APPENDIX A

LOW PRESSURE DOSED SAND FILTERS

I. Introduction

Low pressure dosed sand filters (LPDSF) are aerobic, fixed-film bioreactors that are capable of treating septic tank effluent (or in some cases effluent from aeration treatment units) before it is dispersed into the soil. A low pressure dosed sand filter is constructed below grade, covered with soil, and contained within a watertight PVC liner.

This design was developed by members of the Ohio Department of Health Sewage Treatment Systems Technical Advisory Committee in response to the statewide need for a pretreatment device capable of achieving the standards outlined below without the use of electricity for system designs where the use of electricity is not feasible due to system location or social and religious beliefs. LPDSF are designed to provide for the treatment of typical domestic septic tank effluent before dispersal to soil. This design uses a siphon, or combination of siphons to pressurize the distribution network. This network design has been tested and has shown the ability to provide even distribution across the surface of the sand filter.

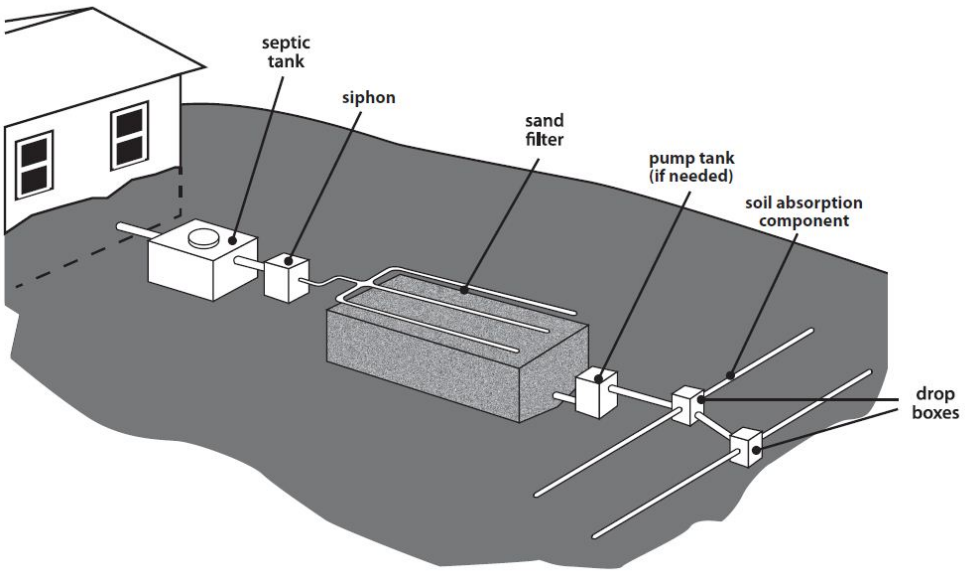

Figure 1. Low Pressure Dosed Sand Filter

II. Limitations and Conditions for Use

(A) A LPDSF designed in compliance with this section is approved for meeting the BOD_5 and TSS standard for a reduction in the size of a soil absorption component and the ten thousand CFU per one hundred milliliter fecal coliform standard for a twelve inch soil depth credit.

(B) Although a septic tank or an approved pretreatment device (such as an aerator) must be used as primary treatment for a sand filter, the design may not combine reductions in the area of the soil absorption component or credits in the vertical separation distance.

(C) In all cases, components must be watertight with sealed entries and exits for piping.

(D) A sand filter designed in accordance with this Appendix is approved to accept a maximum daily design flow of 360 GPD. Two alternatively dosed LPDSF shall be installed when the daily design flow is expected to exceed 360 GPD but is calculated to be below 720 GPD.

(E) Sand filters shall never be placed in surface depressions.

(F) Systems treating wastewater with high concentrations of grease may require the use of a grease trap, as determined by the designer or board of health. Designs shall define, in detail, any and all measures for proper treatment of high strength wastewater.

(G) Septic tanks must be sized in accordance with paragraph (C) of rule 3701-29-12 of the Administrative Code.

III. Sand Filter Design

(A) A LPDSF shall be sized in accordance with Table 1 of this appendix and the following:

(1) When multiple LPDSF are to be used, the dosing method and design of each LPDSF shall meet the criteria outlined within this Appendix.

(2) LPDSF must be sized based on a daily design flow of 120 GPD per bedroom or as otherwise justified for daily peak flow variations or for SFOSTS flows per rule 3701-29-11 of the Administrative Code.

(3) When the daily average flow from a dwelling is expected to exceed sixty per cent of a peak daily design flow of 120 GPD per bedroom, the peak daily design flow shall be increased accordingly.

Sand filter dimensions	18 feet X 20 feet
Sand filter area	360 square feet
Main length	8 to 10 feet
Main size	2 inch
Manifold size	1 ½ inch
Lateral length	8 feet
Lateral size	1 ½ inch
Lateral number	12
Lateral spacing	28 inches
Orifice size	3/16 inch
Orifice number	54
Orifice spacing	2 feet
Design dose volume	25.5 gallons
Design dose length	46 seconds
Design dose per orifice	64 ounces
Design head at end of the lateral	13 inches
Static Head (invert of main – invert of manifold)	13 inches
Drain down (height) in the dosing chamber during a dosing event	9.5 inches

Table 1. Low Pressure Distribution Sand Filter Design Specifications

(B) A buried sand filter must use a polyvinyl chloride liner.

(1) The polyvinyl chloride liner shall have a thickness of at least thirty mil, demonstrate adequate tensile properties, tear resistance, temperature resistance, resistance to soil burial, dimensional stability, and hydrostatic resistance to operate as a watertight liner for the buried sand filter.

(2) The polyvinyl chloride liner must be installed over a three inch layer of sand. The liner must have factory-fabricated boots suitable for field bonding onto the liner to facilitate the watertight passage of piping through the liner.

(3) The location where pipes enter the sand filter through the liner must be water tight. “Pipe boots,” flexible pipe attachments that seal

against the liner and the pipe, must be sized correctly and installed following the manufacturers requirements.

(4) Patches, repairs, and seams must have the same physical properties as the parent material and be approved by the manufacturer of the liner.

(5) A support structure for the liner shall be constructed to be free of any sharp points protruding toward the liner. The space between the structure walls and the excavation shall be filled with sand or other flowable aggregate.

(6) Installation of the liner must take place during favorable weather conditions and meet the manufacturer's specifications.

(7) The liner shall extend to a height above saturated soil and must be sufficiently higher than any adjacent areas where surface water may pond.

(C) The sand media used in the filter shall be natural, washed sand with not more than five per cent passing the No. 200 (75 µm) sieve as determined by ASTM C117, "Test Method for Material Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing." The sand must be installed to a depth of no less than 24 inches. For the purpose of this document, natural sand is defined as naturally deposited silica based sand not manufactured by mechanical processing such as crushing of rock or coarse aggregates.

(1) Buried sand filters must use sand with an effective size of 0.5 to 1.0 millimeters and a uniformity coefficient of 4 or less.

(2) Covered sand filters shall use sand with an effective size of 0.3 to 1.0 millimeters and a uniformity coefficient of 4 or less.

(D) An underdrain must be placed beneath the filter media for the purposes of collection and ultimate dispersal of effluent to the soil absorption unit (see figure 2 of this appendix).

(1) The design shall specify the means by which the underdrain is protected from the infiltration of filter media.

(2) The addition of vent pipes to the underdrain will increase air flow through the filter and should be considered as part of the design. Vent pipes shall terminate above grade.

(3) Underdrain supporting layers and effluent collection media shall comply with the following:

(a) Designs using gravel-less chamber or bundled polystyrene products to construct the underdrain shall include and follow manufacturer recommendations.

(b) Designs using aggregate to bed the underdrain and construct supporting layers shall meet the following specifications:

(i) The underdrain shall be constructed with rigid perforated pipe and laid in good alignment and level. The underdrain must be installed with two layers of aggregate, herein referred to as the supporting layers.

(ii) The underdrain shall be surrounded and covered with at least six inches of aggregate meeting the sizing requirement for coarse aggregate.

(iii) A second, three inch layer of finer aggregate shall be washed with not more than five per cent passing the No. 200 (75 µm) sieve as determined by ASTM C117, "Test Method for Material Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing" and shall be durable with a hardness of 3 or greater on the Moh's Scale of Hardness, meeting a sizing requirements for AASHTO M 43 sizes 7 to 8 and shall be placed over the six inch supporting layer described in paragraph (III)(D)(3)(b)(ii) of this appendix. The sand will shall be placed over this supporting layer.

(E) Sand filters shall be covered to prevent the infiltration of precipitation and surface water.

(1) A geotextile filter fabric shall be installed over the gravel, chambers or expanded polystyrene bundles;

(2) A six inch soil cover shall be installed over the geotextile filter fabric. The soil cover shall consist of topsoil, or similar soil mixture, which

allows for oxygen transfer, and is capable of supporting vegetative growth.

(F) Sand filters shall include no less than two observation ports that extend to the interface of the sand and supporting layer. A sand filter shall also include no less than two observation ports that extend to the interface of the distribution area and sand when the surface is not exposed.

(1) Each observation port must be placed away from points of application and shall be installed with a valve cap or plug.

(2) Diversion collars may be installed to discourage applied effluent from short circuiting the filter along vent pipes.

(3) Installation of more than the minimum number of observation ports may be necessary for adequate observation of the sand surface and supporting layer surface during routine operation and maintenance for some designs.

(G) Access, for the purposes of sampling, must be provided in the discharge line between the sand filter and the soil absorption component in accordance with paragraph (F)(1) of rule 3701-29-13 of the Administrative Code.

IV. Low Pressure Distribution Network

(A) Incremental volumetric control of low pressure distribution is required. The distribution of the network described below has been tested and reviewed by TAC. Alternate designs or variations from this design are prohibited. The complete distribution network must consist of properly pressure rated polyvinyl chloride (PVC) piping and fittings meeting or exceeding industry standards. The selected piping must prevent settling and damage under normal load and operating conditions. All distribution network connections shall be watertight. The design plan shall conform to the network configuration outlined below:

(1) The dosing chamber shall have a diameter of 30 inches and have a minimum height of 42 inches. The dosing chamber shall be watertight and structurally sound.

(2) The siphon shall be a commercially manufactured, three inch unit capable of completing the 25.5 gallon dose in 46 seconds (+/- seven seconds). The reducer between the three inch siphon and the two

inch main shall be installed vertically and shall not be installed horizontally in any case (see figures 5 and 6 of this appendix).

(3) The main piping shall be a minimum of eight feet long and shall not exceed ten feet in length, constructed with two inch PVC piping and shall be constructed per the drawings (see figure 4 of this appendixI).

(4) The manifold shall be constructed with 1½ inch PVC piping and shall be constructed per the drawing (see figure 4 of this appendix). A two inch cross must be installed at the intersection of the manifold and main. A maintenance port must be installed in the distribution line for the purpose of energizing the distribution network for routine maintenance. Ball valves must be installed in the manifold to allow isolation of each half of the sand filter, in the main to allow for its flushing, and preceding the maintenance port to allow for it to be shut off during normal operation. A service box must be installed to access each valve and the maintenance port (See figure 7 of this appendix).

(5) Twelve laterals shall be constructed with 1½ inch PVC piping. Each lateral shall be eight feet long. Laterals shall be spaced at 28 inch intervals along the distribution surface of the filter. Each lateral shall include a turn-up and ¾ inch air gap/ bleeder per the drawing for routine maintenance (See figure 8 of this appendix).

(a) Turn-ups and valves, for the purpose of flushing and cleaning the distribution system, must be installed at the end of each distribution line. A valve box must be provided at the end of each lateral to house the turn up and valve.

(6) The distribution network shall be constructed with 54 orifices that are 3/16 inch in size. The orifices shall be spaced at two foot intervals along the length of the laterals.

(7) The dose shall deliver 25.5 gallons of effluent to the sand filter per dose for an orifice dose rate of 64 ounces. The dose shall be measured at startup to ensure small incremental doses.

(8) The sand filter bed shall have dimensions of 18 feet by 20 feet for a design area of 360 square feet.

(9) The design head at the networks furthest lateral is 13 inches +/- 1.5 inches. The head shall be measured at the end of each lateral at startup.

(10) Orifices shall be orientated down.

(B) A low pressure dosed filter design must specify how the uniform distribution of the effluent across the surface of the sand filter will be ensured.

(1) Wastewater shall be applied within a layer of aggregate above the sand media. The aggregate shall be washed with not more than five per cent passing the No. 200 (75 µm) sieve as determined by ASTM C117, “Test Method for Material Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing” and shall be durable with a hardness of three or greater on the Moh’s Scale of Hardness.

(2) If approved gravelless chamber or bundled polystyrene is to be used, the design shall include and follow manufacturer recommendations.

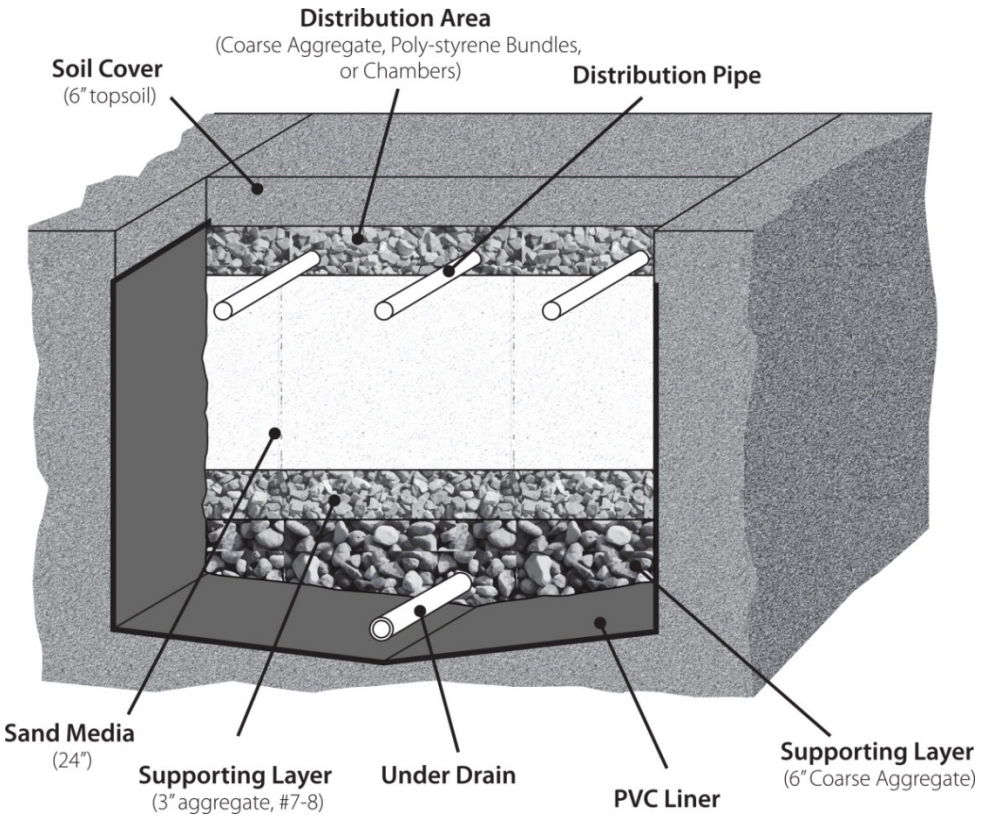

Figure 2. Buried Low Pressure Dosed Sand Filter Cross Section

V. Site Preparation and Installation

(A) Berms, surface grading or other site modifications shall be required as necessary to keep surface water from draining into the sand filter.

(B) Low pressure distribution sand filters shall never be placed in surface depressions.

(C) In all cases, units must be watertight with sealed entries and exits for piping.

(D) Aggregate and media delivered to the site should be tested against design-sizing specifications. All aggregate and media shall be stored, loaded, transported, and installed in such a way as to avoid contamination of the material.

(E) Filter media shall be placed in such a way as to avoid internal layering. Placing the sand by slurry or dropping the sand from a height of several feet should be avoided, because it promotes segregation by grain size.

(F) Sand should be placed into the sand filter in six to eight inch lifts. Each lift should be wetted and then lightly settled. Light settling may be accomplished by walking on the sand.

(G) The filter media surface shall be level and smooth.

(H) The soil cover shall be graded to discourage the ponding of surface water and seeded to promote quick vegetation growth as soon as possible after construction and inspection of the sand filter.

(I) Baseline measurements, for future O&M and monitoring, must be measured and recorded before STS approval by the board of health. Baseline measurements and monitoring information shall include but is not limited to a measurement of the distal operating head of each lateral. As-built records including baseline measurements and O&M instructions shall be provided to the owner, service provider, and the board of health.

(J) The commercial siphon dose unit shall be connected to the main with a union or other non-permanent, serviceable connector for removal and adjustment.

VI. Operation and Maintenance

(A) The LPDSF shall be operated, maintained, and monitored as required by the operation permit issued by the board of health.

(B) A service agreement for a pretreatment component used in a system with a LPDSF shall include the maintenance and monitoring of all system components.

(C) In conjunction with any operation permit conditions or O&M provisions required by the board of health, the O&M of a LPDSF shall include but is not limited to:

(1) Checking vegetative cover for erosion or settling and any evidence of seepage on buried LPDSF.

(2) Flushing of distribution laterals.

(3) Checking for ponding in the distribution area.

(4) Monitoring the dose volume and operating pressure head of the distribution system.

(5) Checking for any surface water infiltration or clear water flows from the dwelling or structures into the system components or around the LPDSF.

Pictures and Drawings

Provided by: Steve Tricamo and Infiltrator Systems, Inc.

The following pictures and drawings are provided for contractor, homeowner, and local health department convenience. In no way should the pictures and drawings provided in this attachment be construed as contradictory or as a replacement to the guidelines provided within the appendix. The mention of trade names or commercial products in this document does not constitute endorsement or recommendation for use by the Ohio Department of Health.

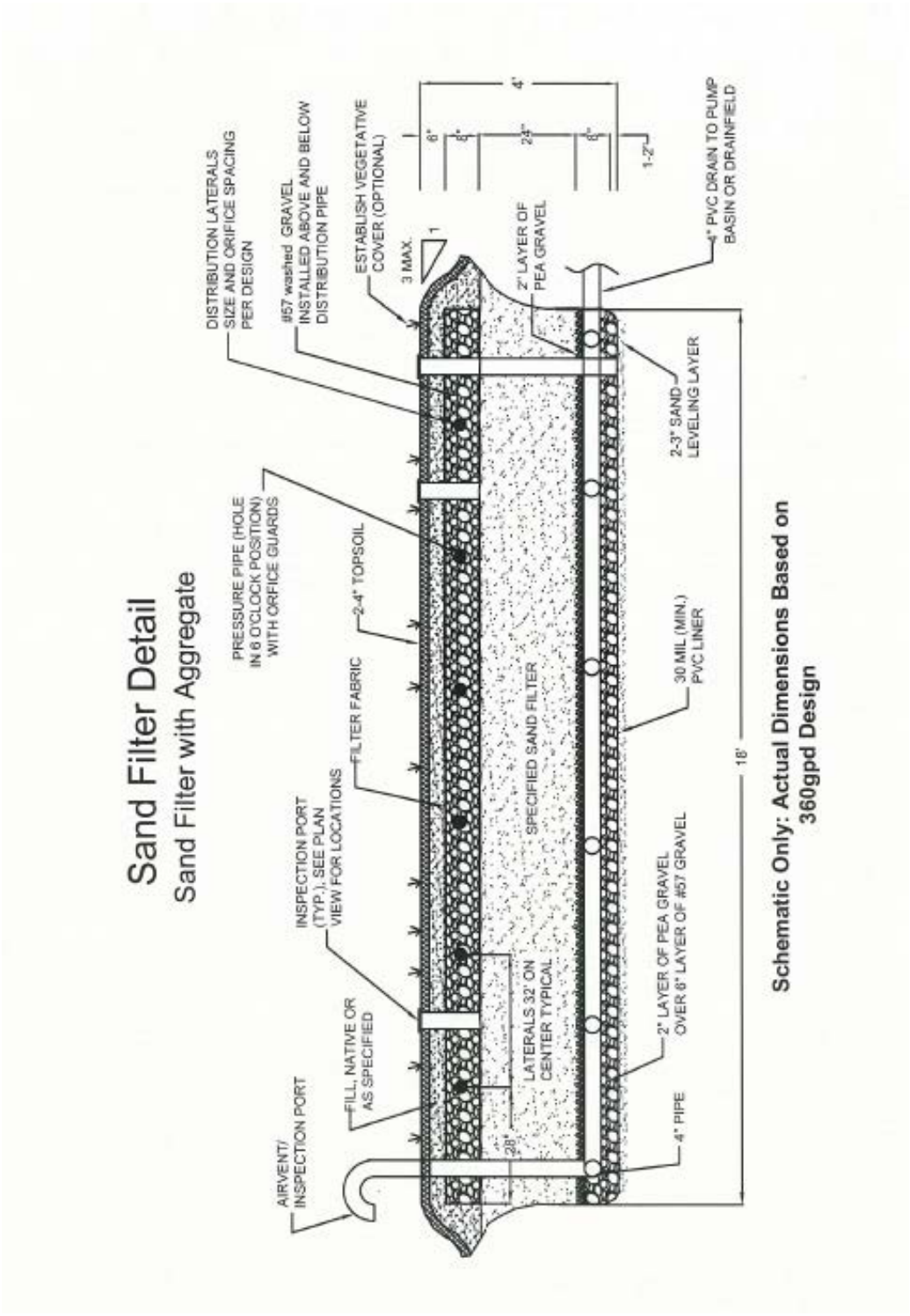
Sand Filter Detail
Sand Filter with Aggregate
DISTRIBUTION LATERALS SIZE AND ORIFICE SPACING PER DESIGN
#57 washed GRAVEL INSTALLED ABOVE AND BELOW DISTRIBUTION PIPE
ESTABLISH VEGETATIVE COVER (OPTIONAL)
3 MAX.
1
6"
4"
24"
6"
1-2"
4'
2' LAYER OF PEA GRAVEL
4" PVC DRAIN TO PUMP BASIN OR DRAINFIELD
PRESSURE PIPE (HOLE IN 6 O'CLOCK POSITION) WITH ORIFICE GUARDS
INSPECTION PORT (TYP.). SEE PLAN VIEW FOR LOCATIONS
FILTER FABRIC
2-4" TOPSOIL
2-3" SAND LEVELING LAYER
30 MIL (MIN.) PVC LINER
SPECIFIED SAND FILTER
AIRVENT/ INSPECTION PORT
FILL, NATIVE OR AS SPECIFIED
LATERALS 32" ON CENTER TYPICAL
28"
2" LAYER OF PEA GRAVEL OVER 6" LAYER OF #57 GRAVEL
4" PIPE
18'
Schematic Only: Actual Dimensions Based on 360gpd Design

Figure 3. Sand Filter Diagram

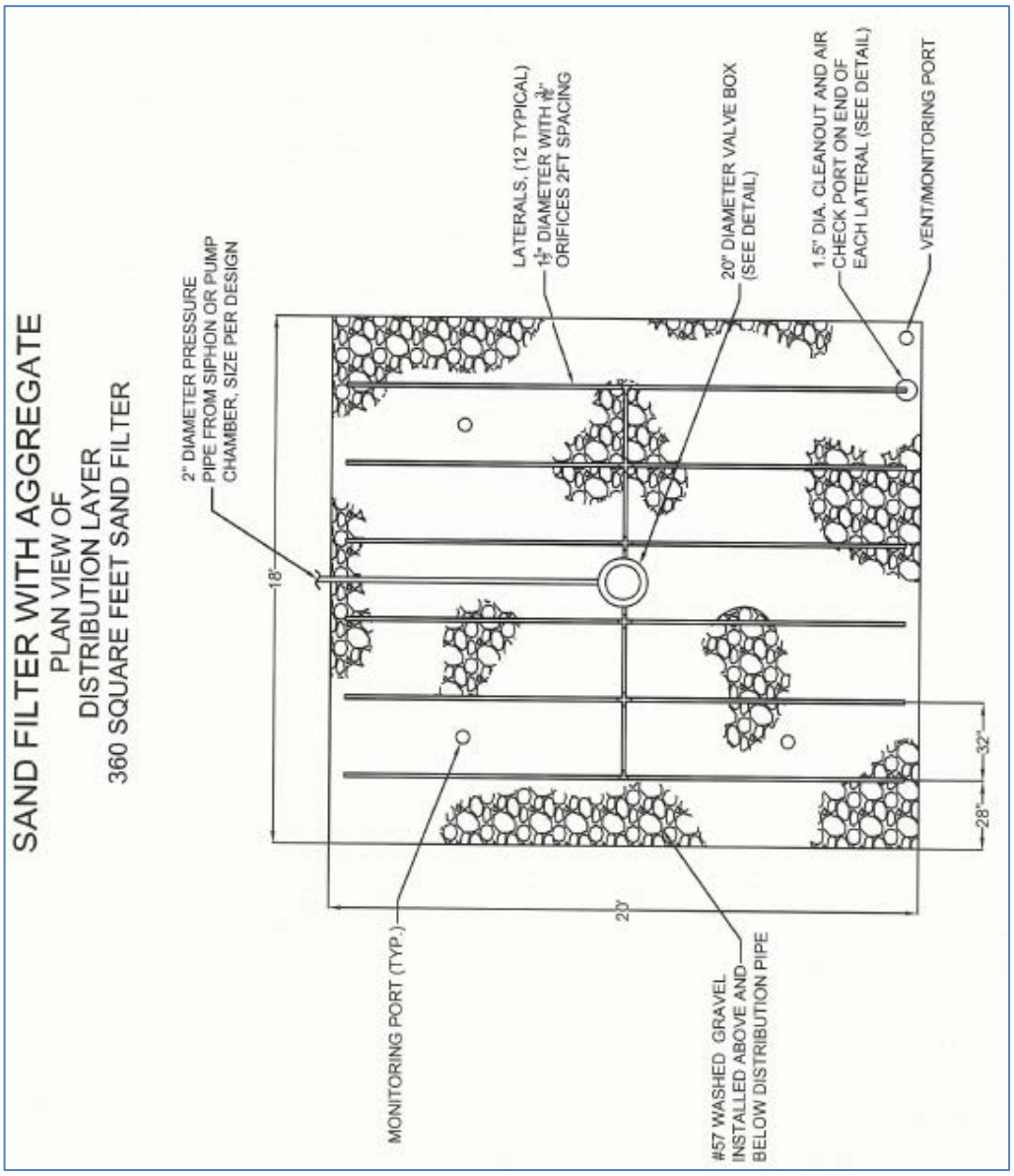

Figure 4. Plan View of Sand Filter Distribution Layer

The siphon is connected to the main with a union or other non-permanent, serviceable connector for removal and adjustment.

Figure 5. Dosing siphon - external view

Figure 6. Dosing siphon - internal view

Figure 7. Service box within the manifold line

Ball valves are installed in the manifold to allow isolation of each half of the sand filter when flushing the distribution network

Figure 8. Turn-up and ¾ inch air gap/ bleeder at the end of each lateral for routine maintenance