



COMMONWEALTH of VIRGINIA
Department of Health

RANDOLPH L. GORDON, M.D., M.P.H.
COMMISSIONER

March 5, 1997

GMP #85

To: District Environmental Health Managers
District Health Directors
OEHS Staff

Through: Donald J. Alexander, Director *Donald J. Alexander*
Division of Onsite Sewage and Water Services

From: Anish R. Jantrania, Ph.D., P.E. *for Anish R. Jantrania*
Technical Services Engineer *by DJA*

Subject: Experimental Protocol for Aquarobic
Filter Bed System
Onsite - System Approval - Aquarobic Filter Bed

The Department has completed a review of the Aquarobic Filter Bed system and the Division has approved an experimental protocol to test the Aquarobic system in accordance with §2.25 of the Sewage Handling and Disposal Regulations. This GMP is intended to provide guidance on how to process applications for Aquarobic systems. The site criteria are contained in the **Experimental Protocol** document.

Conceptually, the Aquarobic Filter Bed system will provide additional wastewater treatment prior to subsurface disposal and thereby reduce the minimum site requirements necessary to treat conventional septic tank effluent. Approval of this protocol is intended to allow the demonstration of the Aquarobic Filter Bed System for the purposes of determining whether the system can overcome soil and site limitations that would prohibit the use of a conventional onsite system where percolation rates exceed 120 MPI, or the required stand-off distance to water table cannot be met, or both.

Aquarobic International Inc. applied for a variance from 2.25.A.2 of the Sewage Handling and Disposal Regulations. The request for the variance was approved and the backup requirements have been modified. In essence, a 100% repair area meeting the site and size requirements of the original Aquarobic Filter Bed System will be an acceptable backup for the sites that do not meet the requirements for a conventional system. Please refer to the February 14, 1997, variance which describes the backup requirements and the justification for granting this variance and required conditions of the variance.

The Department's approval of this protocol is only granted for the Aquarobic Filter Bed System and is not transferable to any other product. Applications for products other than Aquarobic Filter Bed System, or for sites that exceed the scope of this waiver, are subject to the provisions of §2.25.

The process to obtain a construction permit for Aquarobic system begins with filing an application. Applications may be made to review a new site, to modify a previously issued permit, or to convert a 415 certification letter to a construction permit to allow a Aquarobic system. Please note that experimental system cannot be converted to an approval letter and that experimental construction permits cannot be valid beyond the completion of the experiment. All permits issued under this protocol must be recorded with a copy of the variance in the same manner that conditional permits are recorded. Please refer to Section IX-E of the protocol which addresses some practical matters related to experimental permits.

The waiver defines the Aquarobic system as an experimental system. The experimental protocol submitted by Aquarobic was prepared by a Mr. Daniel E. Pavon, the President of the company, and all testing associated with the protocol will be conducted under the auspices of a professional engineer. Local health departments may, at their discretion, require either formal or informal plans and specifications, as deemed appropriate for the proposed use and site conditions, prior to issuing a permit. All provisions of §2.25, except the requirements for a backup site, apply when issuing a permit. A backup site meeting the requirements of February 14, 1997, variance is required prior to permitting any site. Individual permit shall be issued by the local health department and a copy of the permit and site conditions sent to the Division of Onsite Sewage and Water Services.

When a new application is made for a construction permit and it specifically requests a Aquarobic system, an application fee shall be charged and the site shall be evaluated in the same manner as any application for a conventional septic system except that the site and soil conditions contained in the **Experimental Protocol** may be used. If the site and soil conditions meet these criteria, the site shall be deemed suitable for a Aquarobic system.

Applications to convert a 415 certification letter to a Aquarobic system shall follow the same general process, including collecting a fee; however, no soil evaluation is specifically required. A site evaluation (as opposed to soil evaluation) may be necessary to assure that conditions have not substantially changed

GMP #85
March 5, 1997
Page 3

since the letter was issued. If the site and soil conditions are unchanged and meet the criteria contain in the **Experimental Protocol** the site shall be deemed suitable for a Aquarobic system.

When an application is made to convert an existing Type I or II permit to a Aquarobic system, no application fee shall be charged as no site evaluation should be necessary. If the documented site and soil conditions indicate the site meets the criteria in the **Experimental Protocol**, the site shall be deemed suitable for a Aquarobic system.

System design, installation, and operation shall comply with the requirements described in the **Experimental Protocol**, Aquarobic design, construction and installation literature, the Sewage Handling and Disposal Regulations and standard engineering practices.

Attachments

GMP #85

Onsite - System Approval -Aquarobic Filter Bed

Conditions of Approval

Aquarobic Filter Bed System Experimental Protocol

I. System description and operation

The Aquarobic Filter Bed System (Figure 1) consists of a treatment device (the Mini-Plant™) and a raised filter bed disposal system. This experimental protocol is based on the specific components supplied by the Aquarobic International Inc. (540-635-5200). Unless otherwise stated, the components of the Aquarobic Filter Bed System shall comply with the intent, objectives, and requirements of the Sewage Handling and Disposal Regulations.

The Mini-Plant™ is an advanced wastewater treatment system which treats domestic wastewater (BOD₅ and TSS ranging from 100 to 400 mg/l) from residential and commercial units. It has the capacity to treat flows up to 5,000 GPD. The treatment plant is available from the Aquarobic International, Inc. in a custom manufactured fiberglass tank or as an add-on kit to be installed into locally manufactured one compartment concrete tank(s). Table 1 lists Mini-Plants™ proposed to be used under this GMP. A Mini-Plant™ has three main components: a control panel, a tank with the manway, and in-tank components.

The Mini-Plant™ one compartment tank (Figure 2) is sized to hold 3 times the daily expected flow and the air compressor is sized to provide a minimum of 2,100 cubic feet of air per day per pound of BOD₅. The system works on a periodic fill and draw principle (Sequencing Batch Reactor). During 20 hour fill period (normally 6 AM to 2 AM), wastewater is continuously exposed to fine bubble diffused air. At 2 AM the blower stops, and a quiescent settling period of 3 hours follows. At 5 AM a one hour draw period starts and the suspended decant pump discharges the treated effluent into the raised filter bed disposal system. The programmable control system is available to change the settings for any of the three periods to match the daily water use pattern.

The treated effluent is dosed into a raised filter bed disposal system everyday in a one hour period. Typically, from 5 AM to 6 AM, treated effluent is dosed to a distribution grid (4" perforated pipe). The grid is placed level, on 15" on centers, in 12" of ½" to ¾" washed stone, on top of the 30" of filter material (Figure 1). The side slope of the filter bed must be 3:1 or greater. The top surface of the filter bed is designed using a loading rate of:

* 4 GPD/Sq.Ft. for residential systems with flows up to 1,000 GPD, and

* 2.5 GPD/Sq.Ft. for commercial systems of any size and residential systems with flows greater than 1,000 GPD.

The maximum size of the top surface of any filter bed must not be more than 600 Sq.Ft. When a larger area is needed, multiple beds must be used and the beds must be separated by a minimum distance of 15' using a common base area (also known as contact and mantle area). The filter medium used in the raised bed must be approved by the Aquarobic International Inc. Typical filter media has:

- * an effective size of 1.0 to 10.0 mm,
- * uniformity coefficient less than 5.0, and
- * dust content less than 0.5 percent.

The contact and mantle area make the total area for the Aquarobic Filter Bed System. The total area is determined based on the percolation rate of the original soil in "A" horizon and the design flow rate (Table 2). The total area is cut into the original soil ("A" horizon) to a minimum depth of 6", and back-filled with a minimum of 12" of a sandy material (1 mm sand mason sand, or #2 torpedo sand). Thirty inches of fill material is then placed on top of the mason sand in the contact area.

The contact and mantle area for percolation rates less than 250 MPI shall be sized according to Table 2. For percolation rates in excess of 250 MPI, the contact and mantle area shall be sized by the formula:

$$A = QT/25, \text{ where}$$

A = area in Sq.Ft.

Q = design flow in GPD

T = percolation rate in MPI of the soil in "A" horizon.

At a minimum the contact and mantle area shall be at least as wide as the foot print of the filter bed and extend for a minimum of 50' from the outer distribution pipes in the direction of flow. All other horizontal separation distances (for example, well, property line, building, and the others) shall be measured from the filter bed toe (Figure 1).

The placement of sod over the filter bed(s) is a required part of the filter bed. During late fall or early spring, when sod may not be available, a special soil retention cloth (approved by the Aquarobic International, Inc.) may be used to keep soil from eroding until sod becomes available.

II. Scope of Waiver.

This waiver is granted for facilities generating wastewater flows of 1,000 G.P.D. or less and of residential strength (BOD₅ and TSS <400 mg/l). Larger flows may be permitted but shall be reviewed individually to assure compliance with the requirements of § 2.25 of Sewage Handling and Disposal Regulations.

A maximum of 100 systems may be installed under this waiver. Of these, at least 24 systems (selected by the Department based on their location and use) will be monitored for treated effluent quality and the potential ground water contamination. At least 50% of the systems installed will be monitored for operating conditions. The testing protocol is described in Section VII.

III. Siting Criteria.

The Aquarobic Filter Bed System may be used to provide wastewater treatment and disposal at any site that meets one of the following criteria:

1. Any site that fully complies with the criteria contained in the Sewage Handling and Disposal Regulations, including but not limited to absorption area sizing, percolation rate, landscape position, stand-off distances, and set-back distances.
2. Any site that does not comply with the minimum stand-off to limiting conditions (rock and/or water table) requirements or the percolation rate requirements contained in the Sewage Handling and Disposal Regulations but does comply with the requirements of Figure 3. **Note:** In accordance with a variance issued on March 5, 1997, these 100 systems require an available repair area equal to 100% of the original Aquarobic Filter Bed System area (see variance letter for complete details). Systems meeting these criteria shall be sized in accordance with Aquarobic Filter Bed sizing criteria contained in Table 2 and in Section I.
3. Any repair permit that complies with § 2.16 C.2, where the Aquarobic Filter Bed system is used to potentially enhance treatment and disposal.
4. Any site that has a construction permit for surface water discharge system and has a site that complies with the requirements of Figure 3. The surface water discharge permit can be used as a backup system. Note that the Aquarobic Mini-Plants are approved for discharging system (GMP#68).

The stand-off distances to rock and water table for conventional septic systems are proposed for revision. These revisions may affect the stand-off distance for this system. If the proposed revisions are adopted as drafted, the stand-off distance for the Aquarobic Filter Bed system may be revised to 12 inches in all soil types.

IV. Design Criteria.

All portions of the Aquarobic Filter Bed System shall be designed to provide wastewater treatment and disposal which is equal or superior to which may be obtained with a conventional gravity drain field system. Aquarobic International Inc. will prepare a site specific design for every installation that is considered under this GMP. In general, the system must provide adequate wastewater treatment, and adequate sub-surface disposal to render the wastewater harmless to humans and the environment.

The Mini-Plant™ shall be selected from the models listed in Table 1 based on the design flow rate. The Mini-Plant™ one compartment tank (Figure 2) is sized to hold 3 times the daily expected flow and the air compressor is sized to provide a minimum of 2,100 cubic feet of air per day per pound of BOD₅. Aquarobic International Inc. will supply the necessary control panel and in-tank components for each installation.

The Filter-Bed disposal system will be designed based on soil and site conditions. All fill material shall be approved by Aquarobic International Inc. and the specification will be indicated on the final drawing. The size of the filter-bed for design flows less than 1,000 GPD and percolation rates less than 250 MPI is presented in Table 2. The filter-beds selected for ground water monitoring will be sized according to Table 2.

V. Installation

- A. Installers shall be trained by the Aquarobic International Inc. or its representative, and be certified as having passed their minimum training qualifications prior to installing any systems in Virginia.
- B. The manufacturer's recommendations shall be followed for system startup.
- C. All mechanical components must be demonstrated to be fully operational in accordance with their design.

VI. Operation

All system owners shall be provided with written and oral instruction on the proper operation and maintenance of the Aquarobic Filter-Bed system. At a minimum this will include a copy of the Homeowners Manual prepared by the Aquarobic International Inc. Updates, revisions and other changes to this section are the responsibility of the Aquarobic International Inc. Copies of changes should be submitted to the Department on an informational basis and must be distributed to all the customers.

Nothing in this approval is intended to prevent or restrict the development of instructional materials for public use. No prior approval of such literature is required provided the literature contains no endorsements, approvals, or suggestions that the Department in any manner promotes the use of one system above any other.

VII. Testing and evaluation procedures

The purpose of the testing and evaluation procedures is to determine strengths and limitations of the Aquarobic Filter Bed System for providing onsite wastewater treatment and disposal in the Commonwealth of Virginia.

Testing of the first 100 Aquarobic Filter Bed System will be conducted at three levels:

Level 1 testing will include "basic" observation of at least 50% of the installations randomly selected by the Department or the Aquarobic International Inc. during the first three years of operation to determine operating conditions. The primary objective for this testing is to determine if there are any operational problems with the treatment system (such as odor) or disposal system (such as ponding or breakout). Field observations will be recorded in the Form-1 (a copy attached).

Level 2 testing will include sampling and analysis of the Mini-Plant™ effluent and ground water samples collected from the far end of the mantle area. At a minimum, 24 installation will be used for the level 2 testing. Aquarobic International Inc. will install 4" PVC test pipes at the selected installations. The test pipes will be installed between the Mini-Plant™ and the Filter Bed, and at the far end of the mantle area. The primary objectives for this testing is to determine the effluent quality of the Mini-Plant™ and the quality of the water leaving the filter

bed disposal system. Effluent samples will be collected monthly for 18 months and the results will be recorded in the Form-2 (a copy attached). Flow data will be monitored to determine the amount of wastewater (G.P.D.) treated. A complete soil and site evaluation will be performed and recorded prior to installing the systems that will be monitored for the level 2 testing.

Level 3 testing will include sampling and analysis of the treated effluent as it moves through the filter bed disposal system. At least 4 sites with different flow conditions will be selected for the level 3 testing. Effluent samples will be collected from a depth of 12", 18", 24", and 30" below the elevation of the distribution grid as well as from 12" below the original ground level. Ground water monitoring ports will be also be installed at these sites to determine ground water elevations and background water quality. Sites that are selected for the level 2 testing may also be used for the level 3 testing. The primary objective of this testing is to determine the quality of Mini-Plant™ effluent as it travels through the filter bed and to evaluate the need for stand-off distance in the "A" horizon. Effluent samples will be collected monthly for 18 months and the results will be recorded in the Form-3 (a copy attached). Flow data will be monitored to determine the amount of wastewater (G.P.D.) treated.

Aquarobic International Inc. has proposed and the Department has agreed to test the Mini-Plant™ effluent for:

1. pH, temperature, conductivity, chloride(system's performance indicator parameters),
2. BOD₅, TSS (organic strength indicators),
3. ammonia-nitrogen, nitrate & nitrite-nitrogen, total kjeldahl nitrogen, total phosphorus (nutrient indicators), and
4. fecal coliform (bacteriological indicator)

This list of parameter may expand to include more bacteriological parameters, if necessary. The ground water samples and the effluent samples in the filter bed will be analyzed primarily for nutrient and bacteriological parameters. An increase in chloride concentration must be observed to indicate the presence of treated effluent in the ground water samples.

All sampling and the submission of reports, shall be done by, or

under the supervision of, a professional engineer registered in Virginia. The responsibility for assuring that sampling occurs rests exclusively with Aquarobic International Inc. In the event that interim test results preclude the possibility of the product passing the experimental protocol, the Department may notify Aquarobic by certified mail that additional testing is not warranted.

Standards

pH, Conductivity, Temperature, and Dissolved Oxygen: These parameters will be monitored as indicator parameters only. There are no set absolute standards for these parameters.

BOD₅ and TSS: BOD₅ of the Mini-Plant™ mix liquor samples must not be less than 100 mg/l and more than 10,000 for any individual samples and average less than 7,600 mg/l over the sampling period to verify that a typical strength residential waste is being treated.

Effluent from the Mini-Plant™ will be tested to demonstrate treatment effectiveness. BOD₅ of the individual samples must not exceed 20 mg/l and average less than 10 mg/l, and TSS of the individual samples must not exceed 30 mg/l and average less than 15 mg/l.

Chloride: This is an indicator parameter only and will be used to determine presence of the effluent leaving the raised filter in the ground water monitoring wells. There is no absolute standard for this parameter.

Ammonia-N, Total Kjeldahl-N, Nitrate and Nitrite-N: These parameters will be monitored to determine total nitrogen in the treatment plant effluent and in the ground water. There are no absolute standards for different forms of nitrogen and the total nitrogen in the treated effluent. However, the average total nitrogen in the effluent sample from the far end of the mantle area must be less than 10 mg/l. [Note: This standard may be adjusted to correspond with research results on conventional septic tank drain field system technology with 18" stand-off in texture group II, III, and IV soils.]

Total Phosphorus: There is no absolute standard for Total-Phosphorus in the treated effluent. However, the average total phosphorus in the effluent sample from the far end of the mantle area must be less than 1 mg/l. [Note: This standard may be adjusted to correspond with research results on conventional septic tank drain field system technology with 18" stand-off in texture group II, III, and IV soils.]

Fecal Coliform: The average of samples collected from far end of the mantle area shall average less than 10 cfu/100mls and have no single sample in excess 200 cfu/100mls. Sample results obtained during the first six months of operation may be discarded from the performance evaluation at the sole discretion of the Department, when there appears to be due cause. [Note: This standard may be adjusted to correspond with research results on conventional septic tank drain field system technology with 18" stand-off in texture group II, III, and IV soils.]

Surfacing and ponding

Any system that shows surfacing of effluent shall be considered a failure. An evaluation shall be made of the system and the cause of failure and corrective action shall be taken. Ponding depth within the mantle area shall be monitored on a monthly basis for the systems that are included in the Level 2 and Level 3 monitoring. Two monitoring ports shall be installed exclusively for this purpose and ponding depths reported not less than monthly.

VIII. Operation and monitoring.

For the first three years of use after this experimental protocol is granted, Aquarobic International Inc. shall maintain a log of all systems installed. Said log shall include the following minimum information: System location (by tax map or owner's name and county) soil conditions where the system was installed, and all associated physical, biological and chemical data if the system is one being monitored. Said log shall be reported to VDH-OEHS Technical Services Engineer on a quarterly basis and shall be provided by the 15th of the month following the end of the quarter. The log shall be available within 5 business days upon request.

IX. Responsibilities and permitting procedures.

- A. This approval has been granted specifically for the process described in the application made by the Aquarobic International Inc. for the Aquarobic Filter Bed system. Any changes to the components used in this process must be reviewed and approved by VDH-OEHS Technical Services Engineer on a case-by-case basis prior to use.
- B. No contractor may install an Aquarobic Filter Bed system unless they are first certified by Aquarobic International Inc, as meeting their minimum competency standards for contractors.

- C. The Aquarobic Filter Bed system is an experimental system; however for the purposes of permitting, it shall be handled in the same manner as a Type II system.
- D. Permitting shall be done by the local health department based on their satisfactory site evaluation and review of plans and specifications prepared in accordance with the manufacturer's specifications and all applicable state regulations and policies and any relevant local ordinances.
- E. Construction permits (i.e., not operation permits) normally shall be valid for a period of 18 months; however, no construction permit shall be valid beyond the completion date of the experiment. The Virginia Department of Health shall establish the completion date of the experiment by determining when sampling on the 24 systems being monitored under this protocol will be completed. Upon successful completion of the experimental protocol, the Department will convert unused construction permits to conventional construction permits and extend the life of the permit to 18 months from the date of issuance. Such conversion shall be done at no cost to the permit holder. In the event that the system fails the experimental protocol, unused permits will not be renewed.

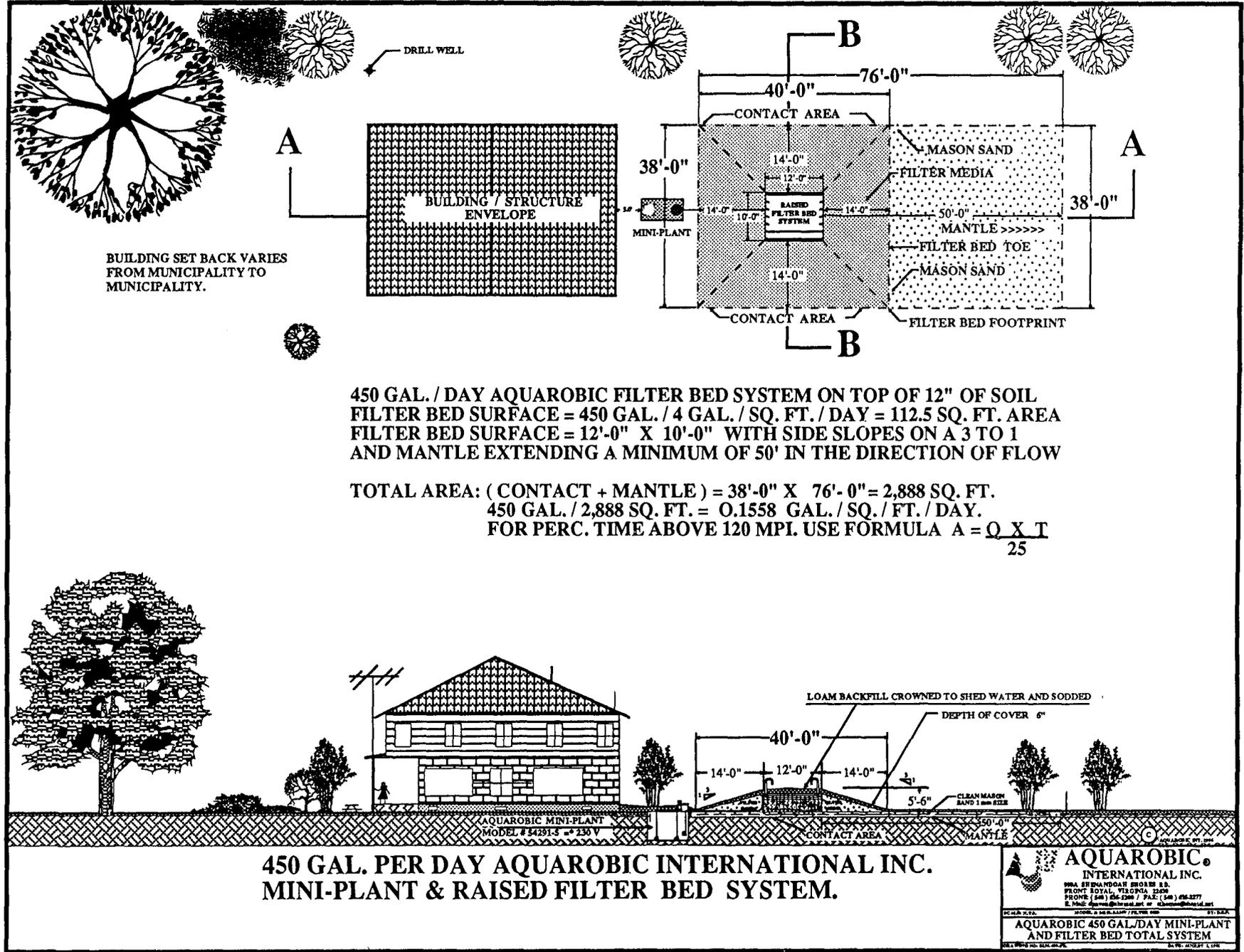
Permits shall note the experimental nature of the system (more detail on this to come from the Department) and that they cannot be converted to an approval letter. Upon successful completion of the experimental protocol, the holder of a valid experimental permit may convert the same to either a conventional construction permit or an approval letter. In the event that the experimental system fails to meet the protocol, the Department's is not obligated to reissue either a construction permit or an approval letter.

- F. Aquarobic International Inc. shall be responsible for providing up to six classes for the VDH staff (up to 50 students each) during the first 6 months after this approval is granted and two classes annually thereafter. The training shall include a manual covering proper siting, sizing, construction, installation and inspection processes for the Aquarobic Filter Bed system. All training materials, the course syllabus and training locations shall be reviewed and approved by the Division prior to training occurring.
- G. Aquarobic International Inc. shall be responsible for submitting information to the VDH-OEHS Technical Services Engineer on the system installation and monitoring results as indicated in the Section VIII. The Department shall

rescind this experimental protocol if Aquarobic International Inc. fails to report the necessary information in the specified time frame. Prior to taking such action the Department shall notify Aquarobic International Inc. of nature of the problem and of the action the Department intends to take.

- H. Should the Aquarobic Filter Bed systems fail to perform to the satisfaction of the Department, the Department shall rescind or modify this experimental protocol. Prior to taking such action the Department shall notify Aquarobic International Inc. of nature of the problem and of the action the Department intends to take.

FIGURE 1: A TYPICAL DRAWING FOR AQUAROBIC FILTER BED SYSTEM



450 GAL. / DAY AQUAROBIC FILTER BED SYSTEM ON TOP OF 12" OF SOIL
 FILTER BED SURFACE = 450 GAL. / 4 GAL. / SQ. FT. / DAY = 112.5 SQ. FT. AREA
 FILTER BED SURFACE = 12'-0" X 10'-0" WITH SIDE SLOPES ON A 3 TO 1
 AND MANTLE EXTENDING A MINIMUM OF 50' IN THE DIRECTION OF FLOW

TOTAL AREA: (CONTACT + MANTLE) = 38'-0" X 76'- 0" = 2,888 SQ. FT.
 450 GAL. / 2,888 SQ. FT. = 0.1558 GAL. / SQ. / FT. / DAY.
 FOR PERC. TIME ABOVE 120 MPI. USE FORMULA $A = \frac{Q \times T}{25}$

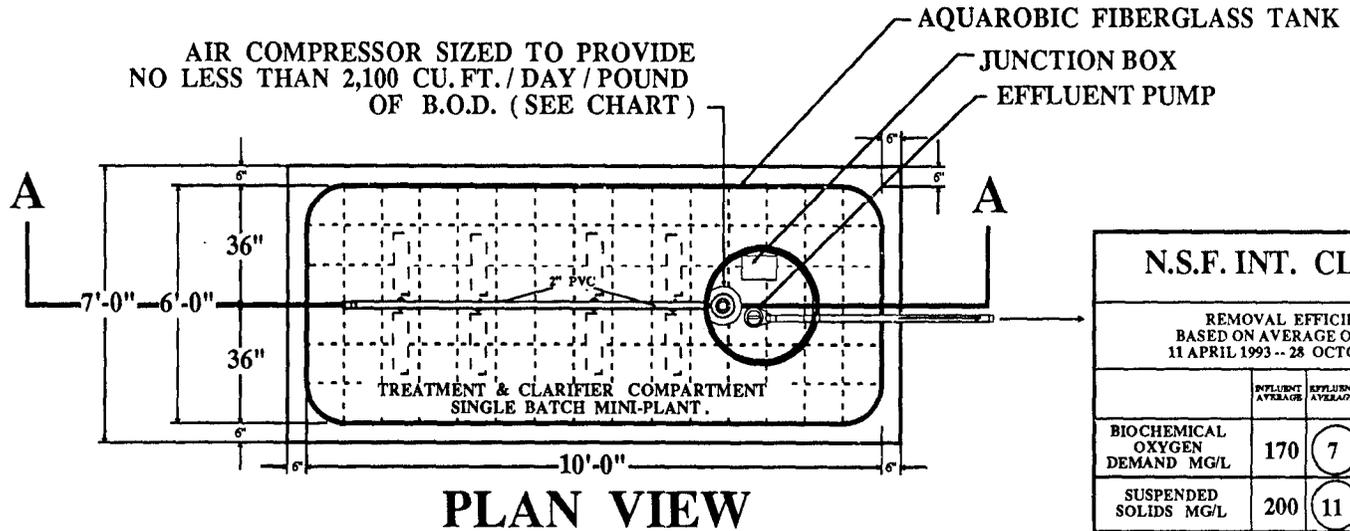
**450 GAL. PER DAY AQUAROBIC INTERNATIONAL INC.
 MINI-PLANT & RAISED FILTER BED SYSTEM.**

AQUAROBIC INTERNATIONAL INC.
 5948 BRUNNENBERG SQUARE RD.
 FRONT STATION, VIRGINIA 22060
 PHONE (703) 636-1200 / FAX: (703) 636-2277
 E-Mail: aquarobic@earthlink.net or albrown@aquarobic.net

AQUAROBIC 450 GAL./DAY MINI-PLANT AND FILTER BED TOTAL SYSTEM

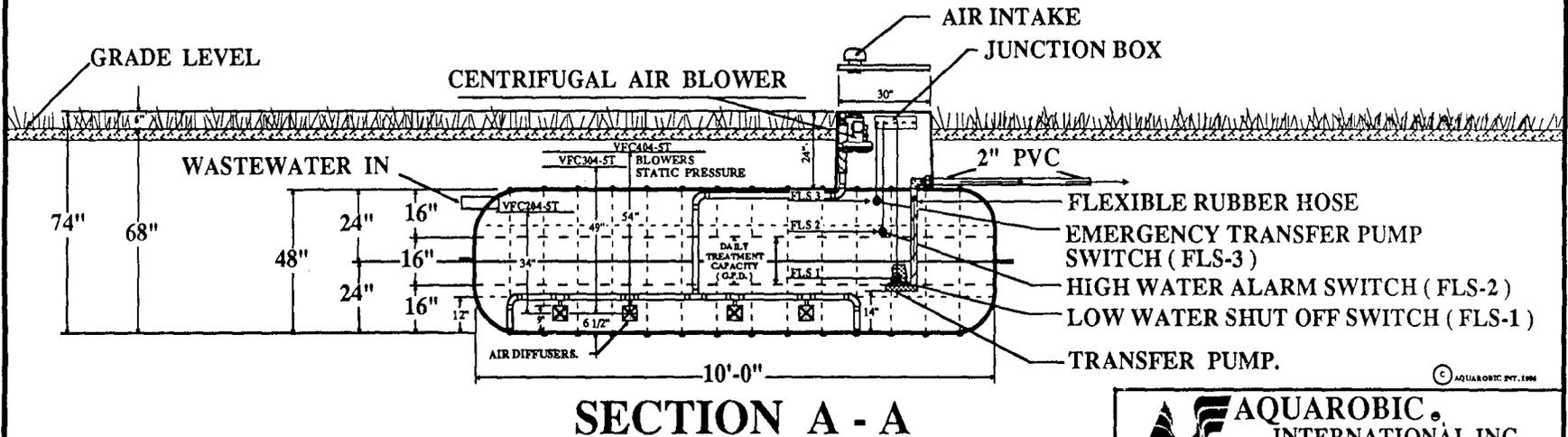
MINI PLANT MODELS # F54291-5-230

AIR COMPRESSOR SIZED TO PROVIDE
NO LESS THAN 2,100 CU. FT. / DAY / POUND
OF B.O.D. (SEE CHART)



N.S.F. INT. CLASS # 1			
REMOVAL EFFICIENCIES BASED ON AVERAGE OF VALUES 11 APRIL 1993 -- 28 OCTOBER 1993			
	INFLUENT AVERAGE	EFFLUENT AVERAGE	PERCENT REDUCTION
BIOCHEMICAL OXYGEN DEMAND MG/L	170	7	163 95.8 %
SUSPENDED SOLIDS MG/L	200	11	189 94.5 %

MINIMUM TANK SIZE:
THREE TIMES THE DAILY WASTEWATER FLOW



AQUAROBIC INTERNATIONAL INC.
999A SHENANDOAH SHORES RD.
FRONT ROYAL, VIRGINIA 22630
PHONE: (540) 635-5200 / FAX: (540) 635-2277

SCALE: NTS. MODEL #: F54291-5-230V BY: D.E.F.
**F54291-500 GAL. / DAY
MINI-PLANT**

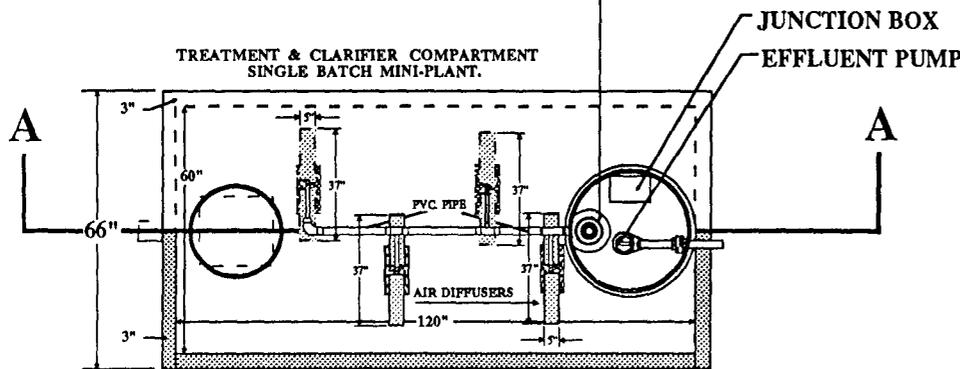
DRAWING NO: 500 GLASS DATE: AUGUST 8, 1996

Aquarobic Experimental Protocol
 March 5, 1997
 Page 14
 FIGURE 1: A TYPICAL DRAWING FOR AQUAROBIC FILTER BED SYSTEM

NOTES:
1. THE CONCEPT HEREIN DISCLOSED IS PROPRIETARY WITH AQUAROBIC INTERNATIONAL INC.
AND MAY NOT BE REPRODUCED OR USED WITHOUT PRIOR WRITTEN AUTHORIZATION.

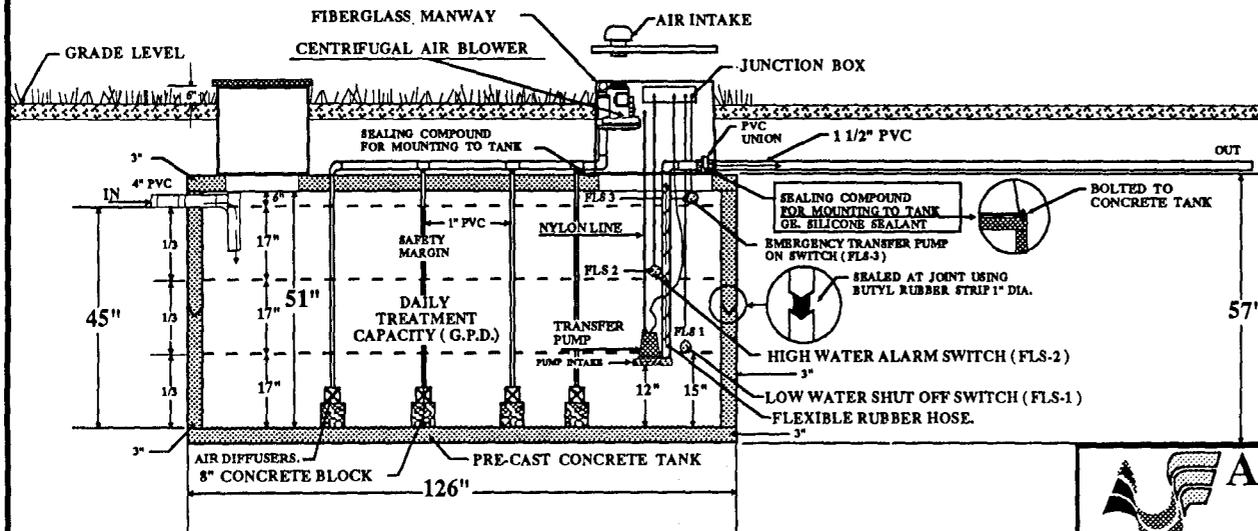
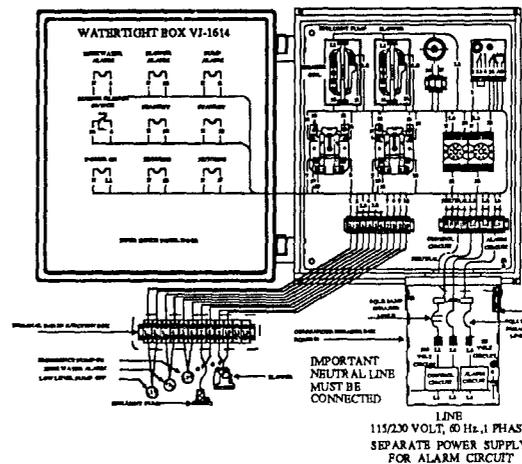
FIGURE 1: A TYPICAL DRAWING FOR AQUAROBIC FILTER BED SYSTEM

AIR COMPRESSOR SIZED TO PROVIDE 2,100 CU. FT. / DAY PER POUND OF B.O.D. (SEE CHART)



TANK CAPACITY: THREE TIMES THE DAILY WASTEWATER FLOW .

PLAN VIEW



SECTION A - A

N.S.F. INT. CLASS # 1				
REMOVAL EFFICIENCIES BASED ON AVERAGE OF VALUES 11 APRIL 1993 -- 28 OCTOBER 1993				
	INFLUENT AVERAGE	EFFLUENT AVERAGE	REDUCTION	PERCENT REDUCTION
BIOCHEMICAL OXYGEN DEMAND MG/L	170	7	163	95.8 %
SUSPENDED SOLIDS MG/L	200	11	189	94.5 %

© AQUAROBIC INT. 1996



AQUAROBIC[®]
INTERNATIONAL INC.

999A SHENANDOAH SHORES RD.
 FRONT ROYAL, VIRGINIA U.S.A 22630

PHONE: (703) 635-5200 / FAX: (703) 635-2277

SCALE: N.T.S. MODELS #: 54291-5-230V BY: D.E.P.

CLASS # 1
500 GPD. MINI-PLANT KIT

DRAWING NO: 51795 - 6 - VA-C 1-1250

DATE: 3/14/1995

NOTES:
 1. THE CONCEPT HEREIN DISCLOSED IS PROPRIETARY WITH AQUAROBIC INTERNATIONAL INC. AND MAY NOT BE REPRODUCED OR USED WITHOUT PRIOR WRITTEN AUTHORIZATION.

Table 1: List of proposed Mini-Plant™

Model Number		Rated Capacity
54291-5	115V	500 GPD (Concrete Tank)
F54291-5	115V	500 GPD (Fiberglass Tank)
54291-6	230V	600 GPD (Concrete Tank)
F54291-6	230V	600 GPD (Fiberglass Tank)
54291-7	230V	700 GPD (Concrete Tank)
F54291-7	230V	700 GPD (Fiberglass Tank)
54291-7.5	230V	750 GPD (Concrete Tank)
F54291-7.5	230V	750 GPD (Fiberglass Tank)
54291-8	230V	800 GPD (Concrete Tank)
F54291-8	230V	800 GPD (Fiberglass Tank)
54291-9	230V	900 GPD (Concrete Tank)
F54291-9	230V	900 GPD (Fiberglass Tank)
54291-10	230V	1,000 GPD (Concrete Tank)
F54291-10	230V	1,000 GPD (Fiberglass Tank)
54291-11	230V	1,100 GPD (Concrete Tank)
F54291-11	230V	1,100 GPD (Fiberglass Tank)
54291-12	230V	1,200 GPD (Concrete Tank)
F54291-12	230V	1,200 GPD (Fiberglass Tank)
54291-13	230V	1,300 GPD (Concrete Tank)
F54291-13	230V	1,300 GPD (Fiberglass Tank)
54291-14	230V	1,400 GPD (Concrete Tank)
F54291-14	230V	1,400 GPD (Fiberglass Tank)
54291-15	230V	1,500 GPD (Concrete Tank)
F54291-15	230V	1,500 GPD (Fiberglass Tank)
54291-20	230V	2,000 GPD (Concrete Tank)
F54291-20	230V	2,000 GPD (Fiberglass Tank)

Table 1: (Cont.)

54291-25	230V	2,500 GPD (Concrete Tank)
F54291-25	230V	2,500 GPD (Fiberglass Tank)
54291-30	230V	3,000 GPD (Concrete Tank)
F54291-30	230V	3,000 GPD (Fiberglass Tank)
54291-35	230V	3,500 GPD (Concrete Tank)
F54291-35	230V	3,500 GPD (Fiberglass Tank)
54291-40	230V	4,000 GPD (Concrete Tank)
F54291-40	230V	4,000 GPD (Fiberglass Tank)
54291-45	230V	4,500 GPD (Concrete Tank)
F54291-45	230V	4,500 GPD (Fiberglass Tank)
54291-50	230V	5,500 GPD (Concrete Tank)
F54291-50	230V	5,500 GPD (Fiberglass Tank)

Table 2: Total Area (Sq. Ft.) Needed for the Filter-Bed

Perc-Rate	Design Flow (GPD)						
	300	450	600	750	800	900	1,000
<= 120	2,627	2,888	3,040	4,000	4,800	4,800	5,100
130	2,627	2,888	3,120	4,000	4,800	4,800	5,200
140	2,627	2,888	3,360	4,200	4,800	5,040	5,600
150	2,627	2,888	3,600	4,500	4,800	5,400	6,000
160	2,627	2,888	3,840	4,800	5,120	5,760	6,400
170	2,627	3,060	4,080	5,100	5,440	6,120	6,800
180	2,627	3,240	4,320	5,400	5,760	6,480	7,200
190	2,627	3,420	4,560	5,700	6,080	6,840	7,600
200	2,627	3,600	4,800	6,000	6,400	7,200	8,000
210	2,627	3,780	5,040	6,300	6,720	7,560	8,400
220	2,640	3,960	5,280	6,600	7,040	7,920	8,800
230	2,760	4,140	5,520	6,900	7,360	8,280	9,200
240	2,880	4,320	5,760	7,200	7,680	8,640	9,600
250	3,000	4,500	6,000	7,500	8,000	9,000	10,000

NOTE: The Aquarobic International Inc. will prepare site specific design for flow rate > 1,000 GPD and/or Perc-Rate > 250 MPI.

Form-1
Aquarobic Field Evaluation

Date: _____	Name: _____
Permit #: _____	Date of Installation: _____
Installer: _____	
Design flow (GPD): _____	User: Residential Commercial
Mini-Plant™ Model #: _____	
Timer Settings Designed: Aeration Start/Stop -	Disposal Start/Stop -
Timer Settings Observed: Aeration Start/Stop -	Disposal Start/Stop -
Field Observation: Odor _____	
	Noise _____
	Ponding _____
	Seepage _____
	Tank _____
	Panel _____
User's Experience: Odor _____	
	Noise _____
	Alarm _____
	Backup _____
	Ponding/Seepage _____
	Power _____
	Overall performance

**Form-2
 Aquarobic Treatment Evaluation**

Sample Date: _____ Sample Collector: _____
 Permit #: _____ Date of System Start-Up: _____
 Analysis Done By: _____ Flow G.P.D.: _____
 Results Approved By: _____

PARAMETER	UNIT	MLX (Opt.)	TRE	MTL
pH	s.u.			
Conductivity	mms			
Temperature	° F			
Dissolved Oxy.	mg/l			
BOD5	mg/l			
TSS	mg/l			
Chloride	mg/l			
Ammonia-N	mg/l			
TK-N	mg/l			
Nitrate-N	mg/l			
Nitrite-N	mg/l			
Total-P(?)	mg/l			
Fecal Coliform				
Total Coliform?				

NOTE: Sample MLX = Mixed Liquor in the Mini-Plant™
 TRE = Treated Effluent from the Mini-Plant™
 MTL = Effluent Sample from the far end of the
 Mantle area

Comments: _____

**Form-3
 Aquarobic Treatment Evaluation**

Sample Date: _____ Sample Collector: _____

Permit #: _____ Date of System Start-Up: _____

Analysis Done By: _____ Flow G.P.D.: _____

Results Approved By: _____

PARAMETER	UNIT	UG	#1	#2	#3	#4	MTL
pH	s.u.						
Conductivity	mms						
Temperature	° F						
Dissolved Oxy.	mg/l						
BOD5	mg/l						
TSS	mg/l						
Chloride	mg/l						
Ammonia-N	mg/l						
TK-N	mg/l						
Nitrate-N	mg/l						
Nitrite-N	mg/l						
Total-P(?)	mg/l						
Fecal Coliform							
Total Coliform?							

NOTE: Sample UG = Ug-Gradient Monitoring Well
 #1 - #4 = 12", 18", 24", 30" below the distribution network
 MTL = Effluent Sample from the far end of the Mantle area

Comments: _____



COMMONWEALTH of VIRGINIA

Department of Health

RANDOLPH L. GORDON, M.D., M.P.H.
COMMISSIONER

February 14, 1997

Mr. Daniel E. Pavón, President
Aquarobic® International, Inc.
999A Shenandoah Shores Road
Front Royal, VA 22630

Dear Mr. Pavón:

On October 30, 1996, the Department received your request for a variance from § 2.25 A.2 of the Sewage Handling and Disposal Regulations. This section requires that detailed plans must be submitted showing how an experimental system can be replaced with an approved system before a construction permit for an experimental system can be issued. The purpose of this regulation is to assure the current and future experimental system owners that, in the event of system failure, an approved system can be installed. This provides a remedy to health hazards associated with improper sewage disposal from a failing system. Without this provision, homeowners may be required to vacate their dwellings or be exposed to the hazards and nuisances associated with a failing sewage system.

In your letter you specifically request the variance for up to 100 Aquarobic® Filter Bed Systems. The purpose of the variance you seek is to allow systems to be installed under an experimental protocol which the Department has prepared as GMP #85. Your letter notes the regulations have created a hardship to you, as well as to the citizens of the Commonwealth, who want to use your system. Further, without this variance, few if any of the proposed systems will be installed, preventing the Department from fully evaluating this technology.

In evaluating a variance, my responsibility is to weigh the benefits of the regulations against the hardship created by the regulations and to determine if granting the variance will result in an unacceptable risk to public health.

Data from Aquarobic® International, Inc. and the National Sanitation Foundation (NSF) indicates that levels of treatment from the Mini-Plant (treatment system) would meet or exceed secondary treatment levels (without disinfection). Based on this information, the Mini-Plant has been approved in the state for surface water discharge. In the event of a surface failure, this effluent, while not innocuous, would pose a significantly lower risk to public health than typical septic tank effluent. The proposed filter bed system for disposal will provide further treatment to the secondary effluent. Consequently, the individual risk from the combination of the Mini-Plant and the filter bed system should be relatively low. By limiting the approval to 100 installations statewide during a three year test period, both individual and public risks are further limited.

The benefit to the public of granting this variance is, that if successful, the Aquarobic® Filter Bed System will provide a wastewater treatment and disposal alternative that will function in a safe, adequate, and proper manner in areas that currently cannot be permitted. It may also provide a method of repairing systems that cannot now be repaired effectively. The benefit of the regulations is that by allowing this technology only in areas with a backup site that complies with the regulations, the public will not be exposed to effluent nominally meeting secondary effluent standards. The treatment technology under consideration has been proven and the greatest potential risk to the public would come from the disposal (recycle) aspect of this proposal, which is experimental. By providing secondary effluent treatment and further by limiting the number of installations to 100, the potential risk to public health is minimized.

On balance, I believe the risks to public health presented by granting this variance would be minimal and the potential benefit to the citizens of Virginia would be greater than the risks of issuing the variance. Therefore, I am granting a variance to §2.25 A.2 of the Sewage Handling and Disposal Regulations with the following conditions:

1. All the sites shall have an absorption area equal to 100% of the original absorption area which meets the criteria contained in GMP #85. This 100% reserve area shall be available on all sites where an Aquarobic® Filter Bed is proposed to be installed.
2. The reserve area shall fully comply with the requirements of GMP #85 in terms of area required and soil and site requirements and shall be maintained in an undisturbed condition.
3. The construction permit and a copy of this variance shall be recorded and indexed in the land records of the circuit court in accordance with §2.13 J.6 of the Sewage Handling and Disposal Regulations.

This variance is effective upon the date of issuance and shall continue in effect until the Aquarobic® experimental process is completed.

Sincerely,



Randolph L. Gordon, M.D., M.P.H.
Commissioner of Health