4.21 Recirculating Gravel Filter

Revision: May 18, 2016
Installer registration permit: Complex
Licensed professional engineer required: Yes

4.21.1 Description

A recirculating gravel filter is a bed of filter media in a container that filters and biologically treats septic tank effluent. The filter effluent is returned to the recirculation tank for blending with untreated septic tank effluent and recirculated back to the filter. The treated effluent is distributed to a disposal trench of reduced dimension. The effluent returned from the filter may either return to the recirculation tank or a combination of the equalization tank and recirculating tank depending on effluent treatment requirements. Minimum system components include, but are not limited to, the following:

1. Septic tank
2. Equalization tank (if nitrogen reduction is required)
3. Recirculation tank
4. Low-pressure distribution system
5. Free-access filters
6. Flow splitter
7. Dosing chamber (if drainfield is pressurized)
8. Drainfield

4.21.2 Approval Conditions

1. Nondomestic wastewater must be pretreated to normal domestic wastewater strengths (section 3.2.1, Table 3-1) before discharge to the recirculating gravel filter system.
2. The bottom of the filter must not come within 12 inches of seasonal high ground water.
3. All pressurized distribution components and design elements of the recirculating gravel filter system that are not specified within section 4.21 must be designed and installed according to the guidance for pressure distribution systems in section 4.19.
4. All tanks and the recirculating gravel filter container shall meet the same separation distance requirements as a septic tank.
5. Recirculating gravel filters required to reduce total nitrogen shall meet the additional design requirements in section 4.21.3.4.
6. System must be designed by a PE licensed in Idaho.
7. Recirculating gravel filters required to reduce total nitrogen to 27 mg/L shall follow the operation and maintenance requirements outlined in sections 1.9.1 and 1.9.3, effective July 1, 2017.
    a. Operation and maintenance must be performed, as described in section 1.9.1, by a permitted complex installer that maintains a current service provider certification.
    b. All subsurface sewage disposal permits issued for recirculating gravel filters meeting the above requirements shall contain the following statement beginning July 1, 2017: *Annual treatment system equipment servicing and reporting is required per IDAPA*

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58.01.03.005.14. Operation and maintenance must be conducted by a complex installer maintaining a current service provider certification.

c. See sections 1.9.1 and 1.9.3 for compliance-related information for recirculating gravel filter operation, maintenance, and reporting.

4.21.3 Design Requirements

Minimum design requirements for the recirculating gravel filter components are provided below.

4.21.3.1 Recirculating Tank

1. Minimum recirculating tank volume shall be capable of maintaining two times the daily design flow of the system (Figure 4-24).
2. The recirculating tank may be a modified septic tank or dosing chamber selected from section 5.2 or section 5.3.
   a. Alternatively, the recirculation tank may be designed by the system's design engineer to meet the minimum requirements of this section and IDAPA 58.01.03.007.
   b. Recirculating tank design is exempt from subsections .07, .08, .10, and .11 of IDAPA 58.01.03.007.
3. The recirculating tank shall be accessible from grade and the return line, pump, pump screen, and pump components shall be accessible from these access points.
4. The recirculating filter effluent return point shall be located before the recirculation tank and shall enter at the inlet of the recirculating tank, unless a gravity float valve is used in which case the return point shall be located near the inlet.
5. The recirculating tank shall meet all other minimum design and equipment requirements of section 4.19.3.4.

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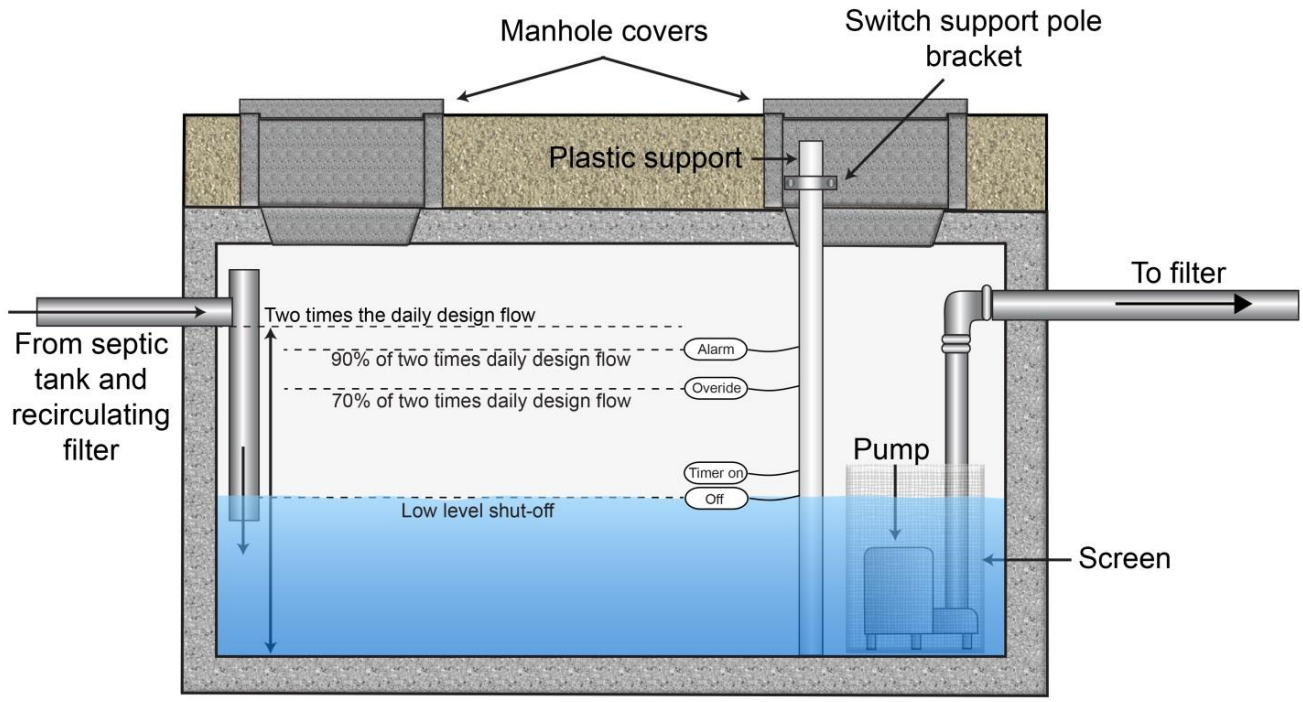

Figure 4-24. Recirculating tank in system design without nitrogen treatment requirements.

4.21.3.2 Recirculating Filter

1. The filter container shall be constructed of reinforced concrete or other materials where equivalent function, workmanship, watertightness, and at least a 20-year service life can be documented.
2. The following requirements must be met for flexible membrane liners when used in place of concrete:
   a. Have properties equivalent to or greater than 30-mil PVC.
   b. Have field repair instructions and materials provided to the purchaser of the liner.
   c. Have factory fabricated *boots* for waterproof field bonding of piping to the liner.
   d. Liner must be placed against smooth, regular surfaces free of sharp edges, nails, wire, splinters, or other objects that may puncture the liner. A 4-inch layer of clean sand should provide liner protection.
3. The filter surface area is sized at a maximum of 5 gallons/ft^2/day forward flow (forward flow is equivalent to the daily design flow from the structure).
4. Filter construction media shall meet the specifications in section 3.2.8.1.3 for pea gravel and section 3.2.8.1.1 for drainrock.
5. Minimum filter construction specifications (i.e., media depth, geotextile fabric placement, cover slopes, filter container height, and piping placement) shall meet the dimensions and locations depicted in Figure 4-25.
6. The bottom of the filter may be sloped at least 1% to the underdrain pipe.
7. An underdrain must be located at the bottom of the filter to return filtered effluent to the dosing chamber meeting the following requirements:

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a. May be placed directly on the bottom of the filter.
b. Placed level throughout the bottom of the filter.
c. Constructed of slotted drain pipe with 0.25-inch slots, 2.5 inches deep and spaced 4 inches apart located vertically on the pipe, or perforated sewer pipe with holes located at 5 and 7 o'clock.
d. One underdrain should be installed for each filter cell zone.
e. The distal end is vented to the atmosphere, protected with a screen, and located within the filter to allow entry of air flow into the bottom of the filter and access for cleaning and ponding observation.
f. Connected to solid pipe that meets the construction requirements of IDAPA 58.01.03.007.21, extends through the filter, and is sealed so the joint between the filter wall and pipe is watertight.

8. Two observation tubes should be placed in the recirculating filter to monitor for ponding and clogging formation.
   a. The monitoring tubes must be secured and perforated near the bottom.
   b. The monitoring tubes must extend through the recirculating filter cover and have a removable cap.
9. The surface of the recirculating filter must be left open to facilitate oxygenation of the filter. No soil cover shall be placed above the upper layer of drainrock in the recirculating gravel filter. However, the filter must be designed to prevent accidental contact with effluent from the surface. The following minimum requirements must be followed:
   a. Chain-link fence or another acceptable protective barrier (Figure 4-25) shall be placed at the top of the filter container and cover the entire surface of the filter to prevent access, unless fencing is placed around the entire system to prevent access.
   b. Geotextile fabric shall be placed over the access barrier.
   c. Fencing around the recirculating gravel filter is recommended for all central systems.

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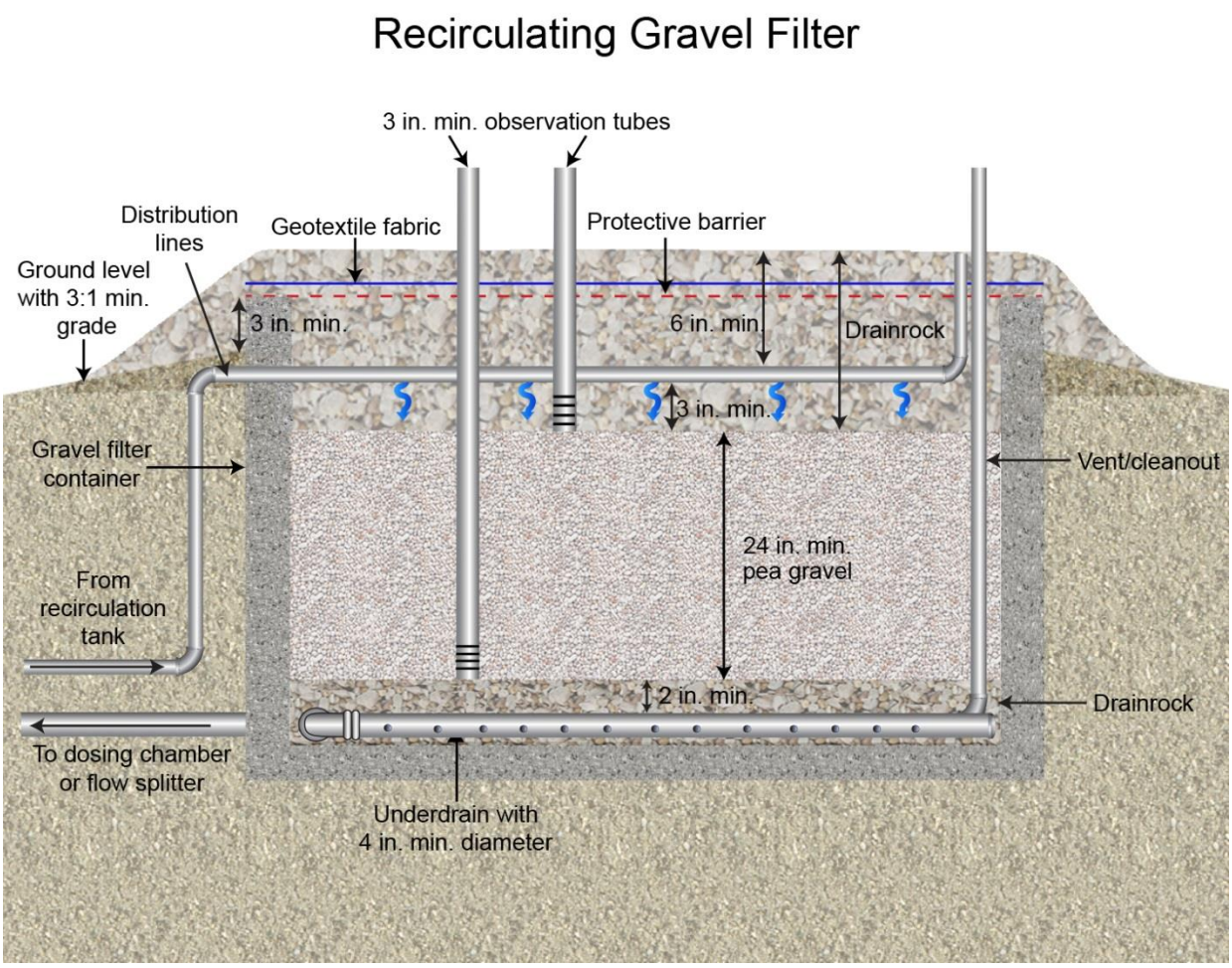

Figure 4-25. Recirculating gravel filter.

4.21.3.2.1 Recirculating Filter Cells

Depending on the volume of effluent and type of structure using a recirculating gravel filter, the recirculating filter may need to be split into cells that contain dosing zones (Figure 4-26). A filter cell is the total filter area that can be served by a single dosing pump or set of pumps. A filter zone is the area of a cell that can be dosed by a single dosing pump at any one time. Zone sizing depends upon pump size, lateral length, perforation size, and perforation spacing. The minimum filter design requirements for cells, zones, and pumps include the following:

1. Single-family homes: one cell, one zone, and one pump. If more than one cell or zone is used for a single-family home, duplex pumps are not required.
2. Central systems or systems connected to anything other than a single-family home (flows up to 2,500 GPD): one cell, two zones, and one pump per zone.
3. Large soil absorption systems (flows of 2,500 to 5,000 GPD): one cell, three zones, and one pump per zone.
4. Large soil absorption systems (flows over 5,000 GPD): two cells, two zones per cell, and one pump per zone.

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5. An alternative to installing one pump per zone is to install duplex pumps connected to sequencing valves that alternate zones for each pressurization cycle. For systems with multiple cells, each cell must have a dedicated set of duplex pumps. Pumps should alternate between each cycle.
6. Filter cells are recommended to be hydraulically isolated from one another and shall be constructed according to the minimum requirements in section 4.21.3.2.
7. Each cell shall be equivalent in surface area and volume and have the same number of zones.
8. Each zone shall have the same number of laterals and perforations.

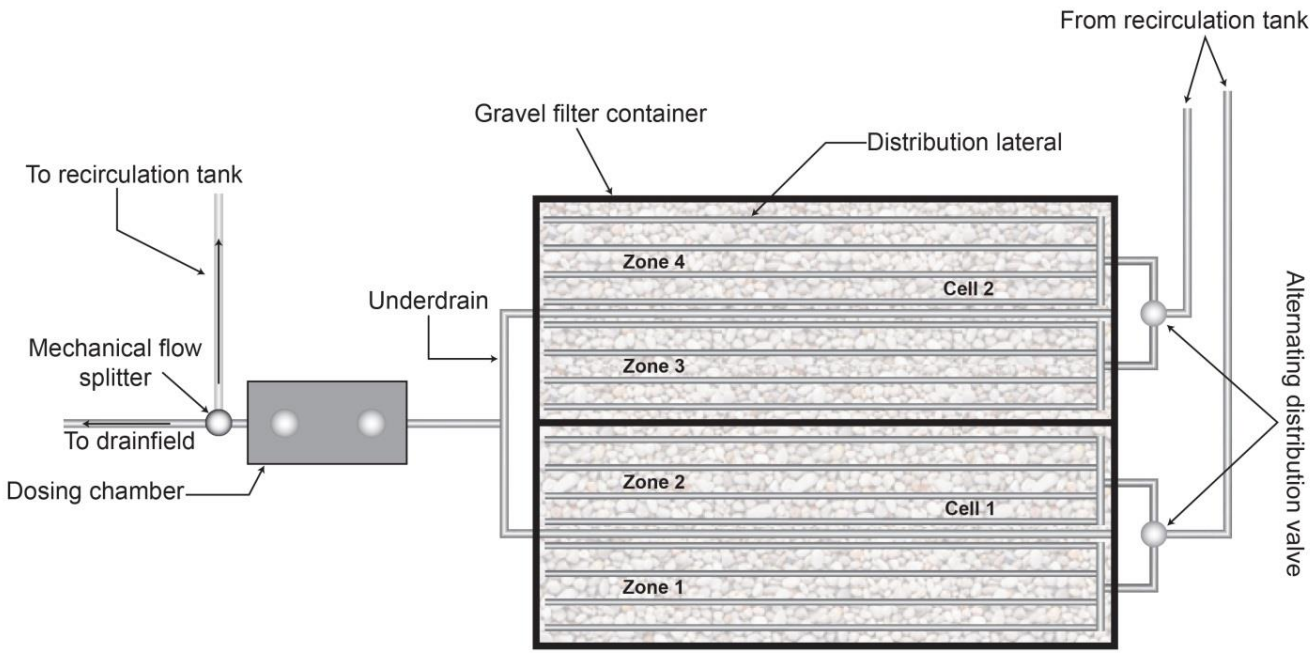

Figure 4-26. Overhead view of a recirculating gravel filter with multiple cells and dosing zones discharging to a dosing chamber and using mechanical flow splitting.

4.21.3.2.2 Recirculating Filter Dosing

1. The minimum recirculation ratio of the filter is 5:1, and the maximum recirculation ratio is 7:1 (the daily flow moves through the filter a minimum of five times or a maximum of seven times before discharge to the drainfield).
2. Timed dosing is required, and the filter dosing cycle should meet the following minimum recommendations:
   a. Pumps are set to dose each zone approximately two times per hour.
   b. Dose volume delivered to the filter surface for each cycle should be 10.4% of the daily flow from the structure (forward flow).
   c. A pump-on override float should be set at a point that equates to 70% of the recirculating tank's volume.
   d. A low-level off float should be placed to ensure that the pump remains fully submerged at all times.

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3. The pump controls should meet the following:
   a. Be capable of monitoring low- and high-level events so that timer settings can be adjusted accordingly.
   b. Have event counters and run-time meters to monitor daily flows.

4.21.3.3 Effluent Return

1. Effluent must be returned from the filter to the recirculation tank, which may occur by gravity or under pressure.
2. Gravity return must occur using a float valve (Figure 4-27) within the recirculating tank, and the float valve must:
   a. Be located on the inlet side of the recirculating tank.
   b. Allow for continual splitting of filtered effluent when the buoy is fully seated and discharging to the drainfield.
   c. Be capable of returning 83% of the filtered effluent to the recirculation tank when the buoy is fully seated.
3. Other types of gravity flow splitters shall not be used to split recirculation flows.
4. Pressurized return must be done using a dosing chamber that meets the minimum requirements of section 4.19.3.4, and the dosing chamber must:
   a. Be located after the recirculating filter.
   b. Use a mechanical flow splitter (Figure 4-28 and Figure 4-29) that is capable of simultaneously returning effluent to the recirculating tank and discharging effluent to the drainfield.
5. Mechanical flow splitters shall:
   c. Be located outside of the dosing chamber and prior to the recirculation tank.
   b. Be capable of returning effluent to the recirculating tank and discharging to the drainfield in a volume ratio equivalent to the designed recirculation ratio (e.g., if a recirculation ratio of 5:1 is used, 83% of the filtered effluent by volume shall be returned to the recirculating tank, and 17% shall be discharged to the drainfield (Figure 4-30 and Figure 4-31).
6. Discharge of effluent to the drainfield must occur after filtration and flow splitting.

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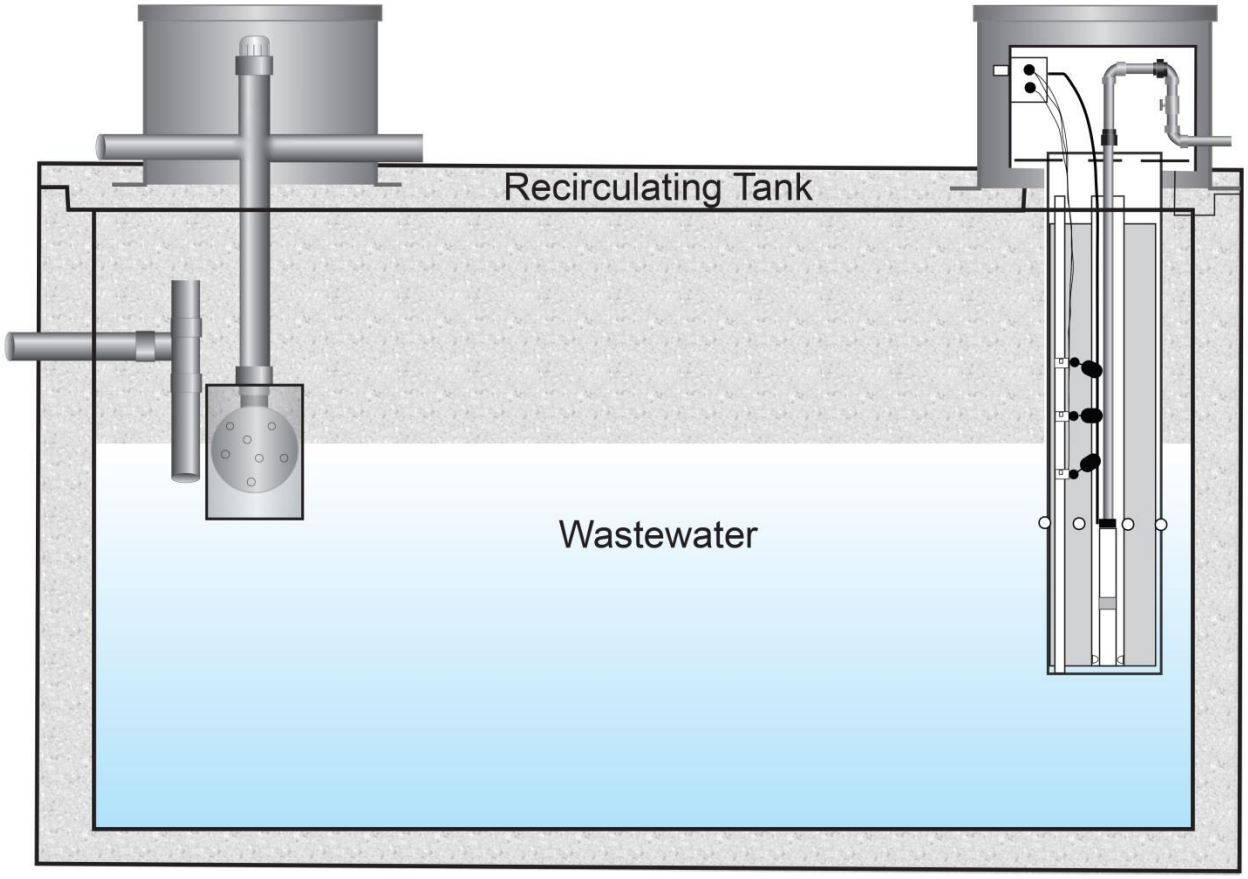

Figure 4-27. Gravity float valve return location within the recirculating tank.

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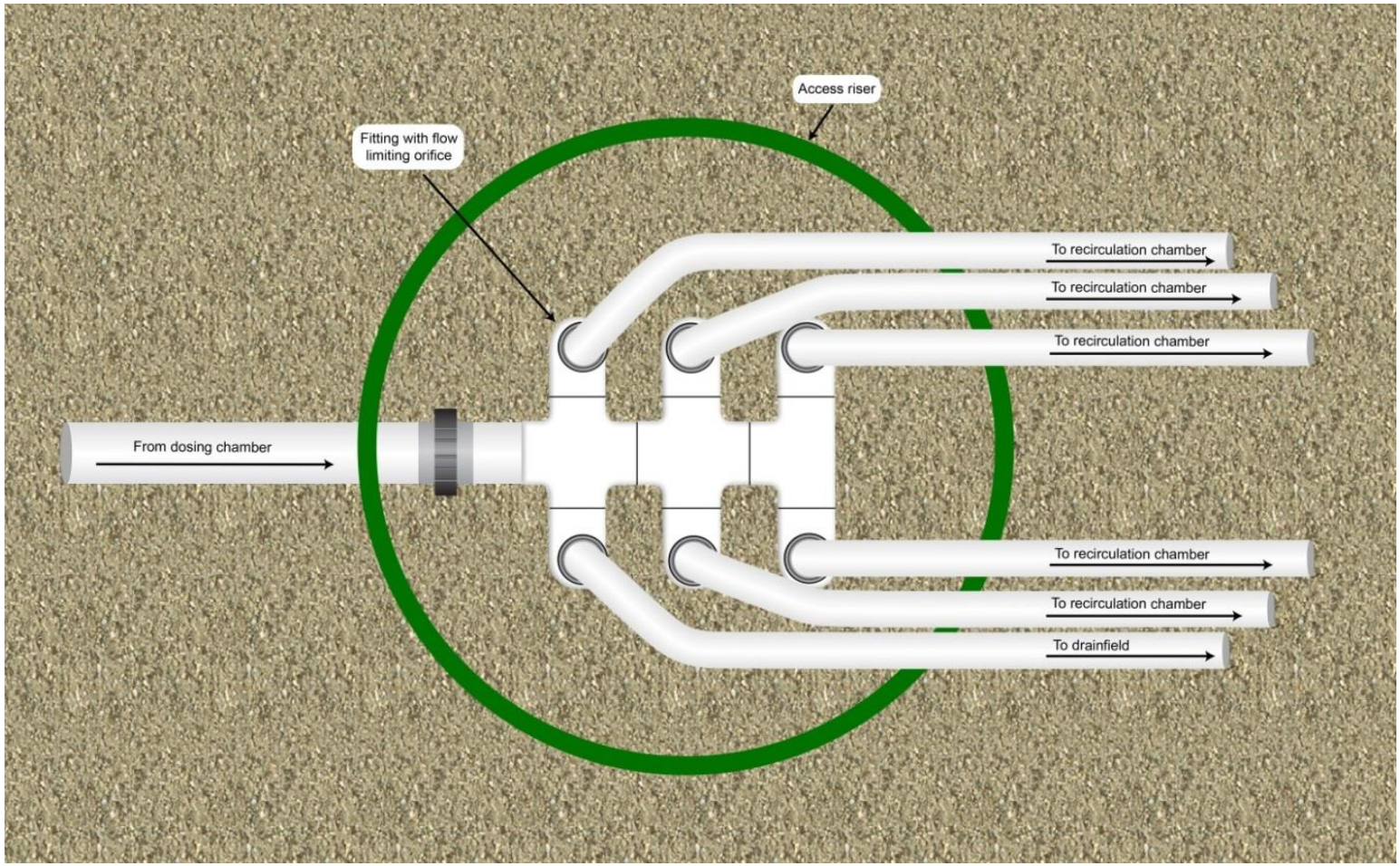

Figure 4-28. Bottom view of a mechanical flow splitter for gravity distribution that delivers wastewater to all transport pipes with each dose.

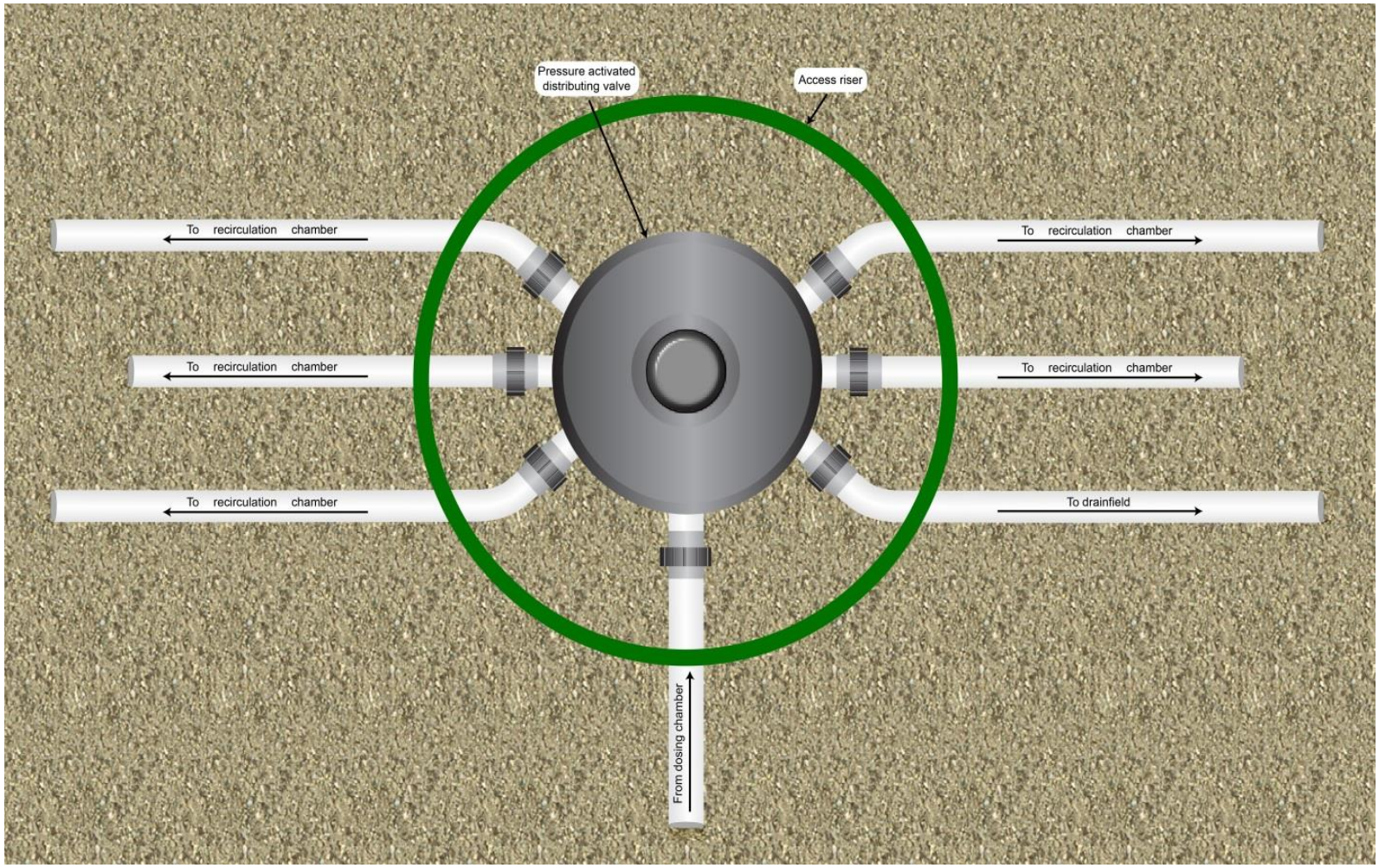

Figure 4-29. Overhead view of a mechanical flow splitter for pressure distribution that only delivers wastewater to one transport pipe with each dose.

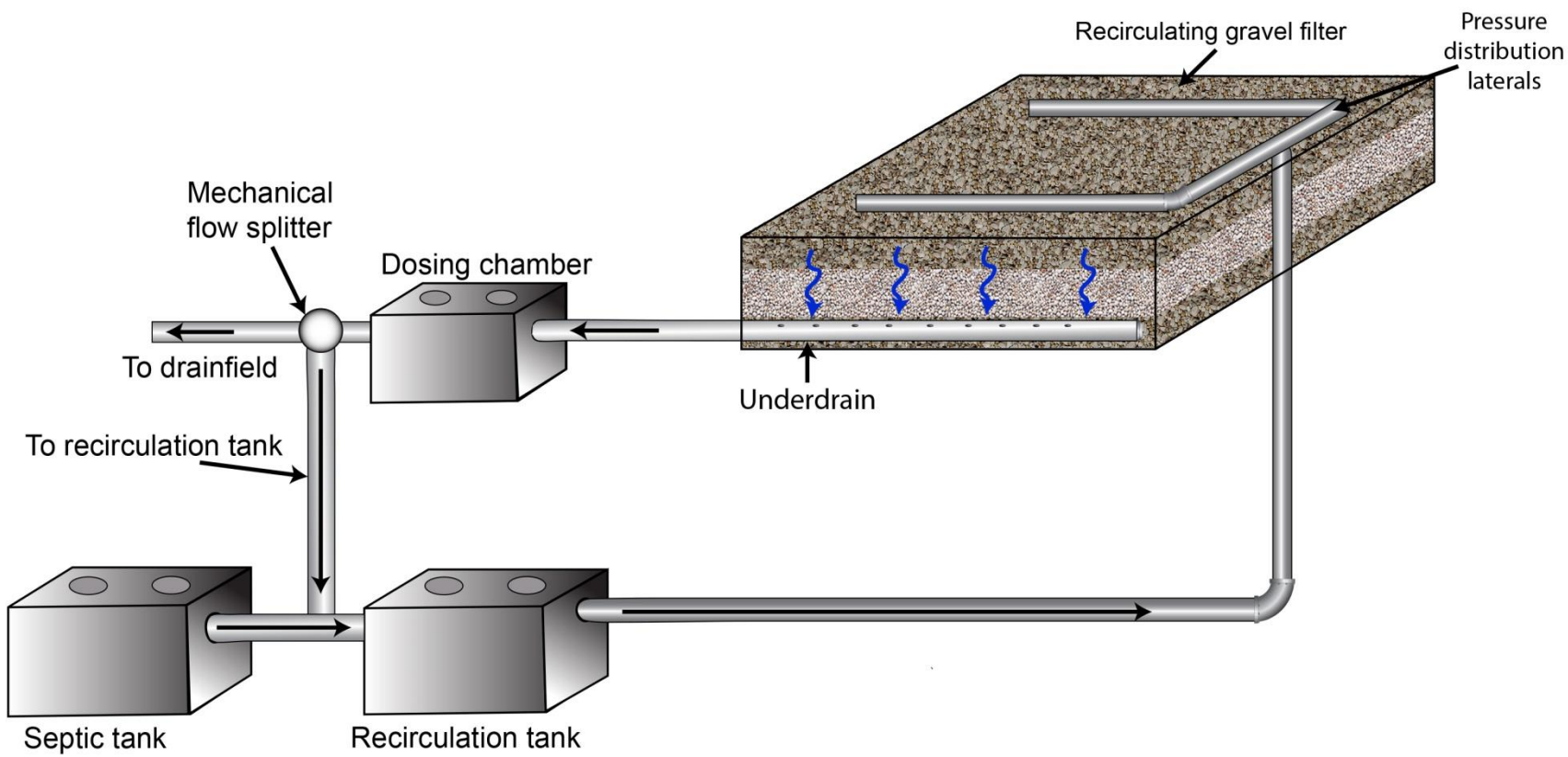

Figure 4-30. Cross section of a recirculating gravel filter system with pressure transport to, and/or within, the drainfield.

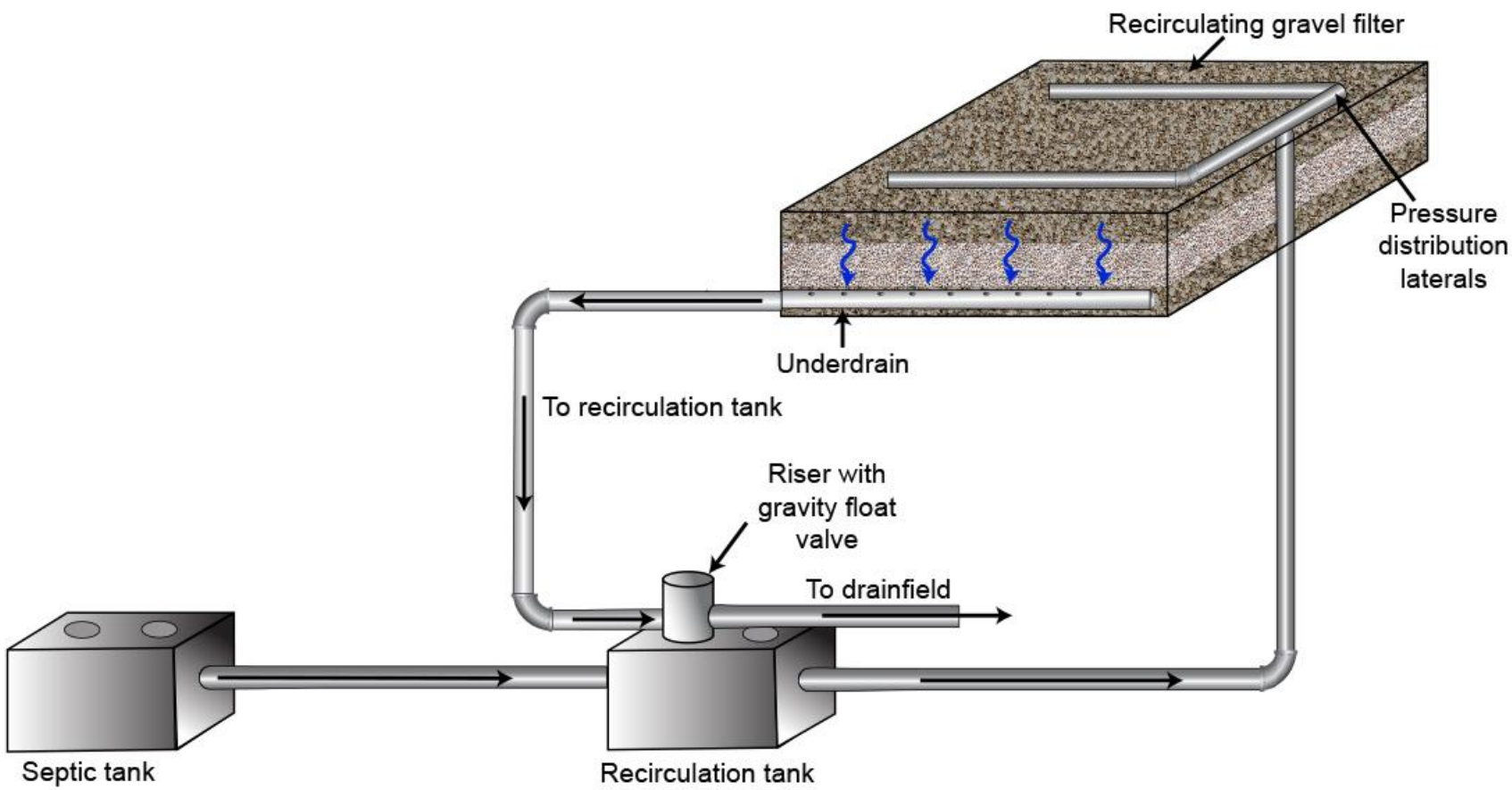

Figure 4-31. Cross section of a recirculating gravel filter system with gravity transport to the drainfield.

4.21.3.4 Additional Design Elements for Recirculating Gravel Filter Systems Required to Reduce Total Nitrogen

4.21.3.4.1 Equalization Tank

1. An equalization tank is required for all recirculating gravel filters treating effluent for total nitrogen.
2. A septic tank sized according to IDAPA 58.01.03.007.07 shall precede the equalization tank.
3. Minimum equalization tank volume shall be capable of maintaining two times the sum of the daily design flow of the system and recirculation volume returned to the equalization tank.
4. The equalization tank may be a modified septic tank or dosing chamber selected from section 5.2 or section 5.3.
   a. Alternatively, the equalization tank may be designed by the system's design engineer to meet the minimum requirements of this section and IDAPA 58.01.03.007.
   b. Equalization tank design is exempt from subsections .07 and .08 of IDAPA 58.01.03.007.
5. The recirculating filter effluent return point shall be located before the equalization tank and shall enter at the inlet of the equalization tank.

4.21.3.4.2 Effluent Return

1. Effluent shall be returned from the recirculating gravel filter in a ratio of 20% to the equalization tank and 80% to the recirculation tank (Figure 4-32).
2. Effluent return from the filter to the equalization tank and recirculation tank may be done by gravity or under pressure.
3. The design engineer must specify how the return ratio will be met with the system design, and document the return flow in the system design calculations (Figure 4-33 and Figure 4-34).

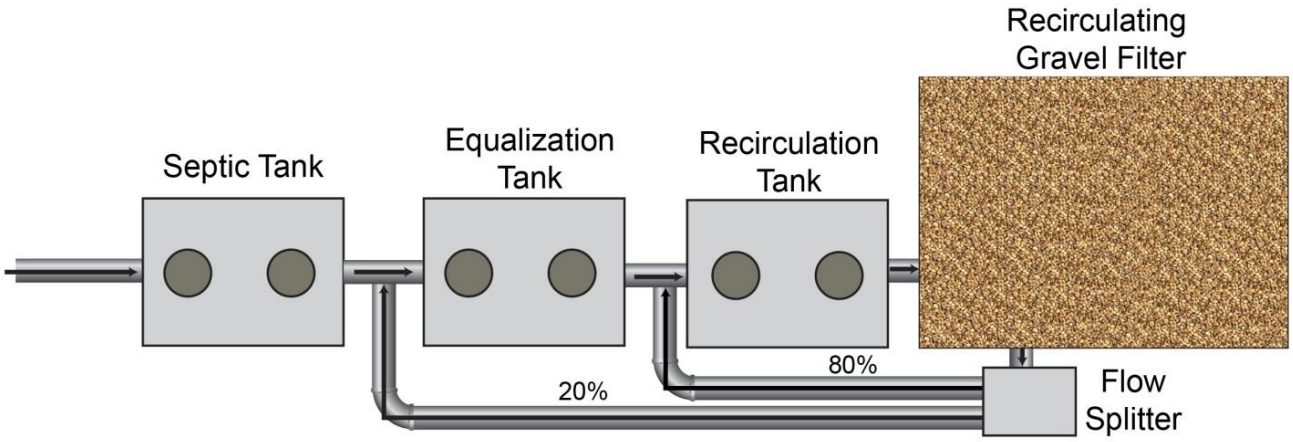

Figure 4-32. Effluent return locations and ratios from the recirculating gravel filter and flow splitter for systems treating total nitrogen.

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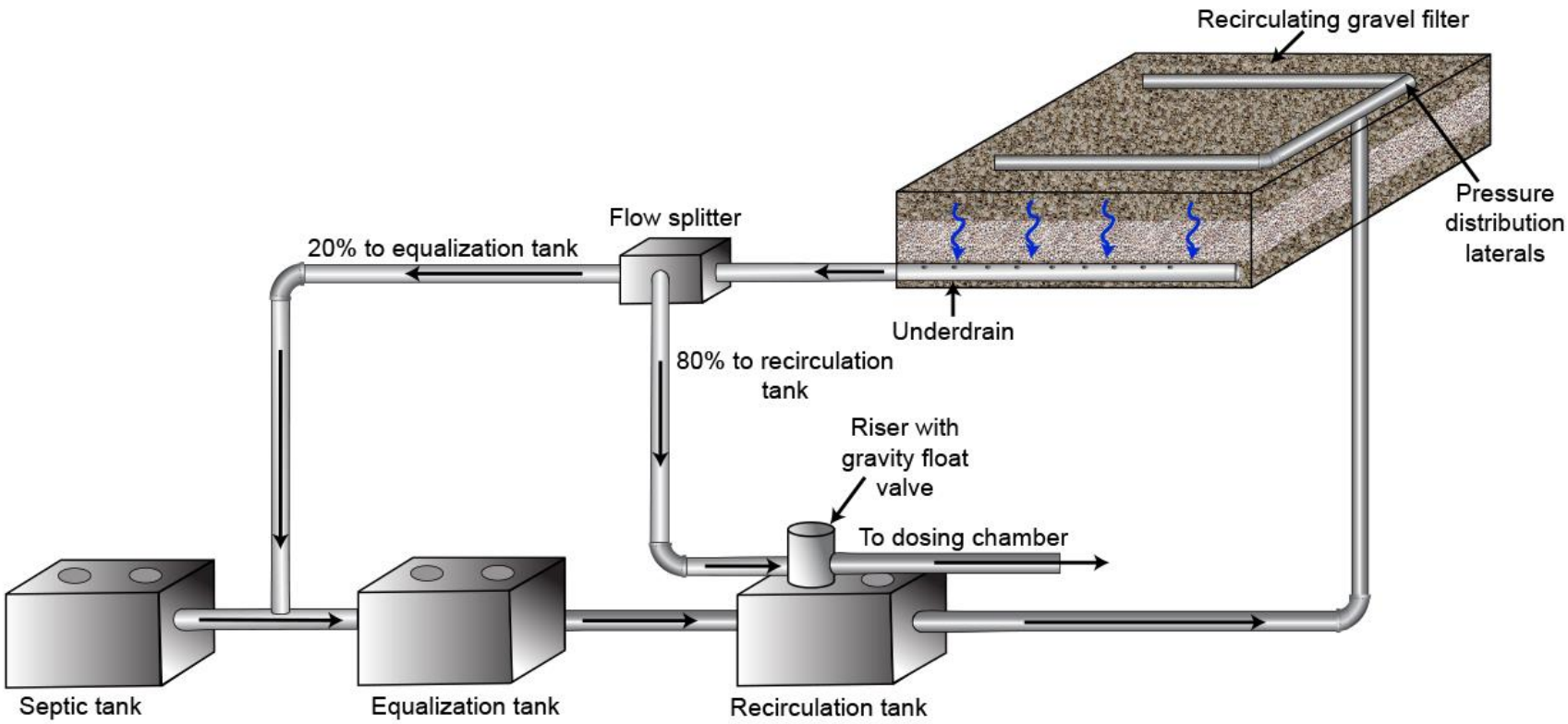

Figure 4-33. Cross section of a nitrogen-reducing recirculating gravel filter system with pressure transport to, and/or within the drainfield.

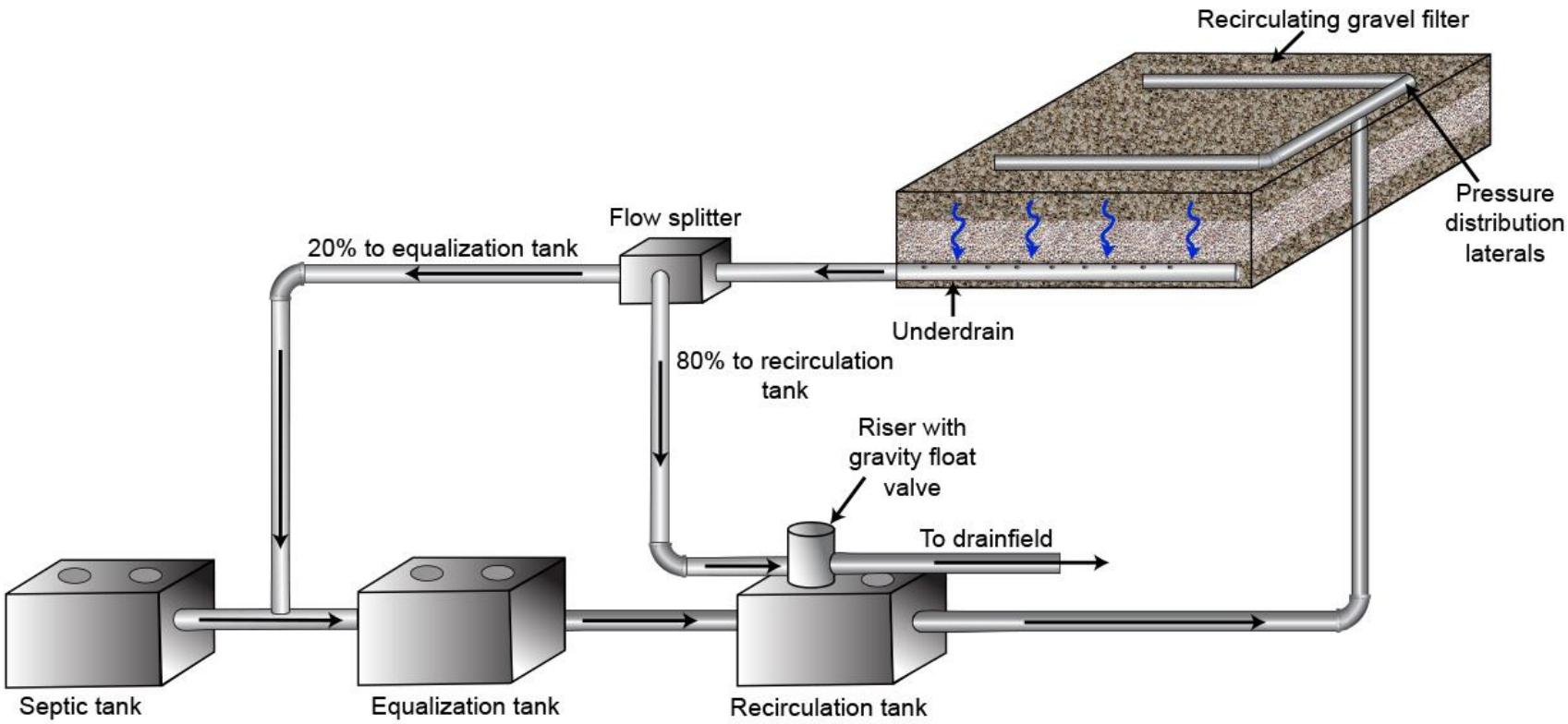

Figure 4-34. Cross section of a nitrogen-reducing recirculating gravel filter system with gravity transport to the drainfield.

4.21.4 Filter Construction

1. All materials must be structurally sound, durable, and capable of withstanding normal installation and operation stresses.
2. Components that may be subject to excessive wear must be readily accessible for repair or replacement.
3. All filter containers must be placed over a stable level base.
4. Geotextile filter fabric shall be placed only over the top of the filter and must not be used in-between the filter construction media and underdrain aggregate.
5. Access to the filter surface must be provided to facilitate maintenance.

4.21.5 Drainfield Trenches

1. Distances shown in Table 4-18 must be maintained between the trench bottom and limiting layer.
2. Pressure distribution, when used, shall meet the following design considerations:
   a. If a pressure distribution system is designed within the drainfield, it must be designed according to section 4.19.
   b. If the pressurized line from the mechanical flow splitter breaks to gravity before the drainfield, it must be done according to section 4.19.3.6.
   c. The recirculation tank and recirculating filter may not be used as the dosing chamber for the drainfield or for flow-splitting purposes.
3. The minimum area, in square feet of bottom trench surface, shall be calculated from the maximum daily flow of effluent divided by the hydraulic application rate for the applicable soil design subgroup listed in Table 4-19.

Table 4-18. Recirculating gravel filter vertical separation to limiting layers (feet).

Limiting Layer	Flow < 2,500 GPD	Flow ≥ 2,500 GPD
	All Soil Types	All Soil Types
Impermeable layer	2	4
Fractured rock or very porous layer	1	2
Normal high ground water	1	2
Seasonal high ground water	1	2

Note: gallons per day (GPD)

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Table 4-19. Secondary biological treatment system hydraulic application rates.

Soil Design Subgroup	Application Rate (gallons/square foot/day)
A-1	1.7
A-2a	1.2
A-2b	1.0
B-1	0.8
B-2	0.6
C-1	0.4
C-2	0.3

4.21.6 Inspection

1. A preconstruction meeting between the health district, responsible charge engineer, and installer should occur before commencing any construction activities.
2. The health district should inspect all system components before backfilling and inspect the filter container construction before filling with drainrock and filter construction media.
3. The responsible charge engineer shall conduct as many inspections as needed to verify system and component compliance with the engineered plans.
4. The responsible charge engineer shall provide the health district with a written statement that the system was constructed and functions in compliance with the approved plans and specifications. Additionally, the responsible charge engineer shall provide as-built plans to the health district if any construction deviations occur from the permitted construction plans (IDAPA 58.01.03.005.15).

4.21.7 Operation and Maintenance

1. The recirculating gravel filter design engineer shall provide a copy of the system's OMM procedures to the health district as part of the permit application and before subsurface sewage disposal permit issuance (IDAPA 58.01.03.005.04.k).
2. Minimum OMM requirements should follow each system component manufacturer's recommendations.
3. Instructions on how to trouble shoot the pump control panel should be included to allow adjustment to pump cycle timing if the low-level off or high-level alarm switch is frequently tripped in order to maintain the minimum 5:1 recirculation ratio.
4. Operation and maintenance directions should be included describing replacement of the filter construction media and informing the system owner that a permit must be obtained from the health district for this activity.
5. Maintenance of the septic tank should be included in the O&M manual.
6. All pressure distribution system components should be maintained as described in section 4.19.5.

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7. Check for ponding at the filter construction media/underdrain aggregate interface through the observation tube in the recirculating filter.
8. Clean the surface of the filter regularly to remove leaves and other organic matter that may accumulate in the aggregate or rock cover.
9. Regularly check the recirculating gravel filter for surface odors. Odors should not be present and indicate that something is wrong. Odors are likely evidence that the dissolved oxygen in the filter is being depleted and that BOD and ammonia removal are being impacted.

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4.22 Intermittent Sand Filter

Revision: February 4, 2016
Installer registration permit: Complex
Licensed professional engineer required: Yes

4.22.1 Description

An intermittent sand filter is a bed of medium sand in a container that filters and biologically treats septic tank effluent. Effluent is pressure dosed across the top of the medium sand in small doses and percolates through the filter media. The filter effluent is then collected by an underdrain at the bottom of the filter and is distributed to a disposal trench of reduced dimension. Components of the intermittent sand filter include a septic tank, dosing chamber, pump (or siphon) and controls, distribution network, sand filter, and drainfield.

4.22.2 Approval Conditions

1. The system must be designed by a PE licensed in Idaho.
2. All pressure distribution components shall be designed according to the pressure distribution system guidance (section 4.19).
3. The design engineer shall provide an O&M manual for the system to the health district before permit issuance.
4. The intermittent sand filter container shall meet the same separation distance requirements as a septic tank.
5. The bottom of the filter must not come within 12 inches of seasonal high ground water.
6. Effluent shall not discharge to the drainfield without passing through the filter first.
7. Nondomestic wastewater must be pretreated to residential strength before discharge to the intermittent sand filter.

4.22.3 Design Requirements

Minimum design requirements for the intermittent sand filter components are provided below.

4.22.3.1 Intermittent Filter

1. The filter container shall be constructed of reinforced concrete or other materials where equivalent function, workmanship, watertightness, and at least a 20-year service life can be documented.
2. The following requirements must be met for flexible membrane liners:
   a. Have properties equivalent to, or greater than, 30-mil PVC.
   b. Have field repair instructions and materials provided to the purchaser of the liner.
   c. Have factory-fabricated *boots* for waterproof field bonding of piping to the liner.
   d. Liner must be placed against smooth, regular surfaces free of sharp edges, nails, wire, splinters, or other objects that may puncture the liner. Provide a 4-inch layer of clean sand for liner protection.
3. Application rate of septic tank effluent to the filter must be 0.7 gallons/ft^2/day.

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4. Filter construction media shall meet the specification in section 3.2.8.1 for drainrock, section 3.2.8.1.2 for medium sand, and section 3.2.8.1.3 for pea gravel.
   a. Medium sand should be placed in a maximum of 8-inch lifts.
   b. Each lift should be wetted before installation of the next lift to minimize settling.
5. Minimum filter construction specifications (i.e., media depth, geotextile fabric placement, cover depth and slopes, filter container height, and piping placement) shall meet the dimensions and locations depicted in (Figure 4-35).
6. The bottom of the filter should be sloped at least 1% to the underdrain pipe for flexible membrane liners.
7. An underdrain must be located at the bottom of the filter to drain the intermittent filter meeting the following requirements:
   a. May be placed directly on the bottom of the filter.
   b. Placed level throughout the filter.
   c. Constructed of slotted drain pipe with 0.25-inch slots 2.5 inches deep and spaced 4 inches apart located vertically on the top of the pipe, or perforated sewer drain pipe with holes located at 5 and 7 o'clock.
   d. One underdrain should be installed for each filter cell zone.
   e. The distal end is vented to the atmosphere, protected with a screen, and located within the filter to allow entry of air flow into the bottom of the filter and access for cleaning and ponding observation.
   f. Connected to solid pipe that meets the construction requirements of IDAPA 58.01.03.007.21, extends through the filter, and is sealed so the joint between the filter wall and pipe is watertight.
   g. If gravity flow is not achievable from the underdrain to the drainfield, the underdrain must be connected to an approved dosing chamber (section 5.3) or an approved septic tank (section 5.2) modified to a dosing chamber that is sized and constructed as described in section 4.19.3.4 to deliver effluent to the drainfield by pressure transportation or distribution. Dosing of the drainfield may not occur from a pump that is located within the intermittent sand filter.
8. Two observation tubes should be placed in the intermittent sand filter to monitor for ponding and clogging formation.
   a. The monitoring tubes must be secured and perforated near the bottom.
   b. The monitoring tubes must extend through the intermittent filter cover and have a removable cap.
9. The surface of the intermittent sand filter shall be covered meeting the following requirements:
   a. The soil cover shall be graded to divert any surface waters away from the intermittent sand filter.
   b. Vegetation on top of the soil cover must be managed so that deep-rooting vegetation does not plug the distribution system.
   c. The design engineer should account for potential freezing conditions in the design of the intermittent sand filter and pressure distribution system.

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4.22.3.2 Intermittent Filter Cells

Depending on the volume of effluent and type of structure using an intermittent sand filter, the intermittent filter may need to be split into cells that contain dosing zones. A filter cell is the total filter area that can be served by a single dosing pump or set of pumps. Cell sizing is limited to 600 GPD. The minimum filter design requirements for cells and pumps include the following:

1. Filter cells are hydraulically isolated from one another and shall be constructed according to the minimum requirements in section 4.22.3.
2. Each cell shall be equivalent in surface area and volume.
3. Each cell shall receive equal volumes of wastewater per dose.

4.22.3.3 Intermittent Filter Dosing

1. Timed dosing is required, and the filter dosing cycle should meet the following minimum recommendations:
   a. Pumps are set to dose each cell once per hour.
   b. Dose volume delivered to the filter surface for each cycle should be 5% of the daily design flow.
   c. A pump on override float should be set at a point that equates to 70% of the dosing chamber's volume.
   d. A high-level audio and visual alarm float should be set at 90% of the dosing chamber's volume.
   e. A low-level off float should be placed to ensure that the pump remains fully submerged at all times.
2. The pump controls should meet the following:
   a. Be capable of monitoring low- and high-level events so that timer settings can be adjusted accordingly.
   b. Have event counters and run-time meters to be able to monitor daily flows.

Figure 4-35 provides a cross-sectional view of an intermittent sand filter cell.

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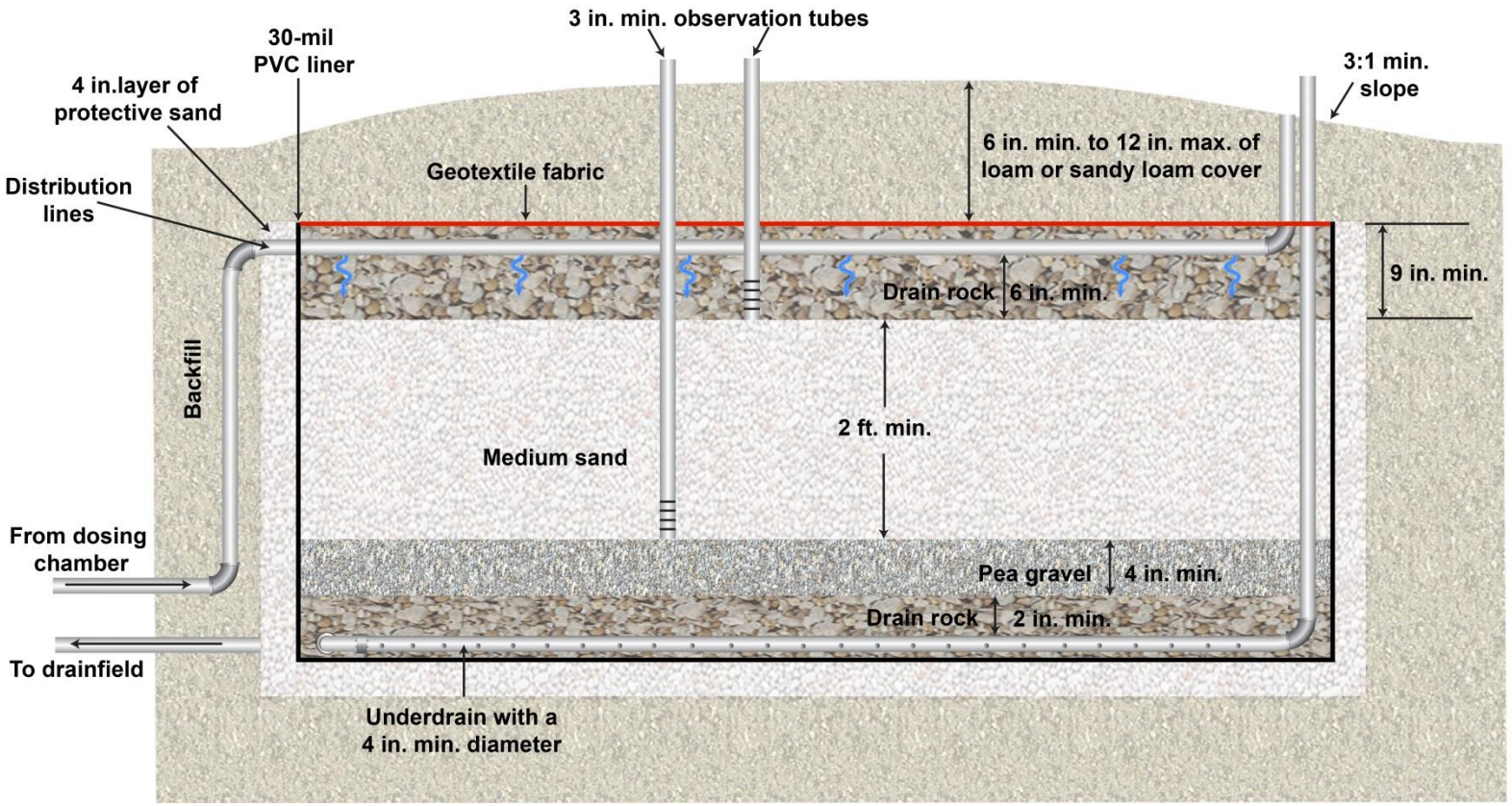

Figure 4-35. Cross section of flexible membrane intermittent sand filter cell.

4.22.4 Drainfield Trenches

1. Distances shown in Table 4-20 must be maintained between the trench bottom and limiting layer.
2. Capping fill may be used to obtain adequate separation distance from limiting layers but must be designed and constructed according to the guidance for capping fill trenches in section 4.3.
3. Pressure distribution may be used with the following design considerations:
   a. The pressure distribution system related to the drainfield is designed according to section 4.19.
   b. The dosing chamber for the intermittent sand filter may not be used as the dosing chamber for the drainfield.
4. The drainfield shall be sized by dividing the maximum daily flow by the hydraulic application rate for the applicable soil design subgroup listed in Table 4-21.

Table 4-20. Intermittent sand filter vertical setback to limiting layers (feet).

Limiting Layer	Flow < 2,500 GPD	Flow ≥ 2,500 GPD
	All Soil Types	All Soil Types
Impermeable layer	2	4
Fractured rock or very porous layer	1	2
Normal high ground water	1	2
Seasonal high ground water	1	2

Note: gallons per day (GPD)

Table 4-21. Secondary biological treatment system hydraulic application rates.

Soil Design Subgroup	Application Rate (gallons/square foot/day)
A-1	1.7
A-2a	1.2
A-2b	1.0
B-1	0.8
B-2	0.6
C-1	0.4
C-2	0.3

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4.22.5 Inspection

1. A preconstruction meeting between the health district, responsible charge engineer, and installer should occur before commencing any construction activities.
2. The health district should inspect all system components before backfilling and inspect the filter container construction before filling with drainrock and filter construction media.
3. The responsible charge engineer shall conduct as many inspections as needed to verify system and component compliance with the engineered plans.
4. The responsible charge engineer shall provide the health district with a written statement that the system was constructed and functions in compliance with the approved plans and specifications. Additionally, the responsible charge engineer shall provide as-built plans to the health district if any construction deviations occur from the permitted construction plans (IDAPA 58.01.03.005.15).

4.22.6 Operation and Maintenance

1. The intermittent sand filter design engineer shall provide a copy of the system's OMM procedures to the health district as part of the permit application and prior to subsurface sewage disposal permit issuance (IDAPA 58.01.03.005.04.k).
2. Minimum OMM requirements should follow each system component manufacturer's recommendations.
3. Instructions on how to trouble shoot the pump control panel should be included to allow adjustment to pump cycle timing if the low-level off or high-level alarm switch is frequently tripped in order to maintain the hourly dosing cycle timing.
4. Operation and maintenance directions should be included describing the replacement of the filter construction media and informing the system owner that a repair permit must be obtained from the health district for this activity.
5. Maintenance of the septic tank shall be included in the O&M manual.
6. All pressure distribution system components shall be maintained as described in section 4.19.5.
7. Check for ponding in the intermittent sand filter observation ports.
8. Vegetation over the intermittent sand filter should be maintained regularly.
9. Sludge depth in the septic tank should be checked annually, and the tank shall be pumped when sludge exceeds 40% of the liquid depth.

Figure 4-36 shows a cross section of an intermittent sand filter system with gravity distribution to the drainfield. Figure 4-37 shows a cross section of an intermittent sand filter system with pressure transport to, and/or distribution within, the drainfield.

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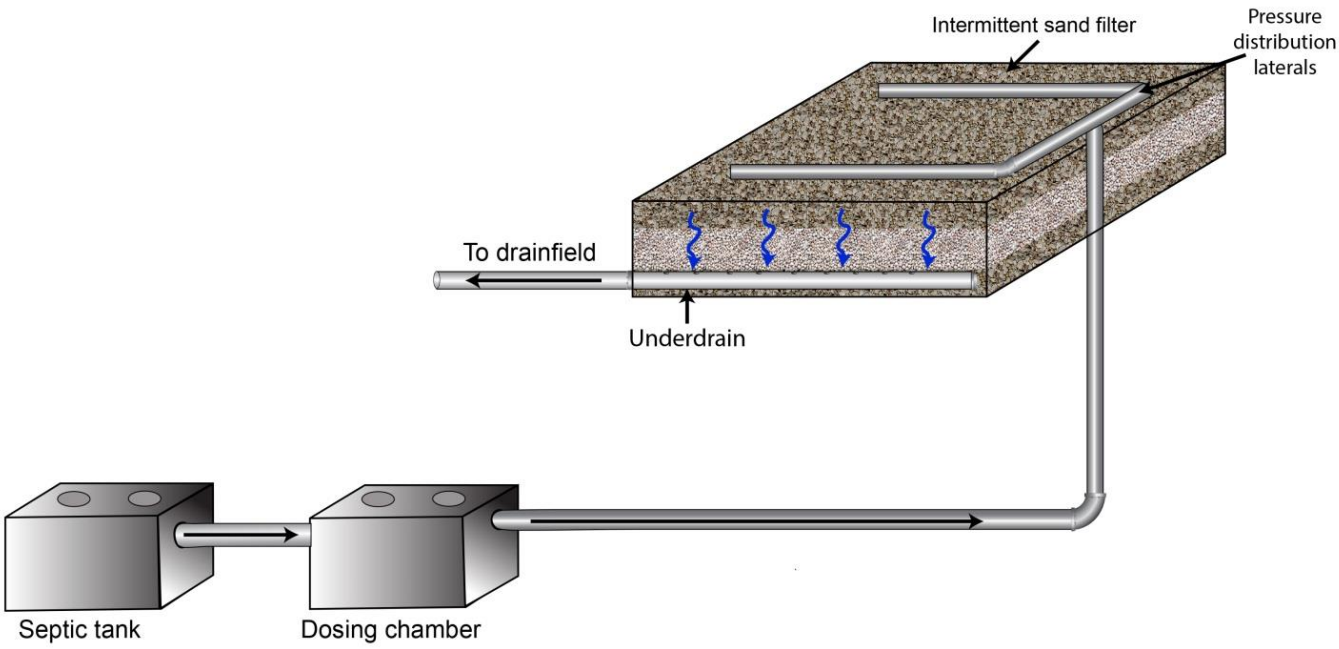

Figure 4-36. Cross section of an intermittent sand filter system with gravity discharge to the drainfield.

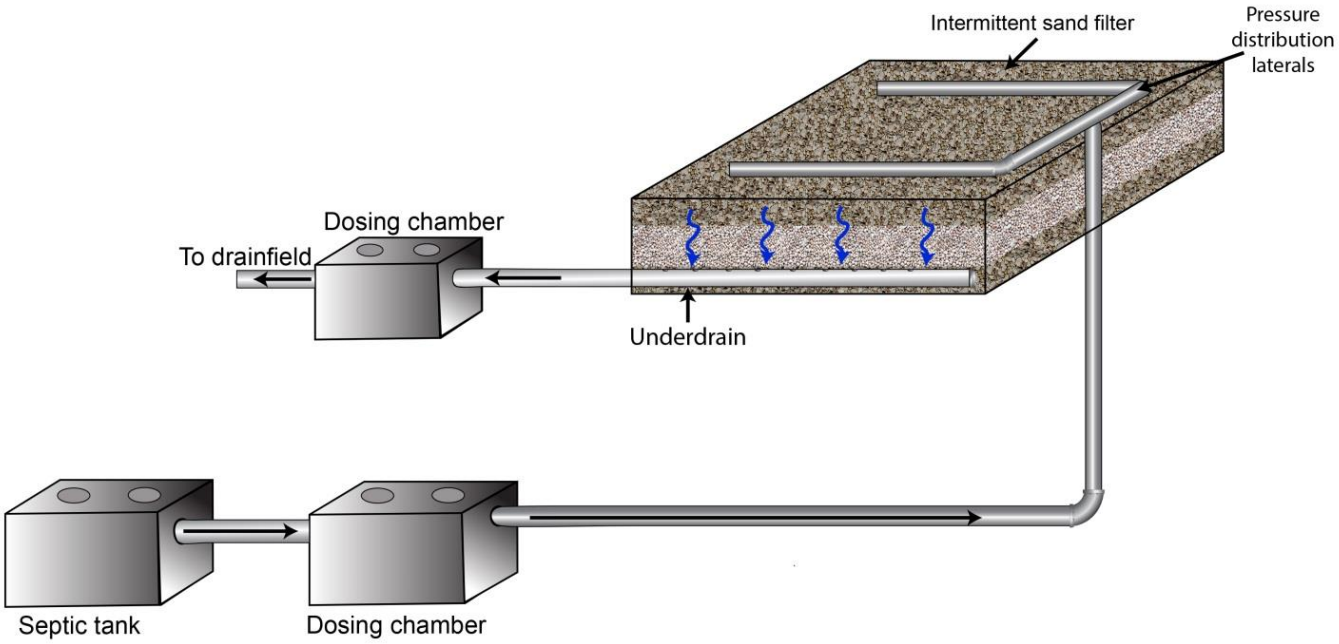

Figure 4-37. Cross section of an intermittent sand filter system with pressure transport to and/or distribution within the drainfield.

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4.23 In-Trench Sand Filter

Revision: July 22, 2015
Installer registration permit: Property owner or standard and basic (complex if pretreated and pressurized enveloped)
Licensed professional engineer required: No (yes if pressurized enveloped)

4.23.1 Description

An in-trench sand filter is a standard trench or bed system receiving effluent by either gravity or low-pressure flow, under which is placed a filter of medium sand meeting the definitions provided in section 3.2.8.1.2. There are two classifications of an in-trench sand filter:

- Standard in-trench sand filter
- Enveloped in-trench sand filter

The standard design is typically used to excavate through impermeable or unsuitable soil layers down to suitable permeable soils. The standard design may also have clean pit run sand and gravel placed between the medium sand and the suitable permeable soils or ground water as long as minimum medium sand depths are used. A basic installer's permit may be used to install gravity flow in-trench sand filters that are not preceded by any complex alternative system components.

Standard in-trench sand filter drainfields may be installed at depths where the sidewalls of the drainfield are located in impermeable or unsuitable soil to address sites that cannot meet the requirements of IDAPA 58.01.03.008.02.b. Unsuitable soils must have application rates <0.2 GPD/ft^2 (Table 2-4). Unsuitable soils with application rates >1.2 GPD/ft^2 (Table 2-4) must use an enveloped in-trench sand filter design.

A modified design to the standard in-trench sand filter is known as the enveloped in-trench sand filter. Enveloped in-trench sand filters consist of a disposal trench with medium sand placed below and to the sides of the drainfield and are used for sites with native soils consisting of coarse to very coarse sand or gravel. The enveloped in-trench sand filter has three subcategories based on effluent distribution and treatment (section 4.23.3.2).

The term drainfield only applies to the aggregate as defined in IDAPA 58.01.03.008.08 or the gravelless trench components approved in section 5.7 of this manual. Medium sand and pit run may be installed deeper than 48 inches below grade as long as the drainfield maintains a maximum installation depth of 48 inches below grade in compliance with IDAPA 58.01.03.008.04. Minimum installation depths must meet the capping fill trench requirements as outlined in section 4.3.

4.23.2 Approval Conditions

1. Except as specified herein, the system must meet the dimensional and construction requirements of a standard trench, bed, or pressure distribution system.
2. Any subclassification of an in-trench sand filter may be used over very porous strata, coarse sand and gravel, or ground water.

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3. A basic permitted installer may install standard or standard enveloped gravity flow in-trench sand filters that are not preceded by any complex alternative system components.
4. A permitted complex installer is required to install a pretreated enveloped in-trench sand filter, pressurized enveloped in-trench sand filter, or any other in-trench sand filters that are preceded by, or contain, a complex system component.
5. Medium sand used in filter construction must conform to the gradation requirements as described in section 3.2.8.1.2.
6. Pit run backfill material, if used, must conform to the gradation requirements as described in section 3.2.8.1.4.

4.23.3 Design and Construction Requirements

Each classification of the in-trench sand filter has its own unique minimum design and construction criteria that must be followed. The following subsections describe the minimum design and construction requirements for each classification of the in-trench sand filter.

4.23.3.1 Standard In-Trench Sand Filter Design and Construction

1. Minimum medium sand depths depend upon site-specific soil profiles.
2. There is no minimum medium sand depth if seasonal ground water or a porous limiting layer is not present (see example 2 in section 2.2.5.2).
3. If seasonal ground water or a porous limiting layer is present the minimum medium sand and pit run depths are dependent upon meeting the method of 72 as outlined in section 2.2.5.2 (Figure 4-38).
4. Pit run material may only be installed at depths of 8 feet below grade or more; medium sand must be used from the bottom of the drainfield to a depth of 8 feet below grade regardless of the drainfield installation depth.
5. The standard in-trench sand filter system shall be sized based on the most restrictive native receiving soil below the medium sand, or pit run, and native soil interface to a depth capable of meeting the method of 72 as described in section 2.2.5.2.
6. Standard in-trench sand filters must maintain a 12-inch minimum depth of suitable native soil below the filter above a porous or nonporous limiting layer (Figure 4-38).
7. Standard in-trench sand filters must maintain a minimum separation distance of 12 inches from the bottom of the drainfield to the seasonal high ground water level.
8. Standard in-trench sand filters must maintain a separation distance from the bottom of the drainfield and any limiting layer that is capable of meeting the method of 72 as described in section 2.2.5.2.

   Design and construction condition 8 may be waived if the standard in-trench sand filter is preceded by an alternative pretreatment system (e.g., ETPS, intermittent sand filter, or recirculating gravel filter) as long as the bottom of the drainfield still meets the minimum separation distances of the applicable alternative pretreatment system.

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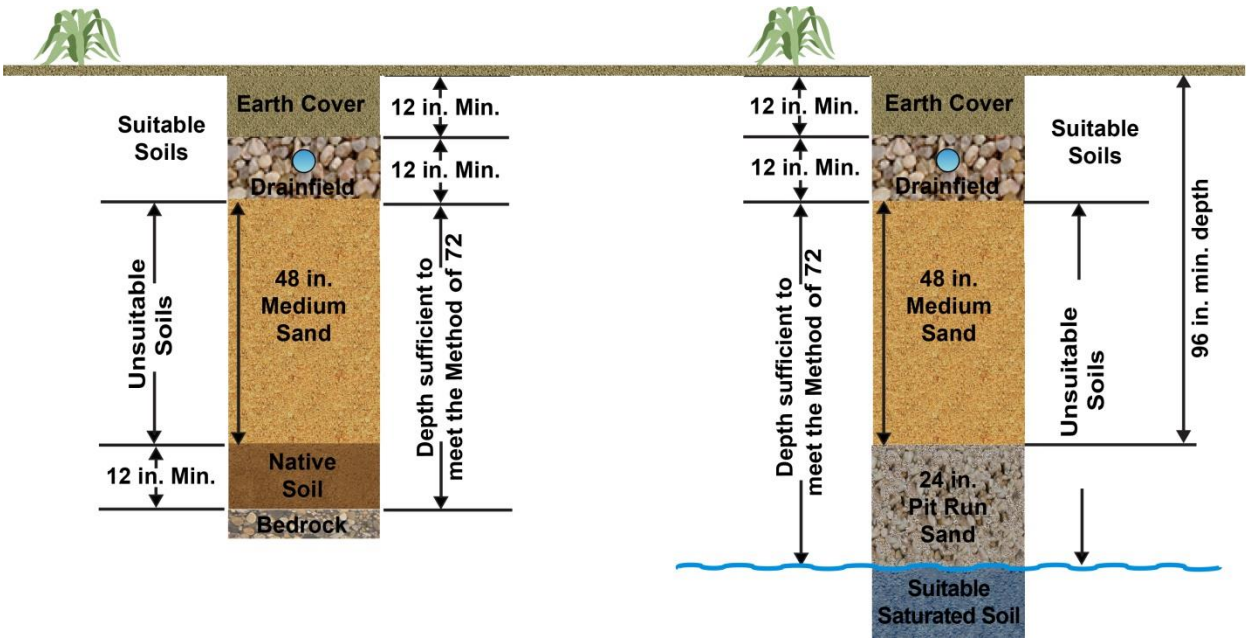

Figure 4-38. In-trench sand filter accessing suitable soils through an unsuitable soil layer.

4.23.3.2 Enveloped In-Trench Sand Filter Design and Construction

The three subcategories of the enveloped in-trench sand filter include in-trench sand filters that receive the following:

- Standard domestic strength effluent
- Pretreated effluent
- Pressure distributed effluent

All the subcategories of enveloped in-trench sand filters have the following same design and construction requirements:

1. The filter sand shall envelop the drainfield so that at least 12 inches of medium sand is between the sides and ends of the drainfield and native soils.
2. Effective disposal area for installing an enveloped in-trench sand filter shall only be credited for the width and length of the drainfield installed. Medium sand width enveloping the drainfield is not credited as disposal area.
3. Enveloped in-trench sand filters may not be used in large soil absorption system designs.

Additionally, each subcategory has design and construction criteria that are independent of the other subcategories. The following subsections describe the minimum independent design and construction requirements for each subcategory of the enveloped in-trench sand filter.

4.23.3.2.1 Standard Enveloped In-Trench Sand Filter Design and Construction

1. The native site soils consist of unsuitable coarse to very coarse sand or gravel meeting the equivalent diameters described in Table 2-1.

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2. Unsuitable soils that have application rates less than clay loam as described in Table 2-4 are not suitable for installation of an enveloped in-trench sand filter.
3. The minimum depth of filter sand below the drainfield shall be 6 feet (Figure 4-39).
4. The enveloped in-trench sand filter must maintain a minimum of 12 inches above any limiting layer from the bottom of the filter sand.
5. The drainfield shall be sized at 1.2 GPD/ft^2.

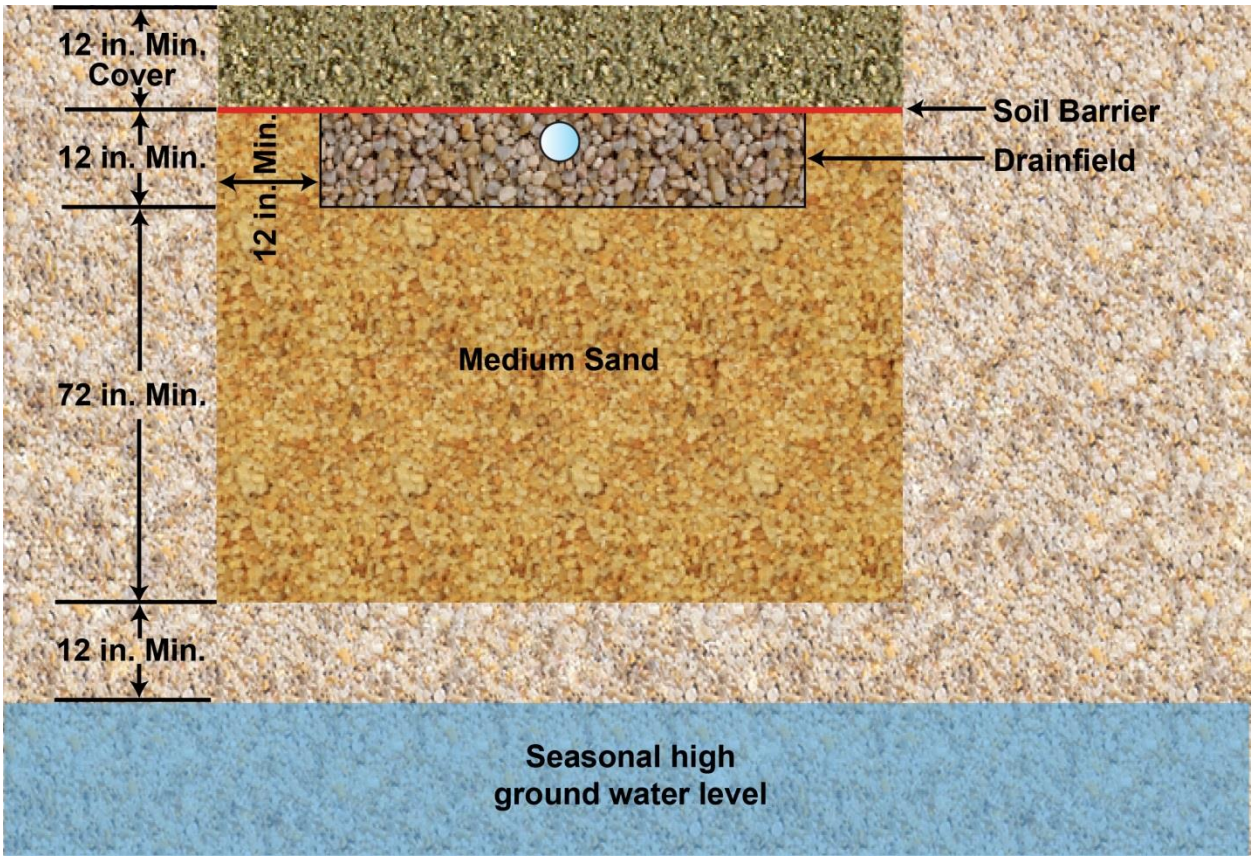

Figure 4-39. Standard enveloped in-trench sand filter for installation in coarse native soils (i.e., coarse or very coarse sand or gravel).

4.23.3.2.2 Pretreated Enveloped In-Trench Sand Filter Design and Construction

1. The effluent shall be pretreated with an extended treatment package system (section 4.8), recirculating gravel filter (section 4.21) or intermittent sand filter (section 4.22).
2. The native site soils shall consist of unsuitable coarse to very coarse sand or gravel meeting the equivalent diameters described in Table 2-1.
3. Unsuitable soils that have application rates less than clay loam as described in Table 2-4 are not suitable for installation of an enveloped in-trench sand filter.
4. The minimum depth of filter sand below the drainfield shall be 12 inches (Figure 4-40).

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5. The enveloped in-trench sand filter must maintain a minimum of 12 inches above seasonal or normal ground water levels and any other porous limiting layer from the bottom of the filter sand.
6. The enveloped in-trench sand filter must maintain a minimum of 12 inches above any nonporous limiting layer from the bottom of the filter sand.
7. The drainfield shall be sized at 1.7 GPD/ft^2.

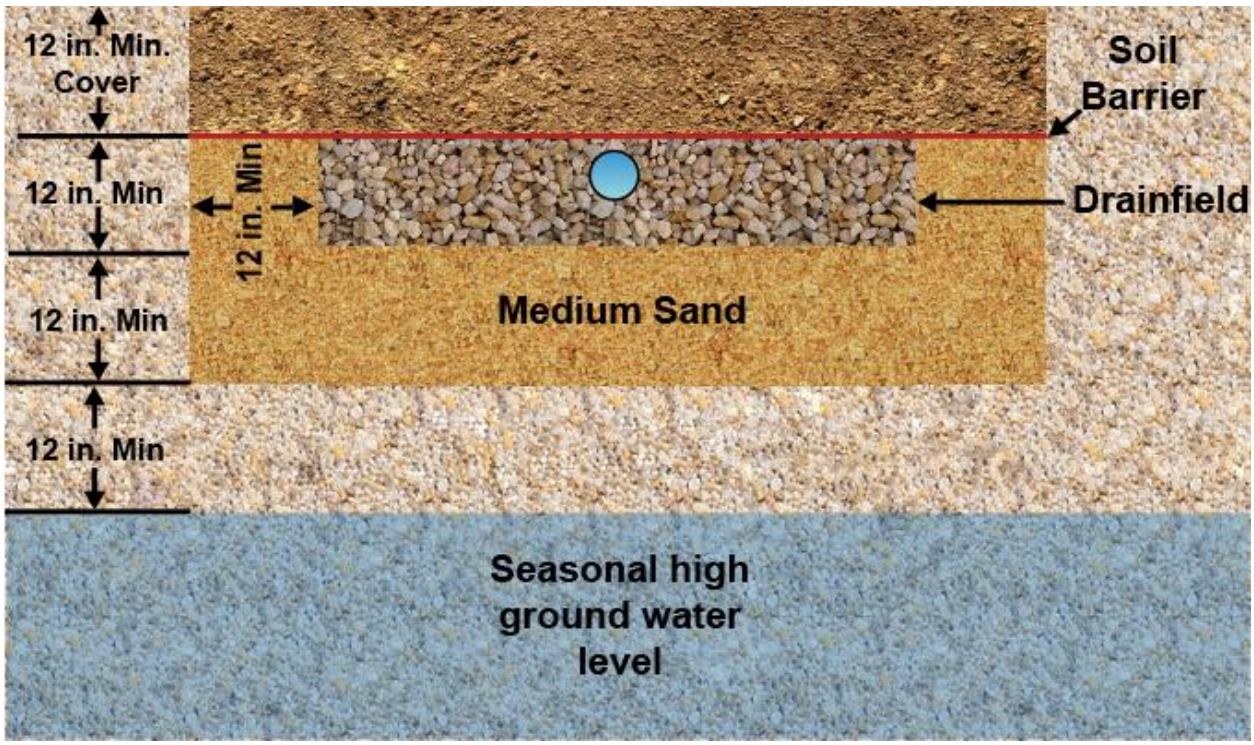

Figure 4-40. Enveloped in-trench sand filter with alternative pretreatment for installation in coarse native soils (i.e., coarse or very coarse sand or gravel).

4.23.3.2.3 Pressurized Enveloped In-Trench Sand Filter Design and Construction

1. The native site soils shall consist of suitable soils no coarser than medium sand or finer than clay loam as described in Table 2-4.
2. The drainfield shall be pressurized and designed according to section 4.19 by a PE licensed in Idaho.
3. The filter sand shall maintain a minimum depth of (Figure 4-41):
   a. 2 feet below the drainfield in design group C soils.
   b. 3 feet below the drainfield in design group A and B soils.
4. A minimum of 12 inches of suitable soils must be maintained between the sand filter and the normal high ground water level or a porous limiting layer.
5. The pressurized enveloped in-trench sand filter system shall be sized based on the most restrictive native receiving soil between the bottom of the medium sand filter and the normal high ground water level or a porous liming layer.

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6. Reduced separation distances to nonporous limiting layers may not be approved through use of this design.
7. Pressurized enveloped in-trench sand filters installed in suitable soils to obtain a reduced separation distance to ground water or a porous limiting layer must maintain a minimum of 12 inches above the seasonal and normal high ground water levels from the bottom of the filter sand.

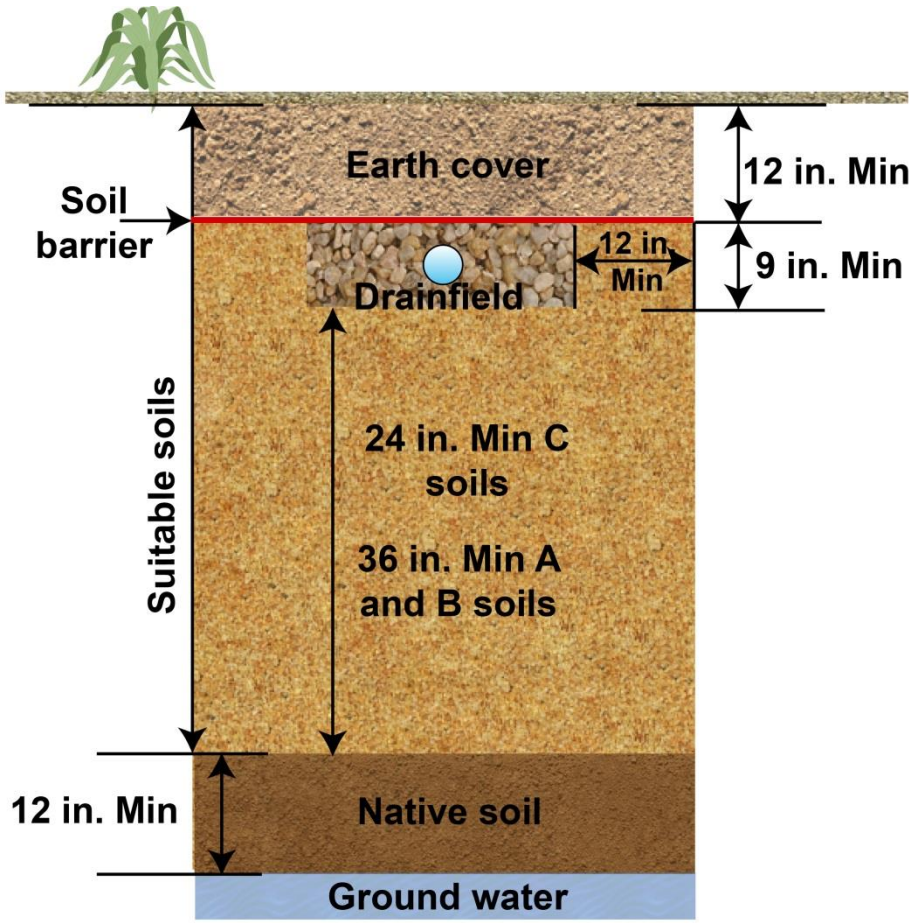

Figure 4-41. Enveloped pressurized in-trench sand filter for installation in suitable soils for a reduction in separation distance to ground water or a porous limiting layer.

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4.24 Sand Mound

Revision: December 10, 2014
Installer registration permit: Complex
Licensed professional engineer required: Yes

4.24.1 Description

A sand mound is a soil absorption facility consisting of a septic tank, dosing chamber, mound constructed of medium sand, a pressurized small-diameter pipe distribution system, and topsoil cap. Figure 4-42 provides a diagram of a sand mound.

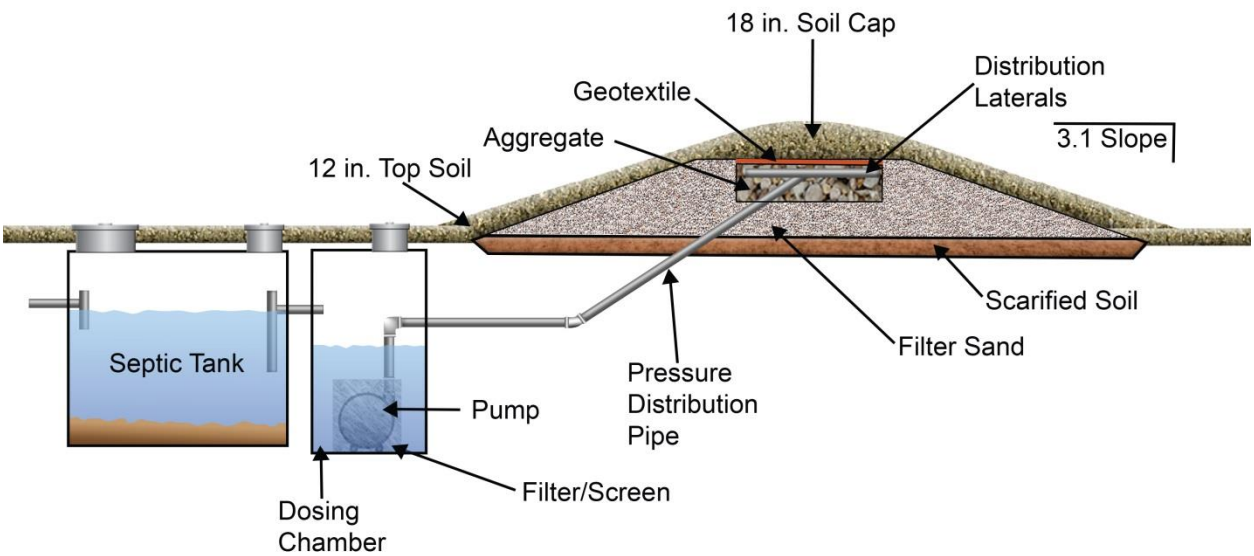

Figure 4-42. Cross-sectional view of sand mound.

4.24.2 Approval Conditions

1. Effective soil depth to limiting layers may vary depending upon thickness of filter sand beneath the absorption bed:
   a. If 12 inches of filter sand is placed beneath the absorption bed, then Table 4-22 lists the minimum depth of natural soil to the limiting layer.
   b. If 24 inches of filter sand is placed beneath the absorption bed, then Table 4-20 in Section 4.22 “Intermittent Sand Filter,” identifies the effective soil depth to limiting layers.
2. The soil application rate used in the sand mound design is based on the most restrictive soil layer within the soil profile’s effective soil depth as determined by approval condition 1 except that the effective sizing depth shall not be less than 18 inches.
3. Table 4-23 shows the maximum slope of natural ground, listed by soil design group.
4. Sand mound must not be installed in flood ways, areas with large trees and boulders, in concave slopes, at slope bases, or in depressions.

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5. Minimum pretreatment of sewage before disposal to the mound must be a septic tank sized according to IDAPA 58.01.03.007.07.
6. The maximum daily wastewater flow to any mound or absorption bed cell must be equal to or less than 1,500 GPD.
7. Multiple mounds, or absorption bed cells, may be used to satisfy design requirements for systems larger than 1,500 GPD.
   a. Appropriate valving should be used in the design to ensure that flows are evenly divided between all of the mounds or absorption bed cells.
   b. Valving should be accessible from grade and insulated from freezing.
8. Design flow rate for the sand mound must be 1.5 times the wastewater daily flow required by IDAPA 58.01.03.007.08 or as determined in accordance with section 3.3 of this manual and is only used in designing the absorption bed cell and medium sand fill.
9. Pressure distribution system and associated component design shall conform to section 4.19 of this manual.

Table 4-22. Minimum depth of natural soil to limiting layer.

Soil Design Group	Extremely Impermeable Layer (feet)	Extremely Permeable Layer (feet)	Normal High Ground Water (feet)
A, B	3	3	3
C	3	2	2

Table 4-23. Maximum slope of natural ground.

Design Group	A	B	C-1	C-2
Slope (%)	20	20	12	6

4.24.3 Design Requirements

The sand mound has three different sections with different design criteria: absorption bed cell, medium sand fill, and soil cap. The minimum design criteria for each section are provided in the following subsections.

4.24.3.1 Absorption Bed Cell Design

1. Only absorption beds may be used. The maximum absorption bed disposal area should be 2,250 ft^2 (A x B). Beds should be a maximum of 10 feet wide (B ≤ 10 feet). Beds should be as long and narrow as practical, particularly on sloped ground, to minimize basal loading. It is recommended that beds are less than 10 feet wide if site conditions will allow.
2. If multiple absorption bed cells are used in a sand mound design, a separation distance of 10 feet should be maintained between each cell (Figure 4-43).
3. Absorption bed cells should only be placed end to end in a single mound design.

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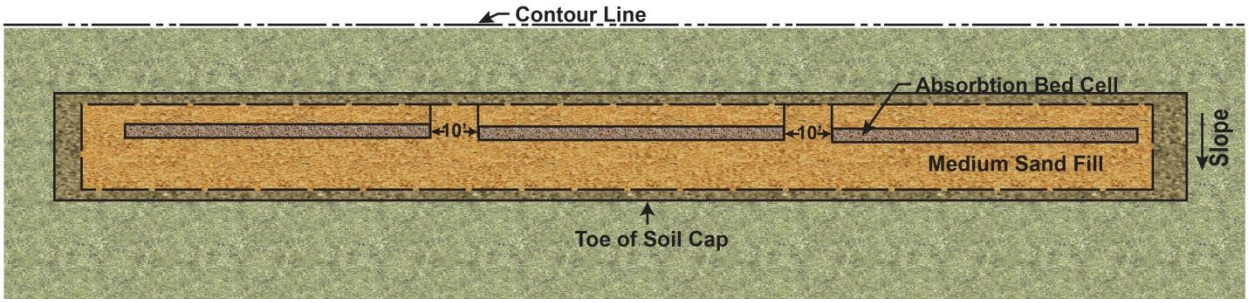

Figure 4-43. Multiple absorption bed cells installed in one sand mound.

4. Application rate of effluent in the sand bed should be calculated at 1.0 gallon/ft^2 (sand HAR = 1.0 gallon/ft^2).
5. Absorption bed must be filled with 9 inches of clean drainrock; 6 inches of which must be below the pressurized distribution pipes.
6. The absorption bed drainrock must be covered with a geotextile after installation and testing of the pressure distribution system.
7. Two observation ports should be installed extending from the drainrock/medium sand interface through the soil cap at approximately the one-quarter and three quarter points along the absorption bed. The observation ports should contain perforations in the side of the pipe extending up 4 inches from the bottom of the port. Observation ports must be capped.
8. Absorption bed disposal area or dimensions may not be reduced through the use of extra drainrock, pretreatment, or gravelless drainfield products.
9. Pressurized laterals within the absorption bed should not be further than 24 inches from the absorption bed sidewall and should not be spaced farther than 48 inches between each lateral within the absorption bed.
10. Orifice placement should be staggered between neighboring laterals.

4.24.3.2 Medium Sand Fill Design

1. Mound sand fill must conform to the medium sand definition provided in section 3.2.8.1.2 of this manual.
2. Minimum depth of medium sand below the absorption bed shall be 1 foot.
3. Medium sand fill shall extend out a minimum of 24 inches level from the top edge of the absorption bed on all sides (medium sand fill absorption perimeter), and then uniformly slope as determined by the mound dimensions and the slope limitations described in item 6 below. This is dimension H in Figure 4-44 and Figure 4-45.
4. Flat sites—The effective area will be A x (C+B+D+2(H)).
5. Sloped sites—The effective area will be A x (B+D+H).

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Equation 4-15 shows the calculation for the absorption bed area.

$$\frac{\text{Design Flow (GPD)}}{\text{Soil Application Rate } (\text{GPD}/\text{ft}^2)}$$

Equation 4-15. Effluent application area.

6. Slope of all sides must be 3 horizontal to 1 vertical (3:1) or flatter.
7. Sand fill area must be as long and narrow as practical, with plan view dimension G exceeding dimension F (Figure 4-44).
8. Slope correction factors as provided in Table 4-24 should be used to determine the downslope width of the medium sand fill for sloped sites.
9. Slope correction factors as provided in Table 4-25 should be used to determine the upslope width of the medium sand fill for sloped sites.

Table 4-24. Downslope correction factors for sloped sites.

Slope (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Correction Factor	1.03	1.06	1.10	1.14	1.18	1.22	1.27	1.32	1.38	1.44	1.51	1.57	1.64	1.72	1.82	1.92	2.04	2.17	2.33	2.5

Table 4-25. Upslope correction factors for sloped sites.

Slope (%)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Correction Factor	0.97	0.94	0.91	0.89	0.87	0.85	0.83	0.81	0.79	0.77	0.75	0.73	0.72	0.7	0.69	0.67	0.66	0.65	0.64	0.62

Figure 4-44 and Figure 4-45 can be used with Table 4-26 and Table 4-27 (sand mound design checklist) for flat and sloped sites.

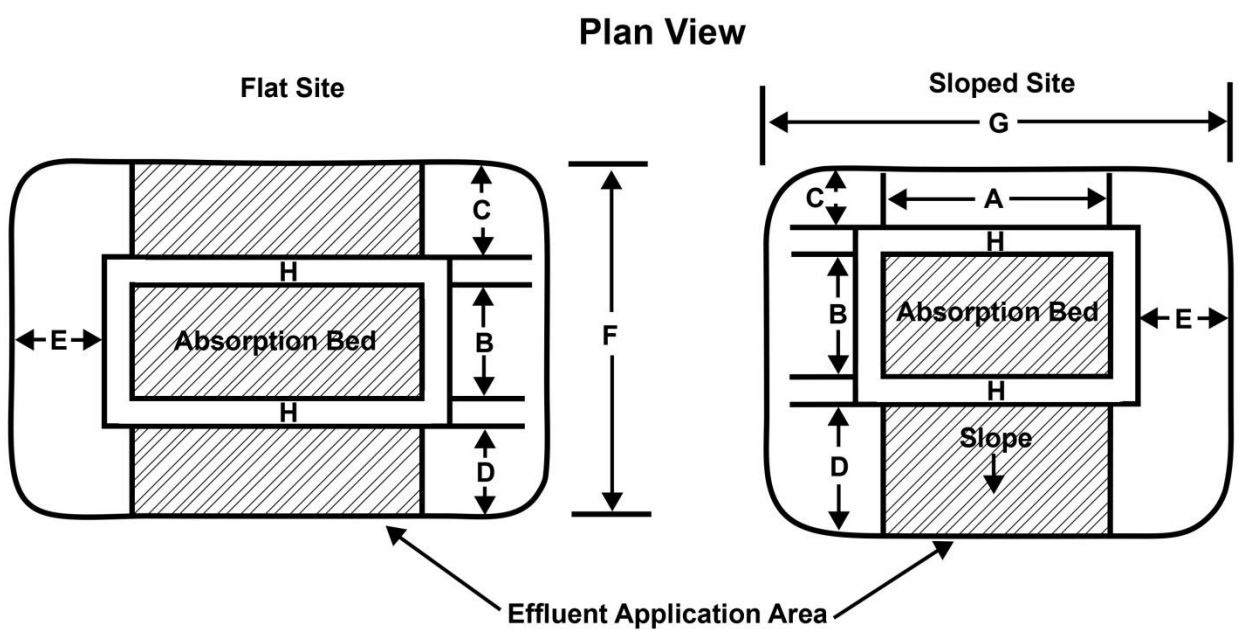

Figure 4-44. Design illustrations for sand mound installation on flat and sloped sites (use with sand mound design checklist).

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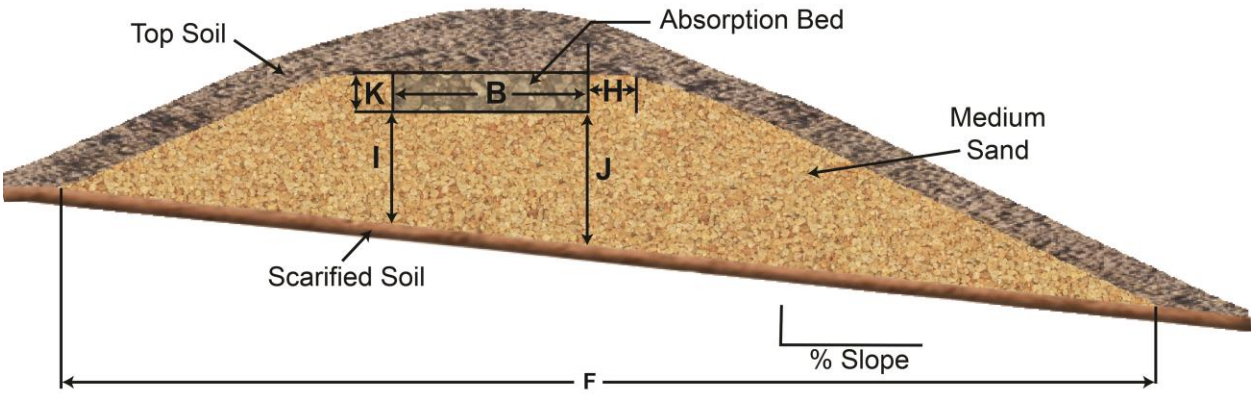

Figure 4-45. Design dimensions for use with the sand mound design checklist.

4.24.3.3 Soil Cap Design

1. Sand mound must be covered with a minimum topsoil depth of 12 inches. The soil cap at the center of the mound must be crowned to 18 inches to promote runoff.
2. Topsoil and soil cap must be a sandy loam, loam, or silt loam. Soils meeting the soil design group classification of A and C shall not be used for the topsoil and soil cap cover.
3. Mound should be protected to prevent damage caused by vehicular, livestock, or excessive pedestrian traffic. The toe of the mound must be protected from compaction.
4. Mounds on slopes should have design considerations taking surface runoff diversion into account.

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Table 4-26. Example sand mound design checklist (use with Table 4-24, Table 4-25, Figure 4-44, and Figure 4-45).

Sand Mound Design Checklist (Example for a three-bedroom house on soil design subgroup B-2 soils, flat site, 12-inch medium sand fill depth below the absorption bed cell)		
1	Determine soil application rate (AR) (Example: B-2 soil)	AR = GPD/ft^2 (Example: 0.45 GPD/ft^2)
2	Determine daily flow rate (DFR) (Example: 250 GPD x 1.5 safety factor)	DFR = GPD x 1.5 (Example: 375 GPD)
	Absorption Bed Cell Design	
3	$Area = \frac{Daily_Flow_Rate_GPD(\#2)}{Sand_Application_Rate_{}^{GPD}/_{ft^2}\left(1.0_{}^{GPD}/_{ft^2}\right)}$	Area = ft^2 (Example: 375 ft²)
4	Width (B): $Width_(B) = \sqrt{\frac{Area_(\#3) \times Soil_AR_(\#1)}{Sand_Application_Rate_\left(1.0\,{}^{GPD}/_{ft^2}\right)}}$ Maximum bed width: 10 ft *Beds may be designed narrower than determined by this equation if desired. Beds are recommended to be as long and narrow as site conditions allow.* Example: $Width_(B) = \sqrt{\frac{(\#3 \times \#1)}{1.0\,{}^{GPD}/_{ft^2}}} \approx 13\,ft$	Width (B) = feet (Example: 13 ft or 10 ft max.) (Example: use 10 ft)
5	Length (A): $Length_(A) = Area_(\#3)/Width_(\#4)$ (Example: 375 ft²/10 ft)	(A) feet (Example: 37.5 ft)
	Sand Mound Design	
6	Total area (TA): $TA = DFR_(\#2)/soil_AR_(\#1)$ (Example: 375 gallon/0.45 gallon/ft^2)	TA = ft^2 (Example: 833 ft²)
7	Medium sand fill absorption bed perimeter (SFAP) area: Flat site: SFAP = 2 x [2 ft x length (#5)] Sloped site: SFAP = 2 ft x length (#5) (Example: 2 x [2 ft x 37.5 ft])	SFAP = ft^2 (Example: 150 ft^2)
8	Effluent application area (EAA) = Total area–(bed area + SFAP): EAA = TA (#6) – [Area (#3) + SFAP (#7)] = (Flat site example: 833 ft^2 – [375 ft^2 + 150 ft^2] = 308 ft^2); (Sloped site example: 833 ft^2 – [375 ft^2 + 75 ft^2] = 383 ft^2)	EAA = ft^2 (Flat site example: 308 ft²; sloped site example: 383 ft^2)

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9	Flat site perimeter (C,D): 0.5 x [EAA (#8)/length (#5)] *Perimeter must maintain a maximum slope of 3:1.* *Perimeter width must result in a disposal area that meets or exceeds the minimum total area (#6). This will be verified in step 16.* (Example: 0.5 x [308 ft^2/37.5 ft] = 4.1 ft)	(C) = (D) = feet (5.25 ft minimum for 3:1 slope in 12 in. mound, 8.25 ft minimum for 3:1 slope in 24 in. mound) (Example: 4.1 ft, use default of 5.25 ft to meet minimum slope)
10	Sloped site: Downslope length (D) = EAA (#8)/length (#5) x DCF *Downslope length must result in a maximum slope of 3:1.* *Downslope length must result in a disposal area that meets or exceeds the minimum total area (#6). This will be verified in step 17.* Example based on 5% slope: (Example: D = [383 ft^2/37.5 ft] x 1.18 = 12.1 ft)	(D) = feet (Example: 12.1 ft)
11	Sloped site: Upslope (C) = [(K + I) x 3] x UCF *Upslope length must result in a maximum slope of 3:1.* Example based on 5% slope: (Example: C = [(0.75 ft + 1.0 ft) x 3] x 0.87 = 4.6 ft)	(C) = feet (Example: 4.6 ft)
12	Flat site: End slope (E) = (K + I) x 3 *End slope length must result in a maximum slope of 3:1.* (Example: [0.75 ft + 1.0 ft] x [3] = 5.25 ft)	(E) = feet (Example: 5.25 ft)
13	Sloped site: End slope (E) = (J + K) x 3 *End slope length must result in a maximum slope of 3:1.* Example based on 5% slope: (Example: [1.5 ft + 0.75 ft] x [3] = 6.75 ft	(E) = feet (Example: 6.75 ft)
14	Total width (F) = B + C + D + 2(H) (Flat site example: 10 ft + 5.25 ft + 5.25 ft + 4 ft = 24.5 ft) (Sloped site example (5%): 10 ft + 4.6 ft + 12.1 ft + 4 ft = 30.7 ft)	(F) = feet (Example: 24.5 ft) (Example: 30.7 ft)
15	Total length (G) = A + (2 x E) + 2(H) (G > F) (Flat site example: [G] = 37.5 ft + [2 x 5.25 ft] + 4 ft = 52 ft) (Sloped site example (5%): [G] = 37.5 ft + [2 x 6.75 ft] + 4 ft = 55 ft	(G) = feet (Example: 52 ft) (Example: 55 ft)

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	Total Area Verification	
16	Flat site: Design area (DA) = A x F [DA ≥ TA(#6)] (Example: [37.5 ft x 24.5 ft] = 918.75 ft^2; (918.75 ft^2 ≥ 833 ft^2)	DA = ft^2 Example: 919 ft^2
17	Sloped site: Design area (DA) = A x (B + D + H) [DA ≥ TA(#6)] (Example (5%): 37.5 ft x [10 ft + 12.1 ft + 2 ft] = 903.75 ft^2); (903.75 ft^2 ≥ 833 ft^2)	DA = ft^2 Example: 903.75 ft^2
	Finished Mound Dimensions (Sand Mound + Soil Cap)	
18	Sand mound length + 6 ft min. (G + 6) (Flat site example: 52 ft + 6 ft = 58 ft) (Sloped site example: 55 ft + 6 ft = 61 ft)	(G+6) = feet (Example: 58 ft) (Example: 61 ft)
19	Sand mound width + 6 ft min. (F + 6) (Flat site example: 24.5 ft + 6 ft = 30.5 ft) (Sloped site example: 30.7 ft + 6 ft = 36.7 ft)	(F+6) = feet (Example: 30.5 ft) (Example: 36.7 ft)

Notes: gallons per day per square foot (GPD/ft2), feet (ft), inches (in.), downslope correction factor (DCF), upslope correction factor (UCF), total area (TA), design area (DA), effluent application area (EAA), sand fill absorption perimeter (SFAP), daily flow rate (DFR), soil application rate (AR)

4.24.4 Construction

1. Pressure transport line from the dosing chamber should be installed first.
   a. The pressure transport line should slope down to the pump so that the pressure line will drain between discharges.
   b. If a downward slope from the mound to the pump chamber is not practical due to the length of run, then the pressure transport line should be laid level below the anticipated frost line for that region.
   c. On a sloped site, the pressure transport line should enter the absorption bed from the end of the bed or upslope side of the mound; do not enter the absorption bed from the downslope side.
2. Grass and shrubs must be cut close to ground surface and removed from the mound site.
   a. If extremely heavy vegetation or organic mat exists, these materials should be removed before scarification and replaced with filter sand (typically 3 or 4 inches of filter sand is added).
   b. Larger than 2-inch caliper trees and shrubs and large boulders are not to be removed. Trees should be cut as close to ground level as possible and the stumps left in place. If stumps or boulders occupy a significant area in the mound placement area, additional area should be calculated into the total basal area of the mound to compensate for the lost infiltrative area.
3. When the soil is dry and site vegetation has been cut or removed, the ground in the basal placement area of the sand mound should be scarified using a chisel plow or backhoe teeth to a depth of 6–8 inches.

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4. Sand fill will then be placed and shaped before it freezes or rains. No vehicles with pneumatic tires should be permitted on the sand or scarified area to prevent the soils from being compacted. For sloped sites, all work should be done from the upslope side or ends of the mound placement area if possible.
5. Absorption bed will be shaped and filled with clean drainrock. The bottom of the absorption bed should be constructed level on all sites regardless of slope.
6. After leveling the drainrock, the low-pressure distribution system manifold and laterals will be installed. The system should be tested for uniformity of distribution.
7. Geotextile fabric must be placed over the absorption bed and backfilled with 12 inches of soil on the sides and shoulders, and 18 inches of soil on the top center. Soil types must be sandy loam, loam, or silt loam.
8. Typical lawn grasses or other appropriate low-profile vegetation should be established on the mound cap as soon as possible, preferably before the system is put into operation. Do not plant trees or shrubs on the mound, or within the mature rooting radius of the tree or shrub from the mound. Trees with roots that aggressively seek water should be planted at least 50 feet from the mound (e.g., poplar, willow, cottonwood, maple, and elm).
9. Mounds placed upslope and downslope from each other should maintain a mound-toe to mound-toe separation distance of 35 feet (Figure 4-46).
   a. The first 15 feet below the upslope mound should remain free of vehicular traffic and other activities resulting in soil compaction.
   b. The 20 feet above the downslope mound should be maintained for construction of the downslope mound.
10. A separation distance of 15 feet should be maintained from the toe of each mound when multiple mounds are constructed on the same elevation contour.

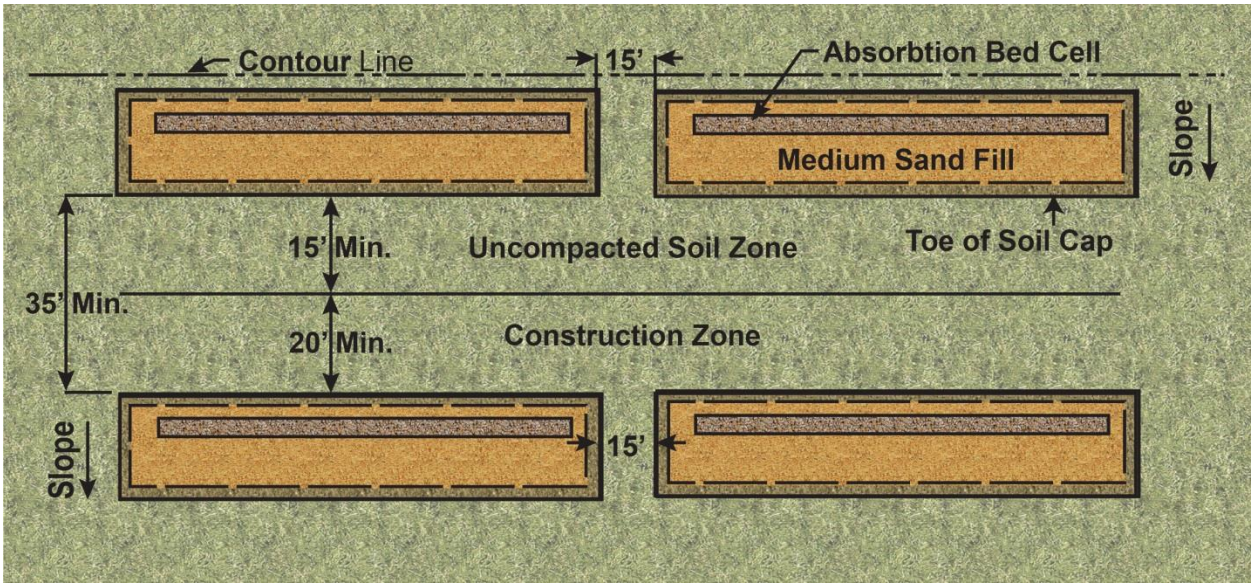

Figure 4-46. Mounds placed upslope and downslope of one another.

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4.24.5 Inspections

1. Site inspections shall be conducted by the health district at the following minimum intervals (IDAPA 58.01.03.011.01):
   a. Preconstruction conference that should be conducted with the health district, responsible charge engineer, complex installer, and property owner (if available) present.
   b. During construction as needed, including scarification, pressure line installation, medium sand mound construction, absorption bed construction, and pressure distribution piping construction.
   c. Final construction inspection including a pump drawdown/alarm check, pressure test of the distribution network, and soil cap material and placement.
2. The responsible charge engineer shall provide the health district with a written statement that the system was constructed and functions in compliance with the approved plans and specifications. Additionally, the responsible charge engineer shall provide as-built plans to the health district if any construction deviations occur from the permitted construction plans (IDAPA 58.01.03.005.15).

4.24.6 Operation and Maintenance

An O&M manual shall be developed by the system's design engineer that contains the following minimum requirements and shall be submitted as part of the permit application (IDAPA 58.01.03.005.14):

1. Operation and maintenance is the responsibility of the system owner.
2. Sludge depth in the septic tank should be checked annually and the tank should be pumped when the sludge exceeds 40% of the liquid depth.
3. All pump and pump chamber alarm floats and controls should be inspected on a regular schedule to ensure proper function.
4. Pump screens and effluent filters should be inspected regularly and cleaned. All material created by cleaning the screen should be discharged to the septic tank.
5. Sand mound observation port caps should be removed and the monitoring ports observed for ponding. Corrective action should be taken, if excessive ponding is present, as specified by the system design engineer.
6. Observation ports for testing of residual head should be inspected regularly to ensure the residual head meets the system design minimum residual head.
7. Lateral flushing should occur annually to ensure any biomat buildup is removed from the distribution lateral. Lateral flushing procedures should be described.
8. On a regular schedule, any valving for sand mounds containing multiple absorption bed cells should be inspected and verified to be functioning properly.
9. Any other operation and maintenance as recommended by system component manufacturers and the system design engineer.

Table 4-26 is a sample sand mound design checklist, and Table 4-27 is a blank checklist for sand mound design.

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Table 4-27. Sand mound design checklist (use with Table 4-24, Table 4-25, Figure 4-44, and Figure 4-45).

	Sand Mound Design Checklist	
1	Determine soil application rate (AR)	AR = _____GPD/ft^2
2	Determine daily flow rate (DFR) *DFR = GPD x 1.5*	DFR = _____GPD
	Absorption Bed Cell Design	
3	$Area = \frac{Daily_Flow_Rate_GPD(\#2)}{Sand_Application_Rate_{}^{GPD}/_{ft^2}\left(1.0_{}^{GPD}/_{ft^2}\right)}$	Area = _____ft^2
4	Width (B): $Width_(B) = \sqrt{\frac{Area_(\#3) \times Soil_AR_(\#1)}{Sand_Application_Rate_\left(1.0\,{}^{GPD}/_{ft^2}\right)}}$ Maximum bed width: 10 ft	Width (B) = _____ft
5	Length (A): $Length_(A) = Area_(\#3)/Width_(\#4)$	(A) _____ft
	Sand Mound Design	
6	Total area (TA): $EAA = DFR_(\#2)/soil_AR_(\#1)$	TA = _____ft^2
7	Medium sand fill perimeter area (SFAP) Flat site: SFAP = 2 x [2 ft x length (#5)] Sloped site: SFAP = 2 ft x length (#5)	SFAP = _____ft^2
8	Effluent application area (EAA) = Total area – (Bed area + SFAP): EAA = TA (#6) – [Area (#3) + SFAP (#7)]	EAA = _____ft^2
9	Flat site perimeter (C,D): 0.5 x [EAA (#8)/length (#5)] (5.25 ft minimum for 12 in. mound, 8.25 ft minimum for 24 in. mound)	(C) = (D) = _____ft
10	Sloped site: Downslope length (D) = [EAA (#8)/length (#5)] x DCF	(D) = _____ft
11	Sloped site: Upslope (C) = [(K + I) x 3] x UCF	(C) = _____ft
12	Flat site: End slope (E) = (K + I) x 3	(E) = _____ft
13	Sloped site: End slope (E) = (J + K) x 3	(E) = _____ft
14	Total width (F) = B + C + D + 2(H)	(F) = _____ft
15	Total length (G) = A+(2 x E) + 2(H) (G > F)	(G) = _____ft
	Total Area Verification	
16	Flat site: Design area (DA) = A x F [DA ≥ TA(#6)]	DA = _____ft^2 ≥ #6
17	Sloped site: Design area (DA) = A x (B + D + H) [DA ≥ TA(#6)]	DA = _____ft^2 ≥ #6
	Finished Mound Dimensions (Sand Mound + Soil Cap)	
18	Sand mound length + 6 ft min. (G + 6)	(G+6) = _____ft
19	Sand mound width + 6 ft min. (F + 6)	(F+6) = _____ft

Notes: gallons per day per square foot (GPD/ft2), feet (ft), downslope correction factor (DCF), upslope correction factor (UCF), total area (TA), design area (DA), effluent application area (EAA), sand fill absorption perimeter (SFAP), daily flow rate (DFR), soil application rate (AR)

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4.25 Seepage Pit/Bed

Revision: April 18, 2013
Installer registration permit: Property owner or standard and basic
Licensed professional engineer required: No

4.25.1 Description

An absorption pit filled with standard drainfield aggregate.

4.25.2 Approval Conditions

1. Seepage pit disposal facilities may be used on a case-by-case basis within the boundaries of Eastern Idaho Public Health District (District Health Department 7) when an applicant can demonstrate to the district director's satisfaction that the soils and depth to ground water are sufficient to prevent ground water contamination. The district director shall document all such cases (IDAPA 58.01.03.008.11).
    a. For all other districts, replacement seepage pits may be allowable as a last resort if no other alternatives are feasible, and the site meets conditions of approval 1.a through 6 as stated herein. The district director shall document all such cases (IDAPA 58.01.03.008.11) and issue the installation permit as a nonconforming permit.
2. For all other districts, the site must meet the requirements of a standard system except that it is not large enough (IDAPA 58.01.03.008.11.b).
3. Area must not have any shallow domestic, public wells, or sink holes connected by underground channels.
4. Pit bottom must be no deeper than 18 feet below the natural ground surface. The bottom of the pit must conform to the effective soil depth chart (IDAPA 58.01.03.008.02.c). *The top of the pit may be more than 4 feet below ground surface.*
5. Seepage pits may not be installed in design group C soils.
6. A test hole must be performed to a depth of 6 feet below the proposed termination of the bottom of the seepage pit prior to permit issuance.

4.25.3 Sizing

The effective area of the pit may be determined from Table 4-28 (for round pits) and by the square footage of the pit sidewalls below the effluent pipe (rectangular beds).

Seepage bed example:

> Pit dimensions are 10 feet wide x 15 feet long, and the pit is 8 feet deep below the effluent pipe:
>
> (10 feet wide) x (8 feet deep) = 80 ft^2 → (80 ft^2) x (2 sidewalls of the same dimension) = 160 ft^2

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(15 feet wide) x (8 feet deep) = 120 ft^2 → (120 ft^2) x (2 sidewalls of the same dimension) = 240 ft^2

(240 ft^2) + (160 ft^2) = 400 ft^2

Round seepage pit example:

(πd) x h = effective disposal area

d = diameter, h = height, π = 3.14

Table 4-28. Effective area of round seepage pits.

Diameter of Seepage Pit (feet)	Effective Depth Below Effluent Line (feet)									
	1	2	3	4	5	6	7	8	9	10
3	9	19	28	38	47	57	66	75	85	94
4	13	25	38	50	63	75	88	101	113	126
5	16	31	47	63	79	94	110	126	141	157
6	19	38	57	75	94	113	132	151	170	188
7	22	44	66	88	110	132	154	176	198	220
8	25	50	75	101	126	151	176	201	226	251
9	28	57	85	113	141	170	198	226	254	283
10	31	63	94	126	157	188	220	251	283	314
11	35	69	104	138	173	207	242	276	311	346
12	38	75	113	151	188	226	264	302	339	377

4.25.4 Construction

1. Standard drainfield aggregate shall be used to fill the entire pit/bed excavation.
   a. If seepage pit rings or structural blocks are used in pit/bed construction the aggregate shall only be required to fill the excavation void around the seepage rings or structural blocks and above the seepage ring lid to a point 2 inches above the effluent pipe.
   b. In pit/bed installations using seepage pit rings a minimum depth of 12 inches of standard drainfield aggregate shall be placed below the seepage rings.
2. Effluent pipe shall be covered with a minimum of 2 inches of aggregate.
3. Seepage pit/bed excavation shall be covered with geotextile, straw, or untreated building paper.
4. The distribution laterals within the pit/bed should meet the requirements for the standard absorption bed (IDAPA 58.01.03.008.10).

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5. If seepage pit rings or structural blocks are used in pit/bed construction the effluent pipe may discharge into the central dump point in the ring structure lid.
6. Effluent and distribution piping used in seepage pit/beds with installation depths greater than 3 feet from grade to the top of the pit/bed installation shall utilize ASTM D3034 or stronger piping to prevent piping collapse.

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4.26 Steep Slope System

Revision: December 10, 2014
Installer registration permit: Property owner or standard and basic
Licensed professional engineer required: No

4.26.1 Description

A steep slope system is a trench system for slopes greater than 20% but less than 46%.

4.26.2 Approval Conditions

1. Soil must be well-drained without evidence of saturation and of soil design group A or B without evidence of textural change in the effective depth.
2. Except as listed in this section, all regulations applicable to a standard system will apply.
3. Trenches must be separated by at least 8 horizontal feet of undisturbed soil.
4. Trenches may not exceed 36 inches in width.
5. The drainfield bottom must be installed at a minimum depth of 30 inches below the natural soil surface on the downhill side of the trench:
   a. The drainfield bottom may not exceed 48 inches below the natural soil surface on the downhill side of the trench.
   b. The required vertical separation distances from the bottom of the drainfield to features of interest (IDAPA 58.01.03.008.02.c) must be capable of being met from the uphill side of the drainfield trench.
6. A gravel drainfield must meet the following:
   a. Contain a minimum of 18 inches of drainrock, 12 inches of which must be installed below the perforated distribution pipe.
   b. Restriction on the credit for the installation of extra drainrock below the drainfield in the steep slope system shall follow section 4.9.
7. A gravelless drainfield must meet the following:

a. Be constructed with an approved gravelless trench component (section 4.11) configuration.
   b. No reduction in drainfield disposal area shall be credited for the installation of the gravelless trench component in the steep slope system.

4.26.3 Construction

1. Trenches may be constructed using serial or equal distribution.
   a. Pressure distribution is recommended but not required.
   b. If serial distribution is used, it is recommended that the system is constructed using drop boxes (section 3.2.6.2).
   c. If equal distribution is used, it is highly recommended that a distribution box (section 3.2.5.2) be utilized, access to the distribution box from grade be available, and equal flow to each trench be verified before backfilling the system.

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2. Regardless of the distribution method used, the drainfield trenches should follow the natural contour of the land surface.
3. In consideration of safety and plumb trench sidewalls, hand excavation of trenches may be necessary.
4. Figure 4-47 illustrates the relationship between the site's vertical drop and horizontal run.

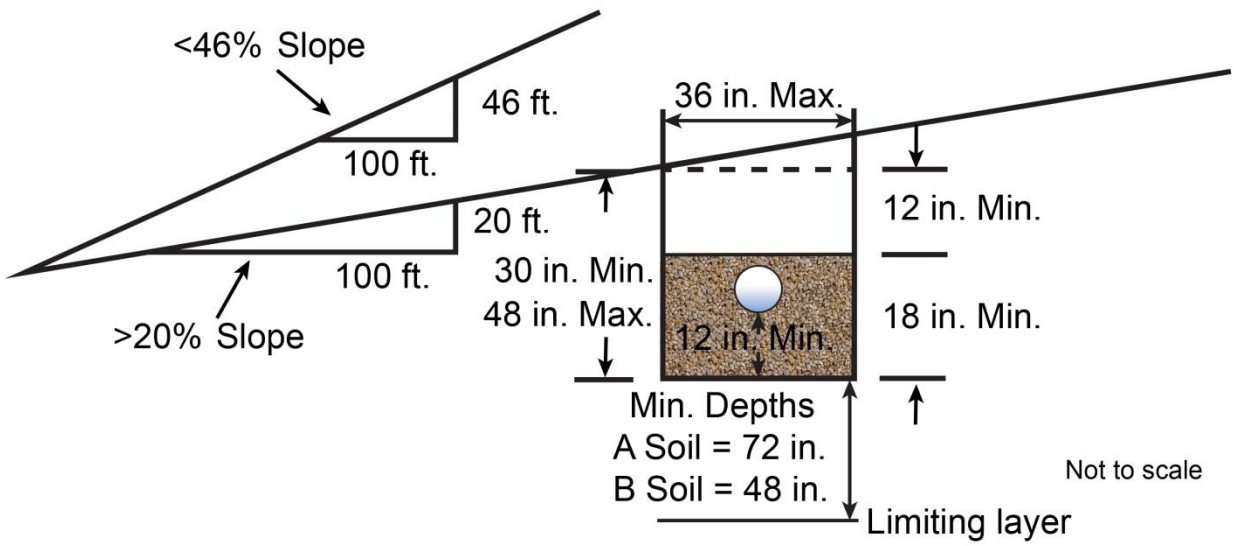

Figure 4-47. Illustration of a steep slope trench with an example of maximum and minimum slope.

Equation 4-16 shows the calculation for determining a site's percent slope.

$$\frac{\text{Elevation Difference from Uphill Point to Downhill Point (Rise)}}{\text{Length Between Uphill and Downhill Point (Run)}} \text{ X } 100$$

Equation 4-16. Percent slope of a site.

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4.27 Subsurface Flow Constructed Wetland

Revision: February 4, 2016
Installer registration permit: Complex
Licensed professional engineer required: Yes

4.27.1 Description

Subsurface flow constructed wetlands are secondary wastewater treatment systems that receive and treat wastewater that has undergone primary treatment in a septic tank. Wastewater flows through a lined, constructed wetland cell filled with porous media in which climate and anaerobic, water-tolerant vegetation is planted. The vegetation provides uptake of the wastewater and a surface for microorganisms to grow, which aid in wastewater treatment. Wastewater exits the horizontally constructed wetland cell, proceeds to a watertight overflow basin, and either discharges to another constructed wetland cell in series with the first, or to a subsurface sewage disposal drainfield. Figure 4-48 provides a diagram of a subsurface flow constructed wetland.

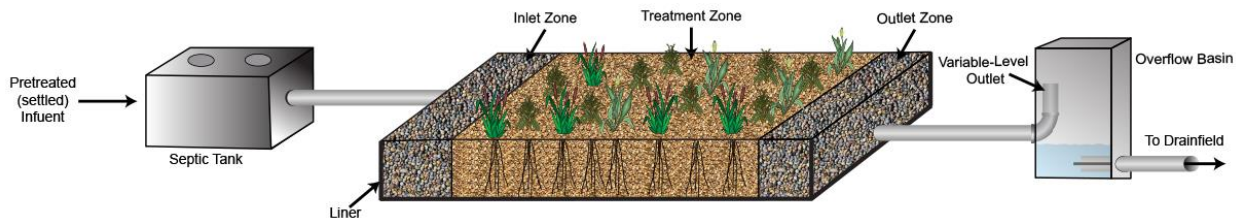

Figure 4-48. Cross-sectional view of a subsurface flow constructed wetland.

4.27.2 Approval Conditions

1. The system must be designed by a PE licensed in Idaho.
2. Wastewater must remain below the ground surface in the constructed wetland.
3. Nondomestic wastewater must be pretreated to residential strength before discharge to the constructed wetland.
4. Effluent shall not discharge to the drainfield without first passing through the constructed wetland.
5. The bottom of the constructed wetland must not come within 12 inches of seasonal high ground water.
6. The constructed wetland shall meet the same separation distance requirements as a septic tank.
7. The design engineer shall provide an O&M manual for the system to the health district before permit issuance.
8. All pressure distribution components shall be designed according to the pressure distribution system guidance (section 4.19).

4.27.3 Design Requirements

Minimum design requirements for the subsurface flow constructed wetland are provided below.

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4.27.3.1 Septic Tank

1. Shall be sized according to the requirements of IDAPA 58.01.03.007.07.
2. Shall have an approved effluent filter (section 5.9) installed at the outlet.
3. The outlet manhole shall be brought to grade using a riser and secured lid to provide maintenance access to the effluent filter.

4.27.3.2 Effluent Transport to the Subsurface Flow Constructed Wetland

1. Gravity flow is the preferred method to transport wastewater from the septic tank to the subsurface flow constructed wetland.
2. If gravity flow is not possible a dosing chamber may be installed meeting the requirements of section 4.19.3.4, and the effluent shall break to gravity following the requirements of section 4.19.3.6 before entering the subsurface flow constructed wetland.
3. If the installation of a pump-to-gravity distribution component is necessary, the drop box shall be accessible from grade for maintenance purposes.
4 Pressurized doses shall have a small volume so the subsurface flow constructed wetland does not receive large surge flows.

4.27.3.3 Subsurface Flow Constructed Wetland

1. The subsurface flow constructed wetland container shall be constructed of reinforced concrete or other materials where equivalent function, workmanship, watertightness, and at least a 20-year service life can be documented, or
2. The subsurface flow constructed wetland container shall be constructed of a flexible membrane liner meeting the following requirements:
   a. Properties equivalent to or greater than 30-mil PVC and compatible with wastewater.
   b. Field repair instructions and materials provided to the purchaser of the liner.
   c. Factory fabricated boots for waterproof field bonding of piping to the liner.
   d. Liner must be placed against smooth, regular surfaces free of sharp edges, nails, wire, splinters, or other objects that may puncture the liner. A 4-inch layer of clean sand should provide liner protection.
3. The subsurface flow constructed wetland shall have a berm that is at least 1 foot above the surface of the planting media with sides that are as steep as possible, consistent with the soils, construction methods, and materials.
4. Filter construction media shall meet the following specifications:
   a. Section 3.2.8.1.3 for planting media (pea gravel)
   b. Section 3.2.8.1.1 for inlet and outlet zone media (drainrock)
   c. Treatment zone media shall have an average diameter between 0.75 and 1 inch and be free of fines.
5. The surface of the subsurface flow constructed wetland shall be level.

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6. The bottom of the subsurface flow constructed wetland shall maintain a uniform slope from the inlet to the outlet of 0.5% to 1% to maintain flow conditions and allow for complete drainage.
7. Minimum filter construction specifications shall also meet the dimensions, ratios, and locations depicted in Figure 4-49.
8. The inlet and outlet zones should be designed to prevent accidental contact with effluent from the surface. Chain-link fencing or another acceptable protective barrier shall be placed below the construction media at the top of the inlet/outlet zones and cover the entire surface of the inlet and outlet areas to prevent access, unless fencing is placed around the entire system to prevent access.

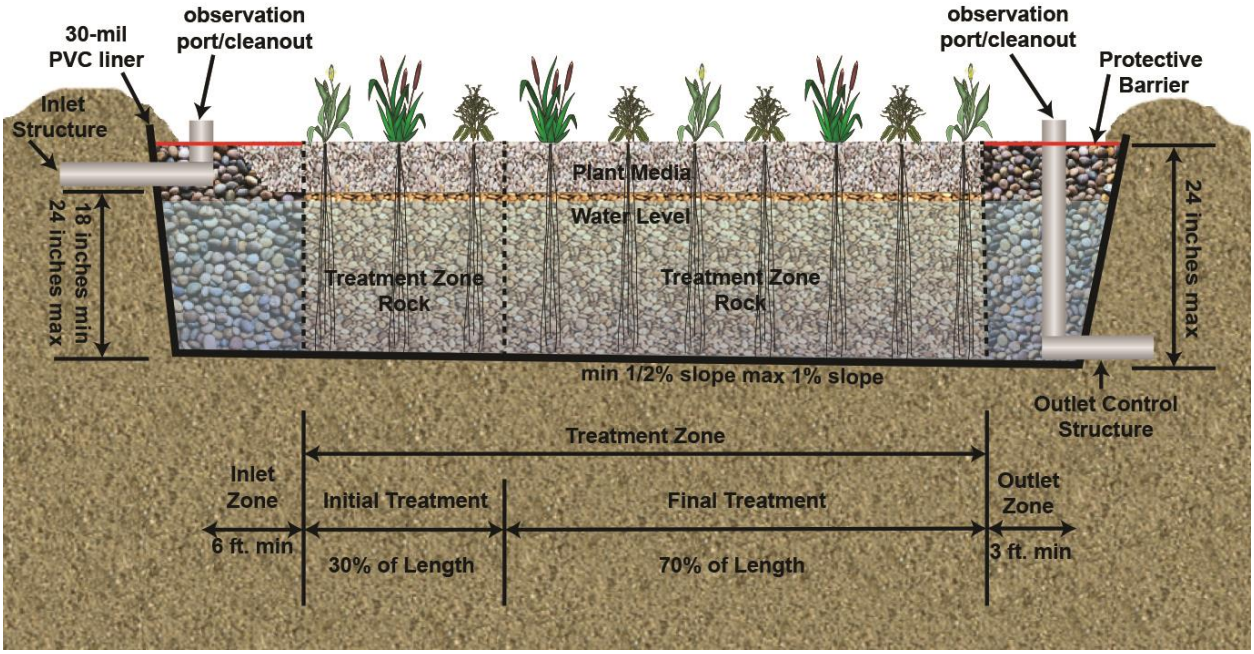

Figure 4-49. Cross-sectional view of a constructed wetland cell.

4.27.3.4 Subsurface Flow Constructed Wetland Sizing

Sizing of a subsurface flow constructed wetland must take into account the loading of BOD and TSS from the wastewater. In addition the treatment zone of the subsurface flow constructed wetland should be capable of maintaining a hydraulic retention time of at least 2 days. Use correctly size the wetland. with the information provided below to correctly size the wetland.

1. Determine the minimum treatment zone surface area for both pollutants (BOD and TSS) and use the largest area (Equation 4-17).

   a. BOD surface area: $A_{SB} = (Q)(B)/(53.5 \text{ lb/acre/day})$
   b. TSS surface area: $A_{ST} = (Q)(T)/(44.5 \text{ lb/acre/day})$

Equation 4-17. BOD and TSS surface area in square feet.

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where:

A_{SB} and A_{ST} = total surface area of the treatment zone in square feet (ft^2) for BOD (A_{SB}) and TSS (A_{ST}).

Q = total daily design flow in gallons per day (gal/day).

B = 0.0018 lb/gal (constant value for the maximum BOD discharged to the system per gallon).

T = 0.00071 lb/gal (constant value for the maximum TSS discharged to the system per gallon).

Example:

A_{SB} = (250 GPD)(0.0018 lb/gal)/(53.5 lb/acre/day) = 0.0084 acres

(0.0084 acres)(43,560 ft^2/acre) = 366 ft^2

A_{ST} = (250 GPD)(0.00071 lb/gal)/(44.5 lb/acre/day) = 0.004 acres

(0.004 acres)(43,560 ft^2/acre) = 175 ft^2

Use A_{SB} = 366 ft^2

2. Apply a 25% safety factor to the required size of the treatment zone.

   Example:

   (366 ft^2)(1.25) = 458 ft^2

3. Determine the size of the initial treatment zone and final treatment zone within the total treatment zone using the following requirements:
   a. Initial treatment zone = 30% of the overall treatment zone area

      Example:

      A_{IT} = 0.3(458 ft^2) = 138 ft^2

   b. Final treatment zone = 70% of the overall treatment zone area

      Example:

      A_{FT} = 0.7(458 ft^2) = 321 ft^2

4. The hydraulic conductivity (K) of clean treatment zone media meeting the sizing requirements in section 4.27.3.3(4) is 30,500 ft/day. Due to filtration and settling of materials, the hydraulic conductivity of the treatment zone is as follows:
   a. Initial treatment zone is 1% of the clean K, or 305 ft/day.
   b. Final treatment zone is 10% of clean K, or 3,050 ft/day.

5. Determine the minimum width based on the hydraulic loading rates that will maintain all flow below the surface of the submerged flow constructed wetland using Darcy's Law (Equation 4-18). The largest width should be used for the overall system design.

$$Q=KWD_W(d_h/L)$$

Equation 4-18. Darcy's Law

where:

L = length of treatment zone = area/width; therefore:

$W^2 = (QA_{si})/(KD_wd_h)$

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where:

A_{si} = surface area of the treatment zone (ft^2)

D_w = depth of water (ft)

W = width of cell (ft)

Q = flow into cell (ft^3/day) (1 ft^3 = 7.48052 gal)

K = hydraulic conductivity (ft/day)

d_h = maximum permissible headloss (ft) (assume = 50% of difference between depth of media and depth of water)

Example:

Initial Treatment Zone = W^2 = [(33.42)(458 ft^2)]/[(305 ft/day)(1.33 ft)(0.167 ft)] = (15306.36 ft^2)/(67.74 ft) = 226 ft →(√226) = 15 ft

Final Treatment Zone = W^2 = [(33.42)(458 ft^2)]/[(3050 ft/day)(1.33 ft)(0.167 ft)] = (15306.36 ft^2)/(677.4 ft) = 22.6 ft →(√22.6) = 4.8 ft

Use 15 ft for both treatment zone widths.

6. Determine the maximum length of each treatment zone by dividing the required treatment area by the width (Equation 4-19).

$L_{IT} = (0.3\ A_T)/W$ **Equation 4-19. Initial treatment zone length.**

where:

L_{IT} = total length of the initial treatment zone

A_T = total required treatment area

W = width (determined in step 5)

0.3 = constant (described in step 3)

Example:

L_{IT} = [(0.3)(458 ft^2)/(15 ft) = 9.2 ft → use 10 ft (Equation 4-20).

$L_{FT} = (0.7A_T)/W$ **Equation 4-20. Final treatment zone length.**

where:

L_{FT} = total length of the final treatment zone

A_T = total required treatment area

W = width (determined in step 5)

0.7 = constant (described in step 3)

Example:

L_{IT} = [(0.7)(458 ft^2)/(15 ft) = 21.4 ft → use 22 ft

7. Verify that the total treatment zone has a hydraulic retention time of at least 2 days assuming a porosity of the treatment media of 30% and that the length-to-width ratio of the submerged flow constructed wetland (inlet zone, total treatment zone, and outlet zone) is 3:1 or less. If the hydraulic retention time and/or the length-to-width ratio of the system do not meet the requirements above, adjust the system dimensions to meet

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the requirements while maintaining the minimum treatment area and minimum width required (Equation 4-21).

$HRT = (L_{TZ}W_{TZ}(1.33)(0.3))/Q$

Equation 4-21. Hydraulic retention time.

where:

HRT = hydraulic retention time

L_{TZ} = length of the total treatment zone

W_{TZ} = width of the treatment zone

1.33 = depth of the water level within the submerged flow constructed wetland at normal operating level

0.3 = porosity of the treatment zone media

7.48052 = gallons per cubic foot

Q = total daily design flow

Example:

HRT = [(41 ft)(15 ft)(1.33 ft)(0.3)(7.48052 gal/ft^3)]/(250 GPD) = (1835.6 gal)/(250 GPD) = 7.34 days (Equation 4-22).

$L{:}W = (L_{TZ}+L_{IZ}+L_{OZ})/W_{TZ}$

Equation 4-22. Length-to-width ratio of the subsurface flow constructed wetland.

where:

L:W = length-to-width ratio

L_{TZ} = length of the treatment zone

L_{IZ} = length of the inlet zone

L_{OZ} = length of the outlet zone

W_{TZ} = width of the treatment zone

Example:

L:W = (32 ft+6 ft+3 ft)/15 ft = 41 ft/15 ft = 2.73/1

Table 4-29 provides the subsurface flow constructed wetland sizing checklist. Use this checklist with items 1–7 above to correctly size the wetland.

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Table 4-29. Subsurface flow constructed wetland sizing checklist.

	Treatment Zone Surface Area	
1	Determine daily design flow (Q)	Q = _____GPD
2	Determine the treatment zone surface area based on BOD and TSS A_{SB} = [(Q)(0.0018 lb/gal)]/(53.5 lb/acre/day); and A_{ST} = [(Q)(0.00071 lb/gal)]/(44.5 lb/acre/day) Convert acreage to square feet and add safety factor using [(Acres)(43560 ft^2/acre)(1.25)] = ft^2	A_{SB} = _____ft^2 A_{ST} = _____ft^2 *Use largest value (A)*
	Initial Treatment Zone and Final Treatment Zone	
3	Determine the size of the initial treatment zone A_{IT} = 0.3 (A)	Initial Treatment Zone = _____ft^2 (B)
4	Determine the size of the final treatment zone A_{FT} = 0.7(A)	Final Treatment Zone = _____ft^2 (C)
5	Determine the minimum width of the treatment zones $W^2 = (QA_{si})/(KD_w d_h)$ Round up to nearest foot	Initial Treatment Zone Width = _____ft Final Treatment Zone Width = _____ft *Use largest value (D)*
6	Determine the maximum length of the initial treatment zone L_{IT} = (B)/(D) Round up to nearest foot	Maximum Length of the Initial Treatment Zone Length = _____ft (E)
7	Determine the maximum length of the final treatment zone L_{FT} = (C)/(D) Round up to nearest foot	Maximum Length of the Final Treatment Zone Length = _____ft (F)
	Retention Time	
8	Verify the total treatment zone has a hydraulic retention time of at least 2 days HRT = $(L_{TZ}W_{TZ}(1.33)(0.3))/Q$	Hydraulic Retention Time = _____days
	Length-to-Width Ratio	
9	Verify that the length-to-width ratio of the wetland is 3:1 or less L:W = $((E+F)+L_{IZ}+L_{OZ})/D$	Length-to-Width Ratio = _____

Notes: gallons per day (GPD); pounds per gallon (lb/gal); pounds per acre per day (lb/acre/day); square feet per acre (ft^2/acre); square feet (ft^2); feet (ft)

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4.27.3.5 Subsurface Flow Constructed Wetland Cells

1. Subsurface flow constructed wetlands may be divided into multiple cells in series to maintain length-to-width ratios (Figure 4-50).
2. Subsurface flow wetlands shall be divided into multiple parallel trains that contain one or more cells as described in Table 4-30.
3. For wetlands with daily design flows of 2,500 gallons per day or more, piping shall be included in the design that allows each cell to be taken off line and bypassed for maintenance and repair needs.
4. Daily flows must be divided equally among each train.
5 Each subsurface flow constructed wetland cell shall contain its own watertight overflow basin as described in section 4.27.3.6.

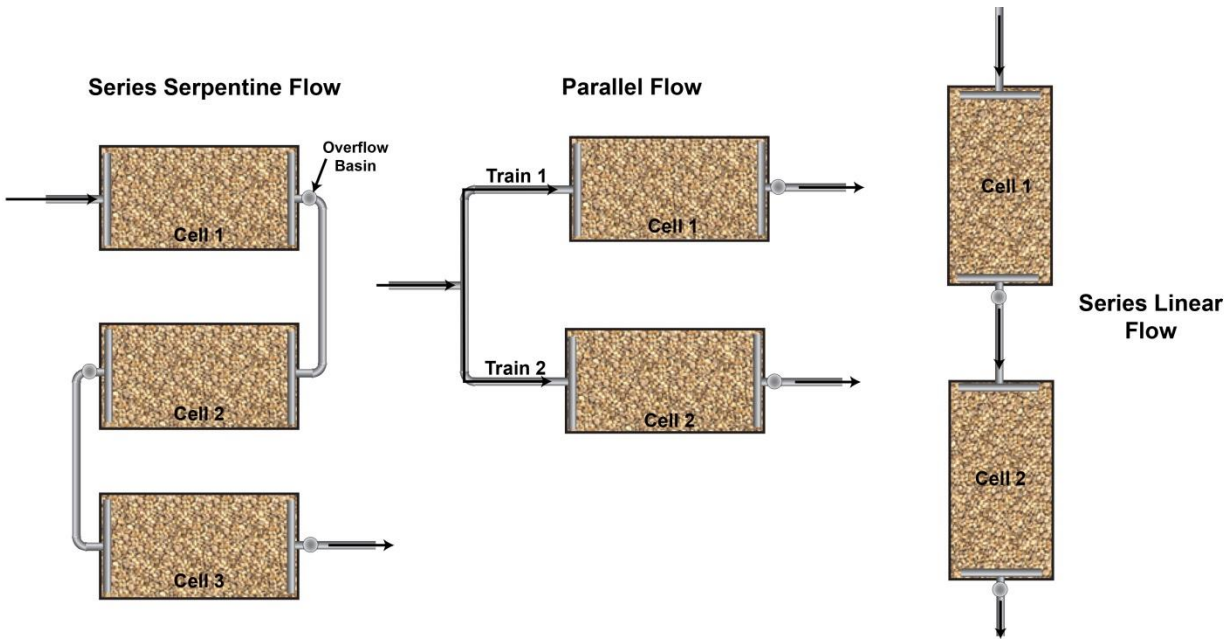

Figure 4-50. Configuration of wetland cells in series and parallel.

Table 4-30. Required subsurface flow constructed wetland trains and cells based on daily design flow.

Daily Design Flow (GPD)	Minimum Number of Trains	Minimum Number of Cells per Train	Minimum Number of Cells
<2,500	1	1	1
2,500–4,999	2	2	4
≥5,000	4	2	8

Note: gallons per day (GPD)

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4.27.3.6 Inlet and Outlet Structures in the Subsurface Flow Constructed Wetland

1. The inlet control structure should uniformly distribute the inflow across the entire width of the constructed wetland (Figure 4-51).
2. The inlet and outlet piping and control structures shall have a minimum diameter of 4 inches.
3. The inlet and outlet control structures shall have cleanouts that are accessible from grade.
4. The inlet control structure shall be located at the top of the drainrock in the inlet zone, be located as close to the inlet wall of the wetland as possible, and be level across its entire length.
5. Orifices on the inlet and outlet control structures should be evenly spaced with a maximum distance between orifices equal to 10% of the wetland width.
6. The outlet control structure should uniformly collect wastewater effluent across the entire width of the wetland.
7. The outlet control structure shall be located at the bottom of the drainrock in the outlet zone, be located as close to the outlet wall of the wetland as possible, and be level across its entire length.
8. The outlet control structure shall discharge to a watertight overflow basin located outside of the constructed wetland.
9. The watertight overflow basin (Figure 4-52) shall have the following:
   a. Minimum diameter of 20 inches and be accessible from grade.
   b. Water level control device that allows the operator to flood the constructed wetland to a point that is level with the surface of the planting media, completely drain the constructed wetland, and maintain the water level within the constructed wetland anywhere in between these two points and maintain a 2-day hydraulic retention time. *Note: Normal operating level is located 4 inches below the surface of the treatment media.*
   c. Gravity flow to the drainfield. If gravity flow is not achievable and/or pressurization of the drainfield or transport piping is necessary, then the watertight basin must be an approved dosing chamber or septic tank that meets the requirements of section 4.19.3.4.

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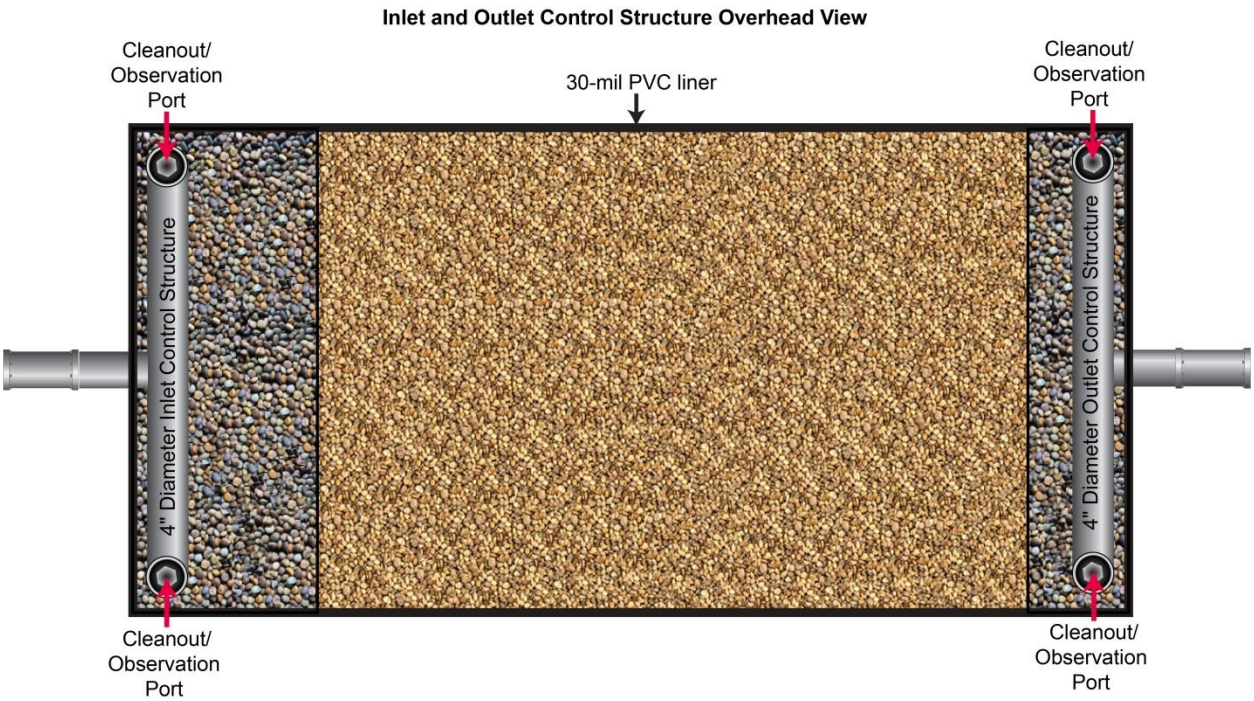

Figure 4-51. Overhead view of a wetland showing the inlet and outlet control structures in relation to the wetland width.

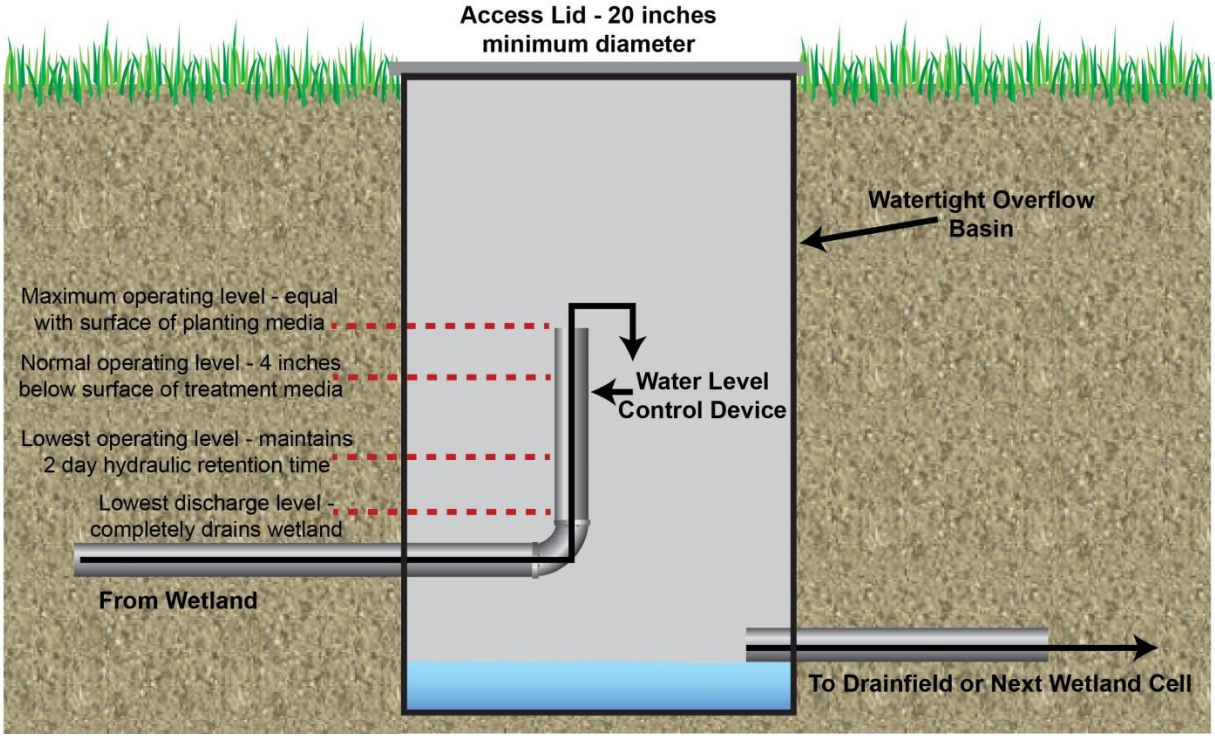

Figure 4-52. Cross-sectional view of an overflow basin.

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4.27.3.7 Subsurface Flow Constructed Wetlands Vegetation

1. Planting densities shall be 1–2 feet on center in staggered rows throughout the treatment zone of the wetland (Figure 4-53).
2. Vegetation should not be established within the inlet and outlet zones of the wetland.
3. Vegetation shall not be established from seed.
4. Plant species requirements:
   a. Capable of producing root depths that will extend to the bottom of the wetland (20 inches)
   b. Tolerant of local climates and continuous submersion of their roots in anaerobic water
   c. No noxious or invasive plants
   d. No flowering or soft tissue plants that decompose rapidly
   e. No emergent woody plants or riparian trees and shrubs
   f. No submerged or floating aquatic plants
   g. Recommended species include, but are not limited to, the following:
      1) Alkali bulrush (*Schoenoplectus maritimus*)
      2) Baltic rush (*Juncus balticus*)
      3) Broadleaf cattail (*Typha latifolia*)
      4) Creeping spikerush (*Eleocharis palustris*)
      5) Hardstem bulrush (*Schoenoplectus acutus*)
      6) Nebraska sedge (*Carex nebrascensis*)
5. Plants should be allowed to establish for up to 6 weeks before wastewater is discharged to the wetland. Raise the water level in the wetland to the top of the planting media. After rooting establishment, lower the water level in the wetland to the normal operating depth of 4 inches below the treatment media surface.
6. To promote plant growth and enhance root development, lower the water level within the wetland on an annual basis from the normal operating level to a level that is equivalent to a 2-day hydraulic retention time within the treatment zone. The water level should be lowered and raised back to a normal operational level over several weeks.

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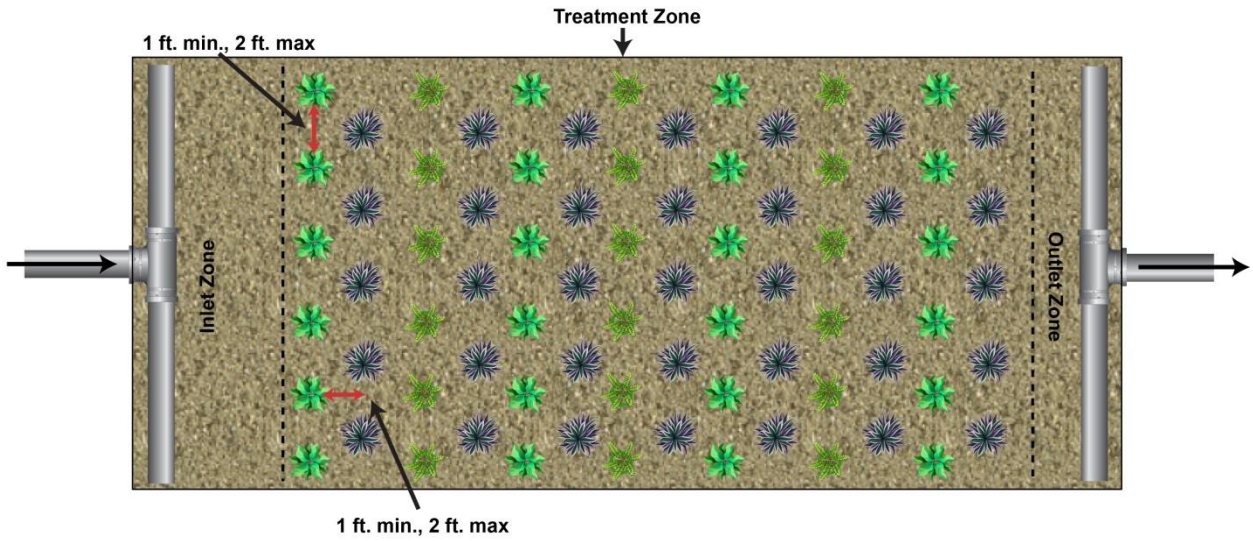

Figure 4-53. Vegetation and planting spacing throughout the wetland treatment zone.

4.27.3.8 Subsurface Flow Constructed Wetlands Temperature Protection

1. Temperature protection of the subsurface flow constructed wetlands and its components should be taken into consideration by the design engineer.
2. Several inches (≥6 inches) of insulating mulch or peat should be placed on a layer of geotextile fabric that covers the surface of the planting media.
3. Plants should not be cut back before the nongrowing season.

4.27.4 Submerged Flow Constructed Wetlands Construction

1. All vegetation in the placement area of the wetlands should be cleared and grubbed to remove large roots and stumps. Large rocks should also be removed.
2. All soil used in constructing the wetland bottom and berm shall be compacted to at least 95% standard Proctor density.
3. When grading and constructing a wetland cell, do not create low spots or preferred flows down a particular side of the wetland that will encourage short circuiting.
4. After grading and compaction, construction equipment should not enter the constructed wetland cell.
5. If used, the flexible liner containment system shall be constructed on top of a protective layer of sand. The protective layer of sand shall consist of a 4-inch layer of clean sand placed, graded, and compacted to match the wetland slope requirements on the compacted native grade.
   a. The liner should be installed according to the manufacturer's recommendations and extend to a height of 12 inches above the treatment media and located within the containment berm at all locations above the planting media.
   b. A geotextile fabric with a weight of 4 ounces should be placed over the liner before placing media in the constructed cell.
6. All media should be washed on site before placement in the constructed cell.

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4.27.5 Drainfield Trenches

1. Distances shown in Table 4-31 must be maintained between the trench bottom and limiting layer.
2. Capping fill may be used to obtain adequate separation distance from limiting layers must be designed and constructed according to the guidance for capping fill trenches in section 4.3.
3. Pressure distribution may be used with the following design considerations:
   a. The pressure distribution system related to the drainfield is designed according to section 4.19.
   b. The dosing chamber for the drainfield trenches may be substituted for the overflow basin from the constructed wetland cell.
4. The drainfield shall be sized by dividing the maximum daily flow by the hydraulic application rate for the applicable soil design subgroup listed in Table 4-32.

Table 4-31. Submerged flow constructed wetland vertical separation distance to limiting layers (feet).

Limiting Layer	Flow < 2,500 GPD	Flow ≥ 2,500 GPD
	All Soil Types	All Soil Types
Impermeable layer	2	4
Fractured rock or very porous layer	1	2
Normal high ground water	1	2
Seasonal high ground water	1	2

Note: gallons per day (GPD)

Table 4-32. Secondary biological treatment system hydraulic application rates.

Soil Design Subgroup	Application Rate (gallons/square foot/day)
A-1	1.7
A-2a	1.2
A-2b	1.0
B-1	0.8
B-2	0.6
C-1	0.4
C-2	0.3

4.27.6 Inspection

1. A preconstruction meeting between the health district, responsible charge engineer, and installer should occur before commencing any construction activities.
2. The site must be inspected when the wetland cell has been excavated and formed and before installing the containment structure. Compaction test results for all fill materials, containment berms, and the wetland bottom shall be provided at this time.

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3. The health district should inspect all system components before backfilling and inspect the filter container construction before filling with drainrock and treatment construction media.
4. The responsible charge engineer shall conduct as many inspections as needed to verify system component compliance with the engineered plans.
5. The responsible charge engineer shall provide the health district with a written statement that the system was constructed and functions in compliance with the approved plans and specifications. Additionally, the responsible charge engineer shall provide as-built plans to the health district if any construction deviations occur from the permitted construction plans (IDAPA 58.01.03.005.15).

4.27.7 Operation and Maintenance

1. The subsurface flow constructed wetland design engineer shall provide a copy of the system's OMM procedures to the health district as part of the permit application and before subsurface sewage disposal permit issuance (IDAPA 58.01.03.005.04.k).
2. Fertilizing the system is not required.
3. System irrigation is not required.
4. Systems with multiple cells must have directions on how each cell may be isolated so repair work can be performed without additional wastewater entering the cell.
5. Periodic surface maintenance may be required for any of the following reasons:
   a. In the spring, the thick layer of leaves and any other organic material that has been built up on the system surface should be removed and disposed of with other yard refuse. Some wetland plants may require trimming but should not be cut back or harvested.
   b. In the summer, if the surface contains weeds, they should be removed and disposed of with other yard refuse. Some wetland plants may require trimming but should not be cut back or harvested.
   c. Autumn maintenance may include gently spreading leaves over the surface and/or replacing the thick layer of mulch or peat over the system. Wetland plants should not be cut back or harvested. Wetland plants and a thick layer of leaves will provide a thermal blanket that will help prevent the system from freezing during the winter.
   d. All woody or fibrous plant starts (e.g., tree saplings and bushes) should be removed any time they are noticed as they may result in damage to the wetland cells or liners.
6. Inspection/maintenance schedule and instructions for the constructed wetland cell(s), septic tank, inlet and outlet control devices, overflow basin, and any mechanical parts associated with system design.
7. Methods to address odors if they become noticeable.
8. Methods to address burrowing animals if they become a problem in or around the wetland cell.
9. A plan to address freezing issues that may arise during colder months. Suggestions include placing a thick layer of mulch or peat over the wetland cell, placing a thick

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layer of leaves over the wetland cell, temporarily raising and then lowering the water level within the wetland cell after the top water level has frozen.

10. Operation and maintenance directions should be included describing the replacement of the wetland cell media and informing the system owner that a repair permit must be obtained from the health district for this activity.
11. Vegetation management instructions should be included for vegetation start-up, harvesting (if necessary), and replacement. Vegetation sourcing information should also be included.

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4.28 Two-Cell Infiltrative System

Revision: December 10, 2014
Installer registration permit: Complex
Licensed professional engineer required: No

4.28.1 Description

Domestic sewage is discharged into a two-cell infiltrative system (TCIS). The cells provide sewage storage during wet seasons. The second cell provides very slow infiltration into the surrounding soils. Evaporation and more rapid infiltration occur during dry seasons, reducing the liquid volume and replenishing the cell's storage capacity.

4.28.2 Approval Conditions

1. Cells may not be placed within 100 feet of the owner's property line and may not be placed within 300 feet from a neighboring dwelling.
2. Bottom of the finished cells must meet the effective soil depths for a design group C soil.
3. Soil design group must be C or *unsuitable clays*.
4. Site must be located in an area of maximum exposure to the sun and wind.
5. Slope must not be greater than 6%.
6. System cannot be placed on fill.
7. Source of make-up water with a backflow prevention system between the source and TCIS must be readily available.
8. Lot size shall be at least 5 acres.
9. This design is for an individual residential dwelling with up to six bedrooms and is not to be used for commercial or industrial nondomestic wastewater.
10. In areas of Idaho where the precipitation exceeds evaporation by more than 6 inches, this design would be considered experimental.
11. A reserve area equal to the size of the second cell shall be required.

4.28.3 Design Requirements

1. The first cell is approximately 32,100 gallons at a liquid depth of 4 feet and should operate full or nearly full at all times.
2. If the water level of the first cell drops below 2 feet, make-up water is added to raise the water level up to the 2-foot minimum pool.
3. The second cell is approximately 51,000 gallons at a liquid depth of 4 feet, which provides 182 days or about 6 months of storage when this cell is dry.
4. Total minimum volume of both cells combined is 83,100 gallons at a liquid depth of 4 feet.

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4.28.4 Construction

1. Shallow permeable topsoils shall be removed before starting excavation and construction (topsoils may be saved and used to provide vegetative cover on the dike embankments).
2. Dike levees, embankments, and inlet piping trenches shall be compacted to 95% standard proctor density.
3. No vehicles with pneumatic tires shall be permitted on the basal area or inside slope of the second cell.
4. Sewage discharge inlet must be placed in the center of the basal area of both cells.
5. Concrete splash pad must be constructed around the discharge inlets.
6. Water depth gauges clearly visible from the edge of both cells shall be installed.
7. Cleanout must be placed on the gravity effluent lines at a point above the maximum liquid elevation.
8. If the sewage is pumped to the system, a check valve and shutoff valve must be placed between the pump and system so that repairs can be completed without draining the cells.
9. Excavation must provide the following dike and embankment details:
   a. Inner slope – 3:1
   b. Outer slope – 2:1 or flatter
   c. Embankment width – 4 feet minimum
10. System must be fenced to exclude children, pets, and livestock. A sign on the fence indicating *Danger—Human Sewage* shall be erected.
11. Diversion ditches or curtain drains must be installed on sloping terrain to prevent surface runoff from entering the system.
12. Before operation of the system, the first cell shall be filled with 2 feet of make-up water.
13. Top and outer embankment shall be seeded or adequately protected from erosion.

4.28.5 Inspection

1. A preconstruction conference should be held between the health district and installer.
2. Site must be inspected at the time the cells are excavated.
3. All required system components and design elements shall be inspected.
4. Inspection is required during embankment construction to verify that all fill material is compacted to 95% proctor density.
5. Prior to operation and before filling the first cell with make-up water, a final inspection shall be completed.

4.28.6 Operation and Maintenance

1. The first cell must be kept filled with at least 2 feet of liquid.
2. Annual maintenance and testing of the backflow prevention device installed on the make-up water supply line shall be performed at least annually and completed according to the manufacturer's recommendations.

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3. Permanent vegetation should be maintained on the top and outer slopes of the embankment except where a foot or vehicle path is in use.
4. Woody vegetation should be removed from the embankments, grasses should be mowed, and other vegetation should not be allowed to grow in either of the cells.
5. Floating aquatic weeds must be physically removed on a regular basis.
6. The fence and all gates surrounding the system must be maintained to exclude animals, children, and other unwanted intrusion.

Figure 4-54 shows a cross-sectional view of a TCIS. Figure 4-55 provides an overhead view of a TCIS.

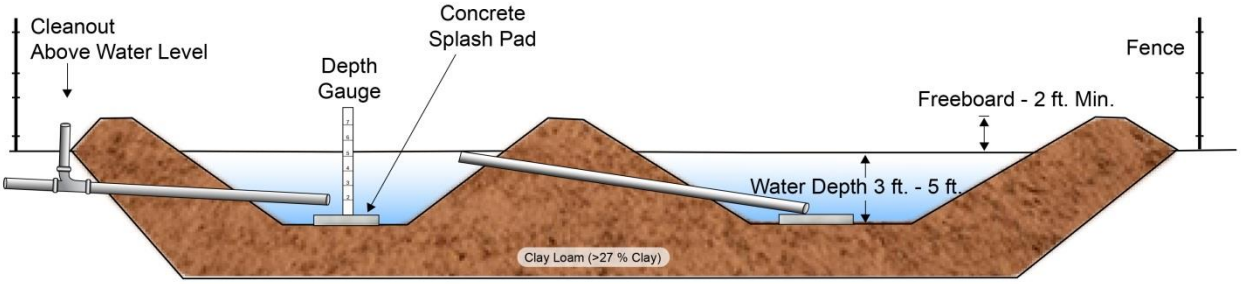

Figure 4-54. Cross-sectional view of a two-cell infiltrative system.

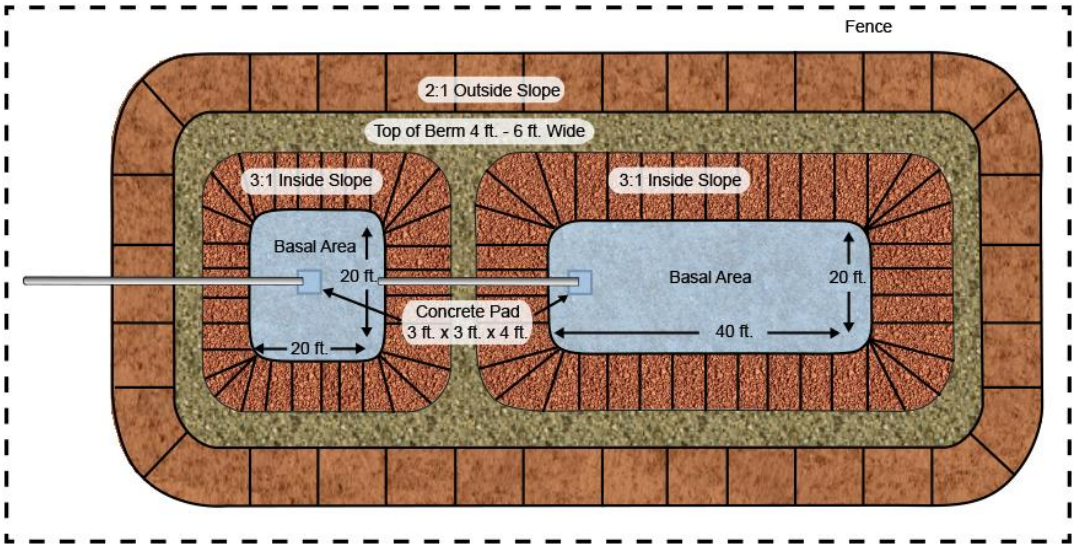

Figure 4-55. Overhead view of a two-cell infiltrative system.

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