July 14, 1993

MEMORANDUM

GMP #33

TO: District Directors
Environmental Health Managers
Environmental Health Supervisors
Environmental Health Specialist

THROUGH: Donald J. Alexander, Director
Division of OnSite Sewage and Water Services

FROM: David D. Effert, Technical Services Chief
Roger A. Cooley, Assistant Technical Services Chief
Division of OnSite Sewage and Water Services

SUBJECT: Generic Plans for Sand Filters Discharge - Plan Review - Design This memorandum supersedes GMP #9 which is to be deleted.

GMP #9, "Generic Plans for Accessible Intermittent and Accessible Recirculating Sand Filters," (November 2, 1992), did not include "generic" plans/specifications for subsurface sand filters because the design and placement of such filters typically are site specific. However, the Discharge Regulations Task Force has recommended that generic plans be generated for subsurface sand filters. As a result, this memorandum has been developed to provide design criteria and "generic" plans/specifications for subsurface sand filters. Design citeria and "generic" plans/specifications for accessible intermittent and accessible recirculating sand filters have also been included in this memorandum. As a result, GMP #9 can be deleted upon receipt of this memorandum.

This information was developed as required by the Discharging Systems Regulations Implementation Manual (1992) and the recommendations of the Discharge Regulations Task Force. The design criteria and "generic" plans/specifications substantially follow the design standards and recommendations provided in the Environmental Protection Agency's Onsite Wastewater Treatment and Diposal Systems Design Manual (1980). The design criteria were selected, because with proper use and maintenance, filter performance has been shown to achieve levels of treatment which comply with the 30 mg/l BOD5 and 30 mg/l suspended solids limits of the State Water Control Board's General Permit. *(Note that the*

'generic' plans are not intended to replace nor should they be used as bid or construction drawings. It may be necessary for bid or construction drawings to be developed for a specific site or project.)

The attached design criteria and "generic" plans/specifications were developed as design standards for discharging onsite wastewater treatment systems for single family residences. Undoubtedly, the design criteria presented here will have to be revised as field experience and new information is obtained. Comments from, all environmental health personnel would be appreciated.

Reference should also be made to GMP #18 entitled, Preliminary Approval of Sewage Discharge System, which outlines the treatment systems which have received preliminary approval under the Alternative Discharging Sewage Treatment Regulations for Single Family Dwellings.

rac/dde

pc: Robert Hicks
Cal Sawyer, P.E.
Environmental Engineering Field Offices - OWP
Office of Environmental Health Services Staff

DESIGN CRITERIA AND GENERIC PLANS/SPECIFICATIONS
for
BIOLOGICAL SAND FILTERS

BACKGROUND

Section 2.27 of the Alternative Discharging Sewage Treatment Regulations for Single Family dwellings requires that plans and specifications for intermittent and recirculating sand filters be prepared by a professional engineer licensed to practice in Virginia, except for generic systems which have been approved by the Division of Onsite Sewage and Water Services. The Discharging Systems Regulations Implementation Manual directed that "generic" plans be developed by the Division of Onsite Sewage and Water Services. The following "generic" plans have been developed in compliance with the Discharging Systems Regulations Implementation Manual.

These "generic" plans substantially follow the design standards and recommendations provided in the Environmental Protection Agency's Onsite Wastewater Treatment and Disposal Systems Design Manual (1980). These "generic" plans, and additional design criteria, were selected because, with proper use and maintenance, sand filter performance has been shown to achieve levels of treatment which comply with the 30 mg/l BOD_5 and 30 mg/l suspended solids limits of the Virginia Water Control Board's General Permit. Note that the "generic" plans are not intended to replace nor should they be used as bid or construction drawings. It may be necessary for bid or construction drawings to be developed for a specific site or project.

ADDITIONAL INFORMATION

Additional information on sand filters can be found in the publication entitled "Discharging Wastewater Treatment Technologies - Sand Filters" (1992), prepared by the Division of Onsite Sewage and Water Services, the Environmental Protection Agency's Onsite Wastewater Treatment and Disposal Systems Design Manual (1980), and the book Environmental Engineering and Sanitation, by Joseph A. Salvato, Jr.

Disclaimer

These "generic" sand filter plans and specifications were prepared to assist the field environmental health specialist with the design and plan review of sand filter systems. They are not intended to replace, nor should they be used, as bid or construction drawings. It may be necessary for bid or construction drawings to be developed for a specific site or project.

DESIGN CRITERIA FOR INTERMITTENT SAND FILTERS (NON RECIRCULATING)

Generic Plans and Design Specifications

Generic plans for a rectangular or circular sand filter configuration are presented in Figures 1 and 2, respectively. Generic design specifications are presented in Table 1.

Number of Filters Needed

A minimum of two filters are to be provided. Non-recirculating filters are usually alternated with one filter resting at all times.

Sand Media Containment Structure

The sand media must be contained in a structure that does not allow the wastewater to leak out; is resistant to the deterioration by sewage; and is able to support the sand and gravel media. The container/tank may be constructed of precast concrete, concrete block, steel, or fiberglass. Other material may be acceptable on a case by case basis. In all cases, the owner/contractor will be responsible for the structural integrity of the tank. It is beyond the scope of Technical Services, or the environmental health specialist, to determine the structural integrity of proposed containment structures. It is strongly recommended that the containment structure be approved by a professional engineer registered in Virginia.

Shape of the Sand Filter Bed

The geometric shape of the sand beds is not critical; hydraulic loading rate, dosing volume, depth and type of sand are more important design parameters. Beds may be rectangular, square, or circular.

Depth and Type of Sand in the Filter Bed

The depth of sand should be a minimum of 30-inches. Eventually the sand will clog and some of the sand will need to be removed. Once the sand depth decreases to 24 inches, additional sand should be added to bring the height up to its original design depth.

The effective size, *Se*, and uniformity coefficient, *Cu*, of the sand are very important in the operation of the sand filter. If the grain size of the sand is too small, the

filter will require much more maintenance and may clog on a regular basis. If the grain size is too large, treatment efficiency will be reduced. A grain size analysis of the sand (indicating the *Se* and *Cu)* must be made prior to its use. The sand must be approved by the local health department prior to using it.

Effluent Distribution and Collection

The distribution of wastewater on the sand may be by upturned pipe, troughs or any other method which does not erode the sand and cause short circuiting of the wastewater through the sand. PVC schedule 40 pipe is recommended throughout the distribution system, although other corrosion resistant pipe may be suitable. The sizing of the force mains and distribution pipe will depend on the pump capacity and the means of distribution. The underdrain(s) should be constructed of 4 inch diameter perforated corrosion resistant pipe. All underdrain(s) must be vented to the atmosphere.

Effluent Dose Volume

The dosing volume is based on the surface area of the sand filter. Typically, the volume of effluent applied per dose is equal to the volume of effluent which would result in 2 inches of effluent ponding above the sand.

DESIGN CRITERIA RECIRCULATING SAND FILTERS

Generic Plans and Design Specifications

Generic plans for a rectangular or circular recirculating sand filter configuration are presented in Figures 1 and 2, respectively. Generic design specifications are presented in Table 2.

Number of Filters Needed

A minimum of two filters are to be provided. Recirculating filters are usually operated simultaneously.

Sand Media Containment Structure

The sand media must be contained in a structure that does not allow the wastewater to leak out; is resistant to the deterioration by sewage; and is able to support the sand and gravel media. The container/tank may be constructed of precast concrete, concrete block, steel, or fiberglass. Other material may be acceptable on a case by case basis. In all cases, the owner/contractor will be responsible for the structural integrity of the tank. It is beyond the scope of Technical Services, or the environmental health specialist, to determine the structural integrity of proposed containment structures. It is strongly recommended that the containment structure be approved by a professional engineer registered in Virginia.

Shape of the Sand Filter Bed

The geometric shape of the sand beds is not critical; hydraulic loading rate, dosing volume, depth and type of sand are more important design parameters. Beds may be rectangular, square, or circular.

Depth and Type of Sand in the Filter Bed

The depth of sand should be a minimum of 30-inches. Eventually the sand will clog and some of the sand will need to be removed. Once the sand depth decreases to 24 inches, additional sand should be added to bring the height up to its original design depth.

The effective size, *Se*, and uniformity coefficient, *Cu*, of the sand are very important in the operation of the sand filter. If the grain size of the sand is too small, the filter will require much more maintenance and may clog on a regular basis. If the grain

size is too large, treatment efficiency will be reduced. A grain size analysis of the sand (indicating the *Se* and *Cu)* must be made prior to its use. The sand must be approved by the local health department prior to using it.

Effluent Distribution and Collection

The distribution of wastewater on the sand may be by upturned pipe, troughs or any other method which does not erode the sand and cause short circuiting of the wastewater through the sand. PVC schedule 40 pipe is recommended throughout the distribution system, although other corrosion resistant pipe may be suitable. The sizing of the force mains and distribution pipe will depend on the pump capacity and the means of distribution. The underdrain(s) should be constructed of 4 inch diameter perforated corrosion resistant pipe. All underdrain(s) must be vented to the atmosphere.

Effluent Dose Volume

The dosing volume is based on the surface area of the sand filter. Typically, the volume of effluent applied per dose is equal to the volume of effluent which would result in 2 inches of effluent ponding above the sand.

Recirculation Ratio

In a recirculating intermittent sand filter a minimum of a 3:1 and a maximum of a 5:1 recirculation ratio of treated wastewater to design flow must be provided. A 5:1 recirculation ratio is recommended. Recirculation may be accomplished by using a distribution box, pressure manifold, moveable gate, pump and timer, floating ball, or any other design which will provide for proper recirculation. If a pump or the floating ball bypass is used, the pump must be provided with a timer. The timer must be set based on the capacity of the pump. The pumped volume would equal 3 to 5 times the design flow. For a three bedroom house designed at 450 gpd and a 5:1 recirculation ratio, the volume pumped would equal 2,250 gallons per day. If the pump has a capacity of 20 gpm, the timer should be set to operate 113 minutes per day.

DESIGN CRITERIA FOR SUBSURFACE SAND FILTERS

Generic Plans and Design Specifications

Generic plans for a subsurface sand filter are presented in Figure 3. Generic design specifications are presented in Table 3.

Number of Filters Needed

Only one filter should be provided.

Sand Media Containment Structure

Subsurface sand filters must have an impervious bottom. This liner may be PVC, concrete, concrete block or clay. The surrounding wall is only necessary to prevent the side walls from caving in while the gravel and sand are being installed. Gravity subsurface sand filters should be a maximum of 12 feet wide.

Depth and Type of Sand in the Filter Bed

The depth of the sand should be a minimum of 30-inches. Clean coarse sand passing 1/4" mesh screen with effective size, *Se*, of 0.30 to 0.60 mm and a uniformity coefficient, *Cu*, not greater than 3.5 must be provided. The sand should be settled by flooding prior to the placement of the distribution pipe.

Wastewater Distribution and Collection

Perforated piping is usually used for distributing the wastewater on the sand filter. The slope of the distributors should be 0.5 percent where dosing tanks are not used. Collector lines should be perforated pipe on a slope of 0.5 to 1.0 percent.

Dosing Volume

If dosing is provided, the filter should be dosed a minimum of twice a day. The minimum dose per cycle should be adequate to completely fill the distribution piping. Dosing can be accomplished by pump or siphon.

Maintenance:

Since subsurface sand filters are usually covered, they are not accessible for maintenance. Therefore, proper pretreatment of the wastewater is essential. It is recommended that the size of the septic tank be increased by 50 percent if a garbage grinder is to be installed.