BEFORE THE TENNESSEEPUBLIC UTILITY COMMISION

NASHVILLE, TENNESSEE

MAY 9, 2025

IN RE: **PETITION OF AQUA GREEN UTILITY INC. TO AMEND ITS CERTIFICATE OF CONVENIENCE AND NECESSTIY**

DOCKET NO: **2500030**

Petition of Aqua Green Utility Inc. to amend its Certificate of Convenience and Necessity

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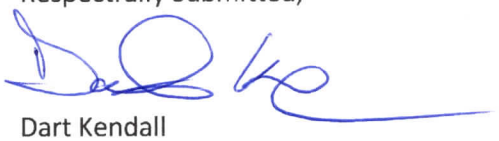
Aqua Green Utility Inc. would like add the enclosed documents to our petition requesting to add the Firefly subdivision to our service area.

Respectfully Submitted,



Dart Kendall
Aqua Green Utility Inc.

Maury County Board of Public Utilities
Maury County Water System
Post Office Box 1196
Columbia, Tennessee 38402-1196
Office 931-375-1159 FAX 931-375-1174

April 22, 2025

Dart Kendall, President
Aqua Green Utility, Inc.
3350 Galts Rd.
Acworth, GA 30102

RE: Firefly Subdivision

Mr. Kendall:

Maury County Board of Public Utilities has the authority to provide sewer service in Maury County. The statute creating the Board of Public Utilities does not grant Maury County Water System exclusive rights to the service area.

Therefore, Maury County Water System has no objections to a private sewer system should the Tennessee Public Service Commission (TPSC) grant a certificate of public convenience and necessity to provide sewer service to a subdivision.

Sincerely,

Todd Shultz, Superintendent
Maury County Water System
931-381-8900

State Operating Permit
Engineering Report

Firefly Subdivision
Maury County, TN

Prepared For:
AquaGreen Utility Inc.

Prepared By:

FES Consulting
Bob Faulhaber - P.E.
May 5, 2025

Project Description

The project is a new, 415 lot subdivision in Maury County, TN. The property will include 415 residential lots and multiple amenities developed in four phases. The property does not have access to public sewer.

Wastewater System Description

A decentralized wastewater system consisting of primary treatment in the form of a septic tanks at each lot pressurized sewer lines to transport the effluent to a secondary treatment system in the form of a fixed film trickle filter and drip dispersal. A description of each component and the conveyance method for the effluent between the components is included below. Further detail is provided on the attached drawings as well.

1. **Septic Tanks** – Each lot will have a 1,000 gallon water tight concrete septic tank. Waste water from each house will flow by gravity to the septic tank via a PVC sanitary sewer pipe. Effluent from this tank will flow by gravity to a pump tank with two effluent pumps that will pump effluent to secondary treatment (trickle filter). The gravity flow will be via a 4" PVC line to a drop Tee with a cleanout connecting to a common PVC line.

2. **Effluent Lines** – Effluent lines will be installed by others, but will be required by the utility to be Schedule 40 glued PVC. Effluent will be delivered to the plant via pressurized lines to the trickling filter(s) . Additional descriptions are provided in the notes attached to the drawings.

3. **Secondary treatment** - The proposed secondary treatment system is an attached growth (fixed film), trickling filter. The trickle filter will utilize manufactured media. The media will be placed in a poured in place concrete chamber approximately 9' deep to form the attached growth (fixed film) treatment unit. The system will include a 460 CFM fan. Anticipated BOD loading of 125 lbs/day requires approximately 420 CFM. Following treatment the effluent will gravity flow through a 6" PVC line to the dosing tank.

4. **Dosing Tank** – Treated effluent from the trickle filter will enter into the dosing tank by way of a 6" gravity line. The dosing tank has a holding capacity of approximately 50,000 gallons. From the dosing tank, effluent will be pumped to one of two locations, the drip fields or back to the trickle filter for recirculation (See below for descriptions). The priority and timing of this routing will be controlled by a PLC system that can be adjusted based on waste water flows, effluent quality and environmental conditions. The typical priority and descriptions of the pumping locations is provided below.

    a. **Recirculate/circulate to the trickle filter** – A duplex pump system will be provided for recirculation in the pumping chamber. Treated effluent from the trickle filter will enter this pumping chamber for recirculation. Recirculation pumps will be on adjustable PLC controlled timers and also set to come on with the drip pumps to assure adequate recirculation rates.

    b. **Drip Field** – Two Little Giant pumps are located within the main chamber of the dosing tank to pump to the drip field. When pumping to the drip fields the effluent line will split into three lines that are connected to three disk filters. These disk filters each have 2 motorized ball valves. The filters block anything

larger than about 130 micron. This is the size needed to protect the drip irrigation tubing. These filters automatically back flush, but should be checked once a year. There are ball valves connected to the supply pipe just before the disk filters that are normally closed and used to back flush the filters either through the alternate pump screen or back to the sewer recirculation line. Next, the pipes tie together before passing through the flow meter. After the flow meter there are 2 motorized ball valves that are closed during back flushing of the filters. Once the effluent leaves the control room it is pumped to the drip irrigation field. Treated effluent from the dosing tank will be pumped to a multi-zone drip field for final effluent treatment and application. A description of the details of the drip field is provided below.

c. Sludge will be pumped back to the 1500 gallon sludge storage tank by PLC controlled timer. Sludge will be removed by a septic tank pump truck and disposed of at an approved municipal plant.

5. **Drip Field** – The drip irrigation field is divided into zones and each zone has a solenoid valve to allow the effluent to enter the zone. The PLC has a timer set for each zone to control flow. Once in the soil, the microbes in the soil and plants uptake nutrients to complete the treatment process. Each zone has air vacuum breaker vents at the high points of the zone, so when effluent drains at the end of a pump cycle the soil and debris will not be drawn into the drip tube emitters. Each zone is connected to a return line through a one way check valve that goes back to a large valve box. In the large valve box there is a normally closed solenoid valve in the return pipe connected to the lower sewer inlet line. Once the system has stopped pumping the valve opens and the remaining effluent is returned to the pump tank.

   The drip field will utilize 0.9 GPH Netafim drip tubing installed in the mapped Stiversville - Hampshire - Nesbitt – Swafford – Maury – Armour – Egam overwash – Inman – Byler and Lindell soils. Drip tubing will be installed at a depth of 7". The drip tubing will follow the ground contours to keep each line of drip tubing level and will be installed at 2' – 5' centers. The target spacing for the drip tubing will be 2' on center, but may be adjusted slightly to account for change in contour and slope (keeping the tubing level will take precedent over maintaining strict 2' spacing). Drip tube pacing will not exceed 5' (as required by Chapter 17 of the design guide) nor be less than 2 ft on center. Two sets of 16 zones will be set up for the drip fields, for a total of approximately 639,000 sf of soil.

Wastewater Flow

The wastewater flow rate is based on the TDEC standard 300 gpd/lot for residential use and usage data from a similar development for the shared facilities. When built out the subdivision will include 415 residential lots for a total of 124,500 GPD and 3,300 GPD additional for the shared facilities.

Daily Flow - 127,800 GPD

Secondary Treatment System Design

Secondary treatment will be achieved through the use of 4 trickling filters. Each trickling filter will utilize synthetic cross flow media. The media will be placed to a depth of 7' with a surface area of approximately 396 ft^2 and a volume of approximately 2,772 ft^3 for each filter. There will be 4 total filters (1 in each phase) for a total surface area of 1,584 ft^2 and a total volume of 11,088 ft^3. The synthetic media will provide approximately 48 ft^2/ft^3 of filter surface area (compared to 15 ft^2/ft^3 for rock media) for a total effective treatment area of approximately 532,224ft^2. The minimum hydraulic loading rate will 81 GPD/ft^2 and an organic loading rate of 14.4 lb BOD5 /1000 ft3 day. This places the system well within the loading rates for industry standard low rate trickling filters for municipal applications based on hydraulic loading rate and organic loading rate. Data for the trickling filter is provided below.

Influent flow rate (max)	-	**127,800 GPD**
Influent BOD_5	-	**150 mg/L**
Filter Bed Area	-	**1,584 ft^2**
Specific Area of filter media	-	**48 ft^2/ft^3**
Filter volume	-	**11,088 ft^3**
Hydraulic Loading Rate*	-	**81 GPD/ft2**
Organic Loading Rate**	-	**14.4 lb BOD5 /1000 ft3 day**

*based on no recirculation and filter bed surface area
**based on filter volume and 150 mg/l BOD (0.001 lb/g)

Soils

The Stiversville - Hampshire - soil series willNesbitt – Swafford – Maury – Armour – Egam overwash – Inman – Byler and Lindell be used for drip dispersion.

Wastewater Soil Loading

Hydraulic Loading Rate

The design hydraulic loading rate for the soil is 0.25 GPD/SF

Drip Line Design

Pressure, head loss (TDH) and flow calculations were run for the drip zones. The worst case zone, due to distance and elevation, is Zone 21. Design calculations for Zone 21 are included as an attachment to this report.

Nitrate Loading Rate

The Nitrate Loading Rate was calculated using Equation 17-2 from TDEC's *Design Guidelines for Wastewater Dispersal Using Drip Irrigation.* The precipitation, potential evapotranspiration, nitrogen fraction removed by denitrification/volatilization, and the maximum nitrate concentration in the leachate are all taken from chapter 16 of the TDEC regulations. The Annual Uptake Rate for Crops is based on grass, which will be planted in the drip field. A Spreadsheet with Nitrate Loading Calculations is attached to this report.

Lwn = 0.21 GPD/SF (see attached spreadsheet)

Design/Effective Loading Rate

The design loading rate and required soil area is shown below

Soil Type	Controlling Loading Rate	Design Flow Rate	Required Soil Area
Stiversville - Hampshire - soil series willNesbitt – Swafford – Maury – Armour – Egam overwash – Inman – Byler and Lindell	0.2 GPD/SF	127,800 GPD	639,000 SF 14.67 Acres

The Netafim Bioline® Calculator estimates the amount of Bioline needed to install a wastewater drip dispersal system, along with other design parameters. It is NOT intended to replace a professional design, and should be used for estimating purposes only. Always consult with a professional designer. Do not use this program with other brands of products.

General Instructions

Fill in the violet-shaded cells. Output information will automatically be calculated and shown in blue-shaded cells. Do not attempt to enter data into the blue-shaded cells. It will erase the formula and potentially impact other output data. To save your information as a .txt file for future reference or submittal, fill in the information in the project's name and address fields below. The name you choose for "Job Name/Homeowner" will become the name of the .txt file. It will be saved on your computer when you click the "Save to File" button at the bottom of the sheet. A file folder will be created for you called "Netafim" and the file will be stored there. For example, if the Job Name / Homeowner for the project is Mr. & Mrs. Jones, all of your information will be saved in a file folder called "Netafim" and the file in this folder will be called "Mr. & Mrs. Jones.txt".

Netafim Bioline® Dripperline Design Recommendations - Based on Maximum Emitter Discharge Rate Per Day

Job Name / Homeowner: Zone 21
Address:
City, State, Zip:
Permit Agency:
Installer Name:
Designed By:
Date:

System Data Input

Gallons Per Day	3,994
Maximum Emitter Discharge Rate Per Day	1.2
Select Emitter Flow Rate (GPH)	0.92
Select Emitter Spacing (inches)	24
Flush Velocity (fps)	2

Assumptions

Estimated Pump Flow Rating (GPM)	80
Inlet Pressure (psi)	25
Inlet Pressure (Feet of Head)	57.8
Row Spacing Between Driplines (feet)	3
Number of Zones	1
Hours Per Day to Use for Dosing	22
Elevation Change from Pump to Dose Tank Outlet (feet)	7
Elevation Change from Dose Tank to Drip Field (feet)	52
Length of Supply Line & Supply & Flush Manifolds (feet)	2100
Type of Pipe - Supply Line & Manifolds	PVC Sch40
Size of Supply & Manifold Pipe (inches)	3
Pipe Roughness Constant	150
Inside Diameter of Pipe (inches)	3.068
Number of Daily Dosing Events Per Zone	4

Calculation Outputs

Total System Information

Application Area Required (square feet)	19,970
Total Amount of Bioline® Required (feet)	6,657
Total Number of Emitters in the Dripfield	3,328

Zone Information

Number of Zones	1
Amount of Bioline® Per Zone (feet)	6,657
Number of Emitters Per Zone	3,328
Minimum Number of Laterals Per Zone	13
Maximum Number of Laterals Per Zone	19
Number of Laterals That Will be Used	18
Maximum Length of Bioline® Laterals Based on Inlet Pressure	270
Flow Rate Per Zone (GPM)	51.0
Holding Capacity of Dripperline Per Zone (Gallons)	88.5
Additional Flow Requirement to Accommodate Flushing Velocity	28.8

Holding Capacity of Piping

Holding Capacity (Gallons) of Supply Line & Supply & Flush Manifolds	806.5
Holding Capacity (Gallons per Zone) of Bioline	88.5
Holding Capacity (Gallons) of Supply Line, Manifolds and Dripperline	895.0

Head Loss Data - Dosing & Flushing Cycle

Friction Loss per 100' (psi) in Supply Line & Manifolds	0.6
Velocity (fps)	3.5
Friction Loss in Supply Line & Manifolds (psi)	12.7
Friction Loss in Supply Line & Manifolds (Feet of Head)	29.4
Additional Pressure Required for Return Manifold and Piping to Tank (psi)	5.0
Additional Pressure Required for Return Manifold and Piping to Tank (Feet of Head)	11.6
TDH (Total Dynamic Head) in Feet of Head	146.2

Control Settings Information

Total System Runtime Per Day (Minutes)	78
Total Runtime Per Zone Per Day (Minutes)	78
Total System Dosing Events Per Day	4
Runtime For Each Dose (Minutes)	20
Off Time Between Doses in the Same Zone (Hours to nearest 0.1)	5

Miscellaneous Information

Dosing Volume Per Emitter Per Dose (gallons)	0.31
Inches Per Week of Dosing	2.25
Volume of a Single Dose (gallons)	1020.7

Pump Selection

Pump Flow Rating (GPM)	79.8
TDH (Total Dynamic Head in Feet of Head)	146.2
Pump Manufacturer	
Pump Model	

Wastewater Application Rates Based on Nitrate Concentration

Master

Nitrate Loading Rate = Lwn = (Cp)(Pr - PET) + U (4.424) / [(1-f)(Cn) - Cp] -- *Eqn. 16-5*

Lwn =		Calculated Allowable Nitrate Loading Rate
Pr =		Table A-3 of Chapter 16 - 5-year return monthly precipitation (in/month)
PET =		Table A-2 of Chapter 16 - Potential Evapotranspiration (in/month)
N- Uptake		Table A-5 of Chapter 16 - Monthly Nitorgen Uptake Rate by Vegetation (lbs/acre/month)
f =		Applied Nitrogen Fraction Removed by Denitrification / Volatilization (%)
Cp =	10	Maximum Nitrate Concentration in Leachate (mg/L)
Cn =	23	Nitrogen Concentration in Applied Wastewater (mg/L)
	4.424	Conversion Factor
U =	100	Annual Nitrogen Uptake Rate for Crop, Variable (lbs/acre/yr)

MONTH	Pr in/mo	PET in/mo	N Uptake %/mo	N Uptake lb/ac/mo	f (Denitrif) %/mo	Lwn in/mo	Lwn in/wk	Lwn in/day	Lwn GPD/SF	Lwh GPD/SF
JAN	7.62	0.10	1%	1	25%	10.98	2.48	0.35	0.22	
FEB	6.72	0.27	2%	2	25%	10.12	2.53	0.36	0.23	
MAR	8.85	0.97	4%	4	27%	14.21	3.21	0.46	0.29	
APR	6.59	2.30	8%	8	29%	12.37	2.89	0.41	0.26	
MAY	6.13	3.59	12%	12	31%	13.37	3.02	0.43	0.27	
JUN	5.52	4.90	15%	15	33%	13.41	3.13	0.45	0.28	
JUL	6.85	5.44	17%	17	35%	18.04	4.07	0.58	0.36	
AUG	4.73	5.00	15%	15	35%	12.86	2.90	0.41	0.26	
SEP	5.54	3.79	12%	12	34%	13.63	3.18	0.45	0.28	
OCT	4.47	1.98	8%	8	32%	10.69	2.41	0.34	0.21	
NOV	6.11	0.82	4%	4	29%	11.15	2.60	0.37	0.23	
DEC	7.55	0.27	2%	2	26%	11.63	2.63	0.38	0.23	
TOTALS	**76.68**	**29.43**	**100%**	**100**		**152.47**			0.21	

Fire Fly Subdivision

Maury County, TN

VICINITY MAP

DRAWING INDEX:

FES Consulting
(931)252-0818
rnfaulhaber@gmail.com

Fire Fly Subdivision
Maury County, TN

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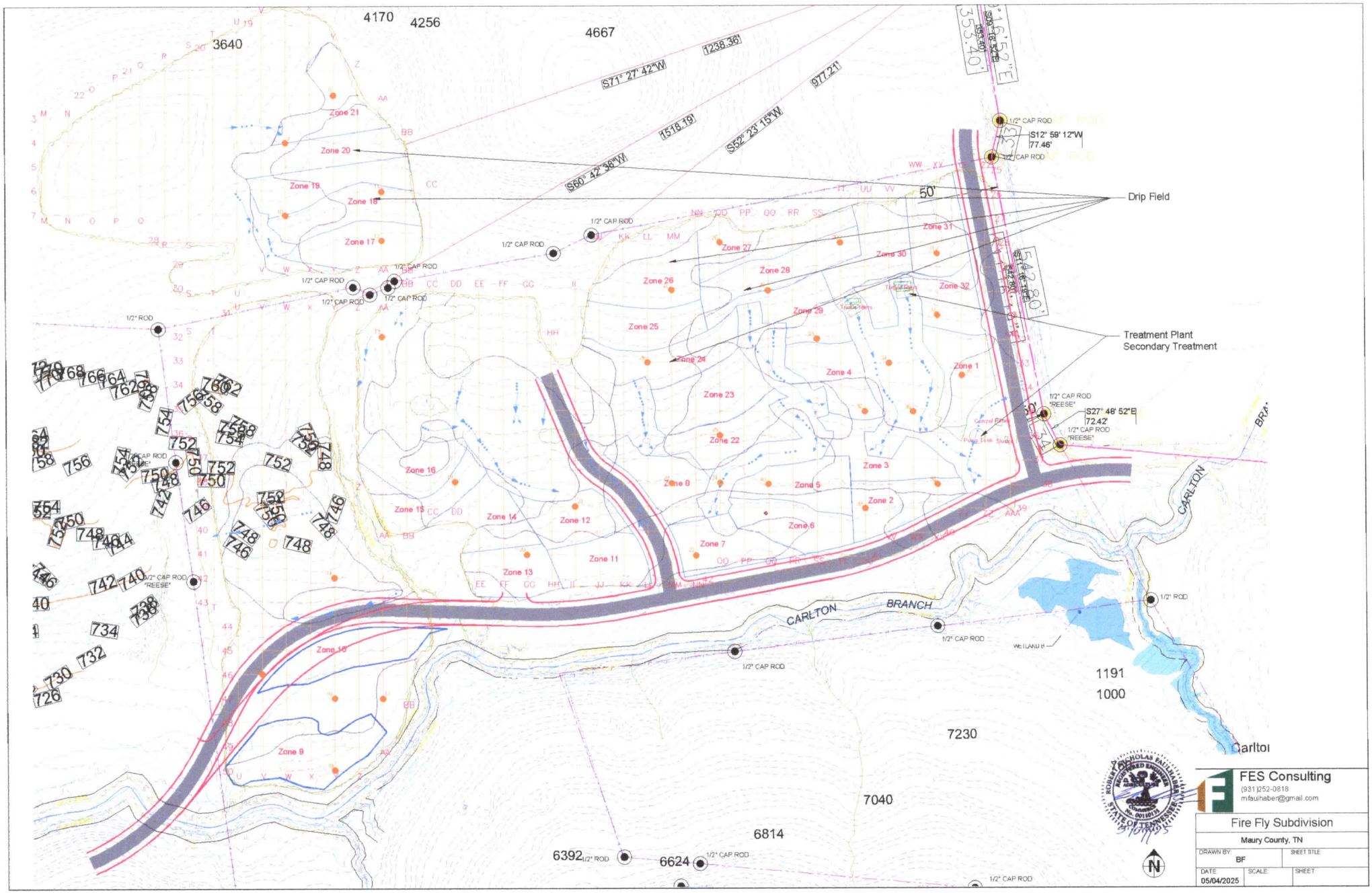
4170
4256
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1238.36'
S71° 27' 42"W
977.21'
1518.19'
S52° 23' 15"W
S60° 42' 38"W
S12° 59' 12"W
77.46'
1/2" CAP ROD
Drip Field
50'
Treatment Plant
Secondary Treatment
S27° 48' 52"E
72.42'
1/2" CAP ROD "REESE"
1/2" ROD
CARLTON BRANCH
CARLTON
Zone 1
Zone 2
Zone 3
Zone 4
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FES Consulting
(931)252-0818
mfaulhaber@gmail.com
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Maury County, TN
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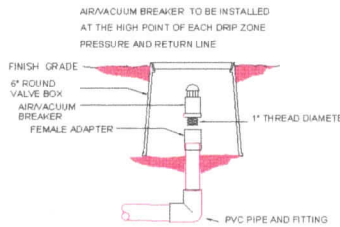

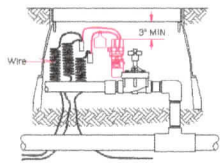

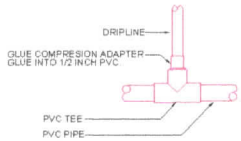

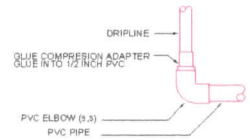

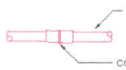

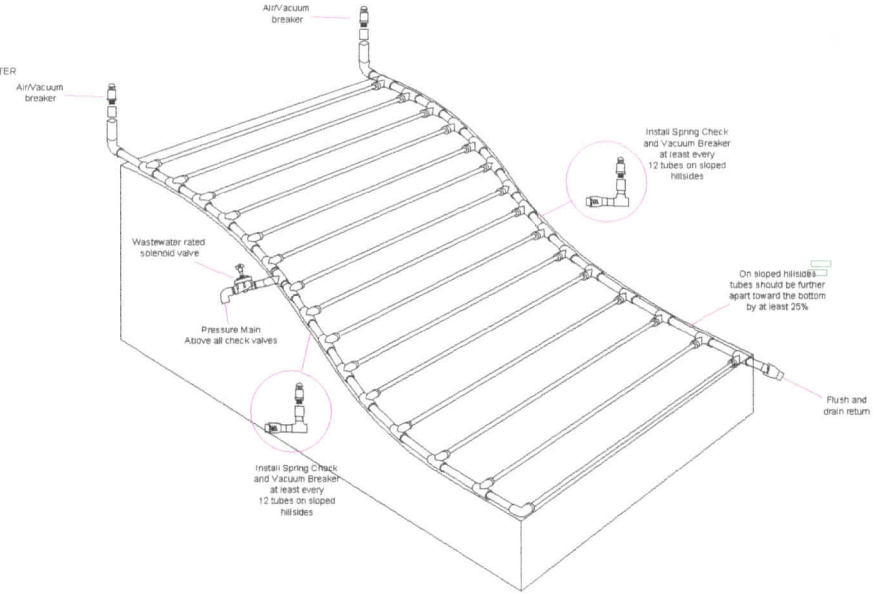

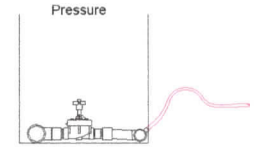

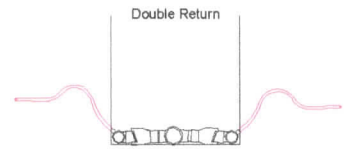

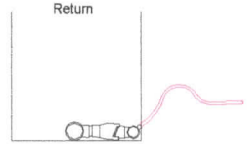

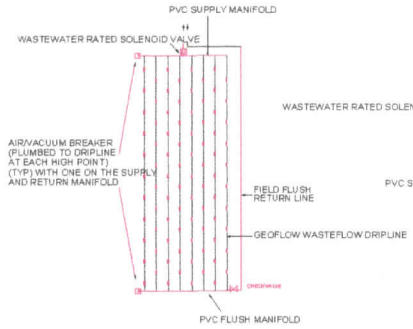

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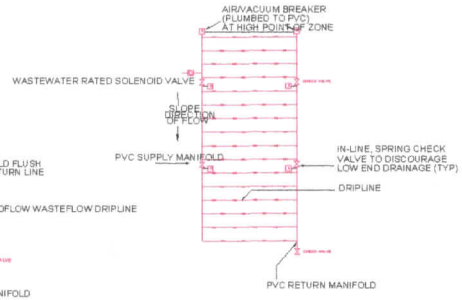
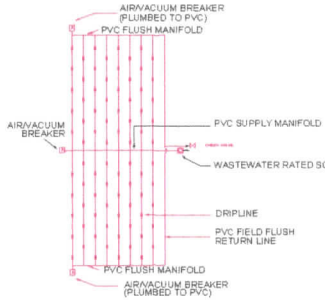


SLOPE LAYOUT FOR SINGLE ZONE
WASTEFLOW PRESSURE COMPENSATING DRIPLINE



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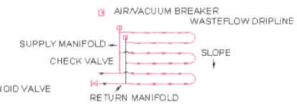

SINGLE ZONE LOOPED SYSTEM SCHEMATIC

FES Consulting
(931)252-0818
rnfaulhaber@gmail.com

Fire Fly Subdivision

Maury County, TN

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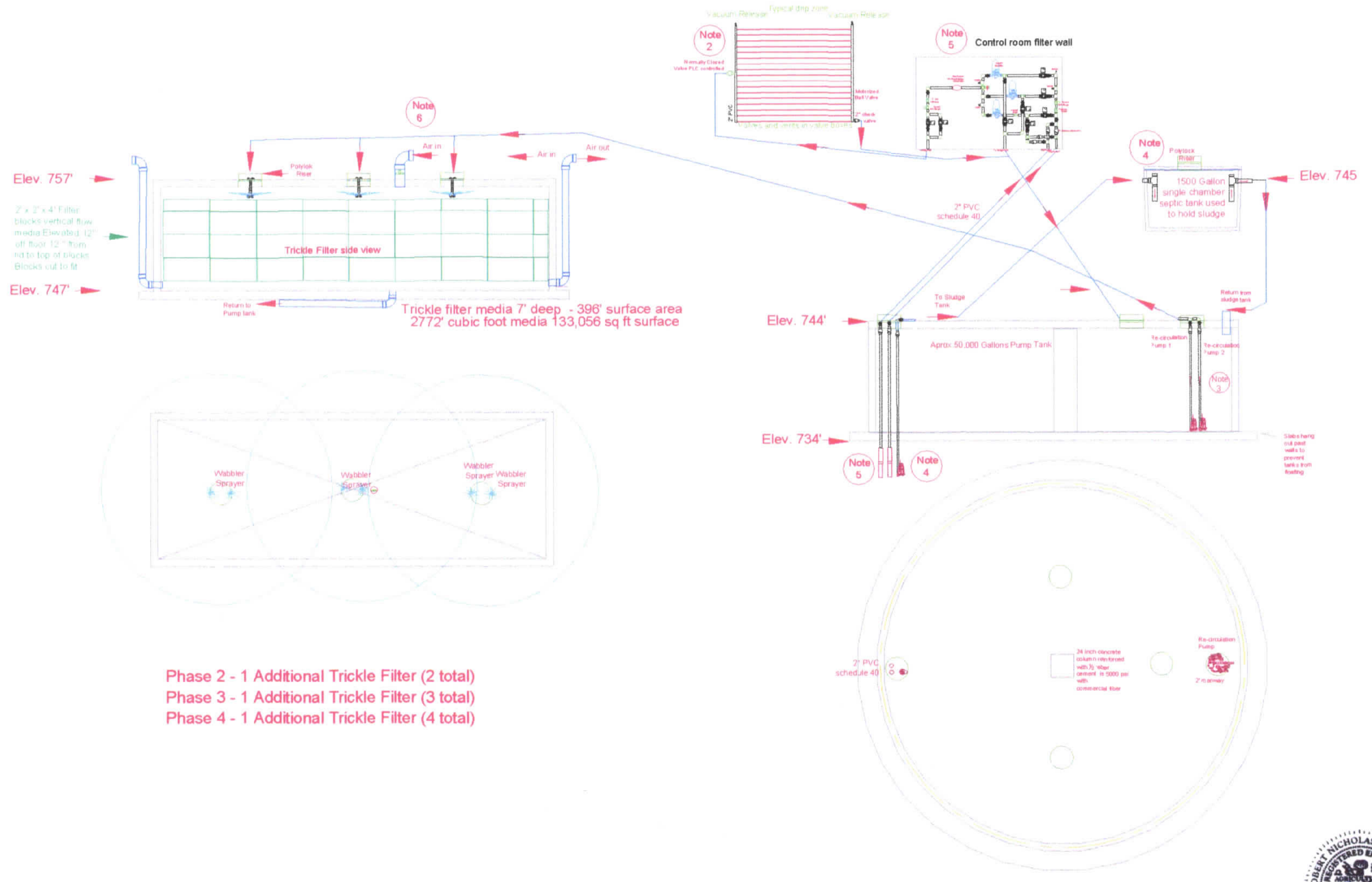
Phase 1 - 1 Trickle Filter


Elev. 757'
Elev. 747'
Note 6
Air in
Air out
Trickle Filter side view
Trickle filter media 7' deep - 396' surface area
2772' cubic foot media 133,056 sq ft surface
Wabbler Sprayer
Note 2
Note 5
Control room filter wall
Note 4
1500 Gallon single chamber septic tank used to hold sludge
Elev. 745
2" PVC schedule 40
Elev. 744'
Aprox 50,000 Gallons Pump Tank
Elev. 734'
Note 3
Phase 2 - 1 Additional Trickle Filter (2 total)
Phase 3 - 1 Additional Trickle Filter (3 total)
Phase 4 - 1 Additional Trickle Filter (4 total)

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(931)252-0818
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Fire Fly Subdivision
Maury County, TN

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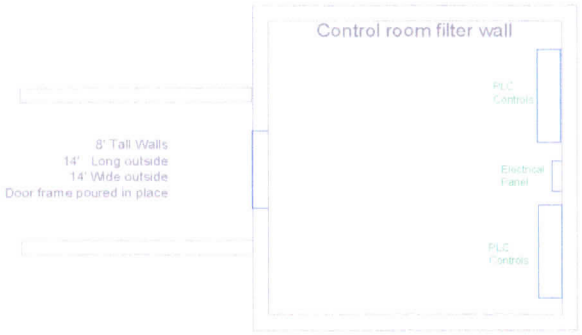
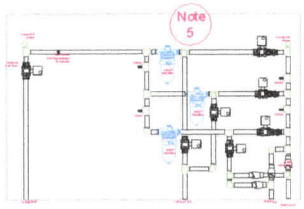
Control Room Top View



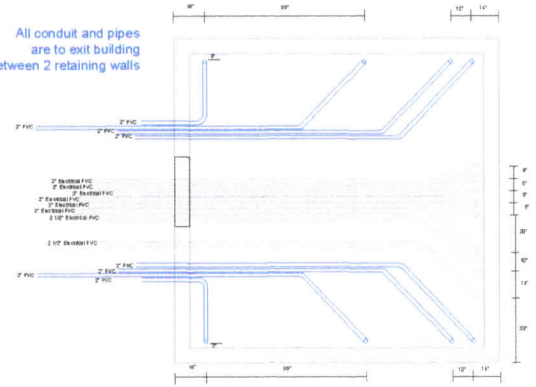
Control room filter wall

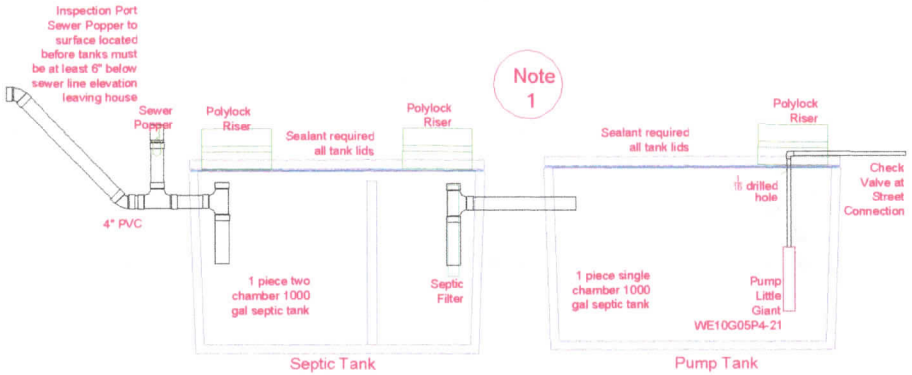


Control Room Side View

Control room under slab conduit

All conduit and pipes are to exit building between 2 retaining walls





FES Consulting
(931)252-0818
mfaulhaber@gmail.com

Fire Fly Subdivision

Maury County, TN

DRAWN BY:	SHEET TITLE:
BF	
DATE: 05/04/2025	SCALE:
	SHEET:

Note 1

Each home or commercial site will be required to have a separate septic tank which follow utility requirements , there will be a combination of 2 possible types of tanks at any location, STEG or STEP.

The STEG tanks will be a 1 piece concrete septic tank with 2 compartments. The 2 piece concrete tanks that have the joint in the side sealed with sealant will not be allowed. Our experience with these tanks show they tend to leak at this joint. If there is no other option, a plastic tank may be accepted. Each tank will have a sewer popper device that allows sewage to escape in case of a line failure, protecting the home from flooding. Use of 4 inch schedule 40 PVC pipe will be required. Each septic tank will have 2 Polylok risers to the surface. This allows easy access for the utility to service these tanks and prevents the homeowner from later building a structure over the tank by accident. The utility assumes all regular and emergency maintenance of these tanks. Each tank will have a septic tank filter restricting solids passage to 1/8 inch, protecting all downstream components. Each tap will have a clean out type access point where it enters the main line. This allows line location quick access and the ability to isolate customers disposing of anything other than domestic sewage.

The STEP type system would be used if a gravity flow from the septic tank is not practical. These systems contain all the features of the STEG tank, but with the addition of a 1 piece single chamber septic dosing tank with one Polylok riser to the surface. These tanks must also follow utility requirements which include: two pumps (Little Giant WE10G05P4-21) with 3 floats in each dosing tank with a small PLC control panel. Our experience has established that 95% of problems at each home on STEP systems will be a pump or float that is bad. Pump selection being a high head type, assures flow from any elevation in the subdivision and this is a pump that the utility already stocks. The PLC at each home alternates each pump. If after 5 hours of pumping the level in the tank has not fallen, the pump is considered bad and the second pump is turned on. A Yellow light is illuminated flashing a code that the pump is bad. A buzzer goes off asking the homeowner to call the utility for service. If the second pump does not lower the water level in the dosing tank, a second buzzer and red light lets the homeowner know that Immediate service is required. (See panel label). The PLC software has many other such redundant features to make sure each home operates.

AQUA GREEN UTILITY

Red Light - High Water Level Alarm!
If power has been out, it
may take 2 hrs for tank
to pump water down.
If alarm is still on,
call 865-908-0432 immediately.

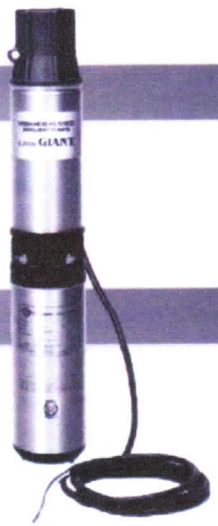
Press switch down to silence
buzzer, press switch back
up for normal operation
when red light goes off.

Yellow Light - Push button to silence.
System needs maintenance.
Please call 865-908-0432.

Green Lights - Should be on, showing that
power is on.
If not, reset your 2 circuit
breakers in your house.

EFFLUENT PUMPS

WE SERIES 1/2 HP



APPLICATIONS

- High head filter effluent • Filtered effluent service • Aeration
- Ornamental fountains • Water fountains

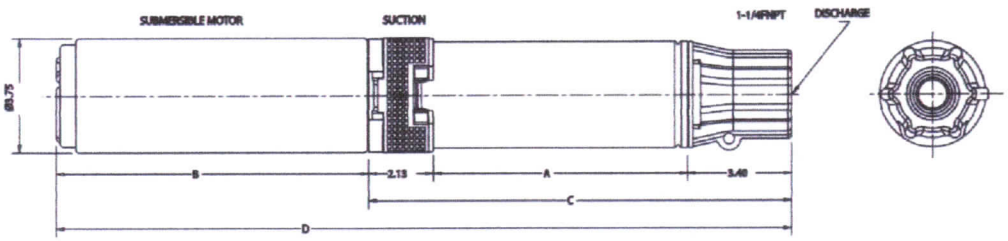
FEATURES

- Franklin Electric submersible motor
- Heavy duty, 300 V, 10' (3 m) SJOW motor stripped leads
- Removable built-in check valve
- Non-corrosive thermoplastic discharge and motor brackets
- Proven "PPO" staging allows close tolerances and increased performance
- High quality top bearing for maximum durability and years of reliable service
- Hex rubber bearing has extra-large surface for shaft stability and multiple flow channels for keeping particles away from bearing surfaces
- Stainless steel up thrust washer prevents excessive wear in service applications
- cCSAus listed

SERIES SPECIFICATIONS

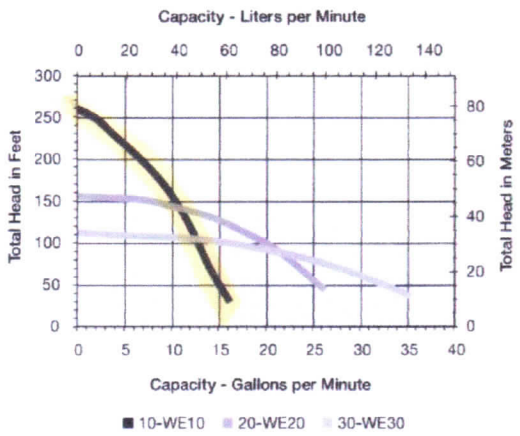
Item No	Model	HP	Volts	Hz	Amps		Watts	Wires	Well Size	Performance (GPM @ Height in Feet)				
					FLA	Start				50'	100'	150'	200'	250'
558221	WE10G05P4-21	1/2	115	60	10	64.4	670	2	4"	15	13	10	7	2
558222	WE10G05P4-22	1/2	230	60	5	23.2	670	2	4"	15	13	10	7	2
558223	WE20G05P4-21	1/2	115	60	10	64.4	670	2	4"	26	20	8	–	–
558224	WE20G05P4-22	1/2	230	60	5	23.2	670	2	4"	26	20	8	–	–
558225	WE30G05P4-21	1/2	115	60	10	64.4	670	2	4"	32	14	–	–	–
558226	WE30G05P4-22	1/2	230	60	5	23.2	670	2	4"	32	14	–	–	–

ENGINEERING DATA



Model	A	B	C	D
2-Wire 10 gpm	7" 17.78 cm	9.38" 23.83 cm	12.53" 31.83 cm	21.91" 55.65 cm
2-Wire 20 gpm	9" 22.86 cm	9.38" 23.83 cm	14.53" 36.91 cm	23.91" 60.73 cm
2-Wire 30 gpm	6.5" 16.51 cm	9.38" 23.83 cm	12.03" 30.56 cm	21.41" 54.38 cm

PERFORMANCE DATA



CONSTRUCTION

Motor Housing	Stainless steel
Impeller Material	Celcon
Diffuser	Glass-filled PPO
Power Cord	10' SJOW
Check Valve	Celcon
Fasteners	Stainless steel
Shaft	Stainless steel
Bearings	PEEK
Discharge	Glass-filled polypropylene

Note 2

The drip field is divided into zones. Each zone the same basic components starting with a pressure main. The pressure main connects to zones with solenoid valves. Then the zones of drip tubing connect to a main which is connected to a return main through a one way check valve. Each zone has a air vent to stop a vacuum from being created.

Note 3

Two alternating pumps controlled by the PLC will recirculate effluent from the pump tank to the trickling filter. The water will be distributed through 6 wobbler spray heads per filter. Liberty FL202M pumps were chosen. There will be 1 set of pumps per 2 filters. There will be 1 PLC control system for 2 filters and each 16 zones. From pump tank to trickling filter there is 20' elevation loss and 400' 4 inch pipe with 8 foot of FL head. The wobblers work at about 10 psi or 23 foot of head. This gives a total 51 foot of head loss needed. These pumps should deliver approximately 93 GPM or 133,920 GPD each. PLC controls both pumps run time and allows any set number of seconds on and not more than 5 minutes off. The sewage flow from the neighborhood will flow over the wobbler spray heads giving additional 31,950 GPD to each filter at capacity.

FL100, FL150 and FL200-Series

Technical Specifications

External Construction:

Pump Volute – Gray iron casting class 25
Pump Legs – Gray iron casting class 25
Motor Cover – Gray iron casting class 25
All casting shall be powder coated for corrosion resistance prior to assembly.

Motor:

Submersible, oil filled and hermetically sealed. Class B insulation rating. 416 Stainless steel rotor shaft. Thermally Protected – single phase models. Three phase models shall have heat breakers incorporated into the control panel, properly sized for the horsepower and amperage of the pump.

Impeller:

2 vane, semi-open design. Cast iron construction.

Dual Shaft Seals:

FL100-Series feature upper unitized carbon ceramic and lower Viton double lip

FL150 and FL200-Series feature upper unitized silicon carbide, lower Viton double lip

Fasteners:

All fasteners shall be 300-series stainless steel.

Power Cord:

25' length standard. Quick-disconnect design allows easy field replacement.

Level Control:

The pump shall be controlled by a wide angle mechanical float sealed in a PVC housing. The float shall have a series plug for manual by-pass operation.

A water-stop seal shall be incorporated into the cord entry to eliminate potential water wicking into the switch.

An adjustable clamp is provided for optional pipe mounting of the float.

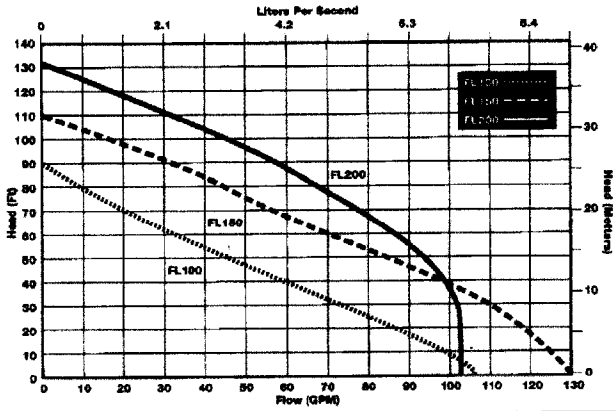
Discharge:

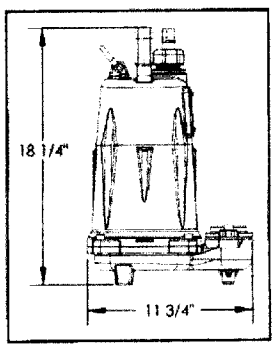
2" FNPT with 1-1/2" FNPT cast iron flange provided.

Model	hp.	Volts	Phase	Amps	Discharge	Automatic	Cord Length	Wgt. Lbs.
FL102M	1	208-230	1	12	1-1/2" & 2"	No	25'	71
FL102A	1	208-230	1	12	1-1/2" & 2"	Yes	25'	72
FL103M	1	208-230	3	9	1-1/2" & 2"	No	25'	71
FL104M	1	440-480	3	4.5	1-1/2" & 2"	No	25'	71
FL152M	1-1/2	208-230	1	15	1-1/2" & 2"	No	25'	81
FL152A	1-1/2	208-230	1	15	1-1/2" & 2"	Yes	25'	82
FL153M	1-1/2	208-230	3	10.6	1-1/2" & 2"	No	25'	81
FL154M	1-1/2	440-480	3	5.3	1-1/2" & 2"	No	25'	81
FL202M	2	208-230	1	15	1-1/2" & 2"	No	25'	82
FL202A	2	208-230	1	15	1-1/2" & 2"	Yes	25'	83
FL203M	2	208-230	3	10.6	1-1/2" & 2"	No	25'	82
FL204M	2	440-480	3	5.3	1-1/2" & 2"	No	25'	82

NOTE: 3-phase models require a control panel for automatic operation. See simplex and duplex panel literature for complete information.

Performance Curve FL100, FL150 and FL200-Series





SSPMA Certified

C SP US
Certified

Specifications subject to change without notice.

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www.libertypumps.com

Note 4

To maintain sludge removal without needing to stop plant treatment operations, a sludge removal pump will be located in the main dosing tank. The designed pumping rate is 25 GPM for 1 minute intervals. With several hours between pumping, this will give the sludge time to settle out in the sludge tank. A 2 inch schedule 40 PVC pipe approximately 55 foot long will go from the sludge pump to the sludge tank with FL = 1 foot of head and velocity of 2.49 fps. The elevation loss from the dosing tank to sludge tank is 10 foot of head. Fittings are estimated at FL of 1 foot of head. Total head is 12. A Liberty Model 281 pump has been selected and is an energy saving model. The Liberty 281 is also a normally stocked item for the utility. A tee will be located at the exit end of the septic tank with a schedule 40 4 inch PVC pipe, which will flow by gravity back into the return pipe as it leaves the trickling filter.

The sludge tank will be a 1500 gallon single chamber septic tank. The tank will have a Polylok riser located in the center of the lid. This lid will allow a septic tank pumper to remove the sludge. Once removed, the sludge will be transported to a proper disposal facility such as a municipal treatment plant.

Liberty Pumps®

280-Series

Cast Iron Submersible Effluent/Sump Pumps

1/2 hp
1-1/2" Discharge
3/4" Solids Handling

Features:

- Liberty's unique, one-piece "Uni-Body" casting
- Quick-disconnect 10' standard power cord allows replacement of cord in seconds without breaking seals to motor (other lengths available)
- Permanently lubricated upper and lower bearings
- Oil-filled, hermetically sealed motors with thermal overload protection
- Stainless steel, removable bottom screen
- Stainless steel rotor shaft
- Stainless steel fasteners

115 V. Models:

280 Manual

281 Wide-Angle Float with Quick Disconnect

283 Wide-Angle Float, Series Plug

287 VMF, vertical magnetic float for heavy-duty sump pump applications

208-230 V. Models:

280HV Manual

281HV Wide-Angle Float with Quick Disconnect

283HV Wide-Angle Float, Series Plug

287HV Vertical Magnetic Float (VMF) Switch

Wide-Angle Floats are mercury-free, mechanically activated.

evolve.

280-SERIES

1/2 hp Submersible Effluent/Sump Pumps

The Liberty 280-Series provides a cost effective "mid-range" pump for on-site waste water systems, liquid waste transfer and commercial heavy-duty sump pump applications that require higher head or more flow. Designed around Liberty's unique "Uni-Body" casting, the 280-Series will provide years of reliable performance.

All Models Feature:

- Vortex style impeller permitting passage of solids up to ¾"
- 416 stainless steel rotor shaft
- Permanently lubricated upper and lower ball bearing
- Epoxy powder coat finish
- All fasteners – corrosion-resistant stainless steel
- 1½" Discharge
- Stainless steel bottom screen – easily removable
- Maximum fluid temperature: 140° F.
- **280-Series Cord Lengths**

Model	10'	25'(-2)	35'(-3)	50'(-5)
280	Standard	Optional	Optional	Optional
281	Standard	Optional	Optional	Optional
283	Standard	Optional	Optional	N/A
287	Standard	Optional	N/A	N/A

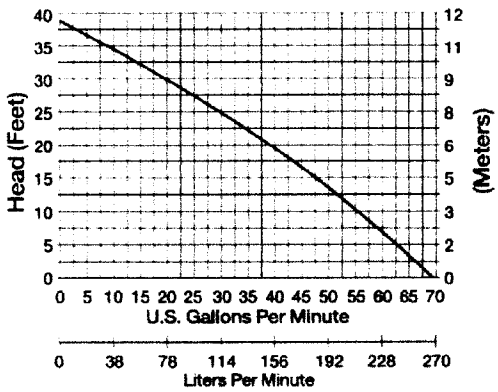
10' cord length standard on all models. For optional lengths, add "-2, -3 or -5" suffix to model number.
Example: for model 280 with 35' cord, order 280-3

Motor Specifications

½ hp 60 Hz 3450 RPM
Oil filled, thermally protected

115 V. Models 8.5 amps
208/230 V. Models 4.6 amps

Performance Curve: 280-Series



Dimensional Data:

Weight: 29 lbs.
Height: 13"
Major Width: 10" (model 287)

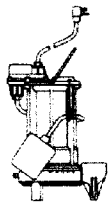
Minimum Sump Diameters:

Model 281, 283...14"
Model 287 VMF...10"

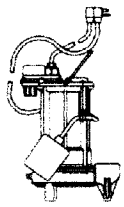
Factory switch settings	Model 281, 283	Model 287 VMF
Turn on level	13"	9.5"
Turn off level	7"	4.0"

The Model 283 features a fully adjustable wide-angle float. Differential adjustments can be made easily by tethering the float to the discharge pipe or other mounting point. Vertical float model 287 is not adjustable.

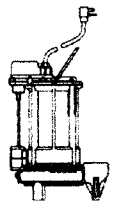
Model 280 Manual, no switch



Model 281 Wide angle float switch with quick-disconnect



Model 283 Wide angle float switch with series (piggy-back) plug



Model 287 VMF-Series Vertical magnetic float for smaller pits – will operate in a 10" diameter sump

SSPMA Certified c US Certified

Specifications are subject to change without notice.

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Note 5

This wall in the control room is dedicated to the drip field filtering and pumping. For the first 2 phases a second wall will be built for the 3rd and 4th phases. There are two alternating PLC controlled pumps located in the main dosing tank (J Class 45HE2S4-PE for phase 1 & 2 then 2 more added for phase 3 & 4). These pumps feed through 3 inch schedule 40 PVC pipe approximately 2100-foot-long Fl = 15 ft head. The flow to the drip field at a normal rate will be approximately 51 gallons per and minute 80 GPM during flush cycle when 2 pumps operate. There are approximately 3328 emitters per zone at .92 gallons per hour for each emitter. During back flush, approximately 80 GPM is needed. The PLC controls automatically brings both pumps online during back flush providing extra flushing. 146 max total foot of head needed. This pump at 51 GPM produces 67 PSI below the rated drip tube pressure of 70 PSI. 3328 emitters at .92 per hour equals 51 GPM.

As the effluent enters the filter wall, it passes two check valves then flows to the motorized Ball valves. These valves open when the PLC starts pumping to the drip field. There are 3 total filter lines to the drip field. If one of these lines stops up, the PLC will send an alert to utility personnel as determined by the pressure switches. The two remaining lines will provide ample flow to continue operations. Next, the effluent passes through the Arkal 130 micron 2 " disk filters. By closing and opening the motorized ball valves, the PLC can back flush each disk filter to keep the filters clean and flowing. The disk filters are cleaned at the beginning of each pump cycle or any time the differential pressure switch activates showing clogging back pressure. The filters are back flushed with effluent filtered by the other two filters. During back flushing operations, the solenoid valve leading to the drip fields is closed to maximize back flush pressure. Effluent used for flushing is then sent to the non pumping drip pump to clear it's intake screens. The solenoid valve before one filter is closed and the solenoid valve between it and the filter is opened for 40 seconds, then the PLC moves on to the next filter line and so on.

After the filters, there is a flow meter in line that allows the PLC to keep track of how much effluent is pumped out to the drip field. Each zone has a flow setting that if exceeded (like a leak) that zone is turned off until repairs are made. There is a final PSI switch before the effluent goes out to the drip field that tells the PLC if a solenoid did not open at one of the zones when it was turned on. During the first 4 minutes of pumping, the current zone solenoid valve opens and flushes the drip tubing at 2 ft per second keeping it clean inside. The current zone is flushed each time the pumping cycle starts.

The pipe to and from the drip field is a maximum of 2100 feet. (Zone 21) Because accuracy is of paramount in drip field calculations, a spreadsheet chart is provided for the worst case zone. The tubing manufacturers charts and calculations were used in the calculations. The friction loss of 1/3 of the flow to each the disk filters is so low it is not considered. The friction loss in 1/3 of flow to the 2 inch PESB solenoid valve are also not considered because it is so low. The friction loss from the main plant tank to the filters is 1.8 foot of head. The chosen pump shows ample capability to provide necessary flow and pressure. With extra pressure available, each solenoid valve at each zone will as needed be equipped with an adjustable pressure regulator (PRS Dial). These valves and filters are normally stocked items for the utility.

E-SERIES

EFFLUENT PUMPS

Ideal for filtered effluent service, aeration, and ornamental fountains and waterfalls, equipped with the power, performance, and reliability you expect from Franklin Electric.

franklinwater.com

Franklin Electric

J-CLASS

E-SERIES EFFLUENT PUMPS

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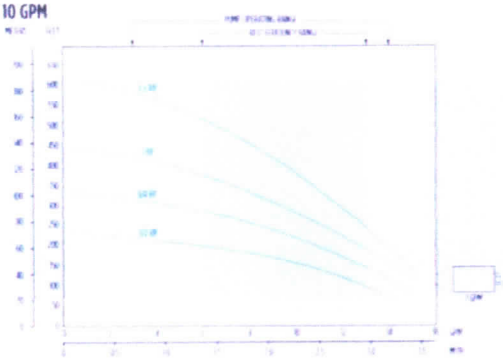
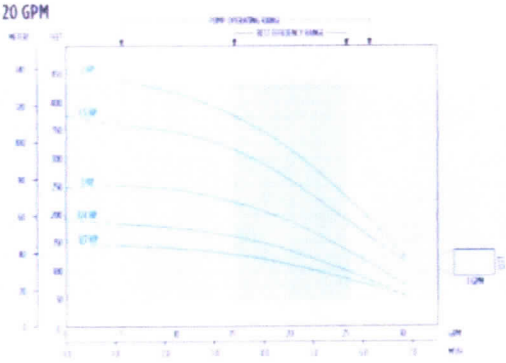
10 GPM



20 GPM



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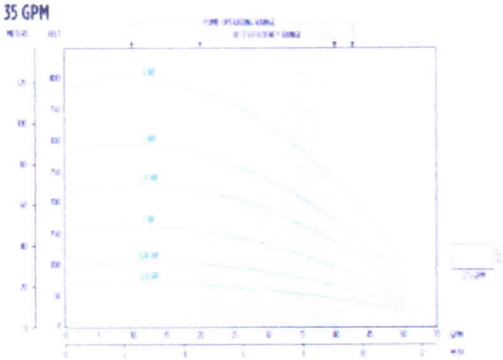
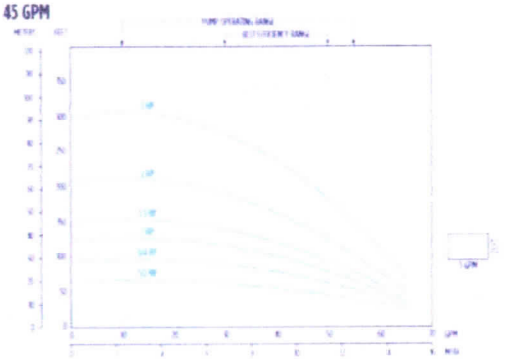
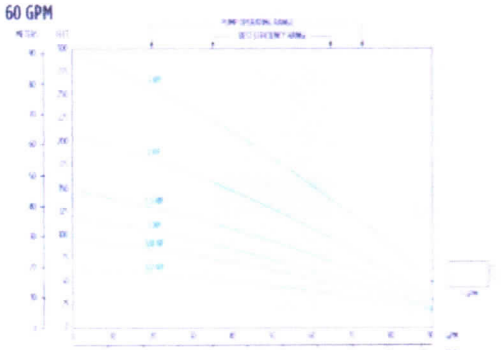
35 GPM



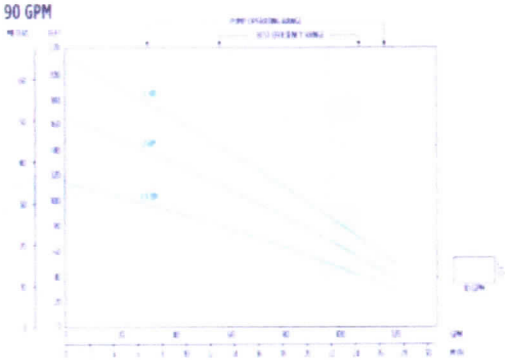
45 GPM



60 GPM



90 GPM



E-SERIES EFFLUENT PUMPS

GPM	HP	Stages	Dimensions (in)			Wt. (lbs)	
			A	B	C	PE	PMA
10	1/2	6	12.97	9.51	22.48	7	25
	3/4	8	14.59	10.64	25.23	8	29
	1	11	17.44	11.73	29.17	9	33
	1.5	9	21.04	15.10	36.14	12	41
20	1/2	6	12.97	9.51	22.48	7	25
	3/4	5	13.65	10.64	24.29	8	29
	1	7	16.10	11.73	27.42	8	32
	1.5	10	19.77	15.10	34.87	11	41

NOTE: PE = Pump end only, PMA = Pump and motor assembly. Maximum diameter with cable guard is 5.46"

Thermoplastic

GPM	HP	Stages	Dimensions (in)			Wt. (lbs)	
			A	B	C	PE	PMA
35	1/2	2	9.1	9.5	18.6	6	24
	1/2	2	9.1	9.5	18.6	6	24
	3/4	3	10.3	10.7	21.0	7	28
	1	5	12.9	11.7	24.6	8	32
	1.5	7	15.4	15.1	30.5	9	38
	2	9	17.1	15.1	32.2	11	44
	3	12	20.9	19.0	40.0	12	53
45	1/2	2	9.1	9.5	18.6	6	24
	1/2	2	9.9	9.5	19.4	9	27
	3/4	3	14.2	10.6	24.9	10	32
	1	4	16.5	11.7	28.2	11	35
	1.5	5	18.6	15.1	33.7	14	43
	2	7	17.6	15.1	32.7	10	43
	3	10	22.9	19.0	41.9	11	52
60	1/2	2	9.9	9.5	19.4	10	28
	1/2	2	9.9	9.5	19.4	10	28
	3/4	3	12.1	10.6	22.7	11	32
	1	4	14.1	11.7	25.8	12	35
	1.5	5	16.5	15.1	31.6	13	44
	2	7	17.6	15.1	32.6	10	44
	3	10	33.3	19.0	52.3	13	54
90	1.5	4	17.1	15.1	32.4	14	41
	2	6	23.4	15.1	38.5	11	42
	3	8	31.4	19.0	50.4	13	52

NOTE: PE = Pump end only, PMA = Pump and motor assembly. Maximum diameter with cable guard is 5.90"

Stainless Steel

Franklin Electric

E-SERIES EFFLUENT PUMPS

- Ideal for effluent pumping applications
- Stainless steel or thermoplastic discharge and motor bracket are tough and non-corrosive. Both materials are highly resistant to damage by minerals, metals, and other substances typically found in water
- Heavy-duty, 300 V, 10' SJOOW motor leads
- Designed to provide years of reliable service:
  - 10 and 20 gpm units are equipped with a highly-engineered shaft bearing with built in dry-run protection
  - High-flow 35 to 90 gpm units are built with a proven and durable ceramic sleeve bearing
- Water flow path through the discharge of the pump is designed to pass particulate to allow for efficient and continuous operation
- Proven hydraulic staging allows close tolerances and increased performance
- Carbon phenolic upthrust washer prevents excessive wear in severe applications
- Removable built-in check valve on 10-20 gpm pumps. No built-in check valves on high capacity pumps
- Powered by a Franklin Electric submersible motor

THERMOPLASTIC ORDERING INFORMATION

1/2 - 1.5 HP Single-Phase Units					
GPM	HP	Volt	Wire	Model	Order No.
10	1/2	115	2	10FE05P4-2W115	94741005
	1/2	230	2	10FE05P4-2W230	94741010
	3/4	230	2	10FE07P4-2W230	94741015
	1	230	2	10FE1P4-2W230	94741020
	1.5	230	2	10FE1SP4-2W230	94741025
20	1/2	115	2	20FE05P4-2W115	94742005
	1/2	230	2	20FE05P4-2W230	94742010
	3/4	230	2	20FE07P4-2W230	94742015
	1	230	2	20FE1P4-2W230	94742020
	1.5	230	2	20FE1SP4-2W230	94742025

THERMOPLASTIC PUMP ENDS

1/2 - 2 HP Pump Ends				
GPM	HP	Stages	Model	Order No.
10	1/2	6	10FE05P4-PE	94751005
	3/4	8	10FE07P4-PE	94751010
	1	11	10FE1P4-PE	94751015
	1.5	15	10FE1SP4-PE	94751020
20	1/2	4	20FE05P4-PE	94752005
	3/4	5	20FE07P4-PE	94752010
	1	7	20FE1P4-PE	94752015
	1.5	10	20FE1SP4-PE	94752020
	2	12	20FE2P4-PE	94752025

NOTES: Discharge is 1-1/4" NPT, maximum diameter across cable guard is 1.90" on all models.

STAINLESS STEEL ORDERING INFORMATION

1/2 - 1.5 HP Single-Phase Units (2 Wire)					
GPM	HP	Stages	Volts	Model	Order No.
35	1/2	2	115	35HE05S4-2W115	93933505
	1/2	2	230	35HE05S4-2W230	93933510
	3/4	5	230	35HE07S4-2W230	93933515
	1	5	230	35HE1S4-2W230	93933520
	1.5	7	230	35HE1SS4-2W230	93933525
45	1/2	2	115	45HE05S4-2W115	93934535
	1/2	2	230	45HE05S4-2W230	93934530
	3/4	3	230	45HE07S4-2W230	93934535
	1	4	230	45HE1S4-2W230	93934520
	1.5	5	230	45HE1SS4-2W230	93934525
60	1/2	2	115	60HE05S4-2W115	93936005
	1/2	2	230	60HE05S4-2W230	93936010
	3/4	3	230	60HE07S4-2W230	93936015
	1	4	230	60HE1S4-2W230	93936020
	1.5	5	230	60HE1SS4-2W230	93936025
90	1.5	4	230	90HE1SS4-2W230	93939025

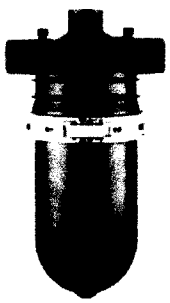
NOTE: Discharge is 1" NPT with no built-in check valve, maximum diameter across cable guard is 1.83" on all models.

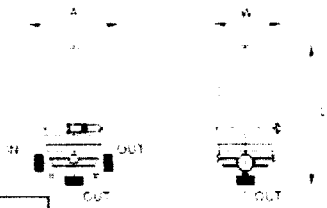
STAINLESS STEEL PUMP ENDS

1" - 10 HP 4" High Capacity Pump Ends				
GPM	HP	Stages	Model	Order No.
35	1/2	2	35HE05S4-PE	93923502
	3/4	3	35HE07S4-PE	93923503
	1	5	35HE1S4-PE	93923505
	1.5	7	35HE1SS4-PE	93923507
	2	9	35HE2S4-PE	93923509
	3	12	35HE3S4-PE	93923512
45	1/2	2	45HE05S4-PE	93924502
	3/4	3	45HE07S4-PE	93924503
	1	4	45HE1S4-PE	93924504
	1.5	5	45HE1SS4-PE	93924505
	2	7	45HE2S4-PE	93924507
	3	10	45HE3S4-PE	93924510
60	1/2	2	60HE05S4-PE	93926002
	3/4	3	60HE07S4-PE	93926003
	1	4	60HE1S4-PE	93926004
	1.5	5	60HE1SS4-PE	93926005
	2	7	60HE2S4-PE	93926007
	3	10	60HE3S4-PE	93666010
90	1.5	4	90HE1SS4-PE	93929004
	2	6	90HE2S4-PE	93929006
	3	8	90HE3S4-PE	93929008

ARKAL
FILTRATION SYSTEMS

Arkal 2" Dual Filter with a detachable spine





Angle/Line Filter

Catalog No. 1204 0_ _ _

Features

- 2 Outlet options – in line or angle
- Non-corrosive
- Detachable spine
- Pressure differential disc compression
- Robust design
- Drain valve at the bottom (optional)
- High volume filter with increased flow capacity
- Adapts to horizontal or vertical installation
- Easy clamp-on filter cover
- Pressure testing ports at filters inlet and outlet
- Available in various filtration grades

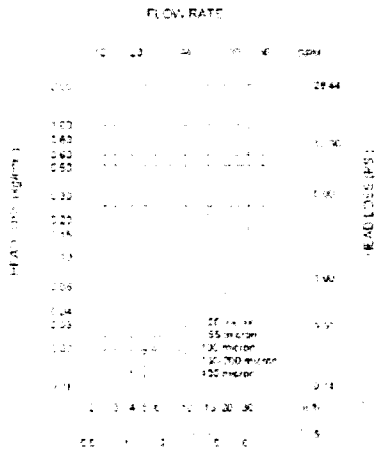
Technical Data

Inlet/outlet diameter	2" BSPT (male) 50 mm – nominal diameter	2" NPT (male)
Maximum pressure	12 atm	168 psi
Max flow rate	25 m^3/h	110 gpm
General filtration area	953 cm^2	148 in^2
Filtration volume	1225 cm^3	75 in^3
Filter length	465 mm	18 5/8"
Housing diameter	200 mm	7 7/8"
Distance between end connections	A = 76 mm B = 130 mm	A = 3" B = 5 1/8"
Outer diameter of filter element	115 mm	4 17/32"
Length of filter element	261 mm	10 3/16"
Weight	5 kg	11 pounds
Maximum temperature	70° C	158° C

Filtration Grades

Blue	(400 micron / 40 mesh)
Yellow	(200 micron / 80 mesh)
Red	(130 micron / 120 mesh)
Black	(100 micron / 140 mesh)
Green	(55 micron)
Grey	(20 micron)

Head Loss Chart



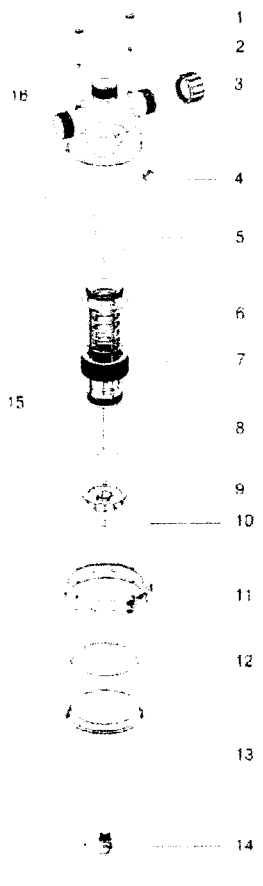
ARKAL
FILTRATION SYSTEMS

Arkal 2" Dual Filter with a detachable spine

Part List

No.	Cat. No.	Description	Materials
1	2511 0103	Gauge port nut (single unit)	RPP
2	5006 0004	Gauge port seal (single unit)	EPDM
3	2511 0200	2" Cap	RPA
4	5019 0112	½" Plug	PP
5	5003 2238	O-ring 2-238	EPDM
6	2502 0212	Spine	RPP
7	2021 1___	Disc set	PP
8	2502 0214	Spine extension	PP
9	2506 0211	Fixing nut	RPP
10	5040 1010	Fastening bolt	SS
11	5042 0030	Clamp	SS
12	5005 0002	Cover seal	EPDM
13	2501 0220	Filter cover	RPA
	2202 0022	Filter cover with stoper with ½" threaded	RPA
	2501 9220	Transparent cover with stopper	RPA
14	5054 0212	½" x ¼" Tap (*)	BRASS
15	2121 1___	Filter element	
16	2204 0001	Filter body complex BSP	
	2204 0002	Filter body complex NPT	

(*) Optional



Materials

RPP - REINFORCED POLYPROPYLENE
RPA - REINFORCED POLYAMIDE
SS - STAINLESS STEEL
PP - POLYPROPYLENE
PC - POLYCARBONATE

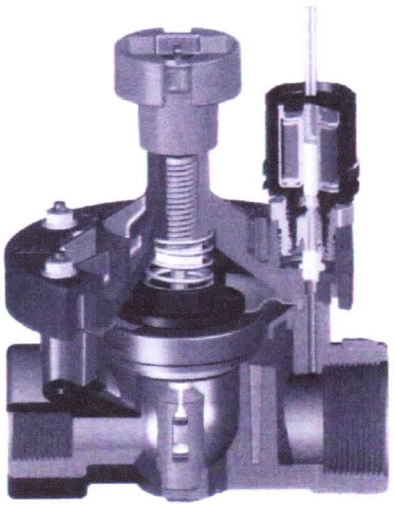
Kibbutz Bet-Zera 15133, ISRAEL Tel. +972-4-6775140 Fax. +972-4-6775461
Email: filters@arkal.com Web: www.arkal-filters.com

ARKAL
FILTRATION SYSTEMS

AK 2" DUAL 9606 /1204EN 11/07

PESB-R Series Valves

Durable Chlorine-Resistant Valves for Reclaimed Water Applications



PESB-R Cutaway

- Reliable operation even in heavily chlorinated water. Valve diaphragm composed of EPDM, a rubber material which is chlorine and chemical resistant
- Plastic valve parts molded of plastic which is chlorine and chemical resistant
- Body constructed of durable glass-filled nylon for long life and heavy-duty performance at 200 psi (13,80 bar) pressure

Features

- One-piece solenoid design with captured plunger and spring for easy servicing. Prevents loss of parts during field service
- PESB-R Conversion Kits also available to convert existing PEB and PESB valves to reclaimed water valve. Kit includes NP handle, sticker, diaphragm assembly, scraper and snap washer
- Stainless steel studs molded into the body. Bonnet can be attached and removed easily without damaging threads
- External bleed protects the solenoid ports from debris when system is flushed.
- Internal bleed operates the valve without allowing water into the valve box; allows pressure regulator to be adjusted without turning on the valve at the controller first
- Low-flow operating capability (0.25 gpm; 0.06 m^3/h; 1,2 l/m) for a wide range of applications
- Slow closing to prevent water hammer and subsequent system damage
- Scrubber mechanism scrapes stainless steel screen clean to break down grit and plant material
- Purple flow control handle standard on PESB-R Series valves
- Compatible with Rain Bird MDC Decoder System

150-PESB-R

How To Specify

100 - PESBR - PRS-D

- **Size** 100: 1" 150: 1 1/2" 200: 2"
- **Model** PESB-R: scrubber model
- **Optional Feature** PRS-D: pressure regulating module

Note: Valve and PRS-D module must be ordered separately.

Options (Order Separately)

- Accommodates optional, field installed PRS-D pressure regulating module to ensure optimum sprinkler performance
- Accepts latching solenoid for use with Rain Bird battery-operated controllers up to 150 psi (10,35 bar)

Operating Range

- Pressure: 20 to 200 psi (1,38 to 13,80 bar)
- Flow: 0.25 to 200 gpm (0,06 to 45,40 m^3 h; 1,2 to 757 l/m)
- Flow with PRS-D: 5 to 200 gpm (1,14 to 45,40 m^3 h; 19,2 to 757 l/m)
- Temperature: up to 150° F (66° C)

Electrical Specifications

- Power: 24 VAC 50/60 cycle solenoid
- Inrush current: 0.41 A (9.84 VA)
- Holding current: 0.28 A (6.72 VA)
- Coil resistance: 30 - 39 ohms

Dimensions

	Height	Length	Width
• 100-PESB-R	6½" (16,5 cm)	4" (10,2 cm)	4" (10,2 cm)
• 150-PESB-R	8" (20,3 cm)	6" (15,2 cm)	6" (15,2 cm)
• 200-PESB-R	8" (20,3 cm)	6" (15,2 cm)	6" (15,2 cm)

Note: The PRS-D option adds 2" (5,1 cm) to valve height

Models

• 100-PESB-R	1" (26/34)
• 150-PESB-R	1½" (40/49)
• 200-PESB-R	2" (50/60)
• 100-PESB-R-WK	1" (26/34) Conversion Kit
• 150-PESB-R-WK	1½" (40/49) Conversion Kit
• 200-PESB-R-WK	2" (50/60) Conversion Kit

BSP threads available, specify when ordering

Recommendations

1. Rain Bird recommends flow rates in the supply line not to exceed 7.5 ft./sec. (2,29 m/s) in order to reduce the effects of water hammer.

2. For flows below 5 gpm (1,14 m^3 h; 19,2 l/m), Rain Bird recommends use of upstream filtration to prevent debris from collecting below the diaphragm.

3. For flows below 1.0 gpm (2,27 m^3 h; 3,78 l/m), Rain Bird recommends the flow control stem be turned down two full turns from the fully open position.

PESB-R Series Valve Pressure Loss (psi)

gpm	100 - 1"	150 - 1½"	200 - 2"
0.25	1.6	-	-
0.5	3.0	-	-
1	1.8	-	-
5	2.9	-	-
10	2.9	-	-
20	2.6	3.5	-
30	5.8	3.1	-
40	10.2	2.3	-
50	16.0	2.1	3.7
75	-	4.3	3.3
100	-	7.5	4.7
125	-	11.9	8.6
150	-	17.0	12.6
175	-	-	14.8
200	-	-	18.9

PESB-R Series Valve Pressure Loss (bar) METRIC

m^3/h	l/m	100 - 1"	150 - 1½"	200 - 2"
0,06	1	0,11	-	-
0,3	5	0,13	-	-
0,6	10	0,15	-	-
1,2	20	0,20	-	-
3	50	0,19	-	-
6	100	0,32	0,22	-
9	150	0,69	0,16	-
12	200	-	0,16	0,25
15	250	-	0,24	0,24
18	300	-	0,33	0,25
21	350	-	0,45	0,30
24	400	-	0,59	0,38
27	450	-	0,75	0,53
30	500	-	0,91	0,67
33	550	-	1,10	0,82
36	600	-	-	0,92
39	650	-	-	1,00
42	700	-	-	1,13
45	757	-	-	1,30

Notes

1. Loss values are with flow control fully open.

2. PRS-D recommended for use in shaded area only.

FRICTION LOSS CHARACTERISTICS PVC SCHEDULE 40 IPS PLASTIC PIPE

(1120, 1220)
C=150
Sizes ½" to 6"
Flows 1 to 900 GPM

PSI Loss of 100 Feet of Pipe (psi per 100 feet)

SIZE	½"	¾"	1"	1 ¼"	1 ½"	2"	2 ½"	3"	4"	6"
I.D.	0.622"	0.824"	1.049"	1.380"	1.610"	2.067"	2.469"	3.068"	4.026"	6.065"
O.D.	0.840"	1.050"	1.315"	1.660"	1.900"	2.375"	2.875"	3.500"	4.500"	6.625"
Wall Thk	0.109"	0.113"	0.133"	0.140"	0.145"	0.154"	0.203"	0.216"	0.237"	0.280"

Flow GPM	Flow GPH	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss	Velocity FPS	PSI Loss
1	60	1.06	0.43	0.65	0.11	0.37	0.03	0.21	0.01	0.16	0.00	0.10	0.00	0.07	0.00	0.04	0.00	0.03	0.00	0.01	0.00
2	120	2.11	1.55	1.29	0.39	0.74	0.12	0.43	0.03	0.32	0.02	0.19	0.00	0.13	0.00	0.09	0.00	0.05	0.00	0.02	0.00
3	180	3.17	3.28	1.93	0.84	1.11	0.26	0.64	0.07	0.47	0.03	0.29	0.01	0.20	0.00	0.13	0.00	0.08	0.00	0.03	0.00
4	240	4.22	5.59	2.41	1.42	1.48	0.44	0.86	0.12	0.63	0.05	0.38	0.02	0.27	0.01	0.17	0.00	0.10	0.00	0.04	0.00
5	300	5.28	8.45	3.01	2.15	1.86	0.66	1.07	0.17	0.79	0.08	0.48	0.02	0.34	0.01	0.22	0.00	0.13	0.00	0.06	0.00
6	360	6.34	11.85	3.61	3.02	2.23	0.93	1.29	0.25	0.95	0.12	0.57	0.03	0.40	0.01	0.26	0.01	0.15	0.00	0.07	0.00
7	420	7.39	15.76	4.21	4.01	2.60	1.24	1.50	0.33	1.10	0.15	0.67	0.05	0.47	0.02	0.30	0.01	0.18	0.00	0.08	0.00
8	480	8.45	20.18	4.81	5.14	2.97	1.59	1.72	0.42	1.26	0.20	0.76	0.06	0.54	0.02	0.35	0.01	0.20	0.00	0.09	0.00
9	540	9.50	25.10	5.41	6.39	3.34	1.97	1.93	0.52	1.42	0.25	0.86	0.07	0.60	0.03	0.39	0.01	0.23	0.00	0.10	0.00
10	600	10.56	30.51	6.03	7.77	3.71	2.40	2.15	0.63	1.58	0.30	0.96	0.09	0.67	0.04	0.43	0.01	0.25	0.00	0.11	0.00
11	660	11.61	36.48	6.62	9.26	4.08	2.86	2.36	0.75	1.73	0.36	1.05	0.11	0.74	0.04	0.48	0.02	0.28	0.00	0.12	0.00
12	720	12.67	42.77	7.22	10.88	4.45	3.36	2.57	0.89	1.89	0.42	1.15	0.12	0.80	0.05	0.52	0.02	0.30	0.00	0.13	0.00
14	840			8.42	14.48	5.20	4.47	3.00	1.18	2.21	0.56	1.34	0.16	0.94	0.07	0.61	0.02	0.35	0.01	0.16	0.00
16	960			9.63	18.54	5.94	5.73	3.43	1.51	2.52	0.71	1.53	0.21	1.07	0.09	0.69	0.03	0.40	0.01	0.18	0.00
18	1,080			10.83	23.06	6.68	7.12	3.86	1.88	2.84	0.89	1.72	0.26	1.21	0.11	0.78	0.04	0.45	0.01	0.20	0.00
20	1,200			12.03	28.03	7.42	8.66	4.29	2.28	3.15	1.08	1.91	0.32	1.34	0.13	0.87	0.05	0.50	0.01	0.22	0.00
22	1,320			13.24	33.44	8.17	10.33	4.72	2.72	3.47	1.28	2.10	0.38	1.47	0.16	0.95	0.06	0.55	0.01	0.24	0.00
24	1,440					8.91	12.14	5.15	3.20	3.78	1.51	2.29	0.45	1.61	0.19	1.04	0.07	0.60	0.02	0.27	0.00
26	1,560					9.65	14.08	5.58	3.71	4.10	1.75	2.49	0.52	1.74	0.22	1.13	0.08	0.65	0.02	0.29	0.00
28	1,680					10.39	16.15	6.01	4.25	4.41	2.01	2.68	0.60	1.88	0.25	1.22	0.09	0.71	0.02	0.31	0.00
30	1,800					11.14	18.35	6.44	4.83	4.73	2.28	2.87	0.68	2.01	0.28	1.30	0.10	0.76	0.03	0.33	0.00
35	2,100					12.99	24.41	7.51	6.43	5.52	3.04	3.35	0.90	2.35	0.38	1.52	0.13	0.88	0.04	0.39	0.00
40	2,400							8.58	8.23	6.30	3.89	3.82	1.15	2.68	0.49	1.74	0.17	1.01	0.04	0.44	0.01
45	2,700							9.65	10.24	7.09	4.83	4.30	1.43	3.02	0.60	1.95	0.21	1.13	0.06	0.50	0.01
50	3,000							10.73	12.44	7.88	5.86	4.78	1.74	3.35	0.73	2.17	0.25	1.26	0.07	0.56	0.01
55	3,300							11.80	14.86	8.67	7.01	5.26	2.08	3.69	0.88	2.39	0.30	1.39	0.08	0.61	0.01
60	3,600							12.87	17.44	9.46	8.24	5.74	2.44	4.02	1.03	2.60	0.36	1.51	0.10	0.67	0.01
65	3,900							13.94	20.25	10.24	9.55	6.21	2.83	4.36	1.19	2.82	0.41	1.64	0.11	0.72	0.02
70	4,200									11.03	10.96	6.69	3.25	4.69	1.37	3.04	0.48	1.76	0.13	0.78	0.03
75	4,500									11.82	12.45	7.17	3.69	5.03	1.55	3.25	0.54	1.89	0.14	0.83	0.02
80	4,800									12.61	14.03	7.65	4.16	5.36	1.75	3.47	0.61	2.02	0.16	0.89	0.02
85	5,100									13.40	15.70	8.13	4.65	5.70	1.96	3.69	0.68	2.14	0.18	0.94	0.02
90	5,400											8.61	5.17	6.03	2.18	3.91	0.76	2.27	0.20	1.00	0.03
95	5,700											9.08	5.72	6.37	2.41	4.12	0.84	2.39	0.22	1.06	0.03
100	6,000											9.56	6.28	6.70	2.65	4.34	0.92	2.52	0.25	1.11	0.03
110	6,600											10.52	7.50	7.37	3.16	4.77	1.10	2.77	0.29	1.22	0.04
120	7,200											11.47	8.82	8.04	3.71	5.21	1.29	3.03	0.34	1.33	0.05
130	7,800											12.43	10.22	8.71	4.31	5.64	1.50	3.28	0.40	1.44	0.05
140	8,400											13.39	11.73	9.38	4.94	6.08	1.72	3.53	0.46	1.55	0.06
150	9,000													10.05	5.61	6.51	1.95	3.78	0.52	1.67	0.07
160	9,600													10.72	6.33	6.94	2.20	4.03	0.59	1.78	0.08
170	10,200													11.39	7.08	7.38	2.46	4.28	0.66	1.89	0.09
180	10,800													12.06	7.87	7.81	2.73	4.54	0.73	2.00	0.10
190	11,400													12.73	8.70	8.25	3.02	4.79	0.81	2.11	0.11
200	12,000													13.40	9.56	8.68	3.32	5.04	0.89	2.22	0.12
225	13,500															9.76	4.13	5.67	1.10	2.50	0.15
250	15,000															10.85	5.02	6.30	1.34	2.78	0.18
275	16,500															11.93	5.99	6.93	1.60	3.05	0.22
300	18,000															13.02	7.04	7.56	1.88	3.33	0.26
325	19,500																	8.19	2.18	3.61	0.30
350	21,000																	8.82	2.50	3.89	0.34
375	22,500																	9.45	2.84	4.16	0.39
400	24,000																	10.08	3.20	4.44	0.44
425	25,500																	10.71	3.58	4.72	0.49
450	27,000																	11.34	3.98	5.00	0.54
475	28,500																	11.97	4.40	5.28	0.60
500	30,000																	12.60	4.83	5.55	0.66
550	33,000																	13.86	5.77	6.11	0.79
600	36,000																			6.66	0.92
650	39,000																			7.22	1.07
700	42,000																			7.77	1.23
750	45,000																			8.33	1.39
800	48,000																			8.88	1.57
850	51,000																			9.44	1.76
900	54,000																			9.99	1.95

Note: Shaded areas of the chart indicate velocities over 5 Ft/Sec. Use with Caution.

Velocities are calculated using the general equation:
V = (0.4085 * (Q / d^2)

Friction Losses are calculated using the Hazen-Williams Equation:
Hf = 0.2083 * (100 / C)^1.852 * (Q^1.852 / d^4.866)

V = FPS (feet per second)

Hf = PSI/100 Ft. (pounds per square inch per 100 feet)

C = 150

Q = GPM (gallons per minute)

d = ID (inside diameter)

Pressure compensating (PC) dripperlines have been used in a variety of subsurface applications for decades. Whether the application is agriculture, where crop quality is largely dependant on each plant getting equal water, or landscape, where even watering yields well-balanced plantings and turf, pressure compensating dripperlines excel.

Beyond the design and maintenance ease that PC dripperline offers due to its precise and measurable rate flow, there is more. Bioline's ability to purge debris whenever it gets into the dripper is another reason Netafim does not use non-pressure compensating dripperlines for wastewater. Using a dripper that may only clean itself at the beginning or end of a dose can lead to drippers not operating properly. This does not happen with Bioline.

Certain soils have the ability to reduce or actually cut-off the flow of non-PC drippers. Especially in tight soils, pressure created in the soil by the water can increase to the point where a non-pressure compensating dripper can actually close and stop dripping. Though these pressures dissipate by gravity after dosing - eliminating it during dosing is the object. Even on flat terrain, using non-PC dripperline can significantly and negatively affect the quality of the dose.

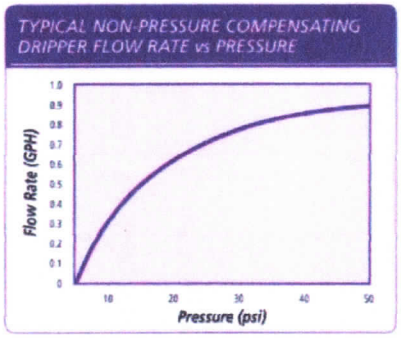


Table 2 *- The curved flow rate of a typical non-pressure compensating dripperline highlights why it is a poor choice for effluent dispersal. As the lateral length increases and/or the pressure decreases, the flow decreases as well. This makes designing a system difficult and reduces the effective management of effluent dispersal over the drip field.*

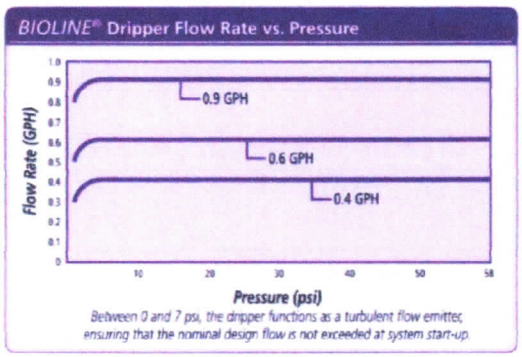


Table 3 *- The flat flow rate line of Bioline represents the concept of pressure compensation and the resulting even discharge of water from each emitter along the full length of the dripperline lateral. This makes system design much easier and increases the effectiveness of effluent dispersal in the drip field, even if there are elevation differences.*

BIOLINE DOSING CHART Maximum Length *(feet)* of a Single Lateral *(0.5 & 1.0 fps)*

Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4	0.6	0.9	0.4	0.6	0.9	0.4	0.6	0.9
Flushing Velocity (fps)		0.5 / 1.0	0.5 / 1.0	0.5 / 1.0	0.5 / 1.0	0.5 / 1.0	0.5 / 1.0	0.5 / 1.0	0.5 / 1.0	0.5 / 1.0
Inlet Pressure (psi)	15	301 / 248	242 / 205	188 / 163	422 / 344	341 / 285	265 / 228	531 / 427	429 / 355	335 / 285
	25	369 / 315	296 / 258	228 / 203	520 / 440	418 / 361	323 / 286	655 / 549	527 / 453	409 / 359
	35	421 / 367	337 / 299	260 / 234	595 / 513	476 / 419	368 / 331	749 / 643	603 / 527	467 / 417
	40	443 / 389	354 / 316	273 / 248	626 / 545	501 / 445	387 / 350	790 / 683	635 / 559	491 / 441
	45	464 / 409	371 / 332	285 / 260	656 / 574	524 / 468	404 / 367	829 / 721	665 / 589	513 / 463
Flow per 100' (GPM/GPH)		0.67 / 40	1.02 / 61	1.53 / 92	0.44 / 26.67	0.68 / 41	1.02 / 61	0.34 / 20	0.51 / 31	0.77 / 46

Additional flow of 0.4 GPM required per lateral to achieve 0.5 fps
Additional flow of 0.8 GPM required per lateral to achieve 1.0 fps

BIOLINE DOSING CHART Maximum Length *(feet)* of a Single Lateral *(1.5 & 2.0 fps)*

Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4	0.6	0.9	0.4	0.6	0.9	0.4	0.6	0.9
Flushing Velocity (fps)		1.5 / 2.0	1.5 / 2.0	1.5 / 2.0	1.5 / 2.0	1.5 / 2.0	1.5 / 2.0	1.5 / 2.0	1.5 / 2.0	1.5 / 2.0
Inlet Pressure (psi)	15	201 / 161	171 / 141	140 / 119	275 / 217	235 / 191	194 / 164	337 / 263	289 / 233	241 / 201
	25	266 / 221	222 / 190	179 / 157	366 / 302	308 / 261	251 / 218	453 / 369	383 / 321	313 / 270
	35	316 / 269	262 / 229	210 / 187	437 / 370	365 / 316	295 / 260	543 / 455	455 / 391	369 / 324
	40	337 / 290	280 / 246	223 / 200	469 / 399	391 / 340	313 / 278	583 / 493	487 / 421	393 / 347
	45	358 / 310	296 / 261	235 / 212	497 / 427	413 / 362	331 / 296	619 / 527	517 / 449	415 / 369
Flow per 100' (GPM/GPH)		0.67 / 40	1.02 / 61	1.53 / 92	0.44 / 26.67	0.68 / 41	1.02 / 61	0.34 / 20	0.51 / 31	0.77 / 46

Additional flow of 1.2 GPM required per lateral to achieve 1.5 fps
Additional flow of 1.6 GPM required per lateral to achieve 2.0 fps

BIOLINE DOSING CHART Maximum Length *(feet)* of a Single Lateral *(2.5 & 3.0 fps)*

Dripper Spacing		12"			18"			24"		
Dripper Flow Rate (GPH)		0.4	0.6	0.9	0.4	0.6	0.9	0.4	0.6	0.9
Flushing Velocity (fps)		2.5 / 3.0	2.5 / 3.0	2.5 / 3.0	2.5 / 3.0	2.5 / 3.0	2.5 / 3.0	2.5 / 3.0	2.5 / 3.0	2.5 / 3.0
Inlet Pressure (psi)	15	128 / 102	115 / 94	100 / 84	172 / 136	155 / 127	136 / 113	205 / 161	187 / 151	165 / 137
	25	183 / 151	161 / 136	137 / 118	248 / 203	220 / 184	188 / 161	301 / 245	268 / 223	231 / 197
	35	228 / 193	198 / 171	166 / 146	310 / 260	272 / 232	229 / 200	379 / 315	333 / 283	283 / 245
	40	248 / 211	214 / 186	178 / 158	338 / 286	295 / 254	247 / 218	413 / 347	362 / 311	305 / 267
	45	266 / 228	229 / 200	190 / 169	364 / 310	316 / 274	263 / 233	447 / 377	389 / 335	327 / 287
Flow per 100' (GPM/GPH)		0.67 / 40	1.02 / 61	1.53 / 92	0.44 / 26.67	0.68 / 41	1.02 / 61	0.34 / 20	0.51 / 31	0.77 / 46

Additional flow of 2.0 GPM required per lateral to achieve 2.5 fps.
Additional flow of 2.3 GPM required per lateral to achieve 3.0 fps

Table 11 - Maximum Length of a Single Lateral of Bioline Based on Flushing Velocity

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Note 6

Air supply will be provided by a down draft pressure fan located on top of each of the trickle filters on a 6 inch pipe. A M-6 pressure type fan will be used. A sensor will be installed to the PLC and an alarm will be sent to utility workers if the fan fails. If the #1 fan fails, a second fan set on first fan and located on the main dosing tank will be switched on by the PLC. The air flow will travel down through the trickle filter through a 6 inch pipe to the main dosing tank, then out the backup fan unit. This will give air to the trickle filter and stop gases from building up in the main dosing tank.

Each fan unit will be rated at 460 CFM which is far in excess of what is required. The extra air flow should help make the process even more efficient.

M-Series inline fans are ideal for long runs of air supply and exhaust applications requiring exacting performance. You can use them as a super quiet bathroom/spa exhausters to eliminate fogged mirrors and lingering odors. They also work great for exhausting high moisture areas such as hydroponics grow rooms or for sub-slab radon gas mitigation. Included with the fan is a strip of vibration isolating foam for a better fit and to minimize any vibration. All models come with standard power cord.

M Series Instructions

Model	Volts	Watts	Amps	Free Air CFM
M-4	120	101	0.9	189
M-6	120	174	1.45	460
M-8	120	215	1.83	720
M-10	120	236	2	810
M-12	120	299	2.52	1100

Specifications