

## Appendix E

# Septic System Construction Regulation For Effective Virus Removal

On the following pages is a model Board of Health Regulation designed to regulate the construction of septic systems permitted within 250 feet of watercourses, and inland or coastal bordering vegetated wetlands. The primary goal of this regulation is to reduce the risk of contaminating surface waters with viral pathogens from wastewaters. The regulation is recommended for adoption in all municipalities within the Buzzards Bay drainage basin and may also be applicable to other coastal communities throughout the Commonwealth. The BBP recommends that the setback distances be 250 ft. from watercourses and inland or coastal bordering vegetated wetlands. When this setback distance cannot be met, we recommend that the application area and distribution systems of the septic system be modified as recommended by this regulation in order to maximize attenuation of viruses.

Because of their extremely small size, viruses are the most difficult pathogen for on-site wastewater disposal systems to remove. Studies have documented that viruses entering groundwater can travel in excess of 200 feet. The maximum travel distance of a particular virus is variable and depends on: groundwater flow velocity, temperature, soil characteristics, and the natural decay rate of the particular type of virus.

Because of the long distances viruses can potentially travel in saturated soil conditions, as well as the difficulty in precisely determining the maximum travel distance for a specific set of conditions, the model regulation attempts to maximize the potential for removal of viruses in the unsaturated zone beneath wastewater disposal systems located within 250 feet of a watercourse or wetland.

The four primary factors that affect the efficiency of viral removal in the unsaturated zone are the soil characteristics, the thickness of the unsaturated zone, the design application rate, and the actual distribution of the wastewater in the leaching facility.

Soils with slower percolation rates are more effective at virus removal than soils with faster percolation rates. However, soils with slower percolation rates do not have the ability to accept wastewater over the long term as effectively as soils with faster rates. For these reasons percolation rates have been considered in this model regulation.

There is an inverse relationship between application rate and virus removal efficiency. The model regulation recognizes this relationship and reduces the acceptable maximum application rate compared to what is acceptable under current state regulations. This reduction is expected to increase virus removal in the unsaturated zone by spreading the effluent over a larger area.

The thickness of the unsaturated zone also affects viral transport and where the unsaturated zone thickness is less than 14 feet, this set back regulation will apply because application rates currently allowable under state regulations do not maximize virus removal.

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Although septic system leaching facilities are designed to receive a specific application rate, this application rate is seldom what actually occurs in a leaching facility that has gravity distribution, as is the case with most septic systems. What typically does happen is that the lowest part of the system is loaded at a much greater rate. This excess loading causes a biological mat to form more quickly in this particular area of the leach field. Once this mat has formed it slows the percolation of wastewater into the soil and the next lowest section of the leaching facility receives excess loading. This situation is referred to as the creeping failure phenomenon. When any particular area of a leaching facility receives excess hydraulic loading its ability to remove viruses from the wastewater is reduced. The model regulation includes measures to help insure better distribution of the wastewater in the leaching facility to reduce the likelihood of excess loading in one area of the leaching facility.

A more detailed description of the rationale behind this model regulation, as well as other model regulations, are available through the Buzzards Bay Project.

# Proposed Regulation

## Supplement To Title 5

### Septic System Construction

#### Section 1.1 General Requirements.

1.11) No septic system leaching facility shall be constructed within one-hundred (100) feet of a Watercourse, as defined in 310 CMR 15.00: THE STATE ENVIRONMENTAL CODE, TITLE 5: MINIMUM REQUIREMENTS FOR THE SUBSURFACE DISPOSAL OF SANITARY SEWAGE, Section 15.01 Definitions, or within one-hundred (100) feet of an inland or coastal Bordering Vegetated Wetland as described in 310 CMR 10.00: WETLANDS PROTECTION.

1.12) If a proposed leaching facility is to be located less than two-hundred and fifty (250) feet from a watercourse, or inland or coastal bordering vegetated wetland, and the bottom of the facility is less than fourteen (14) feet from the maximum adjusted groundwater elevation, the application rate shall be as follows:

Percolation Rate Application Rate

Minutes/Inch Gallons/SqFt/Day

6.0 or less 0.75 or less

6.0 0.50 or less

(The application area needed to achieved these rates shall be calculated using formula given in Section 1.2.)

Maximum adjusted groundwater elevation must be determined using one of the following methods, or a method approved by the Board of Health:

1) using ESTIMATING HIGH GROUND-WATER LEVELS FOR CONSTRUCTION AND LAND USE PLANNING-A CAPE COD, MASSACHUSETTS EXAMPLE, by Michael H. Frimpter and Martha N. Fisher, U.S. Geological Survey, Water Resources Investigations 83-4112, Sep 1983, or;

2) performing an observation test during the wet season as determined by the Board of Health. In marine coastal settings, observation tests must be performed over a complete tidal cycle, excluding "minus tides" as defined by a standard tide table.

A variance application from this section must include a hydrogeologic study showing that no portion of the contaminant plume from the proposed septic

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system will intercept any watercourses, or coastal or inland bordering vegetated wetlands within a distance of 250 ft.

1.13) The bottom of any proposed leaching facility subject to Section 1.12 must be at least five (5) feet above the maximum adjusted groundwater elevation. If a variance from this section is approved by the Board of Health (allowing a separation distance of four (4) feet), the proposed leaching facility must be designed such that the application rate does not exceed 0.50 gallons per square foot per day (gal/sqft/day).

1.14) Each leaching pit, galley, flow diffuser, chamber or other leaching unit, and every ten (10) feet of leaching pipe length in leaching trenches, fields, beds or other pipe oriented systems subject to Section 1.12, must be fed by a separate line from the distribution box (see Figure 2).

1.15) The invert elevations of all exit pipes in a distribution box must be equal. It is recommended that all exit pipes be fitted with an invert leveler cap. All exit pipes must convey equal flows. Equal flow can be accomplished by one of the following methods or a method approved of by the Board of Health:

- 1) the distribution box must be installed on crushed stone which at least six (6) inches deep or on eight (8) inch thick concrete masonry units (or cinder blocks) having a surface area equal to or greater than the base of the distribution box, or;
- 2) the use of a balance-pan spill-type distribution box. A balance-pan spill-type distribution box fills a small (1-2 gallon) pan, inside the distribution box, with effluent before "spilling" out the exit pipes, or;
- 3) the use of a siphon or pump chamber.

1.16) The maximum allowable effective width of a leaching facility shall be twelve (12) feet.

### **SECTION 1.2 Calculation of Application Area.**

1.21) The application area (AA) for a leaching structure subject to Section 1.12 shall be the effective bottom area plus six (6) inches around it for lateral dispersion (see Figure 1). The application area required to satisfy the application rates as stated in section 1.12 can be calculated using the following formula:

$$\text{AA REQUIRED(sqft)} = \text{FLOW(gal/day)/0.75 or 0.50(gal/sqft/day)}$$

where,

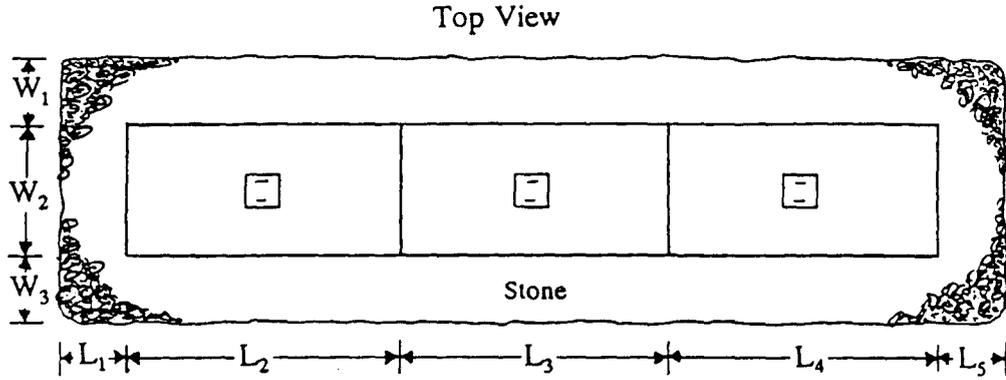
Flow = Gallons/Day as Determined By Title 5, Section 15.02

0.75 or 0.50 = Required Application Rate From Section 1.12 or 1.13 Above

**Fig. 1 DETERMINING APPLICATION AREA (AA)**

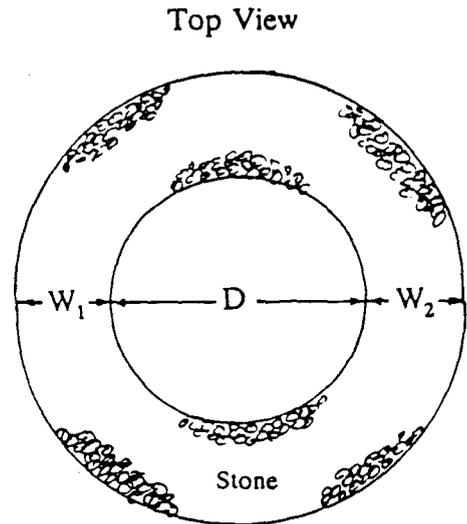
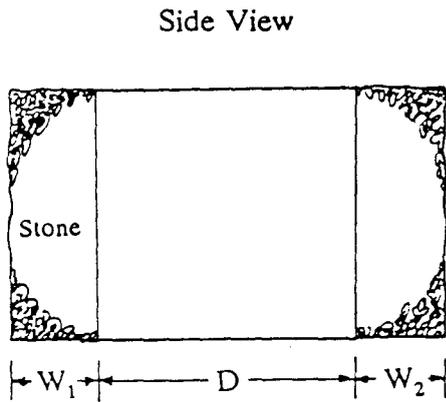
For Rectangular Structures

$$AA = (L_1 + L_2 + L_3 + L_4 + L_5 + 1 \text{ ft.}) \times (W_1 + W_2 + W_3 + 1 \text{ ft.})$$



For Circular Structures

$$AA = [(W_1 + D + W_2 + 1 \text{ ft.})/2]^2 \times (3.14)$$



**Fig. 2 RECOMMENDED DISTRIBUTION THROUGH FLOW DIFFUSERS**

CURRENT METHOD

RECOMMENDED METHOD

