OntarioOnsite
WastewaterAssociation

OOWA's Best Practices Series:

Pump Chamber Guidance Document

Produced by the OOWA Onsite Technical Committee

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BP 1: Pump Chamber Guidance Document

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1.0 Overview

Onsite sewage systems are generally simple passive treatment and disposal systems that perform consistently and reliably, and help to protect our health and the environment without the need for power or mechanical devices. Most sewage systems work using the power of gravity to move solids and liquids through the piping in the system. However, in some cases, one or more pumps are needed and they are in integral part of the sewage system.

This section should not be relied upon to set the requirements for pumps and/or chambers that form a part of a treatment unit other than a septic tank. Always consult the treatment unit manufacturer for specific guidance related to pumps intended to move fluid to or from a treatment unit.

When is a Pump Required?

- To overcome differences in elevation.
- To convey wastewater over a distance to another component of the sewage system.
- To provide dosing to a leaching bed, if the total length of distribution piping in the bed is 150 m or more, or if timed-dosing is used.
- To provide dosing to a treatment unit.
- To provide dosing to an Area Bed or Type A Dispersal Bed (in some cases treated effluent can drain by gravity to these beds).
- To provide dosing to a leaching bed requiring pressurized distribution (e.g., Shallow Buried Trench or Type B Dispersal Bed).

1.1 Types of Pumping Systems

Most pumping systems in onsite sewage applications will include a submersible pump located at the bottom of a basin or chamber. There are two basic types of pumping systems: those that pump raw sewage and those that pump effluent.

There are advantages and disadvantages to each type of pumping system that need to be carefully evaluated in conjunction with site conditions and constraints. Before one can make an informed decision as to the most appropriate type of pumping system, there are a number of factors that should be given due consideration, as outlined in the subsequent sections of this document.

a. Effluent Pumping

This type of system involves a pump chamber after the septic tank or treatment unit that houses an effluent pump to convey effluent to the next component of the system, which may be a treatment unit or a leaching bed (refer to Configuration C in Figure 3). This type of system is intended to pump treated or partially treated effluent that is free of solids. The pump chamber housing the pump must be of sufficient capacity to accommodate the necessary dosing volume, depending on the type of system. One significant advantage of pumping septic tank effluent is that the pump only needs to move liquid which will reduce the potential for solids buildup in the pipes.

b. Raw Sewage Pumping

This configuration involves a pump chamber that is required to pump raw wastewater containing solids to a receiving septic tank or a treatment unit where solids removal and further treatment take place.

Configurations A and B in Figures 1 and 2 respectively, illustrate two possible configurations involving raw sewage pumping. These tend to be relatively small tanks chambers located in close proximity to the building being serviced. The pump chamber contains a pump that is capable of pumping the solids or grinding them into a slurry as it pumps. The need for raw sewage pumping may be due to the distance between the building and a suitable location for the septic system. An internal raw sewage lift pump inside (Scenario A) or outside (Scenario B) the building which pumps flow from basement plumbing fixtures to the main gravity sewer exiting the building, allows the septic tank to be placed at an appropriate depth (therefore ensuring that it is not installed too deep).

It is important to consider the impact of pumping raw sewage directly into the septic tank, in terms of tank sizing and function.

1.2 Pump System Components

A pumping system will generally consist of the following components:

- Pump Chamber
- Pump
- Discharge Piping Assembly and Forcemain
- Liquid level sensor(s); e.g., floats or level transducer
- Control Panel

When a pump system is needed there are numerous factors that must be considered in order to select the appropriate type of system for each specific application.

2.0 Design Considerations

The following sections provide an overview of the many factors that must be considered when designing a pumping system. Additional details are included in the Appendix to this document.

2.1 Location

Consult the Ontario Building Code (OBC) and local by-laws regarding minimum setback distances. Although the OBC does not specify setback distances for pump chambers, with the exception of interior ejector pump chambers, it is recommended that setback distances be consistent with Table 8.2.1.6.A. of the OBC, which specifies minimum clearance distances for treatment units (please see Figure 4 for reference).

In cases where the minimum clearance distances cannot be achieved due to site constraints and/or where the risk of failure such as an overflow may cause environmental or property damage, consideration should be given to providing redundancy in the design of the pumping system, as further discussed in Section 2.2.

Figure 4

Table 8.2.1.6.A.

Minimum Clearances for Treatment Units

Item	Object	Minimum Clearance Distance
1	Structure	1.5 m
2	Well	15 m
3	Lake	15 m
4	Pond	15 m
5	Reservoir	15 m
6	River	15 m
7	Spring	15 m
8	Stream	15 m
9	Property Line	3 m

The location of the pump chamber must also consider accessibility for maintenance of the equipment, as well as proximity to available electrical supply to power the pumps.

2.2 Redundancy

During the design of any pumping system it is important to consider elements of redundancy. All pump systems involve mechanical components that can fail to operate. Redundancy could be incorporated in the form of a larger pump chamber, and/or the provision of duplex pumps which would operate on an alternating cycle and which also help extend the life of the pumps. The provisions of an increased pump chamber capacity and duplex pumps are especially important in situations where the recommended clearance distances cannot be met and/or the risk of failure would result in significant environmental or property damage. When the installation of more than one pump is not practical, it is strongly recommended that a spare pump be provided on site at all times to allow for expedient pump replacement, reducing the cost and frequency of emergency pump outs. This is particularly important for specialty pumps (e.g., grinder pumps) that may not be readily available from a local supplier's stock and may need to be ordered from the manufacturer.

2.3 Pump Chamber

The size of the pump chamber will be influenced by the type of sewage system and the type of dosing required. Time-dosed systems will typically require a larger pump chamber volume than demand-dosed systems. The chamber can be concrete, fiberglass (FRP), or plastic and should have a large access opening at grade over the pumps and valves to allow for easy maintenance.

The pump chamber must be large enough to supply the required dosing volume, and should provide some reserve capacity to allow time for maintenance to occur should the pumps fail to operate. The Ontario Building Code references pump and pump chamber requirements in article 8.6.1.3. *Pumps and Siphons*, sentence 8.7.6.1.(3) *Shallow Buried Trenches* and sentence 8.7.8.2.(8) *Type B Beds*. It is important to note that the OBC requirements are *minimum* standards. Where possible, consideration should be given to providing a larger pump chamber as a form of system redundancy (refer to Section 2.2).

Additional details related to pump chamber sizing are provided in the Appendix.

2.4 Pump

The type and size of pump must be selected based on the characteristics and amount of sewage that needs to be transported, the dynamic head or the elevation differences taking into account the friction loss through the piping (expressed in m or ft) and the size of solids that need to be pumped. It is important to select a pump that is appropriately sized for the application so that it will function efficiently and reliably. Be sure to consult the pump manufacturer regarding the type of pump and whether it is appropriate for the specific application. This is particularly important when pumping raw sewage. Clean water sump pumps are not designed to handle raw sewage solids or withstand corrosive environments and therefore should not be used to pump raw sewage

A pump used for raw sewage should be able to handle the maximum size of solids anticipated to pass through the system or be capable of grinding or macerating large solids to fit through the pump volute and discharge piping. The minimum solids handling capacity of a sewage pump used in onsite sewage systems should be 50 mm (2-inch), unless the pump is a grinder or chopper pump, or the pump is equipped with a suitable suction screen to protect from ingress of solids larger than the pump volute solids capacity and without resulting in excessive maintenance requirements.

Effluent pumps are typically designed to handle no larger than 20 mm (3/4-inch) solids, and thus are only suitable for sewage having undergone a minimum of primary (e.g., septic tank) treatment.

During installation it is recommended to leave excess pump cords tied neatly at the top of the chamber so the pumps can be removed. If the cord is cut short it may not be possible to remove the pump from the chamber.

Additional details related to pump selection are provided in the Appendix.

2.5 Discharge Piping Assembly & Forcemain

The discharge piping and any associated pipe fittings inside the pump chamber (such as valves or couplings) is generally referred to as the discharge assembly.

The type and size of pump will normally dictate the diameter of the discharge piping. For most typical onsite sewage system applications involving effluent pumps or grinder pumps, the diameter of the pump discharge piping is between 32 mm (1 ¼ inche) and 50 mm (2 inche). The recommended materials for discharge piping within the pump chamber are PVC (polyvinyl chloride, Schedule 40 or Schedule 80) or stainless steel (ASTM 304/316, Schedule 40). The remainder of the forcemain (i.e., the buried section after it exits the chamber) is typically HDPE (high density polyethylene, minimum Class 50 or DR32.5), or PVC

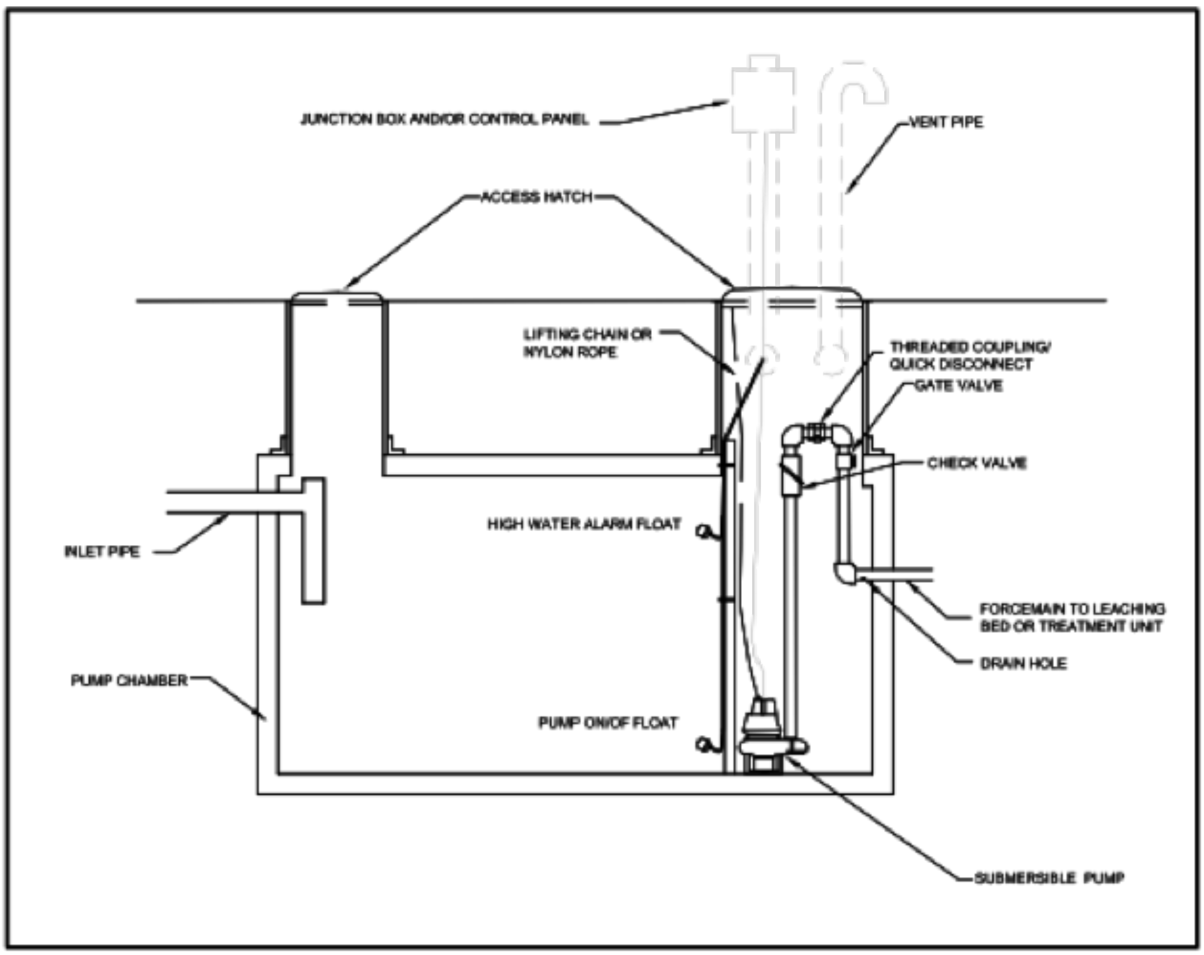
(Schedule 40 or Schedule 80). All plastic piping is recommended to have CSA certification to CAN/CSA-B137.1, CAN/CSA-B137.3, or CAN/CSA-B137.6 (pressure rated PVC or HDPE).

The discharge piping should be appropriately equipped with ball or gate valves and quick disconnects for ease of service and maintenance, all of which should be accessible from the ground surface. A check valve should be installed on the pump discharge to ensure that liquid cannot flow backward through the pump. This prevents unnecessary wear and tear on pump bearings by preventing sewage from flowing back through the pump.

Some means of freeze protection should be provided where sufficient burial below frost depth is not feasible. Where the receiving elevation is higher than the discharge from the pump chamber, a drain hole may be installed on the pump discharge pipe after the check valve (i.e., a 6 to 10 mm [3/16 inch to 3/8 inch] hole drilled into the underside of the pipe). This will allow any liquid in the forcemain to drain back into the pump chamber to prevent freezing. Otherwise, where the receiving elevation is lower than the pump discharge, a check valve installed vertically upward at the top of the discharge assembly may be used to serve as a vacuum break and drain the pipe away from the pump chamber. Where a drain orifice is used, the pump capacity or cycle time must be increased to account for the loss in discharge flow and backflow into the chamber. Pipe insulation and electric heat tracing may also be used for freeze protection.

To allow easy removal of the pump, if the pump is not on a guide-rail system, the discharge piping should be equipped with a quick-disconnect fitting (e.g., union, removable threaded coupling or similar). This allows the pump to be removed without having to cut the piping or enter the pump chamber to disconnect it for maintenance purposes. Fittings involving rubber connectors and hose clamps should not be used on the discharge piping assembly.

Figure 5 illustrates the recommended components and layout of the discharge piping assembly within a pump chamber.



2.6 Floats and Controls

Pump operation is typically controlled with a series of level floats in the tank, which may or may not be linked to a control panel. The number of floats and their function will depend on the type of system and how the pump chamber is intended to operate. Simple demand systems may operate on two floats, while more complex systems involving flow balancing and timer controls may have up to four or five floats. Other systems such as ultrasonic transducers and pressure transducers may also be used; however, it is recommended these systems be backed up by a two float system.

Simple demand dose systems may involve a single wide angle or differential float with no control panel and may be wired directly to the pump, or may include what is called a "piggy back control" (i.e., the float switch plugs directly into the power supply and the pump plugs into the float switch). These configurations do not include a high level alarm float to signal the owner or operator that there is a problem with the system. Therefore, it is recommended that a minimum two float system be used to include a pump control float and a high level float.

Provision of a control panel should be considered for all systems, as it can provide valuable data to aid in system operation, maintenance and troubleshooting.

The type of float should be appropriate for sewage system applications. Slide floats should be avoided if possible because they can become clogged with biological build-up; however, in some cases, even a narrow angle float may not be accommodated in the space available and a slide float may be considered.

Floats and sensors must be accessible from the ground surface to allow maintenance and replacement, as well as adjustment of float heights to control dosing. A removable float tree is the preferred method of installing floats, as it allows for easy removal and easy adjustment of float heights. Excess float cords should not be cut but should be tied neatly at the top of the chamber so the tree can be removed. If the cord is cut short it may not be possible to remove the entire tree from the chamber.

2.7 Control Panel

All pumping systems should include a control panel, the complexity of which will depend on the type of system and the required functionality. The control panel responds to the floats inside the pump chamber to perform basic functions such as signaling the pump to turn on and off, activating timer controls, activating a high water alarm, etc. More complex panels can be used to operate multiple pumps, control timed-dosing systems, and record pump data using hour meters or event counters. The control panel can also be connected to an auto-dialer to notify an operator of an alarm, and in some cases, allow remote access to adjust control panel settings.

The control panel must be contained in an appropriate enclosure (i.e., NEMA/EEMAC 3, 4, or 4X enclosure which is rated for indoor/outdoor use, watertight and corrosion resistant), with properly sealed connections. The use of NEMA 4X rated enclosures is recommended. The location of the control panel is an important consideration, and must take into account ease of access by a service provider, distance to the pump chamber, as well as selecting a location to ensure that alarms are seen and heard when activated.

2.8 Dosing

Consideration must be given to whether the pumping system will be based on demand dosing or timed dosing. Demand dosing is the simplest method, in which a given volume of sewage is delivered to the system based on the float elevation settings and the pump chamber size. Timed dosing delivers the sewage or effluent over a specific period of time by controlling the on and off cycle times for the pump by way of a timer. Timed dosing is required for Shallow Buried Trench systems and Type B Dispersal Beds, and can be used to equalize peak flows in situations where sewage flow rates are variable.

Additional details with respect to demand and timed dosing can be found in the Appendix.

2.9 Alarms

All pumps should be equipped with an alarm. Pumps are mechanical devices which can operate effectively for many years but mechanical parts wear out over time and all pumps will eventually fail to operate. Additionally, pumps may clog with solids resulting in a reduced pumping rate, or failure to pump at all. An alarm notifies the owner or operator that there is a problem with the system.

2.10 Electrical Considerations

All electrical installations shall be performed in accordance with the Ontario Electrical Safety Code (OESC) as enforced by the Electrical Safety Authority (ESA). It is a legal requirement that an ESA licensed electrical contractor perform and verify all electrical components for any installation involving mechanical equipment such as a pump, float switch or control panel. Only electrical equipment essential for the operation of the pump station should be located in the pump chamber. Electrical components and connections must be properly protected from the elements, and located outside of the corrosive environment of the pump chamber. All buried wiring must be housed in appropriate conduit and sealed using approved methods where applicable. Special provisions have been made supplementary to the OESC under Bulletin 22-1-5 (Residential Sewage Lift Pumps) and Bulletin 22-4-1 (Alternative Wiring Methods for Sewage Lift and Treatment Plants).

In order to facilitate easy and safe maintenance, all junction boxes should be located outside of the chamber (e.g., mounted to a post at least 500 mm above grade, below grade in an approved enclosure, or on the side of the building). Junction boxes mounted outdoors shall be suitably rated NEMA 3s, 4, or 4X and have a lockable cover to prevent any tampering.

For pump systems with integrated cable plug, the junction box should contain a 120 V or 240 V receptacle with a ground fault circuit interrupt switch (GFCI) to allow for easy replacement of all floats and/or pumps; however, this is not a code requirement.

Important: It is recommended that the alarm float is wired on its own circuit/breaker, separate from the pump itself. If the pump and alarm are on the same circuit, the pump could trip the circuit and stop operating. The sewage will build up in the tank but the high water alarm will not be triggered because the circuit is still tripped. This will lead to a sewage back-up or overflow. Having the alarm on a separate circuit will ensure that it continues to activate in the event that the pump circuit is tripped.

2.11 Venting

All pump chambers must have adequate venting to avoid build up of harmful gases, air lock and corrosion. This can be accomplished using a separate vent pipe on the pump chamber or septic tank, by using a vented lid, or by connecting to the main building vent stacks. Venting requirements are outlined in articles 7.5.5.1. (venting) and 7.5.7.7. (minimum vent pipe) of the Ontario Building Code. Vent pipes should be between 50 mm (2 inche) and 100 mm (4 inche) in diameter. The minimum size of the vent pipe shall be one size smaller than the size of the largest branch or fixture drain draining to the pump tank.

3.0 Construction Considerations

Any chamber which is used to pump either sewage or effluent should be certified to or conform and be tested in accordance with the latest edition of CSA B-66 to ensure adequacy of construction, materials, and water-tightness.

The installation of a pump chamber outside of a building shall be performed in accordance with article 8.2.2.2. of the Ontario Building Code to ensure the chamber is easily accessible for inspection and maintenance, as well prevent the chamber from settling or shifting once the installation is complete. This typically involves installing the chamber on a base of stone or gravel while considering the depth of the excavation to the high groundwater table or floodplain.

An access lid should be provided at grade in order to identify the system location and facilitate maintenance activities. Access covers must be secured in order to prevent unauthorized access.

It is also recommended that pump chambers be installed away from where heavy machinery/vehicles may travel. In areas of high groundwater, pump chambers may need to be anchored to prevent floatation.

4.0 Maintenance Considerations

All onsite sewage systems require regular maintenance, particularly systems involving a pump or other mechanical device. Typical maintenance and repair activities could include cleaning of the pump, testing of pump and floats to confirm operation, replacement of pump parts (e.g. bearings), replacement of float switches, etc.
It is guaranteed that the pumping system will need to be accessed at some point for maintenance. Therefore, it is crucial that any pumping system be designed and installed with ease of access in mind, including:

- Access hatch brought to ground surface
- All pumps and associated valves accessible from the ground surface to avoid having to enter the pump chamber
- Quick-disconnect and gate valve for ease of pump removal
- Lifting rope or chain to allow pump removal
- Float tree to allow removal and adjustment of floats without entering the tank
- Consideration of guide rail systems for larger pumps and/or deeper installations
- Location of the Control Panel to allow access for maintenance and testing

Appendix

Additional Design Considerations for Pumping Systems

Pump Selection

For any application, optimal functionality of the pump system will require the selection of an appropriate pump (i.e. pump type and pumping capacity). Pumps are usually rated in horsepower, and for the residential/small commercial market, are typically between 1/3 HP and 1 HP. The size of the pump should be based on the amount of sewage generally needing to be transported (usually expressed in L/min or gpm), the total dynamic head (TDH), which includes the elevation differences and friction losses through the piping system (in m or ft), and the size of solids that need to be pumped.

Most pump manufacturers have a performance graph ("pump curve") for each of the pumps that they sell, which graphs the amount of TDH the pump can overcome at a given flow rate. For a particular application, the "system curve" shows the TDH for that system over a range of flows. In order to select an appropriate pump, the system curve and pump curve must intersect within an ideal range.

Minimum Velocity

The pump must be able to transfer the correct amount of flow through the piping within a range of velocities. If a minimum velocity is not maintained, solids can be deposited in the piping, while velocities that are too high cause undue wear and tear on the system. The velocity should be between 0.6 m/s (2 ft/s) and 3 m/s (10 ft/s) and is directly related to the diameter of the piping (i.e. Flow = Velocity x Cross-sectional Area of Pipe).

Total Dynamic Head (TDH)

The total dynamic head (TDH) is comprised of the static head (the elevation difference) and Friction Head (friction losses through the piping system) which the pump must overcome in order to move the effluent.

Static head is the vertical difference between the low water level in the pump chamber (i.e. pump "off" elevation) and the highest point of discharge in the receiving system, usually the header pipe or distribution box for effluent pumping systems, or the inlet of the septic tank for raw sewage pumping applications.

The friction head is the reduction in pressure of the liquid in the pipe as a result of resistance due to friction on the pipe walls and fittings (expressed in m or ft). The calculation of friction head must account for the pipe discharge assembly within the pump chamber, as well as the entire length of forcemain from the pump chamber to the header or distribution box. The friction head will vary with pipe diameter and is calculated using the Hazen-Williams coefficient or "C" factor, which decreases with increasing friction. Hazen-Williams coefficients are tabulated and can be found in many text book and online references.

The friction head also needs to include friction losses associated with pipe fittings such as valves, elbows and tees. In pressure dosing systems, the friction head must include losses associated with discharge orifices, and any minimum pressure head that must be maintained at the furthest extent of the distribution system (e.g. 600 mm for Shallow Buried Trenches). These friction losses can be converted into an equivalent length of straight pipe and added to the total length of piping. Reference texts and online resources can provide the equivalent length for various common pipe fittings in various pipe diameters. Alternatively, friction losses can be calculated using a relationship between the velocity in the pipe a "K-Factor" for the type of fitting.

Selecting an Appropriate Pump

Using the flow rate and the calculated TDH, this point can be plotted on a graph showing the manufacturer's documented pump curves and is often referred to as the "duty point". When selecting a pump, the duty point should be as close to intersecting the manufacturer's pump curve as possible. A pump curve that plots below the duty point indicates that the pump is too small. A pump curve that is slightly above the duty point is acceptable, but care should be taken not to oversize a pump as this can affect the performance of the system. If the duty point intersects the end of a pump curve, the pump will not run efficiently and consideration should be given to a different pump where the duty point intersects a more central location on the pump curve.

Pump Chamber Sizing

The pump chamber should generally be a stand-alone watertight tank, or a completely separate compartment of a larger multi-compartment tank. A pump should never be installed directly into a septic tank, unless it is housed in a designated vault and the volume of the vault is accounted for in design criteria for the septic tank. The pump chamber acts as a reservoir to house the pump, and provides liquid storage. The pump chamber can be square or circular, concrete, fiberglass, or plastic.

The size of the pump chamber and required storage is influenced by the design flow, the type of system and the dosing requirements. For effluent pumping systems operating on a demand dose basis, the size of the pump chamber is determined by the daily sewage flow and the required dosing volume to the leaching bed.

Sentence 8.6.1.3.(4) of the OBC requires the bed dosing to be at least 75% of the internal volume of the distribution pipe within a time period not exceeding fifteen minutes:

8.6.1.3. Pumps and Siphons

(1) Where the total length of distribution pipe required is 150 m or more, the sewage system shall have at least one pump or a siphon contained in a dosing tank that may be a separate compartment within the tank structure, for distribution of the effluent.

(2) Alternating siphons shall not be installed in a sewage system.

(3) Where 2 or more pumps are employed within a dosing tank, the pumps shall be designed such that the pumps alternate dosing, and dosing shall continue in the event that one pump fails.

(4) Where a pump or siphon is required, the pump or siphon shall be designed to discharge a dose of at least 75% of the internal volume of the distribution pipe within a time period not exceeding fifteen minutes.

To determine the dosing volume for an in-ground absorption trench leaching bed, the following elements will have to be determined/calculated:

1. Determine the length of distribution piping in the bed using: $l = QT/200$
2. Determine the internal volume of the distribution piping, assuming using: $V=\pi r^2 l$

Where:
V = volume (m^3)
R = the internal radius of the pipe (m)
l = the total length of distribution piping (m)

3. The dosing volume must be 75% of that volume (V) which must be delivered to the bed in 15 minutes or less.

The pump chamber must therefore be adequately sized to provide the dose volume of 75% of (V), with additional volume available below the pump for solids storage and pump dry-run protection (i.e., approximately 0.1 to 0.2 m depth), and additional volume above the pump dosing level to provide reserve capacity below the inlet pipe to the tank. The minimum recommended reserve capacity is 25% of the required working volume; however, this safety factor must be evaluated against the importance of the application and risk of failure.

Some systems require distribution of effluent to the bed using timed dosing. This would typically include Shallow Buried Trench beds, Type B Dispersal Beds, and any system that employs balancing or equalization of peak flows. The use of timed dosing requires additional reserve capacity within the pump chamber to allow effluent to be evenly dosed to the bed on a fixed interval over a 24 hour period. As a result, time dosed systems will require larger pump chambers than demand dosed systems, and will generally require a working volume at least 75 – 100% of the daily sewage design flow.

Sentences 8.7.6.1.(3) and 8.7.8.2.(8) of the OBC provide the requirements for pump chambers used in conjunction with Shallow Buried Trench and Type B Dispersal Beds:

<u>8.7.6.1.(3) - Shallow Buried Trench</u>
The pump chamber shall be sized to provide sufficient storage volume so that the effluent is evenly dosed on an hourly basis over a 24-hour period.

8.7.8.2.(8) - Type B Dispersal Beds

The pump chamber shall be sized to provide sufficient storage volume so that the effluent is evenly dosed on an hourly basis over a 24-hour period.

Buoyancy

In situations where the groundwater table could potentially be above the base of the pump chamber, it is important to consider the potential for buoyancy as part of the design. Because the amount of water in the pump chamber is variable, the designer must confirm that the tank itself has adequate weight to prevent buoyancy or other measures are taken to prevent floatation. In cases where the water table is high and the tank is not of sufficient weight, it must either be anchored by way of a hold-down slab or deadman blocks, or designed with an expanded base sufficient to counteract the buoyant force.

Dosing/Effluent Distribution

Dosing is important to ensure even distribution of effluent over the entire field. There are essentially three options of delivering the effluent:

a) Pump to gravity system;

b) Pressurized distribution system – demand-dose regimen, and

c) Pressurized distribution system – timed-dose regimen.

A pump to gravity system is a system where a pump delivers effluent or sewage to a location where the rest of the flow is by gravity. A pump to gravity lateral system does not require the work of selecting lateral diameters, orifice diameters and orifice spacing and matching a pump to allow effluent to cover the entire leaching bed. The pump will convey the effluent to a distribution box or header, from which it will flow by gravity to the bed.

Pressure distribution is the even dispersal of septic tank or otherwise treated effluent over a leaching bed whereby the effluent is pumped from a pump chamber through a forcemain to a network of pipes or distribution laterals having discharge orifices, and then discharged over the soil absorption system.

Under a demand dosing setup, the pump starts when a volume of effluent fills the pump chamber to a predetermined level. The pump will deliver as many doses per day as required based on the use in the building and how fast the pump chamber fills. Each time the pump starts, a volume of wastewater is delivered to the pressure distribution network. Usually, the amount is determined by taking the estimated daily sewage flow and dividing by four. For example, for a 2000 L/day system, the pump would be set to dose 500 L of sewage per dose. The actual amount of effluent and the number of times the pump runs depends on the actual use on a given day.

For timed dosing, an adjustable timer controls the pump rest interval and run time for specific dose volumes and times. Peak flows (morning and evening) from a residence are stored and then dosed evenly throughout the day. Using timed dosing rather than demand dosing allows the effluent to be spread out more equally during the day.

Timed dosing also uses floats to control operation. However, the float switch is a signal float instead of a motor-rated switch. When the effluent rises to the preset level, the float sends an electric signal to the control panel which enables the timer. After the prescribed rest interval, the pump delivers the specified volume of effluent by operating for the time it takes the pump to deliver the amount of the dose.

Basic Design Considerations:

The design of laterals in leaching bed with pressure distribution is an iterative process that requires the designer to check the selected pipe size, orifice diameter, orifice spacing and pump, against the pump curve.

The pressure distribution network usually consists of 25 to 75 mm (1 to 3 inch) diameter perforated distribution laterals connected by a central or end manifold of equal or larger diameter. The pump pressurizes the network and is sized to provide relatively uniform distribution of effluent. Because the perforations in the distribution laterals are loaded at approximately the same pressure, they will discharge at approximately the same rate.

The pressure network should be designed to provide a minimum of 600 mm (2 ft) of head at the distal ends of the laterals. The variation in flow rate between the beginning and distal end of a lateral should not exceed 10%.

Uniform distribution can best be achieved by providing as many uniformly spaced perforations as is practical. Minimum perforation size should be 3 to 5 mm because smaller perforations will tend to clog. Maximum perforation size should be such that the even distribution of effluent within the distribution laterals is not adversely affected, while maximizing the number of perforations used. Spacing between perforations should not exceed 1.2 m; however, shorter spacings are more desirable. When doing discharge calculations, all perforations must be accounted for. Smaller perforation diameters allow for more uniform distribution. Larger diameter perforations permit longer laterals with greater spacing between perforations. However, this can result in localized ponding in the leaching bed beneath the perforations, and can reduce the effectiveness of the distribution of effluent within the system.

To minimize flow variation, the manifold should have as small a volume as possible. Central manifolds are preferred over end manifolds, as they tend to minimize lateral length and manifold size.

Additional Resources

There are many printed and online resources, as well as training courses that provide additional information on the design of pumping systems.

Glossary

Effluent: the pretreated liquid waste discharged from an on-site sewage treatment system receiving a minimum of primary (e.g., septic tank) treatment.

Effluent Pump: is a pump designed for the transfer of effluent.

Pump Capacity: rate of flow stated in litres per minute or gallons per minute at a defined total dynamic head (pressure).

Minimum Velocity: the minimum speed at which the flow must move through the pipe to prevent deposition of solids, generally accepted as 0.6 metres per second or 2 feet per second.

Static Head: the actual vertical distance measured from the minimum water level in the pump chamber to the highest point in the discharge.

Friction Head: the additional head created in the discharge system by resistance to flow within the pipes and other system components (e.g. valves, couplings, etc.).

Sewage Pump: a pump suitably designed and rated for the handling of raw sewage and expected maximum size of influent solids.

System Operating Head: residual pressure required to operate the system. In simple pumped systems the operating head is normally zero. Systems that would have an operating head would be a pressurized leaching bed system such as a Shallow Buried Trench System or a Type B bed under the Building Code.

Total Dynamic Head: the combined total of the static, friction and operating head. This is the total pressure required to lift the effluent from the pump chamber and effectively push it out through the pipes to the discharge point.