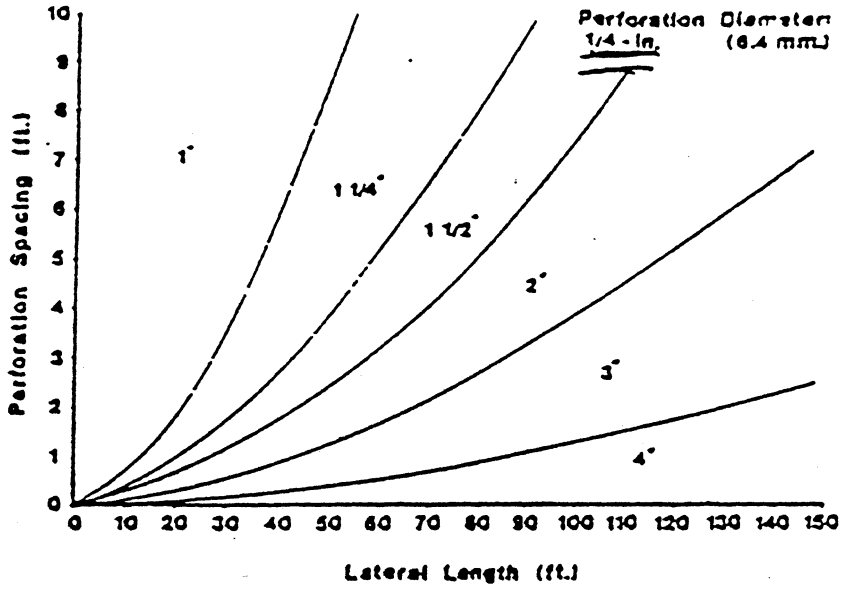
Friction Losses in Plastic Pipe (C = 150) Vs. Flow Rate and Pipe Diameter
(1 in = 2.54 cm, 1 ft = 0.305 m, 1 gpm = 6.3 x 10 m /s)

Flow gpm	1	1 1/4	1 1/2	2	3	4	Flow gpm
			ft/100 ft				
1	0.10						1
2	0.35	0.12					2
3	0.75	0.25	0.10				3
4	1.28	0.43	0.18				4
5	1.93	0.65	0.27	0.07			5
6	2.70	0.91	0.38	0.09			6
7	3.59	1.21	0.50	0.12			7
8	4.60	1.55	0.64	0.16			8
9	5.72	1.93	0.80	0.20			9
10	6.95	2.35	0.97	0.24			10
11		2.80	1.15	0.28			11
12		3.29	1.35	0.33			12
13		3.91	1.57	0.39			13
14		4.37	1.80	0.44	0.06		14
15		4.97	2.05	0.50	0.07		15
16		5.60	2.31	0.57	0.08		16
17		6.27	2.58	0.64	0.09		17
18		6.96	2.87	0.71	0.10		18
19			3.17	0.78	0.11		19
20			3.49	0.86	0.12		20
25			5.27	1.30	0.18		25
30				1.82	0.23	0.06	30
35				2.42	0.35	0.08	35
40				3.10	0.43	0.11	40
45				3.85	0.54	0.13	45
50				4.86	0.65	0.16	50
60					0.91	0.23	60
70					1.21	0.30	70
80					1.55	0.38	80
90					1.93	0.48	90
100					2.35	0.58	100
125					3.55	0.88	125
150					4.97	1.23	150
175						1.63	175
200						2.09	200
250						3.16	250
300						4.42	300

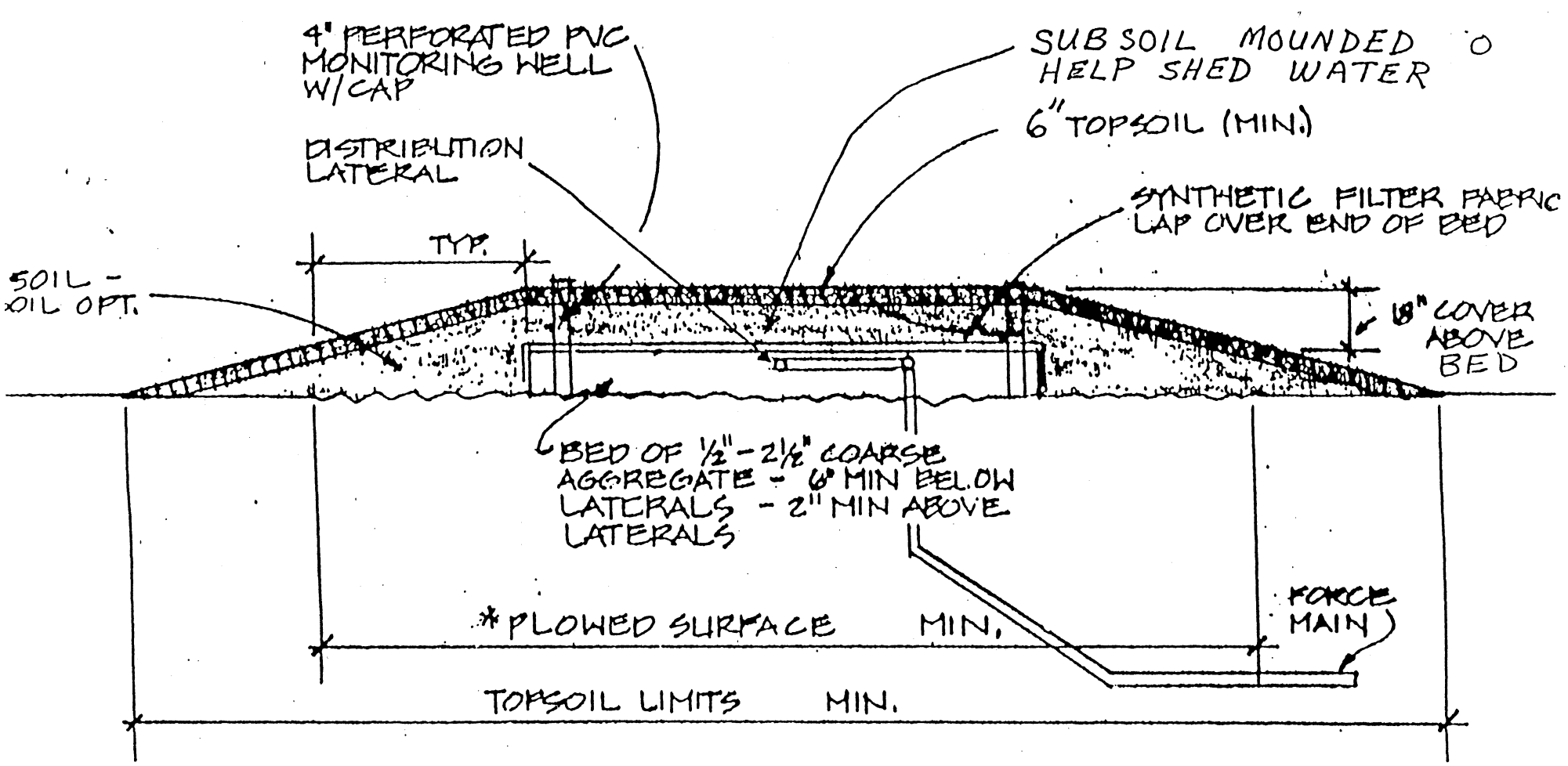
Manifold Diameters for Various Manifold Lengths, Number of Laterals and Lateral Discharge Rates (for Plastic Pipe Only.)



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

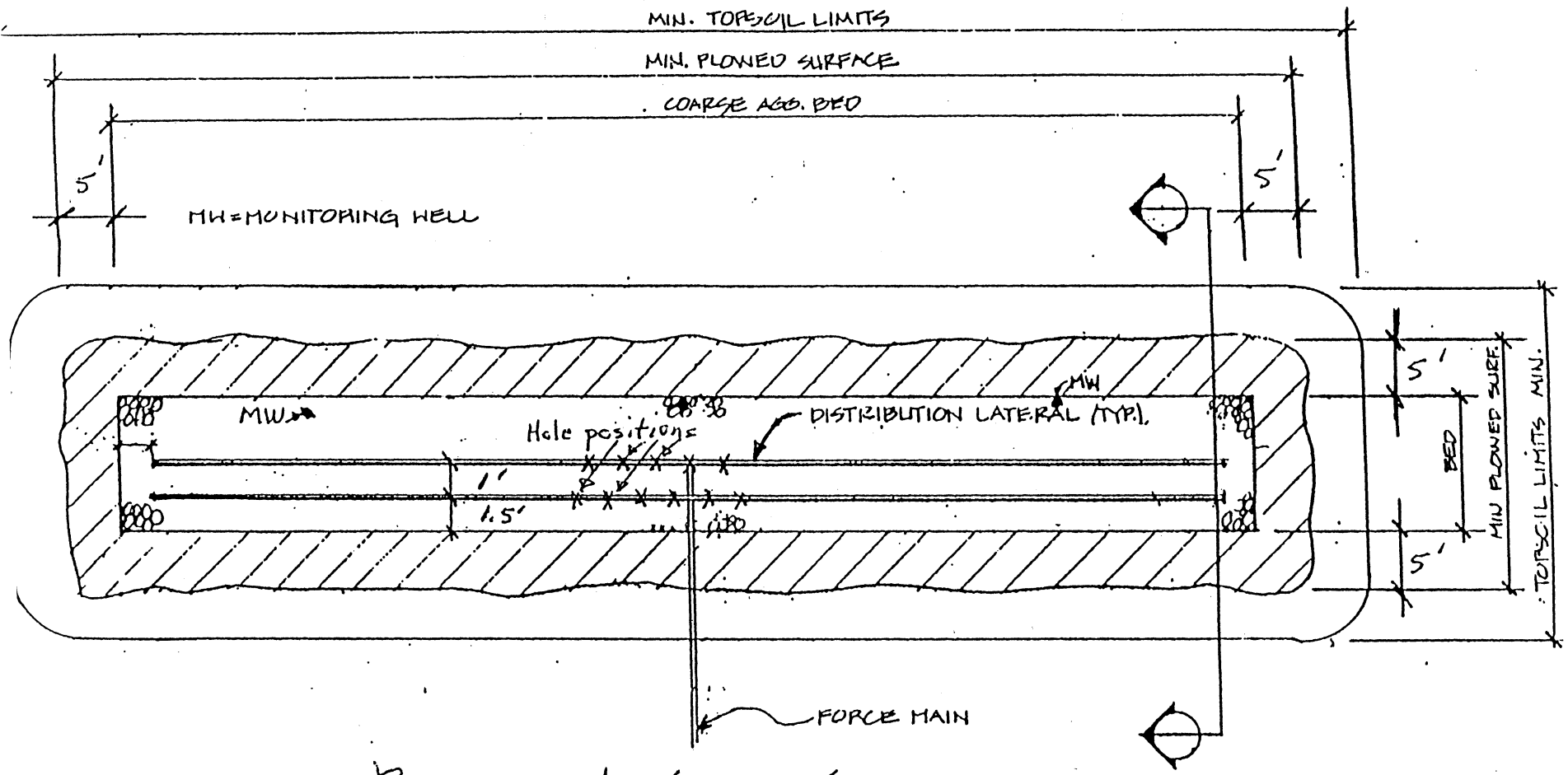


Minimum Lateral Diameter for Plastic Pipe (C_h = 150) Versus Perforation Spacing and Lateral Length for 1/4-in (6.4 mm) Diameter Perforations (1 ft = 0.305 m)



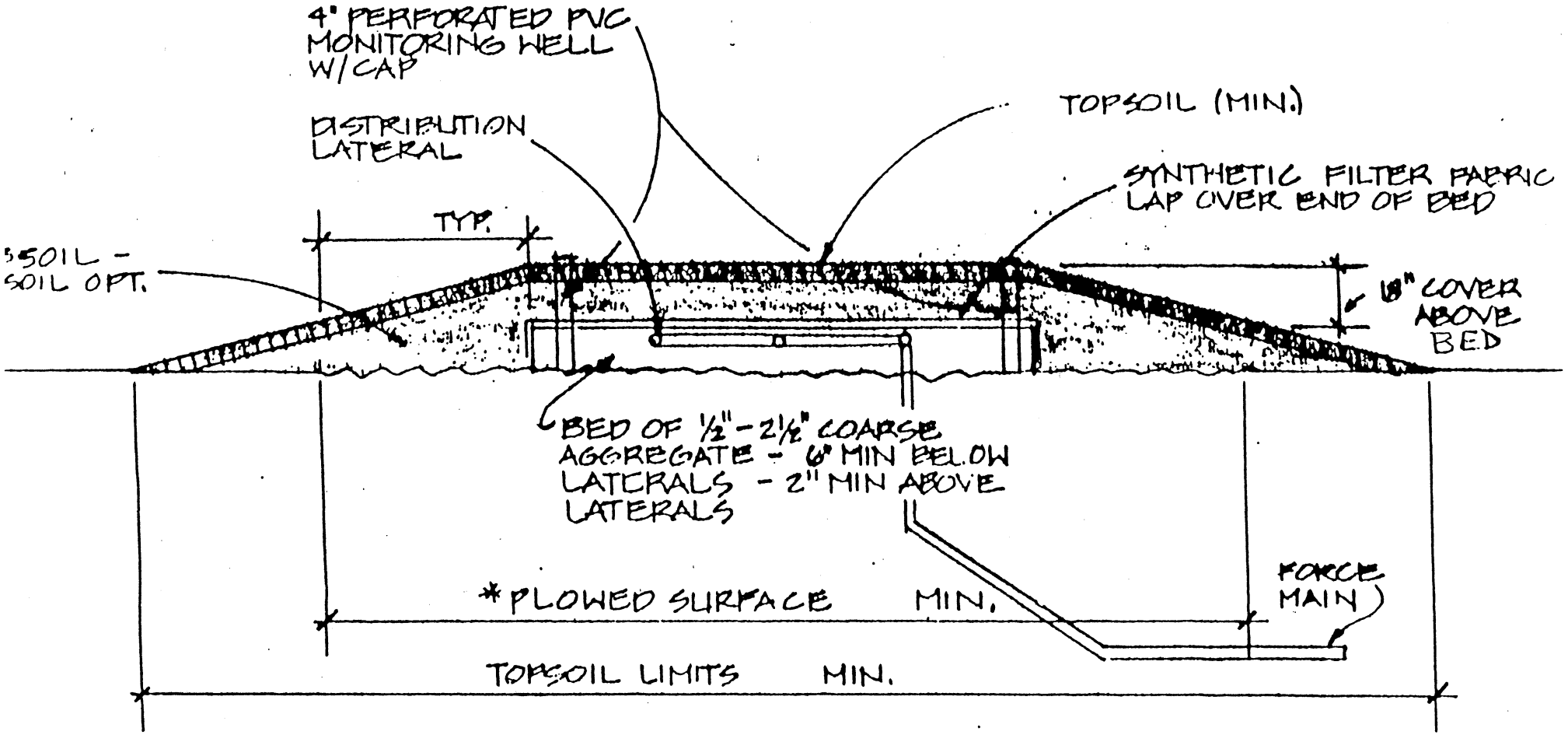
* PRIOR TO PLOWING, MOW VEGETATION AS CLOSE AS POSSIBLE.

CROSS-SECTION OF AT GRADE SYSTEM SLOPING SITE



PLAN OF AT GRADE SYSTEM

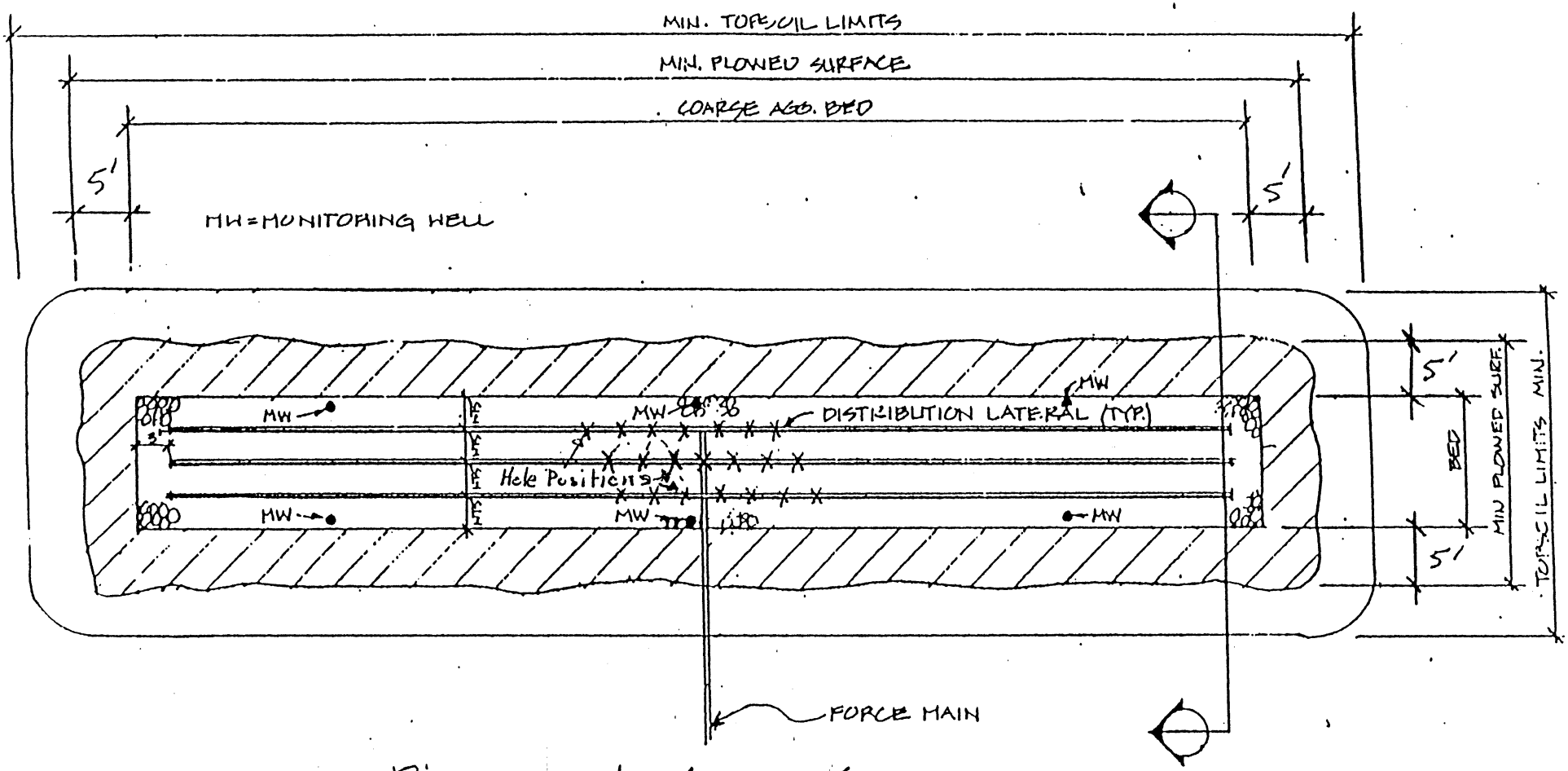
SLOPING SITE



* PRIOR TO PLOWING, MOW VEGETATION AS CLOSE AS POSSIBLE.

CROSS-SECTION OF AT GRADE SYSTEM

LEVEL SITE



PLAN OF AT GRADE SYSTEM
LEVEL SITE