***OSCAR-LOWeFLOW*™ Treatment System Design Manual**
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Manufactured by:

Lowridge Onsite Technologies
PO Box 1179
Lake Stevens, WA 98258
877 476-8823
info@lowridgetech.com

Introduction:

This manual is written in two sections: first the *OSCAR* design and then the *LOWeFLOW*™ section. Even though there are two sections, the *OSCAR-LOWeFLOW*™ system is considered one complete treatment and dispersal system.

The ***OSCAR*** (**O**nsite **S**and **C**oil **A**rea **R**echarge) is a combined treatment and dispersal component for use with the *LOWeFLOW* treatment unit. The *OSCAR* is comprised of a 6" layer of C-33 sand media and a series of Netafim Bioline drip tubing coils. The sand media is placed on a prepared soil surface. *OSCAR* coils are then placed on the sand media and then are covered with another 6" of sand media. No other cover material is needed. To control erosion, spread straw over final cover until vegetative cover takes hold: plant grass seed or other ground cover as soon as possible. See Appendix J for more details.

The sand/soil interface is the discharge point of the treated wastewater. Vertical separation is measured from the original soil surface prior to preparation and the restrictive layer. If enough soil depth is present, the basal area can be excavated to lower the profile of the *OSCAR*. The *OSCAR-LOWeFLOW*™ system meets treatment level "B" (15 mg/l CBOD5, 15 mg/l TSS, and 1,000 FC/100 ml MPN), without UV disinfection.

The single family residence packages are designated as: *LFOS-240, LFOS-300, LFOS-360, LFOS-450, and LFOS-480,* and have the corresponding design flows of 240, 300, 360, 450, and 480, gallons per day. The *LFOS-240, 300, 360, 450, and 480* include an *LF-500* treatment unit (500 gpd) with the corresponding number of *OSCAR* coils. For design flows over 500 gpd see appendix B for details.

The *LOWeFLOW*™ unit has 7 standard design flow rates: 500, 1000, 1500, 2000, 2500, 3000, and 3500 gallons per day. The *OSCAR* units can be designed in increments of 50 or 100 gallons per coil per day. Consequently, an *OSCAR-LOWeFLOW*™ system could be designed for 850 gpd: an *LF-1000* with 17 *OSCAR* coils (17 x 50 gallons = 850 gallons per day).

The *LFOS-240, 300, 360, 450, & 480,* are standard packages. All other design flows greater than 500 gallons per day are considered custom and will require design assistance from *Lowridge Onsite Technologies, LLC*.

OSCAR Design:

Each ***OSCAR*** coil is designed to treat and dispose of 50 or 100 gpd of *LOWeFLOW*™ effluent, depending on soil depth and *OSCAR* coil model specified. Minimum vertical separation depth is 12", except in soil type 1 where a minimum of 18" of vertical separation will be required.

There are two models of *OSCAR* coils: OS-50 and OS-100. The OS-50 coils form a 5' wide row and must be used in soil depths 12"-18". In soil depths of 18" or greater, the OS-100 can be specified. The OS-100 coils form a row 7.1' wide. Tables III & IV dictate the overall minimum "shoulder" length for the corresponding design flow for each coil model. See appendix I for details of OS-100's foot print and specifications.

An OSCAR has two (2) sizing criteria: *hydraulic layout* and *basal* area. The hydraulic layout includes the number of coils and how they are to be connected. The basal area refers to the overall foot print of the *OSCAR* sand/ soil interface.

Hydraulic Layout: Coils are arranged in laterals. Each lateral is a single coil or a group of coils linked in series between the supply and flush manifolds. Coils will be arranged in a single line along the contour. The *OSCAR* coils are timed dosed and flushed, manually, once per year.

The standard single family residence *OSCAR* packages with design flows between 240 to 480 gpd include a 30 gpm, 110 volt, turbine pump and a HWN-. 7-man headworks for dosing the *OSCAR* coils. This pump will perform in a large majority of design applications. Table I depicts the number of OS-50 coils and laterals required for a given design flow using this pump. The table II depicts the number of OS-100 coils and laterals required for a given design flow with the same pump. The criteria in these tables **must be** followed.If a deviation is required, call *Lowridge* for assistance.

The tables also indicate how much excess head, under the pump curve, is available for supply line elevation lift and friction loss. All manifolds, supply and flush lines are 1" 40 PVC. The designer must calculate the total dynamic head (TDH) for the *OSCAR* supply line. Use the flow rate indicated under the heading "Flush GPM" in Tables I or II for the corresponding design flow to calculate the friction loss of the supply line. If the calculated TDH is greater than the "Excess TDH" value in Tables I or II, call *Lowridge* for assistance. TDH is calculated by adding the friction loss of the supply line to the elevation lift from liquid level in pump tank to the *OSCAR* coils. Use the following Hazen-Williams formula to calculate friction loss. Always use the flush flow rate to calculate the friction loss.

$$f = L\,(Q/K)^{1.85}$$

F= friction loss through pipe in feet of head
L= length of supply line in feet
Q= Flush GPM
K=47.8 (1" sch 40 PVC pipe)

Table I
Hydraulic Layout
OS-50 Coils
12" to 18" soil depth

Design Flow	Total Coils	# of Lats.	Coils per lat.	Dose gpm	Flush gpm	Excess TDH
240	5	5	1	1.75	12.0	50'
300	6	3	2	2.1	12.0	50'
360	8	4	2	2.8	12.0	50'
450	9	3	3	3.15	12.0	50'
480	10	5	2	3.5	12.0	50'
600	12	4	3	4.2	12.0	50'

Table II
Hydraulic Layout
OS-100 Coils
18+" soil depth

Design Flow	Total Coils	# of Lats.	Coils per lat.	Dose gpm	Flush gpm	Excess TDH
240	3	3	1	2.1	12.0	50'
300	3	3	1	2.1	12.0	50'
360	4	4	1	2.8	12.0	50'
450	5	5	1	3.5	12.0	50'
480	5	5	1	3.5	12.0	50'
600	6	6	1	4.2	12.0	50'

Table III
Minimum Shoulder Lengths
OS-50
12” to 18” soil depth

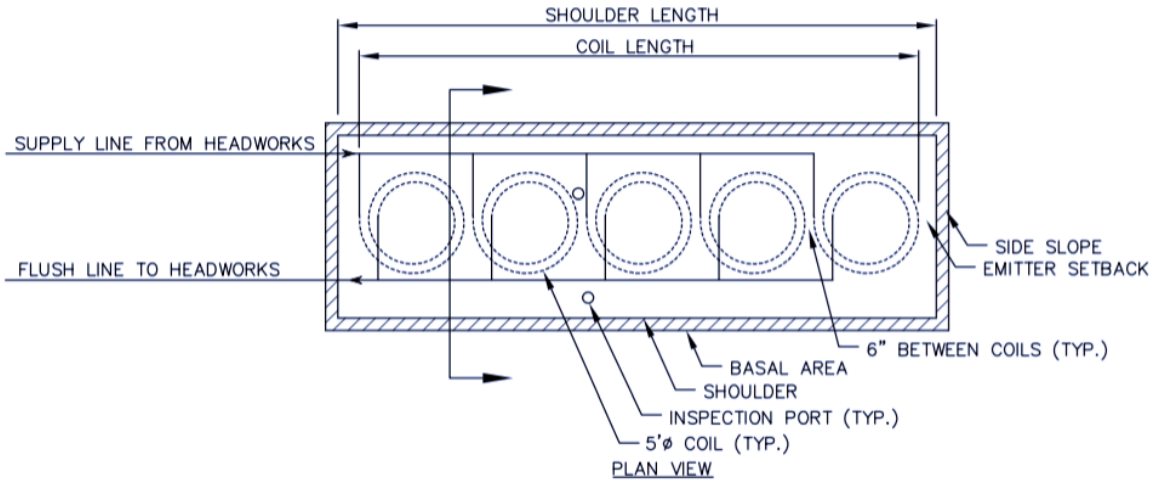
Design Flow	Minimum Shoulder Length
240	28’
300	33.5’
360	44.5’
450	50’
480	55.5’
600	66.5’

The dimensions in Table III represent the minimum required length of the outer shoulder which includes the coils, spacing between coils, and the shoulders. These lengths can be extended to match site conditions. Minimum shoulder spacing is 6”. See illustration below for example of shoulder length.

Table IV
Minimum Shoulder Lengths
OS-100
18+” soil depth

Design Flow	Minimum Shoulder Length
240	21’ 3”
300	21’ 3”
360	28’ 4”
450	35’ 6”
480	35’ 6”
600	42’ 6”

The dimensions in Table IV represent the minimum required length of the outer shoulder which includes the coils, spacing between coils, and the shoulders. These lengths can be extended to match site conditions. Minimum shoulder spacing is 6”. See illustration below for example of shoulder length.



Basal Area:

The basal area is comprised of the total area where the sand media is in contact with the receiving soil. The minimum required basal area is calculated by dividing the design flow rate by the soil loading rate specified in WAC 246-272A. (local codes may have differing loading rates).

Example, Soil type 4
240 gpd ÷ 0.6 gpd/ft2 = 400 sq. ft.

Combining Hydraulic and Basal Area Requirements:

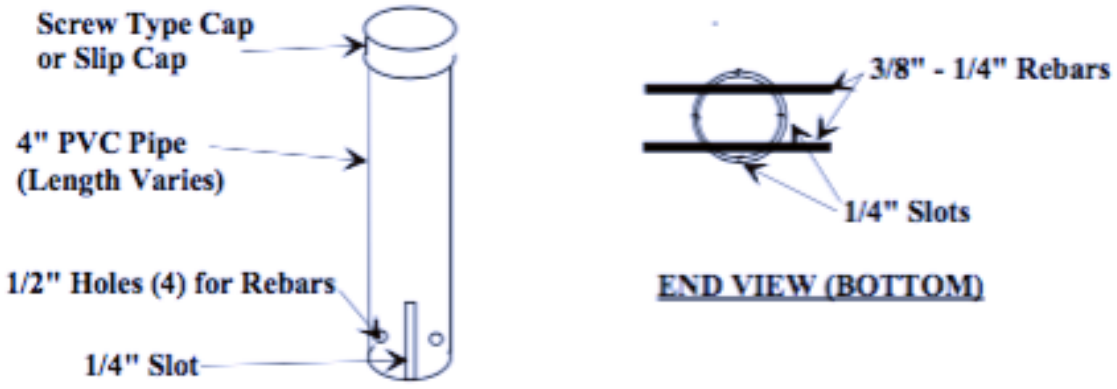
On flat sites (0-5% slope), the coils will be placed as evenly as possible in the center of the basal area. The coils will be arranged in a single line with a minimum separation between coils of 6". Also, no emitter shall be placed within 6" of the sand media shoulder.

On sloping sites (>5 to 20% slope) the coils will be placed in a single line, parallel to the contour and one edge of the coils must be placed within 12" of the upslope basal boundary. There must be at least 6" separation between sand shoulder and an emitter and between any two emitters of different coils.

To combine the coil layout and the basal area, start with the coil layout. Refer to Tables III & IV for minimum shoulder lengths. Zero to five percent (0 to 5%) slopes are considered flat for basal area calculations. On flat sites the coils should be placed in the center of the basal area. The coils will be placed in a single line, although the line can be curved to match site contours. Also, no emitter shall be placed closer than 6" to the sand media shoulder.

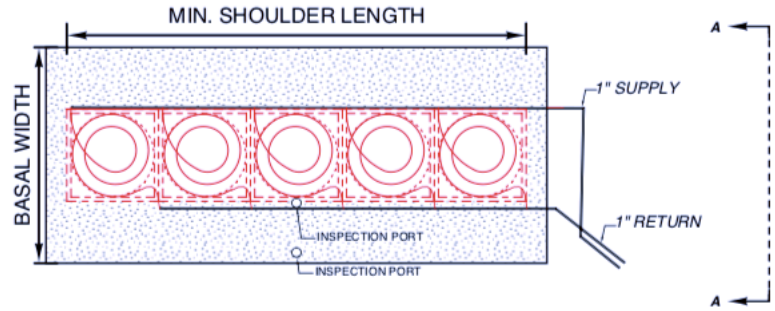
On sloping sites, (>5 to 20%) the coils will be placed parallel to the contour and one edge of the coils must be placed within 12" of the upslope basal boundary. There must be at least 6" separation between the sand shoulder and an emitter. With the OS-50 coils, there must be at least 6" between drip tubing in different coils. With the OS-100 coils there must be 12"

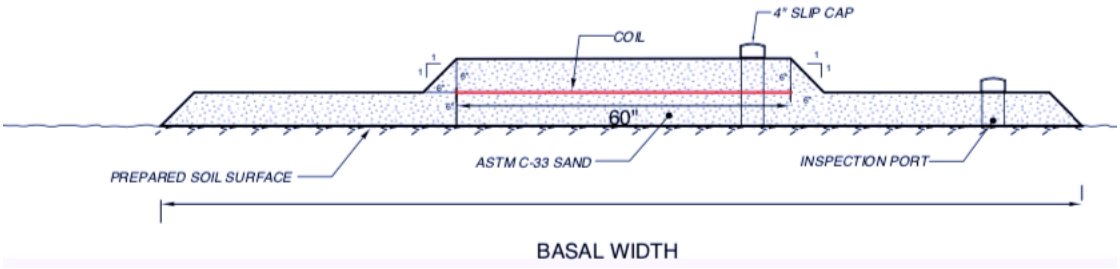
between tubing of different coils. Side slopes of the sand media must be at least 1:1 slope. Two inspection ports must be installed: one in the coil area and the other in the basal area as shown. See illustration below.



The following are examples of OSCAR designs with OS-50 coils.

FLAT SITE





Example: (refer to illustration above and Table III).

240 gpd design flow, soil type 4 (0.6 gpd/ft2), flat site

Basal area required = daily design flow ÷ soil loading rate

400 sq. ft. = 240 gpd ÷ 0.6 gpd/ft2

Minimum shoulder length (see Table III) is **28'**.

Minimum side slopes at 1 : 1 slope @ 6" (2 x 6" = 1') = **1'**

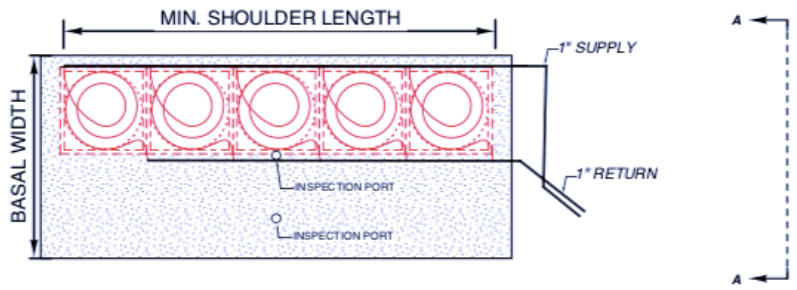
Minimum basal length= shoulder length + side slopes

28' + 1' = 29'

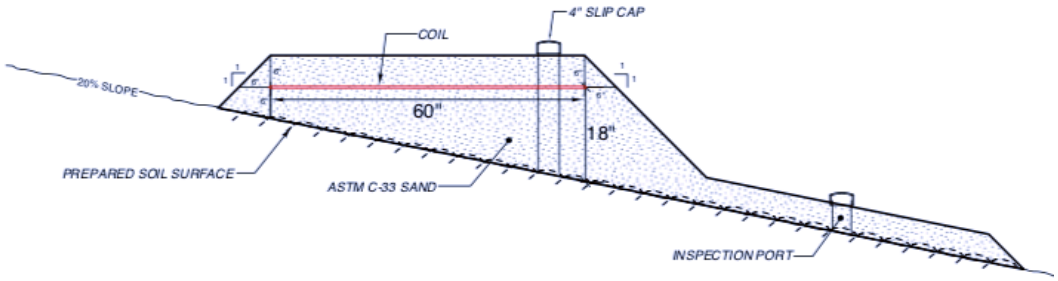
Basal area width = required basal area ÷ minimum basal length

= 400 sq. ft. ÷ 29' = 13.79 or 14'

Basal area dimensions for soil type 4 = 29' long x 14' wide.



Plan View



SLOPING SITE (12-18" of soil, OS-50)

When calculating the required basal area for a sloping site the same process is used as a flat site except for one criterion. The side slope value must include the increased sand depth due to the sloping site. In order to keep the coils level on a sloping site, additional sand must be placed under the downslope side of the coil. The greater the sand hight, the greater the side slope. To calculate the additional sand depth use the following formula:

Diameter of coil x % slope of site

In the illustration above the 20% slope needs an additional 12" of sand to maintain a level coil network.

60" (diameter of coil) x 20% = 12"

The additional 12" of sand needs to be added to the minimum required sand of 6" to equate to the **18"** of sand on the downslope side of the coil.

Example:

240 gpd design flow, soil type 4 (0.6 gpd/ft2), sloping site

Basal area required = daily design flow ÷ soil loading rate

400 sq. ft. = 240 gpd ÷ 0.6 gpd/ft2

Minimum shoulder length (see Table III) is **28'**.

Minimum side slopes at 1 : 1 slope @ 18" (18" x 2) = **3'**

Minimum basal area length = shoulder length + side slopes

28' + 3' = 31'

Basal area width = required basal area ÷ minimum basal length

400 sq. ft. ÷ 31' = 12.9' or 13'

Minimum basal area dimensions for soil type 4 = 31' long x 13' wide.

Timer Settings:

Timer settings for the *OSCAR* are set at the factory and are short and very frequent (3 minutes and 38 seconds off and 22 seconds on. The timer settings for the LOWeFLOW are 3 minutes 30 seconds off and 30 seconds on). It is expected that the supply line will stay charged between doses. It is therefore strongly recommended to site the OSCAR coils at or above the discharge tank elevation (pump up to the OSCARs) and install a check valve on the discharge pump.

There are two reasons for changing the timer settings:

1. The *OSCAR* is installed down slope from the discharge tank. The timer settings may need to be modified to avoid over dosing the *OSCAR* and a vacuum breaker must be installed on the supply line inside the pump chamber to prevent siphoning. Pump down hill to the *OSCAR* should be the last option and is not recommended. Call *Lowridge* for assistance in changing timer settings.
2. In colder climates where the supply line needs to drain between doses, the "on time" will need to be increased to compensate for filling the supply line prior to each dose. Call *Lowridge* for assistance in changing timer settings.

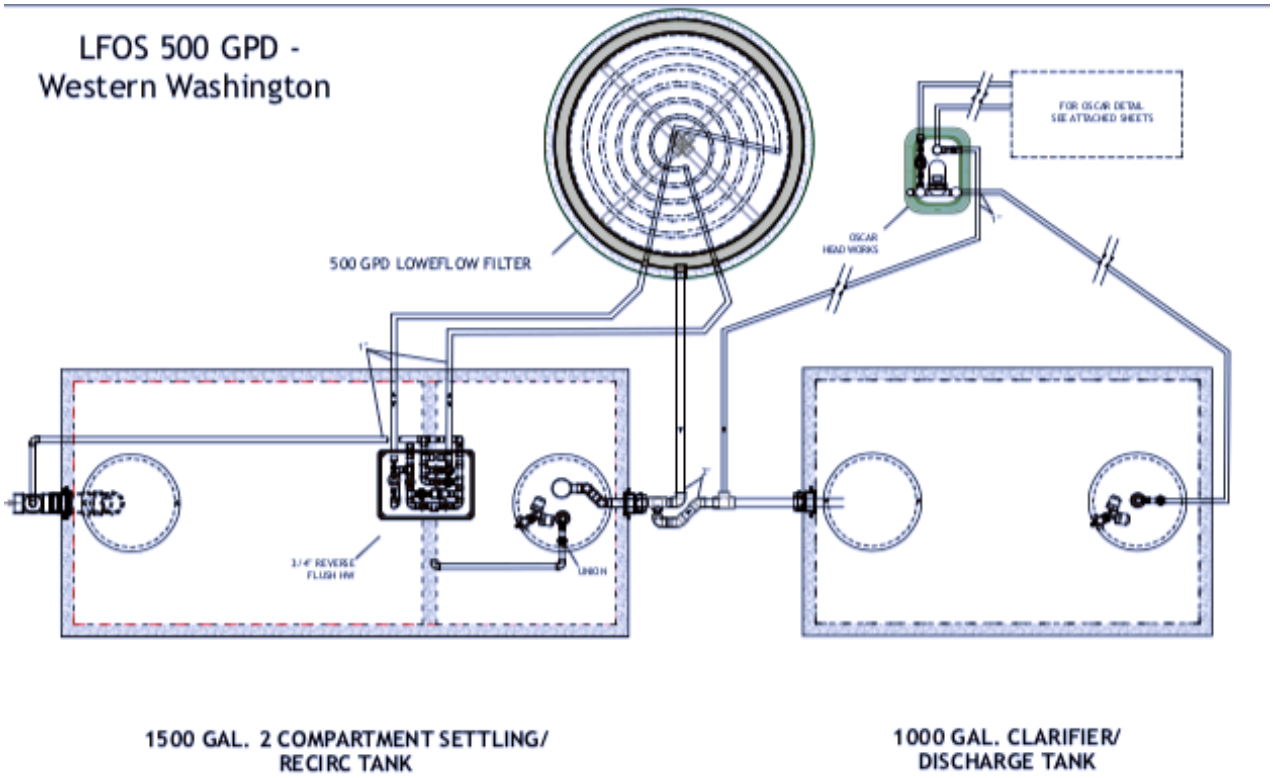
Set-backs:

	When the item to be setback from is:	
	Upgradient[1]	Downgradient[2, 3]
Setback distance from **property lines**, **driveways**, **buildings**, **ditches** or **interceptor drains**, or any other development which would either impede water movement away from the mound or channel groundwater to the mound area.	10 feet	30 feet
Setback distance from **well**, **suction line** or **surface water**.	100 feet	100 feet

[1]The item is upgradient when liquid will flow away from it upon encountering a water table or restrictive layer.
[2]The item is downgradient when liquid will flow toward it upon encountering a water table or restrictive layer.
[3]The edge of required basal area.

All other set backs are according to local code or WAC 246-272A.

***OSCAR-LOWeFLOW*™ Treatment Unit**



The *LOWeFLOW*™ treatment unit is comprised of the *LOWeFLOW*™ recirculation filter, a septic tank, recirculation tank, discharge/clarification tank, headworks, and control equipment.

Wastewater is collected in a standard septic tank where gross solids are settled out and primary treatment occurs. Septic tank effluent flows from the septic tank into the recirculation tank. Liquid in the recirculation tank is mixed with treated filtrate from the *LOWeFLOW*™ filter. The mixed liquid is dosed to a drip tubing network called a *Coil* in the top of the *LOWeFLOW* ™ filter. Treated filtrate from the *LOWeFLOW*™ filter flows back to the recirculation tank through the split flow tee. The position of the splitter valve determines the flow path of the filtrate. When the liquid level in the recirculation tank is high enough to seat the splitter valve, all of the filtrate passes to the discharge/ clarification tank, otherwise, all or a portion of the returning filtrate returns to the recirculation tank.

Effluent from the discharge tank is timed dosed to the *OSCAR* coils for final dispersal.

LOWeFLOW Design Criteria

There are four segments to the *LOWeFLOW*™ Treatment unit design: filter sizing, number of *Coils*, tanks, and pump/control equipment. The standard residential *LOWeFLOW*™ unit (***LF-500***) is a 500 gpd kit with some field assembly required (for parts list see appendix C). For system design greater than 500 gpd design flows see appendix "B".

Filter sizing:

A standard residential 500 gpd unit is sized based on 25 gpd/sq. ft. or 20 sq. ft. The media for the *LOWeFLOW*™ filter shall be *Growstone* (see Appendix A). The depth of the media required between the tubing and underdrain is 30". There is an additional 3" of media covering the drip tube and 3" deep layer of media for the underdrain. The over-all height of the *LOWeFLOW*™ filter is 36". Child proofing mesh must be placed over the coils prior to final cover media installation.

Drip Tubing Network Layout:

The tubing used in the *LOWeFLOW*™ Treatment unit is exclusively Netafim Bioline™, 0.42 gph emitters. Each residential *LOWeFLOW*™ unit is equipped with four (4) 100 foot laterals configured in a pre-assembled *Coil*. The *LOWeFLOW*™ unit is intended to be operated at a 4:1 recirculation ratio. See appendix D for details on timer settings.

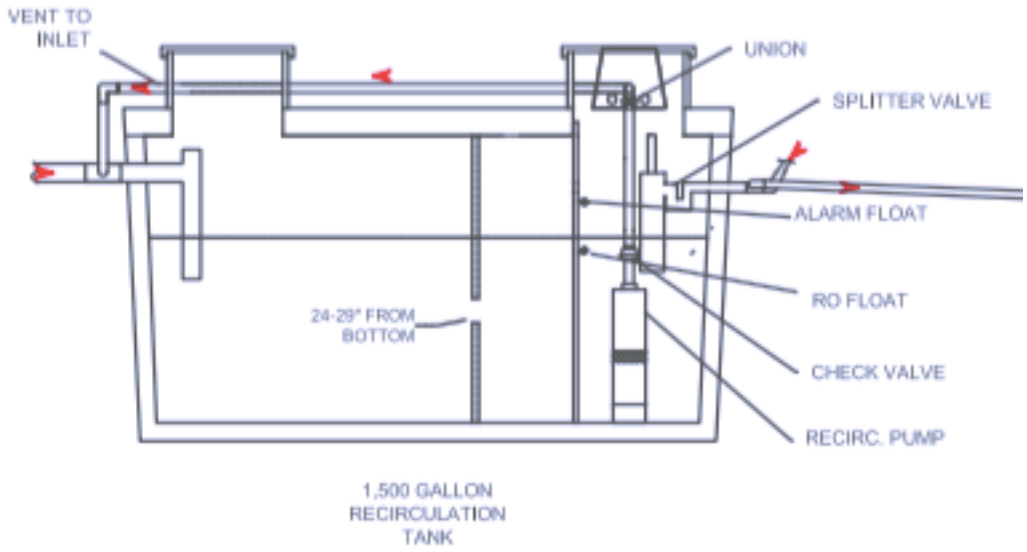
Tanks:

All tanks must be approved by Washington State Department of Health as wastewater containment vessels. Minimum liquid volumes for a 500 gpd design flow are:

- Settling (septic) tank **800 gallons**
- Recirculation tank **400 gallons**
- Clarification volume **250 gallon**

There are two options for septic/recirculation tank arrangements: a double compartment concrete tank with a flow through port between compartments or two tanks, a single compartment septic tank and a separate recirculation tank. Poly or fiberglass tanks can only be used with the two tank option.

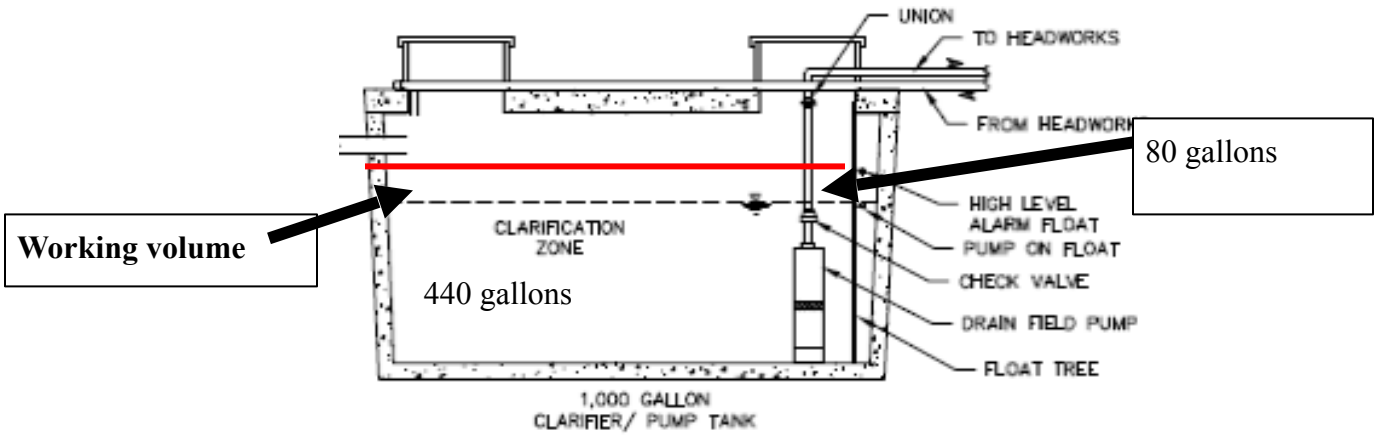
Single tank: Concrete tanks only for this option.



A 1500 gal two-compartment tank with a 2/3 first compartment and 1/3 second compartment volume split and a 4" diameter flow through port 24-29" above the floor. The first compartment serves as the primary settling (septic) tank and the second compartment is the recirculation tank.

Clarifier: The *OSCAR-LOWeFLOW*™ system must incorporate at least 250 gallons of clarifying capacity for a 500 gpd design flow. Clarification capacity is the minimum liquid in the discharge tank to submerge the discharge pump. The discharge pump is 22" tall. A standard 1,000 gallon pump tank (minimum requirement) has a volume of 20 g/inch. (Check with the tank manufacturer for exact figures). When the pump is submerged, there are 440 gallons of dead volume in the tank. This volume is in excess of the 250 gallons needed for the clarification volume. The working volume depth is 4" or 80 gallons.

Emergency storage for the clarification/pump chamber is achieved in the recirculation tank through the control panel. A high level alarm in the clarification/ pump chamber will override off the recirculation pump. When a high level condition occurs in the clarifier/discharge tank the recirculation pump is overridden off and no flow will progress from the recirc tank to the clarifier/discharge tank until the high level condition in the clarifier/discharge tank is corrected.



Pumps/Control Equipment

The *OSCAR-LOWeFLOW*™ Treatment system incorporates a recirculating pump which has two functions: dose the *LOWeFLOW*™ filter and flush the *Coil* and disc filter.

The *OSCAR* will need a 30 gpm ½ hp turbine pump. The standard control panel used in most residential application is the ***LF2P-RF-OS-AUXR*** which will accommodate the recirculation/flush pump, a discharge pump, and the *LOWeFLOW*™ headworks. A high level alarm in the discharge tank overrides off the recirculation pump. Emergency storage for pump failure is only needed in the settling/recirculation tank.

Appendix A

Media:

LOWeFLOW
Growstone
OSCAR

ASTM C-33 sand media: as per Washington Department of Health's Recommended Standards and Guidance for Intermittent Sand Filters.

Appendix B: Design flow greater than 500 gpd.

Design flow of 600 gpd: The 600 gpd system is upsized 20% from the 500 gpd unit.

Design parameters:

Tanks, minimum liquid volumes:	
Settling tank	960 gallons
Recirc. Tank	480 gallons
Clarifier capacity	300 gallons
Filter basins:	2-LFB-500
Coils	2-LF-500 coils
Child proofing mesh	

Design flows of >600 to 1000 gpd:

Tanks, minimum liquid volumes:	
Settling tank	200% of design flow
Recirc. Tank	80% of design flow
Clarifier	50% of design flow
Filter basin:	2-LFB-500
Coils	2-LF-500 coils
Child proofing mesh	

For flows over 1,000 gpd additional *LOWeFLOW™ Coils* can be added in increments of 500 gpd with a series of 500 gpd poly basins each containing a 500 gpd coil. Basins must plumbed in parallel. Call *Lowridge Onsite Technologies* for assistance.

Appendix C: Parts list for standard residential, 500 gpd kit:

- *LOWeFLOW™* basin & *Coil* (child proofing mesh)
- Headworks: disc filter, solenoid valves, pressure gauges
- Splitter valve
- Splitter tee
- Recirculation pump: 1/2 hp, 30 gpm turbine pump
- *LF2P-RF-OS-AUXR* Control panel
- Floats for recirculation and discharge pumps
- Headworks for *OSCAR* coils
- *OSCAR* coils necessary for design flow

- *OSCAR* pump: ½ hp, 30 gpm turbine pump

Appendix D: Timer Settings for Recirculation Pump

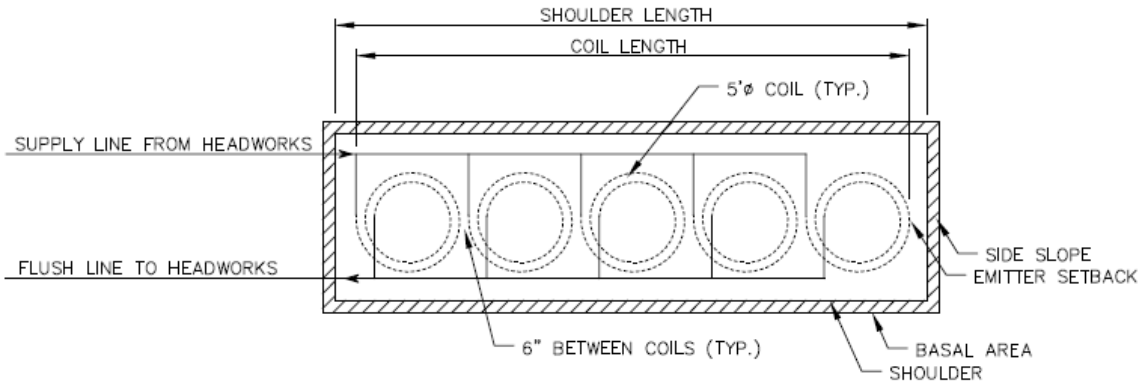
The goal is to achieve a recirculation ratio of 4:1 of the average daily flow. The table below gives the timer settings for a variety of average daily flows. Note that the "ON" time is always **30 seconds**. The standard 500 gpd *Coil* has an estimated flow rate of 5.5 gpm. Actual flow may vary.

Ave. Daily Flow	Recirc. Flow rate	"ON" Time	"OFF" Time
100 gpd	400 gpd	30 seconds	9.5 min
150	600	"	6.0
200	800	"	4.5
250*	1000	"	3.5
300	1200	"	3.0
350	1400	"	2.5
400	1600	"	2.0
500	2000	30 seconds	1.5 min

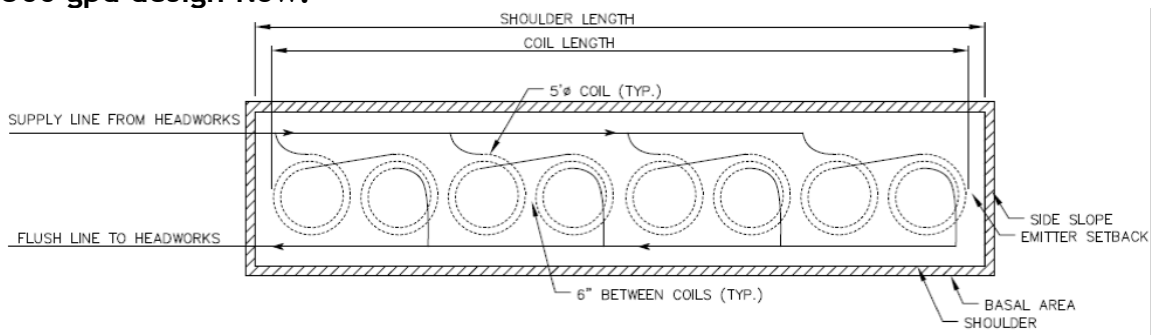
*Factory default setting.

Appendix E:
Sample Design layouts

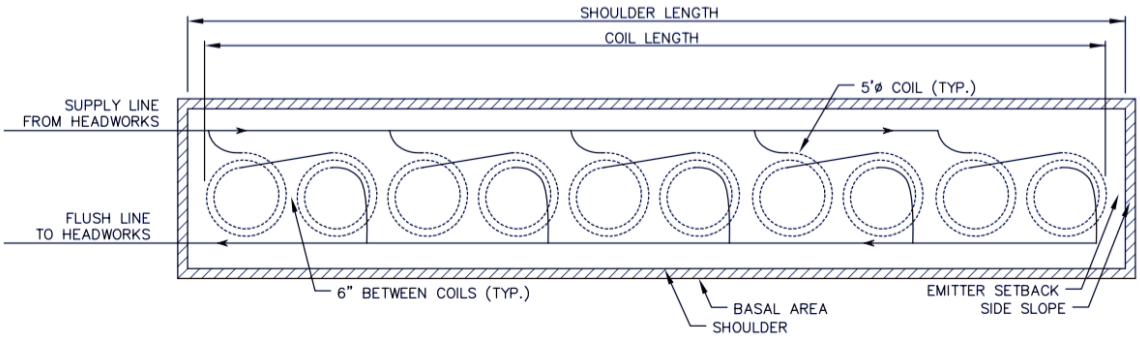
240 gpd design flow:



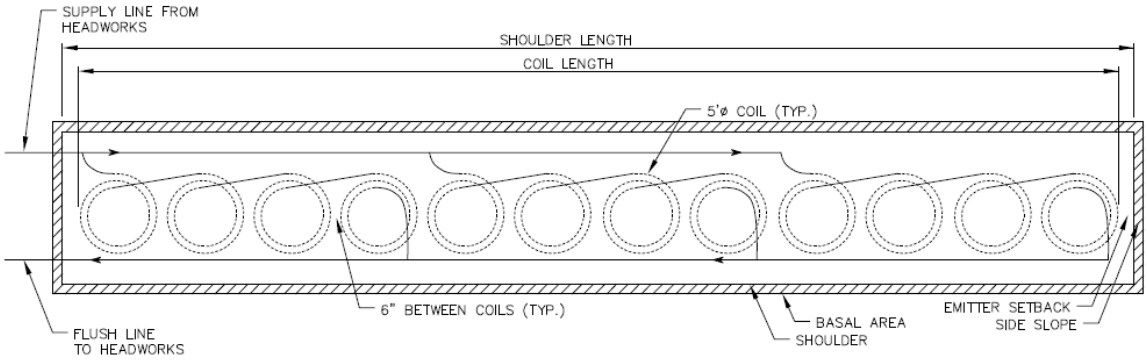
360 gpd design flow:



480 gpd design flow:



600 gpd design flow:



Appendix F:
Headworks: HWN-.7-man

- ¾" Arkal disc filter, mesh, 130 micron
- ¾" Arad flow meter
- Three oil filled pressure gauges
- One ball valve

Appendix G:
OSCAR Parts list

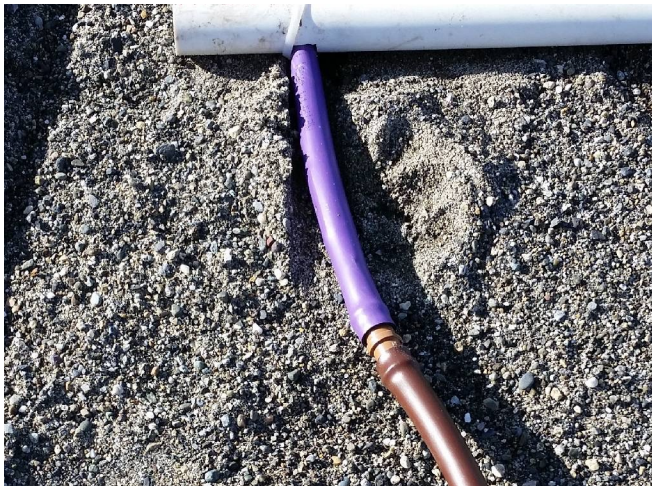
Each OSCAR unit will include:

- OS-50 Coils (whatever quantity is necessary for the design flow)
- PVC fittings and drip tubing adapters
- LOT-HWN-.7 manual headworks
- Solid ½" poly tubing for connections
- ½ hp, 110 volt, 30 gpm turbine pump

Appendix H:
***OSCAR* coil Connections**

Manifolds and supply lines are 1" Sch 40 PVC

Manifold and blank tech line adapter and connection.



Blank tech liner and Bioline connection with internal coupling

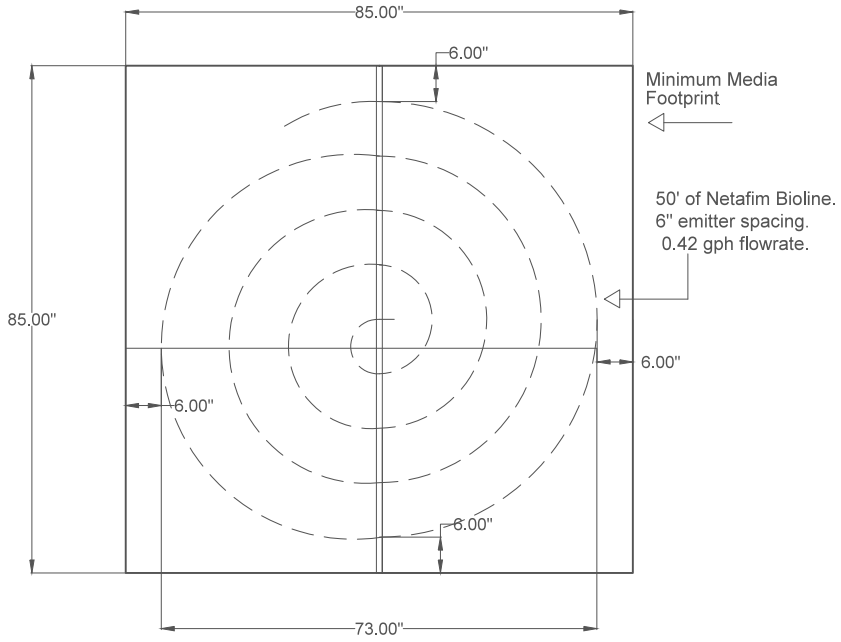
Appendix I:

OS-50 & OS-100 Coil Detail.

OS-50: The OS-50 OSCAR coil is made with 25’ of custom Netafim Bioline with 0.42 gph emitters @ 6” spacing (50 emitters), an average of 2 emitters per sq. ft. Each pre-assembled coil has a minimum area of 25 sq. ft. (5’ x 5’). There must be a minimum of 6” spacing between each coil and a minimum of 6” spacing between any coil and the should edge. Table III contains the minimum shoulder length for a given design flow. The “shoulder length” is the total minimum distance from the outside shoulder edge of the first coil to the opposite end shoulder of the last coil. This dimension includes all the coils, coil spacing, and shoulder spacing on each end.

OS-100: The OS-100 OSCAR coil is made with 50’ of custom Netafim Bioline with 0.42 gph emitters @ 6” spacing (100 emitters), an average of 2 emitters per sq. ft. Each coil has a minimum area of 50 sq. ft. (85”x85”). The actual coil diameter is 73”. The coil bracket is 85” long. When the coil brackets are aligned end to end the minimum coil spacing is automatically achieved. There must be a 12” minimum spacing between the tubing of differing OS-100 coils and a 6” spacing between any tubing and the shoulder edge. Table IV contains the minimum shoulder length for a given design flow. The “shoulder length” is the total minimum distance from the outside shoulder edge of the first coil to the opposite end shoulder of the last coil. This dimension includes all the coils, coil spacing, and shoulder spacing on each end. See illustration below.

OS-100 Coil Detail:



Appendix J:

There may be a desire to cover the OSCAR with something additional to the specified ASTM C-33 sand. Options include:

- Landscape jute mat with grass seed or other ground cover plantings.
- a thin layer of mineral soil (<10% organic by weight).
- Straw with grass seed or other ground cover plantings.

Do Not Cover Sand with:

- organic mix (manufactured top soil from compost)
- filter fabric

The intent is not to have too much additional cover over the final sand layer. Placing too much cover will inhibit plant root growth. Because the sand is in effect sub-surface irrigated, grass and other ground cover will grow rapidly, forming a firm protective cover over the OSCAR. At the end of the first growing season the sand layer will be as firm as soil.

On a standard mound system, where soil cover is required, the soil cap can dry out in the Summer months requiring additional irrigation to maintain vegetative cover.

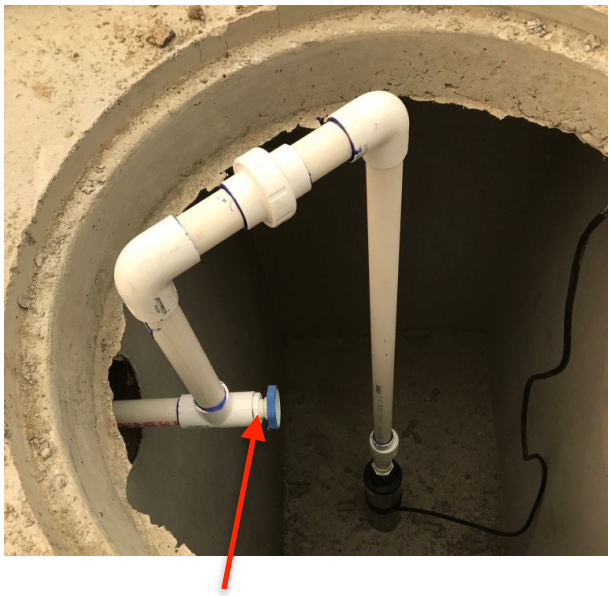
Appendix K: Cold Weather Options.

In cold climates (eastern Washington) it may be necessary to prevent freezing in of both the OSCAR and LOWeFLOW headworks. This is especially true in vacation homes where the power is turned off for the winter. In these situations Lowridge recommends using the cold weather package. This package includes a few additional parts in the standard package that allow critical plumbing sections to drain between doses. Refer to the drawing and photos that follow for details.

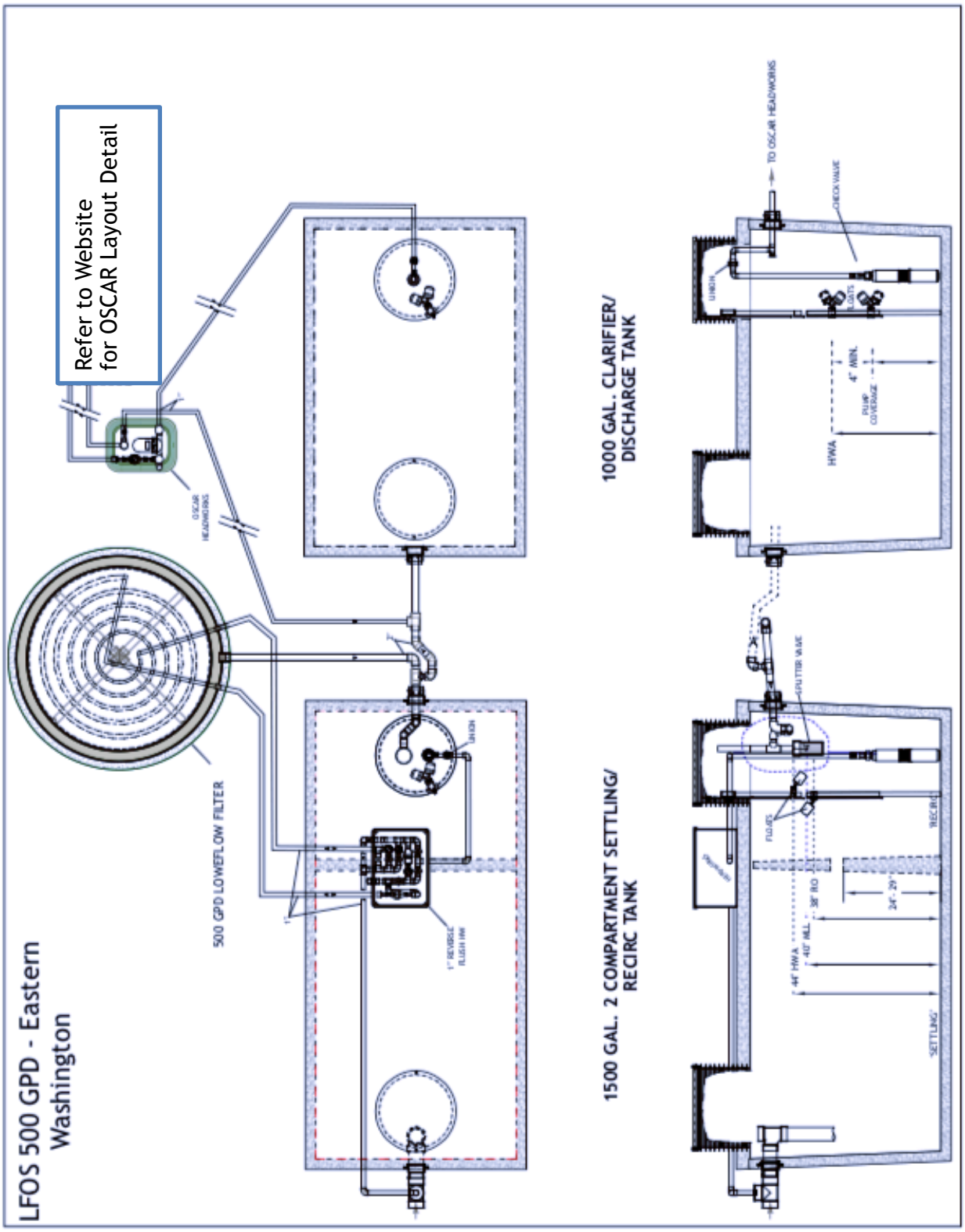
Cold weather option

Photos of OSCAR Cold Weather Supply Line Plumbing:

4” x 1” Tank adapter



“King Fitting” Drain


LFOS 500 GPD - Eastern Washington
Refer to Website for OSCAR Layout Detail
500 GPD LOWEFLOW FILTER
1000 GAL. CLARIFIER/ DISCHARGE TANK
1500 GAL. 2 COMPARTMENT SETTLING/ RECIRC TANK